Strategy Appraisal Report

Authority Scheme Reference	ACC451/002A (IMAN000629)
Defra / WAG LDW Number	
Promoting Authority	Environment Agency, Anglian Region
Scheme Name	Cranbrook/Counter Drain Flood Risk Management Strategy

Date	April 2008
Version	5

SAR for Cranbrook / Counter Drain Flood Risk Management Strategy

Version	Status	Signed off by:	Date signed	Date issued
1	Draft for Review	JAS	10/08/07	13/08/07
2	Final for Issue	JAS	22/08/07	23/08/07
3	Final	JAS	02/01/08	02/01/08
4	Final	JAS	13/02/08	13/02/08
5	Final	SM	23/04/08	23/04/08

The cover photograph shows the existing Welches Dam Pumping Station from the opposite bank of the Counter Drain with the Ouse Washes in the background.

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GLOSSARY OF TERMS

Term	*Meaning / Definition*
BAP	Biodiversity Action Plan
BCA	Benefit/cost analysis
CFMP	Catchment Flood Management Plan
cumecs	Cubic metres per second
Defra	Department of Environment, Food and Rural Affairs
DSR	Detailed Strategy Report
EAP	Environmental Action Plan
EIA	Environmental Impact Assessment
FCDPAG	Flood and Coastal Defence Project Appraisal Guidance
Flood Risk	Standard of Protection
ha	Hectares (0.01 km^2)
IDB	Internal Drainage Board
km	Kilometres
km^2	Square kilometres
MCM	Multi-Coloured Manual
MLBB	Middle Level Barrier Bank
MLC	Middle Level Commissioners
PAR	Project Appraisal Report
PS	Pumping Station
PSO	Preferred Strategic Option
PVc	Present Value Cost
PVd	Present Value Damage
SAC	Special Area of Conservation
SAM	Scheduled Ancient Monument
SAR	Strategy Appraisal Report
SEA	Strategic Environmental Assessment
SEO	Strategic Environmental Objectives
SoD	Scheme of Delegation
SoP	Standard of Protection
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
WAG	Welsh Assembly Government

EA APPROVAL HISTORY SHEET			
Project Title: Cranbrook/Counter Drain Flood Risk Management Strategy			Agency Project Code: ACC451/002A (IMAN000629)
Agency Project Manager: Sadia Moeed			Date of SAR: March 2007
Consultant Project Manager: John Sheppard			Consultant: Atkins Ltd.
AGENCY STAFF INVOLVEMENT			
Position	Name	Signature	Date
"I have reviewed this document and confirm the project meets EA and Defra/WAG investment appraisal criteria and recommend approval in the sum of £			
Originator (PM)	Sadia Moeed		
Reviewer (Project Executive)	Chris Allwork		
"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	Tim Melville		
NEAS Unit Manager	Fiona Wren		
"I have reviewed this document and confirm that it complies with the current PAR guidelines"			
PAR Reviewer	Paul Burrows		
"I confirm the project is ready for submission to PAB/NRG"			
Operations Manager	Richard Nunn		

~~PAB – Project Assessment Board (Projects less than £2 million)~~	NRG – National Review Group (Projects greater than £2 million)
(Delete as appropriate)	

Date of Meeting:	Chairman:	PAR Amendment No:
Project Presenter(s):		
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 £:		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	
PAR Submitted		Date:
Project Approval	By: In the sum of: £	Date:

Defra or WAG APPROVAL (Delete as appropriate)	
Submitted to Defra / WAG or Not Applicable (as appropriate)	Date:
PAR Amendment No. (if different):	
Defra/ WAG Approval: or Not applicable (as appropriate)	Date:
Comments:	

Notes

- Signatures required for "Agency Staff Involvement" boxes.
- Agency Project Manager to complete (or delete as appropriate), the subsequent boxes as the project is progressed, to provide a complete record of the approvals history.

FINANCIAL SCHEME OF DELEGATION (FSoD) COVERSHEET

1.						
	Project name	Cranbrook/Counter Drain Flood Risk Management Strategy			**Start date**	2007
					End date	2107
	Business unit	Anglian		**Programme**	Capital GIA	
	Project ref.	ACC451/002A	**Regional FSoD ref.**	AO306 (Form A)	**Head Office FSoD ref.**	

2.	**Role**	**Name**	**Post Title**
	Project Sponsor	Dave Gillett	Asset System Management Team Leader
	Project Executive	Chris Allwork	Projects Team Manager (Appraisals)
	Project Manager	Sadia Moeed	Project Manager

3.	**Outline Risk Assessment (ORA) Category**	**Low**	✓	**Medium**	☐	**High**	☐

4.	**FSoD schedule**		**Description**	**Delegation**	
				Regional – up to	**Environment Agency – up to**
	A1	☐	Non FRM project	£5m	£5m
	A2	☐	FRM project within approved strategy	£5m capital	£50m WLC Defra/£5m capital NAW
	A3	☐	FRM project outside of approved strategy	£5m capital	£50m WLC Defra/£5m capital NAW
	A5	☐	Consultancy project	£300k	£500k
	A9	✓	FRM Strategy	£500k	£50m WLC Defra/£5m capital NAW
	O1	☐	IS/IT project	--	£5m
	T2	☐	Purchase or lease of land and buildings	£40k purchase/£10k pa lease	£5m

5.	**FSoD value**	**£k**
	Preparation costs for FRM Strategy	292
	Project costs	N/a
	Whole Life Costs (WLC) of FRM Project or Strategy	83,200k

6.	**Required level of Environmental Impact Assessment (EIA)**	**N/A** ☐	**Low** ☐	**Medium** ☐	**High** ✓

7.	**FSoD approver name**	**Post title**				**Signature**	**Date**
	Barbara Young	Chief Executive					
	FSoD consultee name	**Post title**				**Signature**	**Date**
	Ken Allison	PAB/NRG Chair	**RED** ☐	**AMBER** ☐	**GREEN** ☐		
	Miles Jordon	NCPMS Manager					
	Nigel Reader	Director of Finance					
	Paul Leinster	Director of Operations					

8.	**Form G**	**Form G value (£k)**	**Regional FSoD ref.**	**Head Office FSoD ref.**	**Latest FSoD authorised cost (£k)**
	1				
	2				
	3				

1 Executive Summary

SUBMISSION TO OBTAIN STRATEGY APPROVAL

Anglian Region: Cranbrook/Counter Drain Flood Risk Management Strategy
£83,200k Whole Life Cash Cost Approval Value

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.

Route:

National Capital Programme Manager	Miles Jordan
National Review Group	Ken Allison
Regional Director	Harvey Bradshaw
Director of Operations	Paul Leinster
Director of Finance	Nigel Reader
Chief Executive	Barbara Young
Defra	

1.0 Introduction & Background

1.0.1 This Strategy Appraisal Report (SAR) details the Flood Risk Management Strategy for the Cranbrook/Counter Drain. The strategy study area is within the Great Ouse catchment for which a Catchment Flood Management Plan (CFMP) is currently being finalised with completion anticipated in Spring 2008. Both this strategy and a separate strategy for the adjacent Tidal River Ouse system (due for completion in 2008) link with and take into account the CFMP.

1.0.2 The study area is to the west of the Ouse Washes and encompasses a number of villages and high grade agricultural land. The flood risk is managed as follows:

a. The Cranbrook/Counter Drain combines an upland carrier (6km) and man-made embanked drain (22km) which collects from the catchment, and drains to the Tidal River Ouse system through the Old Bedford Sluice.
b. During times of flood, evacuation is mainly by Welches Dam Pumping Station (PS) which pumps from the Counter Drain into the Ouse Washes.

1.0.3 The key objectives of this study are:

a. Assess the flood risk within the catchment;
b. Review the suitability of the existing drainage system;
c. Plan the short, medium and long term strategies for the entire drainage system; and
d. In determining the long term plans assess the likely environmental impact upon the drainage system and any effects on adjacent drainage systems.

2.0 The Problem

2.0.1 The Cranbrook/Counter Drain is a pumped drainage system protecting 8737ha of agricultural land and numerous properties. There are six Internal Drainage Board

pumps which drain the catchment and pump into the Counter Drain, which is an embanked channel. During high flows Welches Dam Pumping Station transfers water from the Drain to the Ouse Washes. This strategy addresses the need to identify the most sustainable way to manage this system over the next 100 years.

2.0.2 The Pumping plant of the Welches Dam PS (grid reference TL 46042 86085) is at the end of its useful life and has had recent failures in 1998, 2003 and January 2007. In addition there are operational issues relating to the ageing Old Bedford Sluice/Lock and leakage along the Cranbrook Drain.

2.0.3 The probability of the pumps at Welches Dam PS failing to start is estimated at 1 in 5 (20%) chance. The embanked channels provide a 1 in 25 (4%) chance of flooding each year.

2.0.4 The 'Do Nothing' option would result in the failure of the drainage system within 10 years with the loss of 308 properties, two major roads, 8737ha of high grade agricultural land, and a reduction in value of 1031 properties.

2.0.5 The Counter Drain is designated a Special Area of Conservation [SAC]. The Ouse Washes, which receives pumped discharge from Welches Dam is an area of international importance, designated a Special Protection Area (SPA), Site of Special Scientific Interest (SSSI), SAC and a RAMSAR site.

2.0.6 Four Internal Drainage Boards (IDBs) depend on the Counter Drain.

3.0 Strategic Options Considered

3.0.1 From a longer list of options the following were considered in detail.

3.0.2 Option 3, sustain by refurbishing Welches Dam and replacing.in the long term

3.0.3 Option 4 (a),1 & 2 , maintain/improve by alternative pumping to the Ouse Washes:

3.0.4 Option 4 (b), 1 & 2, maintain/improve by alternative drainage:

3.0.5 Option 4 (c), maintain/improve by providing flood storage. (Stored flood flows would be pumped back into the system with the cessation of the event by a new pumping station, considerably smaller than Welches Dam PS).

3.0.6 Option 5, maintain/improve by building a new pumping station and then decommission Welches Dam PS.

4.0 Preferred Strategic Option (PSO)

4.0.1 The PSO is 4(c): maintain/improve the current service level by developing flood storage reservoir solutions as after use of proposed local mineral abstraction sites. It is estimated that it will take 20 years for sufficient sites to become available. Due to the poor reliability and environmental risk of diesel spillage, Welches Dam PS will need to be refurbished immediately for the interim period, after which time it will be decommissioned and a new pumping station built to pump back stored flood water. Other strategy works and studies proposed within the first five years include flood storage follow on studies, installation of IDB PS instrumentation, and Cranbrook Drain leakage project appraisal.

4.0.2 The PSO provides the most cost effective and environmentally sound solution by sustaining the Standard of Protection (SoP) at a 1 in 25 chance of occurrence in any given year, which is the minimum indicative standard of flood protection for the catchment (Land Use band B).

4.0.3 Effects of climate change , within the next 20 years, will be accommodated by the surplus capacity of the drainage system. Long term climate change will be accommodated by appropriate sizing of the future storage reservoirs.

4.0.4 The PSO has potential for long term environmental benefit.

4.0.5 When compared to all the options the PSO health and safety risk (arising from construction activities) is moderate/low. There is an overall improvement in health and safety resulting from reduced operation and maintenance activities.

4.0.6 The storage area for the PSO has been provisionally identified by Cambridgeshire County Council in their long term plan for the area. A high level feasibility for the storage option is included in Appendix I.

5.0 Economic Case & Priority Score

5.0.1 The 'Whole life' cash costs of the PSO is £83,200k [£28,700k present value cost] over a 100 year appraisal period. The costs and benefits evaluated in this study have been based on a July 2007 base date. The benefit/cost ratio is 7.5 (with 60% optimism bias) and Defra priority score is 25 as detailed in Table 1-1.

Table 1-1: Economic Case

Economic Case	
Present Value benefits	£ 216,000k
Present Value costs	£ 28,700k
Net present value	£ 187,000k
Benefit cost ratio	7.5
Defra priority score	
Economics	14.1
People	0.8
Environment	10.0
Total	**25**

6.0 Environmental Considerations

6.0.1 A voluntary Strategic Environmental Assessment (SEA) report has been prepared in accordance with the Environment Agency internal policy and Defra Guidance.

6.0.2 In line with the Habitats Regulations (1994), Appendices 11 and 12 were completed setting out the potential effects of the PSO on this Natura 2000 site as part of the Appropriate Assessment process. Natural England agreed with the Environment Agency assessment that the Strategy could provide minor benefits hydrologically for the special wildlife interests of the Ouse Washes SPA/SAC but will not have an adverse impact on it (see Appendix G). A full Appropriate Assessment was not required.

6.0.3 The Cranbrook Drain is a man-made drain, or 'artificial waterbody' and as such under the terms of the Water Framework Directive, is expected to have achieved at least 'Good Ecological Potential' by 2015. The preferred option is not likely to reduce the water quality and it will reduce the risk of accidental diesel spills into the drain, it is in keeping with the aims of the Water Framework Directive.

6.0.4 Projects resulting from this Strategy will be screened by the NEAS Officer and appropriate mitigation undertaken, following further internal and external consultation. Planning approval and consents required from statutory bodies will be also be progressed at project level as each scheme identified by this Strategy

is implemented. Cambridgeshire County Council has agreed in principle to the PSO and this proposal is included in their long term plan for the area.

6.0.5 A plan summarising environmental constraints and opportunities in the context of the landscape of the study area is included as *Figure 3 (Appendix A)*.

6.0.6 The key environmental issue is the need to protect the designated sites during construction and ensure benefits of improved flood management outweigh the short-term disruption to wildlife.

6.0.7 Key opportunities include:

a. Development of cycle paths, bridleways, footpaths, navigation links and water recreation;
b. Alleviation of problems affecting protected sites and creation of new habitats;
c. More sustainable management of water flows through creation of a flood storage area;
d. Addition of fish refuges by the intake of the pumping station;
e. Redevelopment of the pumping station into a visitors centre; and
f. Re-use and recycling of existing materials.

6.0.8 Appropriate post construction monitoring is identified in the SEA.

7.0 Risks

7.0.1 Table 1-2 summarises the 5 key risks to the implementation of the PSO and the proposed mitigation measures.

Table 1-2: Key Strategic Risks & Mitigation Identified

Risk	Mitigation measures.
Cost estimate reliability	• 60% optimism bias applied • Sensitivity analysis in economic assessment • Financial risk assessment at PAR/ Detailed Design stage for all works.
Technical viability assumptions of storage option	• Undertake follow on studies. • Review PSO.
Welches Dam PS fails early	• Maintain regular maintenance procedures. • Ensure Welches Dam PS refurbishment is implemented as soon as possible.
Storage reservoir does not get constructed or is delayed	• Maintain regular contact with Cambridge County Council to ensure that mineral extraction plans are progressing. • Review PSO
Changes in regional/national catchment management	• Current catchment management plans reviewed as a part of the study (SEA). Regularly reviewed. • Continued liaison within Agency and Natural England as a part of strategy review process.

8.0 Implementation

8.0.1 Following approval of the PSO, PARs for each element of work will be prepared.

8.0.2 Follow on studies will commence to inform future flood storage project appraisal.

8.0.3 Following completion of the first 5 years work plan, the need to review the strategy will be considered.

8.0.4 The whole life cost is shown in Table 1-3 below. A full breakdown of all the construction, future monitoring and asset renewal costs are shown in Table 3-3.

Table 1-3: Whole Life Cost of Strategy

Item	Welches Dam PS Refurbishment. £k. First 5 Yrs	Studies & minor works. £k. First 5 Yrs	Total £k
Agency Cost (including surveys)	25	15	40
Preliminary Costs	0	10	10
Consultant Fees	150	115	265
Construction Costs	1,500	32	1,530
Environmental Enhancement Costs	20	0	20
Cost Consultant	5	0	5
Compensation	0	0	0
Contingency @ 60%	1,020	103	1,120
Inflation @ 5% per annum	267	32	
Total Capital Cost	**2,990**	**307**	
Future monitoring and construction. Asset renewal and flood storage contingency @ 60%			24,700
Environmental Enhancement Costs			240
Maintenance Costs Over Period of Strategy			55,200
Whole Life Cash Cost (incl maintenance but without inflation)			83,200

9.0 Contributions & Funding

9.0.1 No capital contribution by IDBs to the replacement of the Environment Agency assets are expected (e.g. Welches Dam PS refurbishment).

9.0.2 Operation and maintenance cost of Welches Dam PS will continue to be funded as the long standing local precept arrangements (24% Environment Agency, 76% IDB). This funding will be subject to review in subsequent strategy reviews.

10.0 Status

10.0.1 This is a Flood Risk Management Strategy for the Cranbrook/Counter Drain catchment. It will form the basis for individual scheme approval submissions.

10.0.2 The Environmental Report has identified a number of Strategic Environmental Objectives (SEO) to be addressed through the implementation of the strategy.

10.0.3 Works arising will contribute to housing targets by protecting property, as well as the potential for Biodiversity Action Plan (BAP) habitat creation with the flood storage area, which the Local Authority is keen to work with us on.

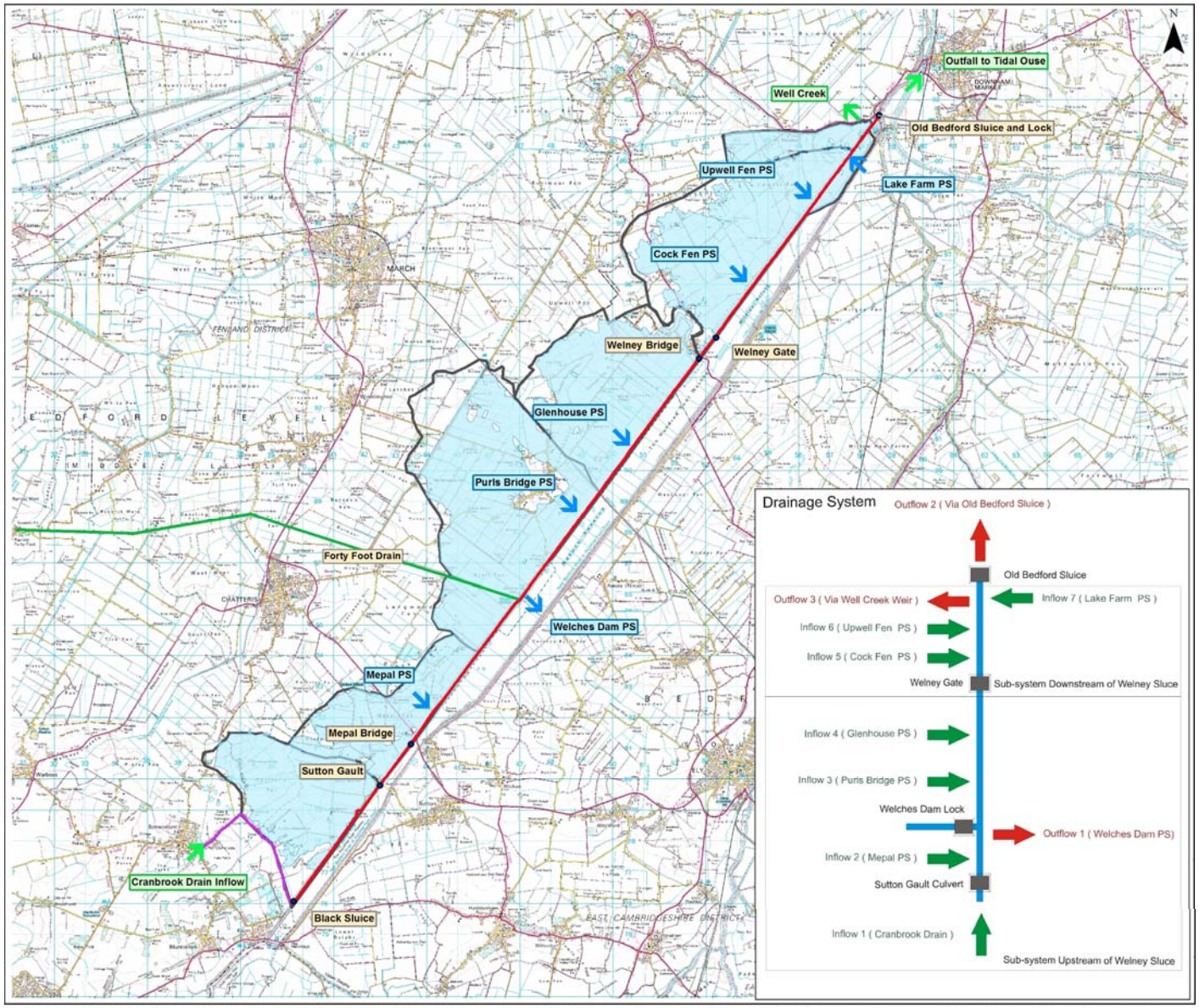
11.0 Recommendations

11.0.1 Scheme of Delegation (SoD) A9 Approval is sought for the preferred strategy which is to improve the current service level by refurbishing Welches Dam Pumping Station in the short term and developing Flood Storage, as after-use of mineral abstraction sites, in the medium term. This will allow the decommissioning of Welches Dam P S . Over the strategy period, capital and maintenance works will be required to the Old Bedford Sluice and other assets in the system as detailed in Table 3-3 of this document. The Flood Warning Service will be reviewed at regular intervals in line with the Flood Warning Investment Strategy (2003/4 to 2012/13) and the Flood Warning levels of service. The indicative whole life cost is £83,200k (including £10,500k contingency).

Directors Briefing Paper

Region:	Anglian		**Project Executive:**	Chris Allwork	
Function:	Flood Risk Management		**Project Manager:**	Sadia Moeed	
Project Title:	Cranbrook/Counter Drain FRM Strategy		**Code:**	ACC451/002A	
NEECA Consultant:	WS Atkins	**NCF Contractor:**	TBC	**Cost Consultant:**	Arup
The Problem:	Flood Risk; ageing unreliable pumping plant (Welches Dam Pumping Station); significant environmental sensitivities (Ouse Washes)				
Assets at risk from flooding:	308 properties, A142 and A1101 roads, 8737 Ha land. Additionally 1031 properties significantly devalued.				
Existing standard of flood protection:	1 in 25 chance		**Proposed standard of flood protection:**	1 in 25 chance	
Description of proposed scheme:	PSO is to maintain flood risk in longer term by additional flood storage facilitated by mineral working after-use; thus avoiding pumping onto the Ouse Washes. In the interim refurbishment of Welches Dam is proposed until storage becomes available.				
Costs (PVc): (100 year life inc. maintenance)	£28,700k	**Benefits: (PVb)**	£ 216,000k	**Ave. B: C ratio: (PVb/PVc)**	7.5
NPV:	£ 187,000k	**Incremental B: C ratio:**	1.2	**Whole life cost (cash value):**	£83,200k
Choice of Preferred Option:	Strategic Option 4(c): Sub-option 3				
Total cost for which approval is sought:	**£83,200k (Whole life cash cost) (incl £10,500k contingency)**				
Delivery programme:	Projects recommended for first 5 years: Welches Dam refurbishment (implementation) Flood Storage follow on studies Cranbrook Drain leakage control / Low Bank stability PAR				
Are funds available for the delivery of this project?	To be confirmed				
External approvals:	Defra				
Defra approval:	Defra priority score: 25 (economics 14.1, people 0.8, environmental 10.0). 308 properties.				

Key Plan



2 Business Case

2.1 Introduction & Background

2.1.1 The Study Area

2.1.1.0.1 The Cranbrook/Counter Drain System drains part of the 'Middle Level' Fenlands in Cambridgeshire and Norfolk. *Figures 1, 2 and 3 (Appendix A)* indicate the location and extent of the study area including designated environmental sites.

2.1.1.0.2 The Cranbrook Drain carries water from the relatively high land around Somersham, Colne and Earith and discharges by gravity into the head of the Counter Drain at Black Sluice to the north-east of Earith. The Counter Drain then flows in a north-easterly direction between flood embankments. It receives pumped flows from the lowland fens via six pumping stations along the watercourse, which are operated by three IDBs and a private landowner. Fluvial evacuation of the drainage system is through the Old Bedford Sluice when tide levels in the Tidal River Ouse are favourable; but during times of flood, evacuation is primarily through Welches Dam PS into the Ouse Washes.

2.1.1.0.3 Welches Dam PS and other associated structures (Black Sluice, Welches Dam Lock, Welney gate, Well Creek weir and Old Bedford Sluice) are operated by the Environment Agency. These structures are used to manage flood risk as well as other Environment Agency functions such as navigation and water resources.

2.1.1.0.4 The drainage system operates under a summer and a winter regime. In the summertime it is used to supply irrigation and to support navigation, whilst in the winter the prime function is flood risk management.

2.1.1.0.5 The combined lowland catchment area of these pumping stations is 104 km^2. The study area is characterised by typical Fenland, flat and open countryside where water resources are carefully managed to meet the agricultural demands. The Counter Drain is designated as a SAC. The Ouse Washes is an area of international conservation importance and is designated as a SPA, SSSI, SAC and a RAMSAR site. The Ouse Washes are part of the River Great Ouse system and drains into the New Bedford River and then the Tidal River Ouse at Denver.

2.1.1.0.6 The Environment Agency has a statutory duty to maintain navigation in the Counter Drain from Old Bedford Sluice to Welches Dam Lock, as stated in the Anglian Water Authority Act 1977.

2.1.2 This Report

2.1.2.0.1 A full strategic study has been carried out for the Cranbrook/Counter Drain system in accordance with the Defra Flood and Coastal Defence Project Appraisal Guidance (FCDPAG) 2 guidelines; a Detailed Strategy Report (DSR), [Volumes 1, 2 and 3] is provided as supplementary information to this Strategy Appraisal Report (SAR). This SAR forms the basis of a submission for A9 approval in accordance with the Agency Financial SoD and provides a summary of the detailed strategy study.

2.1.3 Links to High Level Plans and adjacent plans

2.1.3.0.1 This SAR details the Flood Risk Management Strategy for the Cranbrook/Counter Drain. The strategy study area is within the Anglian Region (Central Area) and sits within the area covered by the Great Ouse Catchment Flood Management Plan (CFMP). The Great Ouse CFMP is currently being finalised following consultation on the draft document, with completion anticipated in the Spring of 2008. The draft CFMP (and action plan

published by the local planning authority) promotes storage of flood flows with consideration to be given to storage created via after-use of mineral extraction.

2.1.3.0.2 Both this strategy and a neighbouring strategy for the adjacent Tidal River Ouse system (See Appendix B, due for completion in 2008) link with and take into account the CFMP. A Map of the study boundary for the Tidal River Ouse Strategy is in Appendix B which shows there is no duplication of the 'damages' identified by this Strategy. An additional benefit to this Strategy is that gravity discharge remains possible through the Old Bedford Sluice which marries the objective of the Tidal River Ouse Strategy to "allow gravity discharge through the Old Bedford Sluice to permit drainage of the Counter Drain".

2.1.3.0.3 This Strategy identifies that the 'Do Nothing' option would impact on the adjacent Middle Level System (MLS). The MLS strategy, does not allow for the additional flooding into its catchment that the failure of the Cranbrook Drain would cause.

2.2 Problem

2.2.1 Flood Risk

2.2.1.0.1 Failure of the drainage system, of which the Welches Dam PS is a critical element, will result in permanent flooding of the lowland catchment.

2.2.1.0.2 The probability of the pumps at Welches Dam failing to start automatically is estimated at 1 in 5 (20%) chance. Therefore when pumping is required there is a 20% chance that the automatic start-up mechanism will fail and operatives are required to attend the site and start the pumps. The current flood protection provided by the embanked channels excluding freeboard, is a 1 in 25 (4%) chance of flooding each year. The catchment land use band, in accordance with the FCDPAG guidelines, is B. This confirms an indicative range for the flood risk of 1 in 25 years to 1 in 100 years chance.

2.2.1.0.3 This standard of flood defence is reliant on discharge of normal fluvial flows through the Old Bedford Sluice and Lock structure and the effective operation of the Welches Dam PS. The PS was commissioned in 1948, with a nominal capacity of 10 cumecs, and is nearing the end of its useful life. In 1998 improvement works were carried out at a cost of £234k. In 2003 both pumps failed resulting in £105k of temporary pumping costs and in January 2007 a diesel pipe failure resulted in a 6000 litre spill (potential catastrophic environmental incident). This reinforces the urgent need to address the PS's poor reliability. In addition there are issues relating to the ageing Old Bedford Sluice and Lock structure. Normal fluvial discharge through this structure is becoming progressively less efficient because of bed levels in the Tidal River Ouse. This is a key issue being addressed in the Great Ouse Tidal River Strategy Study.

2.2.1.0.4 The extent of the flood risk under the 'Do Nothing' scenario is shown in Figure 1 Appendix A, The Drainage System).

2.2.1.0.5 All of the above is set against a background of considerable environmental sensitivity relating to the Ouse Washes.

2.2.2 Strategic Aims & Objectives

2.2.2.0.1 The Cranbrook/Counter Drain system is reliant on a number of structures and drainage watercourses to provide the effective drainage of the whole catchment. A number of these structures are nearing the end of their asset life and require refurbishing/replacing in order to continue the effective drainage of the system. A strategic approach is required to appraise these structures in the context of the catchment to determine the most appropriate course of action prior to decisions being made on engineering options on an individual basis.

2.2.2.0.2 The key aims and objectives of the Strategy are to:

a. Assess the flood risk within the Cranbrook/Counter Drain catchment;
b. Review the suitability of the existing drainage system;
c. Plan the short, medium and long term strategies for the entire drainage system;
d. Assess the likely environmental impact upon the drainage system and any effects on adjacent drainage systems; and
e. Ensure the strategy aligns with the objectives of the Great Ouse Tidal River Strategy (See Appendix B) and River Great Ouse CFMP.

2.2.2.1 Defined Time Frames

2.2.2.1.1 The definitions of time frames used throughout this strategy study are as follows:

a. Short term - from 0 to 5 years
b. Medium term - from 6 to 25 years
c. Long term - from 26 to 100 years

2.2.2.2 Opportunities/Constraints

2.2.2.2.1 Opportunities, which may arise as part of this strategy study, are noted as:

a. To prevent the risk of pollution of SAC/SPA by diesel spills from PS equipment;
b. Flood risk improvements to the Cranbrook/Counter Drain system;
c. Improved restoration of the mineral extraction workings (and to a higher level) than may otherwise be achieved without the link to this strategy. In addition, use of this excavated area for the strategy will prevent the unnecessary loss of additional agricultural land that would occur if the flood storage area was created elsewhere;
d. Health and Safety improvement of operation and maintenance;
e. Potential for refurbishment works at Welches Dam PS to improve the PS building and access, and the reliability and efficiency of pumps;
f. Additional local benefit by tying in flood risk management to support the Earith/Mepal Area Action Plan developed by Cambridgeshire County Council, which details the mineral extraction plans for the area;
g. In the short term, the addition of fish refuges to the intake of the pumping station (included in costs);
h. In the long term, modifying the Welches Dam Pumping station building to a visitor centre or educational facility (rather than allow this historical feature of the landscape to deteriorate) which may attract the public to the area subject to additional budgets (non FRM) being available (included in costs).

2.2.2.2.2 In addition, the following opportunities and enhancements associated with the new flood storage area may be considered at project level for feasibility and potential environmental enhancement:

i. Potential for recreational activities such as walking, horse-riding and water sports in the vicinity of the flood storage area for the benefit of local people and visitors to the area; and
j. Potential for the creation of new habitat to be incorporated into the new flood storage facility, for example, by the compartmentalising of the pit into areas of shallower and deeper water or areas which will be filled / drained first according to need (hence preserving the habitat for the majority of the year). Liaison with

Natural England would be required to ensure suitability of proposals and discuss potential for creation of BAP habitat.

2.2.2.2.3 Constraints, which may impact on the outcome of this strategy study and will need to be considered, are noted as:

a. Availability of funding, including from the IDBs who part fund the upkeep of Welches Dam PS;
b. Any temporary works resulting from the implementation of the strategy could have a potentially adverse effect on the Counter Drain SAC and Ouse Washes SPA. When the scheme PARs are prepared, mitigation will be provided in the Environmental Action Plan;
c. The performance of the Old Bedford Sluice in relation to its fluvial discharge to the Tidal River Ouse; and
d. Delivery of the flood storage reservoir is related to future mineral extraction plans set out by Cambridgeshire County Council.

2.3 Options Considered

2.3.1 Option Development

2.3.1.0.1 Options were selected for detailed appraisal following a series of workshops to assess health and safety, environmental, technical and economic feasibility. These were, attended by the project team and a representative of the IDBs. Options discounted at an early stage are shown in Table 2-1. The options which were shortlisted are discussed in further detail in this section. These were subject to a more detailed financial, environmental and technical appraisal, and an optimisation exercise carried out to find the optimum standard of protection and therefore select the preferred strategic option.

Table 2-1: Options Discounted in the Second Stage

Description	Reason for discounting
Decommission Welches Dam PS and raise the flood embankment	Order of magnitude increase in cost in excess of £12million based on comparison with raising the Middle Level Barrier Bank in 1990's. Stability issues associated with raising bank.
Decommission Welches Dam PS and build new pumping station at Black sluice or Sutton Gault	Higher cost with no technical, environmental or health and Safety advantage.
Decommission Welches Dam PS Modify existing IDB pumping stations to pump directly to the Ouse Washes.	Adverse implications for water quality and quantity within the Ouse Washes.
Decommission Welches Dam PS and construct a new drainage channel upstream of Welney gate to drain water to the Middle Level Drain	High cost and associated changes in flow in Counter Drain may have implications for its ecological and navigable status.
Decommission Welches Dam PS and improve use of drainage channel controlled by Well Creek Weir.	Poor hydraulic performance would not achieve the indicative flood risk standard.
Provide temporary pumping facilities only and maintain for 20 years.	Health and Safety liability to operatives and public, risk of diesel contamination, increased O&M due to increased corrosion from openness to elements, openness to vandalism and theft, automatic operation difficult to ensure resulting in manual operation required. High cost - 2 weeks of temporary pumping in 2003 cost approximately £105k.

2.3.2 'Do Nothing': Option 1.

2.3.2.0.1 All control structures, channels and embankments between the Cranbrook Drain and the Old Bedford Sluice and Lock structure, including Welches Dam Lock on the Forty Foot Drain, would be abandoned. Welches Dam PS would fail within a few days of operation as the diesel fuel would run out. The IDB pumping stations would also cease to pump through lack of maintenance to control gear. Fluvial flooding would commence and the catchment would gradually fill as the only outlet would be the Old Bedford Sluice.

2.3.2.0.2 The Old Bedford lock gate, and Welney gate, would both operationally 'fail open' and remain open after a period of between 5 and 10 years. Water would then enter the drainage system via the Tidal River Ouse and flood the catchment. It has been assumed that the tidal doors would fail in the open position as failures generally occur in mid operation. The average tidal flow into the Cranbrook drain is calculated at 15cumec with a peak flow of 46 cumec. The average fluvial flow is 0.5 cumec with a peak flow of 16 cumecs (100year storm)

2.3.2.0.3 This would result in the whole of the Counter Drain catchment being inundated at an average rate of 15.5 cumecs. The inundation of the Cranbrook catchment would lead to permanent flooding of 308 properties, the A142, A1101 and 8737 ha of agricultural land. In addition 1031 properties would be devalued due to being cut off for long periods.

2.3.2.0.4 The tidal/fluvial waters would eventually spread into the neighbouring 'Middle Level System (MLS)' which is a drainage system managed by the Middle Level Commissioners (MLC). With the assumption that under 'do nothing' all assets in the Cranbrook /Counter Drain system and MLS will be abandoned, the damages in the MLS amount to £3.6b.

2.3.2.0.5 In order to assess the effect on the MLS, of abandoning assets in the Cranbrook / Counter Drain system, it is assumed that the MLS system will be maintained. It is then possible to measure the reduction in Standard of Protection and the associated costs to the MLC of receiving the additional flow from the Cranbrook system.

2.3.2.0.6 Once the Cranbrook / Counter Drain system is fully inundated the flood would spread until it would meet the high ground of Well Creek to the north, the banks of the 16ft drain to the west and the banks of the 40ft drain to the south. The flood flows would then overtop the banks of the 16ft drain (1.4m AOD) and flow into the 16ft drain maintained by the MLC IDB. Once in the 16ft drain the flow would enter into the MLS drainage system ultimately finding its way to the St Germans pumping station. The St Germans pumping station is currently being upgraded with the new facility having a design capacity of 100 cumecs comprising 6 variable speed pumps, each with a maximum capacity of 16.6 cumecs. The new station will be completed in 2010. Consequently the additional 15.5cumecs from the counterdrain would result in one of the pumps running continuously, averaging 15.5 cumecs, increasing the annual running cost of the station by between £200k and £300k (depending on the electricity tariff). In addition the maintenance costs of the St Germans pumping station would increase.

2.3.2.0.7 The new St Germans pumping station is designed to accommodate a one in 66 year fluvial event (flood risk of 1.5%). The addition of 15.5 cumec would reduce this SoP to 1 in 33 years (Flood risk of 3%) To maintain the MLS to the design SoP would require bank rising at an approximate cost of £8m. The MLS protects some 70,000 ha high grade agricultural land, 24,000 properties and numerous scheduled ancient monuments. The MLS drainage system would additionally suffer saline infiltration which would influence the use of the drainage system for summer irrigation, the consequences of which would be very damaging to the agriculture.

2.3.2.0.8 Should the Old Bedford Sluice fail in the closed position, fluvial flooding would inundate the catchment within 7 years. Should the Old Bedford Sluice continue to be maintained, fluvial flooding would inundate the catchment within 10 to 20 years (depending on the silt levels in the Tidal Ouse). Once the catchment was full it will spill into the MLS as described above. As the average flow is low at 0.5 cumec the reduction on the MLS SoP would not be significant reducing to 1 in 63 years. However, in order for the MLS to maintain a SoP of 1 in 66 years, to accommodate storm flows from the Cranbrook Drain catchment, bank raising in the MLS would be necessary at an approximate cost of £8m.

2.3.2.0.9 Finally, the 'Do Nothing' would present a major risk to the integrity of the SAC status of the Counter Drain as it could adversely affect the habitat of the Spined Loach. If this were to prove to be the case, under the Habitats Regulations, this issue would preclude the adoption of 'Do Nothing' if there are feasible alternative options that do not risk adversely impacting the SAC.

2.3.2.0.10 With climate change there is an increased impact on the MLS, this is discussed further in section 2.3.10.

2.3.3 'Do Minimum' (maintain until failure): Option 2.

2.3.3.0.1 This assumes that there is no major investment apart from attendance to maintain regular items. Major breakdowns would result in the failure of Welches Dam within 5 years and both the Welney Gate and the Old Bedford Sluice failing in their open positions after a period of 5 to 10 years. The damage would then be as per the 'Do Nothing' option. As with the 'Do Nothing' option this could impact on the SAC status of the Counter Drain which would be unacceptable under the Habitats Regulations.

2.3.4 Common Measures for Strategic Options 3 to 5.

2.3.4.0.1 For all of the following strategic maintain/improve options 3, 4(a), 4(b), 4(c) and 5, there are common works to be implemented, which are included in the economic assessment and are as follows:

a. Replacement of Old Bedford Sluice and Lock in the medium term (within 10 years) would be essential to maintain the integrity of the SAC (which is a statutory requirement under the habitats Directive), ensure gravity partial fluvial flows and maintain statutory navigation rights to the drainage system. This is critical to the strategy as failure of the Tidal Barrier makes any fluvial defences redundant. It also results in saline intrusion and reduction in SoP for the MLS.
b. Refurbishment/renewal of each of the six IDB pumping stations that feed into the Counter Drain as required over the strategy period. (IDB funded)
c. All other major control structures in the drainage system kept fully operational by refurbishment/replacement and continuing with the existing maintenance regime as detailed in Appendix B to the DSR [Volume 2].
d. Consideration of leakage control measures for Cranbrook Drain (see DSR volume 1).
e. Fitting of instrumentation at each of the IDB pumping stations for monitoring pumping hours and intake water levels. This will provide data to enable the continuous improvement of the river catchment model. (IDB funded)

2.3.5 'Sustain' (maintain/improve): Option 3.

2.3.5.0.1 The refurbishment of Welches Dam PS would be undertaken in the short term (within 5 years) to improve the current poor reliability levels. Due to the age of Welches Dam PS structure, the complete replacement of this pumping station would need to be undertaken in 20 to 25 years time.

2.3.6 Maintain/improve with Alternative Pumping: Option 4(a) [Sub-Options 1 and 2].

2.3.6.0.1 Sub-option 1 considers the refurbishment of Welches Dam PS pumping plant in the short term (within 5 years) at a reduced capacity supplemented by a new pumping station at Black Sluice or Sutton Gault. Due to the age of Welches Dam PS structure, its complete replacement would need to be undertaken in 20 to 25 years time.

2.3.6.0.2 Sub-option 2 differs from sub-option 1 in that the additional station would be constructed adjacent to the Old Bedford Sluice and would pump direct to the Tidal River Ouse.

2.3.7 Maintain/improve with Alternative Drainage: Option 4(b) [Sub-Options 1 and 2].

2.3.7.0.1 Sub-option 1 considers the decommissioning of Welches Dam PS after 5 years together with improvements to the Forty Foot Drain to accommodate the floodwater. This would pass floodwater from the Cranbrook/Counter Drain system into the Middle Level Commissioners drainage system. This would combine with water from the Middle level system and pass to the PS at Wiggenhall St Germans where it would be returned to Tidal River Ouse.

2.3.7.0.2 Alternatively, sub-option 2 considers the refurbishment and reduction of Welches Dam PS capacity, after 5 years, using the existing structure. Improvements to Forty Foot Drain would be undertaken to accommodate remaining flood flows. The complete replacement of a reduced PS at Welches Dam would need to be undertaken in 20 to 25 years.

2.3.8 Maintain/improve with Flood Storage: Option 4(c).

2.3.8.0.1 Flood storage could be implemented through the use of newly licensed quarries under the Cambridgeshire County Council Earith/Mepal Action Plan (CCCE/MAP), once quarrying has finished. As quarrying has only just begun in the area, this is viewed as a medium term solution that could take up to 25 years to fully implement.

2.3.8.0.2 Cambridgeshire County Council Strategic Planning department are positive about this option and state “it is the most interesting option from a mineral planning perspective”, as it aligns with and will be a part of their Earith/Mepal Action Plan that forms a part of a new Minerals and Waste Development Plan.

2.3.8.0.3 This option considers the immediate refurbishment of Welches Dam PS plant in the short term (5 years) to extend its life to 25 years (common to Option 3, Sustain), during which the mineral abstractions would take place. The flood storage basin would be created and phased in after 15 to 25 years using the exhausted gravel workings, providing an ample storage basin for floodwater from the entire drainage catchment. A new small pumping station of approximately 1 cumec capacity adjacent to the storage would return flows from the storage basin back to the Counter Drain.

2.3.8.0.4 Once the storage basin is operational Welches Dam PS would be decommissioned. In recognition of decreasing gravity discharge to the Tidal River Ouse as a result of bed level increases and future sea level rise, this option also includes for the provision of a small pumping station of approximately 0. 5 cumec at the Old Bedford Sluice.

2.3.8.0.5 Appendix I details a high level feasibility for the storage option utilising areas that the CCCE/MAP has identified for this flood storage as after use of mineral extraction.

2.3.9 Maintain/Improve with a New Pumping Station: Option 5.

2.3.9.0.1 Construct a new pumping station adjacent to Old Bedford Sluice and decommission Welches Dam PS. The removal of Welney gate and alterations to Sutton Gault Culvert would also be necessary. It should be noted that an increase in pumping capacity over that of Welches Dam PS is required to maintain the current flood risk level due to the hydraulic constraint of the Counter Drain (gradient) in passing flows to the new pumping station (i.e. some of the storage capacity from the Counter Dain is lost that is otherwise available when the PS is located at Welches Dam).

2.3.10 Climate Change

2.3.10.1 Climate change – Tidal Flows

2.3.10.1.1 For the 'Do Nothing' scenario the Old Bedford Sluice will fail open and flows through this structure will increase as sea levels rise and are predicted as below:

Table 2-2: Predicted flow increase through OBS due to climate change.

Time horizon	Average daily flow into the counter drain (m^3/s)	Peak daily flow into the counter drain (m^3/s)
10 years	16.4	47
20 years	17.5	48
100 years	39.4	69.4

2.3.10.1.2 The effect of these increased flows would not increase the flood depths in the counterdrain catchment but would increase the flood flows weiring over the 16ft and 40ft drain banks, into those drains and into the adjacent Middle Level System (MLS). The effect of this on the SoP for both the Counter Drain Catchment and MLS is summarised in *Table 2-3* below.

Table 2-3: Change in SoP and damages due to climate change.

	Cranbrook / Counterdrain catchment SoP	Middle Level System SoP	Do nothing damages
Design SoP	25 years	66 years	
Do nothing	Nil	1 in 66 years	**£15m** MLS increase in damages **£201m** Cranbrook drain
Do nothing with 100 yrs climate change	Nil	1 in 22 years	**£36m** MLS increase in damages **£201m** Cranbrook Drain

2.3.10.1.3 For the do nothing scenario it is assumed that all assets in the Cranbrook / Counter Drain catchment are abandoned and this area reverts to fen and marshland. To allow for the flow entering the MLS from the Cranbrook / Counter Drain catchment there is an additional cost to the MLS of £15m to allow for additional pumping at St. Germans and bank raising.

2.3.10.1.4 With the application of the current climate change guidance with respect to sea level rise, there is no change in damages for the Cranbrook / Counter Drain catchment as this area will still revert to fen and marshland. However, there is an increased tidal flow into the MLS which reduces the SoP and increases the flood damages.

2.3.10.1.5 *Table 2-2* demonstrates the need to maintain the tidal barrier at the old Bedford Sluice, to prevent permanent inundation of the Cranbrook / Counter Drain catchment and significant increase in damages in the MLS catchment.

2.3.10.1.6 Note: In the scenario that all assets in the Cranbrook / Counter Drain and MLS catchments are abandoned and the whole area reverts to Fen and Marsh land and the total damages are £3.8bn, of which £3.6bn are from the MLS. It is inappropriate to use these total damages for this strategy as this will involve double counting of the damages used in the justification for works in the MLS.

2.3.10.2 Climate change – Fluvial flows

2.3.10.2.1 Climate change was modelled using a 20% increase in fluvial flows (which is a conservative interpretation of the climate change impacts Oct 2006 guidance).

2.3.10.2.2 Do nothing: If the tidal barrier is maintained the Cranbrook Counter Drain catchment will be inundated within 10 years by fluvial flows. With climate change this inundation will have occurred by year 8. Once the catchment is inundated there will be an additional 0.5 cumec average daily flow entering the MLS, with climate change this will increase to 0.6. The capacity of the new St. Germans pumping station will be 100 cumecs. Therefore this amount can be accommodated in the MLS with negligible additional cost.

2.3.10.2.3 Do minimum, sustain & Alternative Pumping options (Maintain/Improve)
The pumping station/s capacities for each option will need to increase by 20% to 12 cumec. This will impact on the capital costs of the options as follows:

Table 2-4: Increase in capital cost for Do Minimum, sustain & Alternative Pumping Options due to Climate Change .

Option	Capital cost (no climate change)	Estimated increase in capital cost	Where increases occur
3	£1.7m	£54k (3%)	PS M&E equipment affected only
4a 1 & 2	£5.4m	£450k (8%)	PS M&E and Civil
5	£3.5m	£300k (8%)	PS M7E and Civil

2.3.10.2.4 Alternative Drainage

Sub options 1 and 2 of 4b consider all or half the flow entering the Middle Level System via the 40ft drain. A 20% increase in flows will increase the cost of the bank raising in the MLS and also the cost of the pumping station included in option 4b2. This will impact on the Capital costs as follows:

Table 2-5: Increase in capital cost for Alternative Drainage Options due to Climate Change.

Option	Capital cost (no climate change)	Estimated increase in capital cost	Where increases occur
4b1	£8.3m	£830k (10%)	MLS Bank raising. (Assumed 20% flow will increase bank cost by 10%)
4b2	£6.7m	£616k (9%)	MLS Bank raising, (Assumed 20% flow will increase bank cost by 10%). PS M&E and Civil (8%)

2.3.10.2.5 Maintain/improve with flood storage (Preferred option)

For Option 4c (preferred option) a 20% increase in fluvial flows by year 20 can be accommodated by the capacity in the current system, with an acceptable freeboard allowance still in place for the first 20 years. In the longer term the storage volume can be increased by 20%. The cost of this will not impact on the economics as the mineral extraction company will pay for the additional extraction.

2.3.10.3 Conclusion on Climate Change

2.3.10.3.1 Tidal: For Do nothing the effect of climate change with respect to sea level rise is a significant increase in damages in the neighbouring MLS estimated to be in the region of £36m.

2.3.10.3.2 Fluvial: To accommodate fluvial climate change the in sustain, do minimum/maintain improve options the % increase in cost is similar for all options. This means that it will not impact on the order of best benefit cost ratios and hence will not impact on the selection of the preferred option.

2.3.11 Over Design Events

2.3.11.0.1 For options 3, 4 and 5, floods in excess of the design events would overtop the Counter Drain first at Sutton and Mepal and, depending on the severity of the event, then at the other IDBs. When the flood water recedes, water behind the defences would migrate to the IDB drainage systems from where it would be pumped back into the Counter Drain.

2.4 Cost of Options

2.4.1 Estimated Costs

2.4.1.0.1 Estimated Capital and Maintenance Costs have been evaluated for all of the strategic options and are detailed in Appendix E to the DSR [Volume 2]. A summary of the costs of each strategic option are given in Table 2-6: The price date is July 2007.

2.4.2 Asset Life & Residual Costs

2.4.2.0.1 The appraisal period of this strategy is 100years. As some assets have a lifetime beyond the appraisal period their residual costs have been taken into account to ensure equality of assessment between the different options.

Table 2-6: Summary of Strategic Option Costs.

Option	Sub-option	Capital Cost (100 yrs) £k	Maintenance Costs (100 yrs) £k	Present Value Cost PVc £k	Present Value Cost (PVc) £k (with 60% optimism Bias)
1	-	0	0	0	0
2	-		5,780	4,970	4,970 *
3	-	15,500	57,800	24,800	29,300
4(a)	1	19,000	57,800	27,500	33,600
	2	18,900	57,800	27,300	33,400
4(b)	1	18,200	53,600	28,300	35,700
	2	18,500	55,700	27,600	34,200
4(c)	-	14,600	55,200	24,200	28,700
5	-	12,000	57,600	25,300	30,100

* Optimism bias not applied to existing costs

2.5 Benefits of Options

2.5.1 Overview & Staged Approach

2.5.1.0.1 The economic assessment for the strategy options has been undertaken in accordance with the FCDPAG published by Defra. This assessment is detailed in *Appendix F* to the DSR [Volume 2].

2.5.1.1 Stage 1

2.5.1.1.1 This is a 'high level' comparison of strategic options. Each of the options has been compared to find the most economic option to sustain the SoP. A base date of July 2007 has been used throughout the appraisal.

2.5.1.1.2 The Stage 1 results, summarised in *Appendix C,* shows that the strategic option with the best benefit/cost ratio is option 4(c), namely refurbish Welches Dam PS within 5 years at 10 cumecs (with a design life of 25 years) and phase in flood storage over the next 15 to 20 years, thereafter decommissioning Welches Dam PS.

2.5.1.1.3 A high level costing and economic assessment was carried out to determine whether or not, through optimisation, a different option had the potential to provide a better standard of protection. This determined that option 4(c) is the most cost effective solution for providing a range of standards of protection. Full details of this assessment are given in appendix F in volume 2 of the DSR.

2.5.1.2 Stage 2

2.5.1.2.1 The economic information from Stage 1 has been carried forward to the selection of the Preferred Strategic Option (PSO) as detailed in *Section 2.7 and Appendix E*. Economic results form one of a number of fields (health and safety, environmental, etc) for comparison to select the PSO.

2.5.1.3 Stage 3 - Optimisation

2.5.1.3.1 To establish the optimum standard of protection, option 4(c) was modelled for a range of SoP, and an economic analysis undertaken. These sub options, the results of which are summarised in *Appendix D* are:

a. Sub option 1. Flood risk increased to a 1 in 5 chance (20%)
b. Sub option 2. Flood risk increased to a 1 in 15 chance (6.7%)
c. Sub option 3. Flood risk sustained at a 1 in 25 chance (4%)
d. Sub option 4. Flood risk reduced to a 1 in 50 chance (2%)

2.5.1.3.2 Following the FCDPAG3 'Decision Rule', SoP sub-option 3 is the first option falling within the indicative flood risk chance requirement of 1 in 25 where the incremental benefit/cost ratio is greater than 1. A higher standard cannot be justified as the incremental benefit cost ratio is significantly less than three. The results of the economic assessment are summarised in Table 2-9 below.

2.5.1.4 Flood Warning

2.5.1.4.1 Flood warning has been accounted for in the calculation of damages

2.5.1.5 Non-economic and Environmental Benefits

2.5.1.5.1 The principal non-economic and environmental benefits are:

a. The after-use of mineral extraction pits as flood storage offers the potential of recreational opportunities for visitors to the area, such as walking, cycling, horse riding and water sports. There is also potential for Wildlife/BAP habitat to be created within the flood storage area via the compartmentalisation of the pit into areas of shallower and deeper water, and areas which will be drained or inundated at different rates depending on the flood risk situation at the time. Approximate present value benefits have been calculated for these environmental benefits, a summary of the results in shown in Table 2-7 below. It has been decided not to use these figures in the economic justification for the strategy as these depend on broad assumptions regarding the areas and types of habitat and

visitor numbers, these are detailed in DSR Appendix F. A great deal of research would be required to get more accurate figures. However these benefits can be valued for inclusion in the future PAR for the flood storage reservoirs.

Table 2-7: Summary of Potential Environmental and Recreational Benefits.

	PV benefits (£k)		
	Mid	Low	High
Environment	5,350	1,530	16,800
Recreation	255	64	638
Combined	**5,610**	**1,590**	**17,500**

b. Use of an existing pit for the flood storage area will ensure the sensitive restoration of the site following extraction, and remove the potential loss of additional agricultural land in the area for creation of a storage area.

c. Improved health and safety of operation and maintenance.

2.5.1.5.2 Future studies include Environmental Action Plans for all works undertaken, Environmental Appraisal Reports for the flood storage option, Old Bedford Sluice works, Low Bank stability works and for refurbishment and replacement of IDB and EA structures. Reviews of the SEA report will be undertaken at 5 yearly intervals. The proposed implementation timetable for these studies / reports is listed out in Chapter 7 of the SEA Report (Volume 3, Appendix G of the DSR). Monitoring will be carried out throughout the life of the project, and ecological surveys undertaken before, during and after the works. Ongoing consultation with key stakeholders will be required.

2.5.1.6 Assumptions About Loss of Property

2.5.1.6.1 Flood damage values have been calculated based on the depth damage database (assuming long flood durations) for detached properties used in the multi-Coloured Manual (MCM) issued by the Flood Hazard research Centre 2003.

2.5.1.6.2 A combination of Address Point Data and LiDAR was used to determine the number of properties at risk from flooding.

2.5.1.6.3 Properties that permanently flood, of which there are 308, would be abandoned. Of the remaining 1,031 properties (mostly residential) located in the drainage district boundaries it is assumed their market value would reduce by 50%. This reflects their proximity to advancing and unchecked flood waters which would cut off their local access

2.5.1.6.4 For the A142 and A1101 the disruption costs stand at more than £1 billion (See DSR volume 2, Appendix F for how this is calculated). Consequently the cost of raising the carriageways has been included in the economic analysis.

2.5.1.6.5 See Table 2-8 below for a breakdown of the do nothing damages.

Table 2-8: 'Do Nothing' Pv Damages

Item	Pv Damages (£k)
Residential And Agricultural Damages	62,600
Depreciation of House Prices by 50%	67,300
A142 Alterations	46,300
A1101 Alterations	25,200
St Germans Electric Costs	6,730
MLB Bank Raising	8,300
Total	**£216,000**

2.5.1.7 Justification for Flood Events

2.5.1.7.1 The Counter Drain system is volume dependent. Therefore a frequency analysis based on the available pump records was carried out to derive appropriate design event inflow hydrographs. A range of sensitivity analyses was carried out to determine the combination of volume and event duration that caused the most severe flooding.

2.5.1.7.2 Climate change has been accounted for indirectly by increasing the flooded volumes by 20%. With reference to section 2.3.10 & 2.7.3.2, the determination of the Prefered Strategic Option does not alter with climate change.

Table 2-9: Optimisation of Preferred Option [Stage 3]

Variable	'Do Nothing'	'Do Minimum' (Maintain)	'Sustain' (maintain / improve)	Flood Storage - Option 4(c)			
	Option 1	Option 2 {Flood Risk increases from a 1 in 25 chance to < a 1 in 1 chance within 10 years}	Option 3 {Flood Risk maintained at a 1 in 25 chance}	Sub-option 1 Welches Dam 5 cumec {Flood Risk increased to < a 1 in 5 chance}	Sub-option 2 Welches Dam 7.5 cumec {Flood Risk increased to a 1 in 15 chance}	Sub-option 3 Welches Dam 10 cumec {Flood Risk maintained at a 1 in 25 chance}	Sub-option 4 Welches Dam 15 cumec {Flood Risk reduced to a 1 in 50 chance}
	(£k)	(£k)	(£k)	(£k)	(£k)	(£k)	(£k)
PVc	-	4,970	29,700	28,000	28,400	28,700	30,000
PVd	216,000	175,000	398	1,610	770	398	115
PVb		41,700	216,000	214,800	216,000	216,000	216,000
NPV		36,700	186,000	186,800	187,000	187,000	186,000
Average Benefit-Cost Ratio		8.4	7.3	7.7	7.6	7.5	7.1
Incremental Benefit-Cost Ratio			7.1	7.5	2.3	1.2	0.2

Notes: 1. All sub-options to Option 4(c) are maintain/improve options.

2. This process is to determine the economic optimum - including improve options; following the PAG 3 decision rules. Option 4(c) [sub-options 1& 2] fail to meet the minimum indicative SoP.

3. As Option 4(c) [sub-option 3] has an incremental benefit cost ratio above unity, this becomes the preferred option.

2.6 Environmental Issues

2.6.0.0.1 The SEA process explains how environmental and sustainability issues have been taken into account through the Strategy's development. The Environment Agency has undertaken a voluntary SEA for this Strategy in accordance with internal policy and Defra guidance, and the results are recorded in Appendix G in Volume 3 of the DSR which supplements this SAR. There is no adverse impact on the SAC. Please see Volume 3, Appendix G for a summary of the appropriate assessment.

2.6.0.0.2 The SEA has been carried out following a top-down approach, producing a strategy for the wider geographic area, rather than focusing on particular projects. This approach aims to ensure that future plans or programmes in the area will be compatible with each other and with current European Directives and Regulations.

2.6.0.0.3 This SEA process comprises three phases summarised as Screening and Scoping, Assessment and Evaluation, and Implementation and Monitoring. The SEA report presents the outputs of the first two phases and makes recommendations for the third (Implementation and Monitoring). Further information regarding the process and methodology is presented in Section 2 of the SEA Report.

2.6.1 Consultation

2.6.1.0.1 Extensive consultation with stakeholders has been undertaken at key stages in the SEA process (as outlined in Table 2-10 below) to gather environmental data and obtain comments on potential flood defence strategies.

Table 2-10: Key Stages in the Consultation Process

SEA Stage	Consultation Activity	Timing
Initial Strategic Option Identification and Evaluation	Issue of Consultation Document	July 2004
Evaluation of Alternative Strategic Options and Selection of the Preferred Strategic Option	Issue of Scoping Report Workshop	September - December 2004
Assessment of the Preferred Strategic Option	Issue of Consultation Document	January 2005
Consultation on draft Strategy and SEA Report	Issue of draft Strategy and SEA Report	March – May 2006

2.6.1.0.2 The initial consultation was undertaken with 38 organisations and involved written communication outlining the long list of options being considered and asking for comments. The reply slip also requested the provision of relevant data and records relating to the study area. This period of consultation was initiated in July 2004, and consultees were given four weeks in which to respond. A summary of responses is presented in Table 1, Appendix J.

2.6.1.0.3 A second written consultation exercise was used to obtain comments on the SEA Scoping Report and the options and draft SEA Objectives set out within it. Consultation on the Scoping Report began in October 2004, for a period of four weeks. A summary of responses is presented in Table 2, Appendix J. In addition a workshop was held on 30 November 2004 with key parties (EA, IDB, English Nature). As described in Section 6 of the SEA report (DSR, Vol 3) the preferred strategic option was selected on the basis of this consultation. Minutes from this workshop (held on 30 November 2004) outlining the

process by which the preferred strategic option was selected, are also presented in the SEA Report (DSR, Vol 3).

2.6.1.0.4 A third written round of consultation was used to obtain comments on issues related to the preferred strategic option (i.e. to refurbish Welches Dam in the short-term and create a flood storage facility in the longer term). This provided an opportunity for consultees to state whether or not they supported the preferred strategic option and provide further information on any issues that were of concern. The third round of consultation was initiated in January 2005, with consultees being asked to respond within four weeks of the consultation starting. A summary of responses to the Preferred Option Consultation Document (December 2004) is presented in Table 3, Appendix J.

2.6.1.0.5 A further formal round of consultation was undertaken in March to May 2006 in which consultees were invited to provide comments on the SEA Report and draft Strategy Report. The consultation ran for a period of eight weeks, and included advertisement under the Environmental Assessment of Plans and Programmes Regulations 2004, SI 2004, No. 1633. This provided the public with the opportunity to review and comment on the reports. Comments from this consultation are presented in Table 4, Appendix J with details of how the comments were taken into account.

2.6.1.0.6 A broad range of consultees were involved in the SEA process and the identification of a preferred strategy including both statutory bodies and other interest groups *Table 2-11*. In addition, consultation was also undertaken with representatives from the various activities and functions of the Environment Agency.

Table 2-11: Consultee List

Consultees	
British Horse Society (Cambridgeshire)	Manea Parish Council
Cambridge Albion Angling Association	Middle Level Commissioners
Cambridgeshire County Council	National Farmer's Union (East Anglia Region)
Defra	Norfolk County Council
Downham West Parish Council	Norfolk Landscape Archaeology
East Anglian Waterways Association	Norfolk Wildlife Trust
East Cambridgeshire District Council	Royal Yachting Association
East of England Development Agency	RSPB
East of England Tourist Board	Sutton & Mepal Internal Drainage Board
English Heritage	Sutton Parish Council
English Nature (Cambridgeshire)	The Inland Waterways Association (Peterborough Branch)
Fenland District Council	The Rambler's Association (Cambridgeshire)
Fenland Wildfowlers' Association	The Rambler's Association (Norfolk)
GO-East	The Wildfowl & Wetlands Trust
Great Ouse Boating Association	The Wildlife Trust (Cambridge & Peterborough)
Histon & District Angling Club	Upwell Internal Drainage Board
Huntingdonshire District Council	Welney Angling Club
King's Lynn & West Norfolk Borough Council	Welney Parish Council
Letchworth & District Angling Association	Zander Angler's Club
Lower Ouse & Fenland Fisheries Consultation Association	
Manea & Welney District Drainage Commissioners	

2.6.1.0.7 In summary, the response to the consultation effort was fair with approximately 36% of consultees responding to the initial consultation, 50% to the Scoping Report and 40% providing comments on the preferred strategic option. Overall, it was evident from the responses received that there was a good general understanding amongst stakeholders as to why a flood defence strategy is required for the catchment; however, not all

consultees appeared to have fully understood that the study is only concerned with 'high level' strategic issues. During the final consultation in March to May 2006, responses were received from approximately 35% of the organisations consulted. Responses showed a good understanding of the scheme and comments were generally supportive of the Strategy as a whole. It will be important to continue these consultation links during the implementation of the Strategy.

2.6.2 The Study Area & the Habitats Regulations

2.6.2.0.1 The area comprises the Cranbrook Drain and Counter Drain (aka Old Bedford River / River Delph) which are situated immediately adjacent to the Ouse Washes, a *Natura 2000* site with the following designations: Special Protection Area (SPA), Ramsar site and Special Site of Scientific Interest (SSSI). The Counter Drain is also designated as a Special Area of Conservation (SAC). The locations of designated sites situated within the study area are shown on *Figure 3 (Appendix A)*.

2.6.3 Requirements of the Water Framework Directive

2.6.3.0.1 The Cranbrook Drain is a man-made drain, or 'artificial waterbody'. Under the terms of the Water Framework Directive, artificial waterbodies are expected to have achieved at least 'Good Ecological Potential' by 2015, by way of improvments in water quality. The preferred option is not likely to reduce the water quality in the Drain and because it will address the potential for accidental diesel spills from the pumping station into the drain, whilst also reducing the risk of flooding, it is in keeping with the aims of the Water Framework Directive.

2.6.4 Environmental Constraints & Opportunities

2.6.4.0.1 The key environmental constraints and opportunities were identified through the collection and collation of baseline data via a combination of literature reviews, data requests, consultation with stakeholders and site visits. Consideration was also given to the recognition and understanding of future environmental trends within the study area. These constraints and opportunities are summarised in Table 2-12, and are shown on Figure 3 (Appendix A).

2.6.5 Strategic Environmental Objectives

2.6.5.0.1 A range of SEOs were developed (Table 2-13) building on knowledge of the study area and the aspiration and policies of key stakeholders. These SEOs indicate the desired direction for environmental change within the study area. The methodology for developing the SEOs and the indicators by which fulfilment of each objective can be assessed are described in detail in Section 2.3 and Table 2.1 of the SEA report, respectively.

2.6.6 Alternative Options Considered

2.6.6.0.1 Section 2.3 details the alternative strategic options considered. Environmental appraisal techniques included the evaluation and comparison of the alternative strategic options against the SEOs (see Table 2-14). Significance of impacts in Table 2-14 have been assessed based on indicators of environmental performance which are listed in the Table 2.1 of the SEA Report. The options, which accorded most closely with the SEOs, were the alternative pumping option (Option 4a), the alternative discharge option (Option 4b) and the flood storage option (Option 4c).

2.6.6.0.2 The significance of predicted environmental impacts of each option was also assessed for Options 1 to 4c. Selection of the preferred option is discussed in detail in Section 6 of the SEA report and Section 2.7 of this report.

Table 2-12: Key Environmental Constraints & Opportunities

Receptor	Summary of Key Environmental Issues, opportunities and constraints
Human Beings	♦ Need to balance short term disturbance caused by construction works against the benefits gained from improved flood risk management. ♦ Recreational opportunities, e.g. creation of cycle paths, bridleways, footpaths, navigation inks, water recreation opportunities.
Flora and Fauna	♦ The need to protect the Ouse Washes SPA, SSSI and Ramsar site, and the Ouse Washes SAC as well as other protected species and important conservation sites. ♦ There are also opportunities to enhance protected sites, improve water quality and create new habitats.
Air and Climate	♦ Improved flood risk management can take a sustainable approach to managing the effects of climate change.
Landscape and Visual Amenity	♦ The study area is within an area of fenland characterised by its flat open landscape and rural location. ♦ There is the opportunity to maintain this character and create new wetland areas.
Water	♦ Water resources are carefully managed within the study area and the demands of agriculture and drinking water need to be considered. ♦ There are opportunities for managing the flow and volumes of water in the area more sustainably through use of a flood storage facility to hold floodwater during periods of high flow and control its input into the drainage system (and onto the Ouse Washes).
Land Use	♦ Need to balance potential land-take for flood storage area against the benefits of more sustainable and reliable flood protection for the area. ♦ There is the opportunity for a flood storage area to be used as an area for habitat creation.
Cultural Heritage, Archaeology	♦ Need to balance the potential for disturbance of archaeological relics by construction activities with the benefits of improved protection from flooding for SAM located within the catchment.
Traffic and Transport	♦ Construction traffic may have an impact on the integrity of road infrastructure and disturb local traffic flow during construction works. ♦ There is potential for improved navigable conditions and integration into regional navigation schemes (e.g. the proposed Fens Waterways Link).
Soil, Geology and Hydrology	♦ Disturbance of soils during construction works. Opportunity for flood storage option to provide a sustainable end use for local mineral extraction.
Use of Natural Resources	♦ Potential to increase sustainability of the pumping system by reducing use of fossil fuels either by changing to electrically powered pumps or to a reduced or non-pumping drainage solution. This also has the potential to reduce long-term running and maintenance costs and risk of pollution from diesel. ♦ During construction, the opportunity to re-use and recycle materials, and source timber from certified sources.

Table 2-13: Strategic Environmental Objectives

Theme	Objective
Flood Management	**1.** Manage the risk and perception of risk from flooding to people, property, land and the environment. **2.** Provide protection from flooding in a manner consistent with plans, policies and objectives.
Climate Change	**3.** Ensure the strategy is sustainable in terms of climate change over its life time.
Flora, Fauna and Fisheries	**4.** Protect and enhance biodiversity throughout the study area. **5.** Protect and enhance sites of nature conservation importance including designated sites of local, national and international importance particularly the Ouse Washes.
Cultural Heritage and Archaeology	**6.** Protect and conserve features of archaeological and heritage importance throughout study area.
Landscape	**7.** Conserve and enhance the landscape character of the area, integrating all works into the local landscape character.
Human Beings	**8.** Improve sustainability of agricultural and commercial activities reliant on flood protection within the study area.
Recreation and Amenity	**9.** Protect and enhance recreation and amenity facilities within the study area, including those related to angling, bird watching, navigation, walking, cycling, horse riding and nature conservation.
Traffic, Transport and Navigation	**10.** Ensure compatibility with transport and navigation infrastructure within the study area.
Land Use	**11.** Achieve an environmentally sustainable approach to land use within the Cranbrook/Counter Drain catchment.
Soils and Geology	**12.** Protect the quality of soils and underlying geology within the Cranbrook/Counter Drain catchment.
Water	**13.** Protect and enhance water quality within the Cranbrook/Counter Drain System. **14.** Ensure no detrimental impact of changes in water levels and flows within the study area, particularly within the Ouse Washes.
Air Quality	**15.** Ensure no detrimental impact to local air quality.
Use of Natural Resources	**16.** Employ the principles of sustainable development as Environment Agency policy dictates.

2.6.7 The Preferred Strategic Option (PSO)

2.6.7.0.1 The PSO 4(c) (*Section 2.7*) is to refurbish Welches Dam PS in the short term (within the next 5 years) and maintain for up to 25 years, whilst developing a longer term flood storage solution as an after use of local minerals extraction adjacent to the counter drain.

2.6.7.0.2 Environmental issues associated with the PSO have been identified through data review and a further consultation exercise on the preferred option undertaken in January 2005. The responses to this consultation indicated widespread support for the preferred option from statutory and non-statutory stakeholders which is further supported in later correspondence.

2.6.7.0.3 An assessment to determine the likley significance of impacts (both adverse and beneficial) of the preferred strategic option was also undertaken. Likely significant effects of the preferred strategic option and possible mitigation measures to address any adverse impacts are presented in Table 2-9. Impacts and mitigation measures will be considered in detail at project level through the production of Environmental Action Plans and Environmental Reports where appropriate.

2.6.7.0.4 In line with the Habitats Regulations (1994), Appendices 11 and 12 were completed setting out the potential effects of the PSO on this Natura 2000 site as part of the Appropriate Assessment process. This concludes the strategy "could provide minor benefits hydrologically for the special wildlife interests of the Ouse Washes SPA and SAC, but will not have an adverse impact on the SPA / SAC". Natural England has confirmed in writing that they concur with the conclusion. A copy of the letter from Natural England and completed Appendix 11 and 12 forms are included in Appendix G.

2.6.8 Implementation & Monitoring Proposals

2.6.8.0.1 An initial assessment of likely significant environmental effects (both beneficial and adverse) of the PSO is presented in Table 6.11 of the SEA Report. Potential beneficial impacts include reduced risk of flooding and opportunities to improve public access and facilities in the vicinity of the Ouse Washes designated sites.

2.6.8.0.2 The key potential adverse impact identified is damage, disturbance or injury to protected species and their habitats. Mitigation measures will be considered on a project by project basis, and implemented through Environmental Action Plans prepared for each scheme.

2.6.8.0.3 Mitigation is likely to include detailed ecological surveys prior to commencement of work and liaison with key stakeholder organisations such as Natural England and the RSPB.

2.6.8.0.4 The SEA Directive requires that the significant environmental effects of implementing the plan or programme should be monitored in order to identify unforeseen adverse effects and to enable remedial action to be undertaken to reduce or eliminate these effects. *Table 7.2* of the SEA Report presents proposals for future monitoring that can be used to evaluate the environmental impacts of the PSO and to identify whether strategic environmental objectives are being achieved.

2.6.8.0.5 Much of the environmental information needed to assess the projects which arise out of the PSO is already being collected by the Environment Agency and other organisations. These datasets will need to be brought together at the scheme level as part of the environmental assessment of the potential impacts of the Welches Dam PS refurbishment and of the potential flood storage area.

Table 2-14: Evaluation of the Eight Alternative Strategic Options on the Options Short-list with the SEOs

Objective Number	Objective	Option Number							
		1	2	3	4(a)[1]	4(a)[2]	4(b)[1]	4(b)[2]	PSO* 4(c)
1	Manage the risk and perception of risk from flooding to people, property, land and environment.								
2	Provide protection from flooding in a manner consistent with plans, policies and objectives.								
3	Ensure the strategy is sustainable in terms of climate change over its lifetime.								
4	Protect and enhance biodiversity throughout the study area.								
5	Protect and enhance sites of nature conservation importance, including designated sites of local, national and international importance, particularly the Ouse Washes.								
6	Protect and conserve features of archaeological and heritage importance throughout study area.								
7	Conserve and enhance the landscape character of the area, integrating all works into the local landscape character.								
8	Improve sustainability of agricultural and commercial activities reliant on flood protection within the study area.								
9	Protect and enhance recreation and amenity facilities within the study area.								
10	Ensure compatibility with transport and navigation infrastructure within the study area.								
11	Achieve a sustainable approach to land use within the Cranbrook/Counter Drain catchment.								
12	Protect the quality of soils and underlying geology within the Cranbrook / Counter Drain catchment.								
13	Protect and enhance water quality within the Cranbrook / Counter Drain system.								
14	Ensure no detrimental impact of changes in water levels and flows within the study area, particularly within the Ouse Washes.								
15	Ensure no detrimental impact to local air quality.								
16	Employ the principles of sustainable development as EA policy dictates.								

Key to table (significance of impacts):

Negative (adverse) impact — Negligible Impact — Positive

Option 1 'Do Nothing'
Option 2 'Do Minimum' (maintain)
Option 3 Sustain (maintain / improve)
Option 4(a)[1] Alternative Pumping [Sub-Option 1]
Option 4(a)[2] Alternative Pumping [Sub-Option 2]
Option 4(b)[1] Alternative Drainage [Sub-Option 1]
Option 4(b)[2] Alternative Drainage [Sub-Option 2]
Option 4(c) Flood Storage

Notes: The 'new pumping station' option (Option 5) was initially discounted on hydraulic grounds but was later reinstated into the short-list of options. This option was finally discounted on economic grounds during a workshop in July 2004, and therefore, was not assessed against the SEOs.

* The negative impacts indicated for the PSO are largely associated with the excavation of the storage area and would be mitigated out with the flood storage strategy.

Table 2-15: Likely Significant Effects of the Preferred Strategic Option

Stage of Implementation	Description of Activity	Receptor	Potential Effect on Receptor	Duration of Impact	Significance of Impact	Mitigation / Comments
Refurbish Welches Dam PS	Refurbishment at 0-5 years and continued maintenance of pumping station for next 6-25 years.	Human beings	Increased reliability of pumping station (decreased risk of flooding due to failure).	Medium term (ie. 6-25 years), direct impact.	++	NA
			Short timescale for implementation (by year 5). Protection against flooding quickly brought up to standard (ie. by year 5) and maintained until flood storage available.	Short to medium term (ie. 0-25 years), direct impact.	++	NA
		Human beings, traffic and transport, air quality.	Limited construction works required, therefore less inconvenience due to large vehicles, low levels of noise and dust disturbance.	Short term (temporary), direct impact.	x	Contractor to follow best practice guidelines.
		Natural Resources	Continued use of fossil fuels or electricity to power pumping station.	Short to medium term (ie. for duration of pumping station's life – 0 to 25years), direct impact.	x	NA
		Protected species.	Protected species (otter and water vole) in immediate vicinity of Welches Dam PS may be disturbed during refurbishment works.	Short term (temporary), direct impact.	x	Ecological surveys prior to works commencing.

Stage of Implementation	Description of Activity	Receptor	Potential Effect on Receptor	Duration of Impact	Significance of Impact	Mitigation / Comments
	Continued pumping of water from Welches Dam PS during high flows.	Fauna and flora on Ouse Washes	Continued pumping of water onto Ouse Washes contributing to degradation of internationally designated sites.	Short to medium term (ie. 0-25 years), direct impact.	x	Appropriate Assessment (Section 6.5) has shown that inputs from Welches Dam PS have a minor impact on the Ouse Washes.
			Limited construction works required for refurbishment and maintenance.	Short term, secondary impacts during refurbishment works.	x	NA
Flood Storage (General)	Creation of flood storage area.	Human beings	Reduced risk of flooding once operational.	Long-term (ie. 25-100 years), permanent, direct impact.	++	NA
			Loss of prime agricultural land to flood storage facility possibly affecting landowners' livelihoods.	Long-term (ie. 25-100 years), permanent, secondary impact.	x	Planning permission required. Compensation may be paid to landowners.
			Potential for water sport facilities to be integrated into the scheme.	Long-term, secondary impact.	+	Benefit to local community.

Stage of Implementation	Description of Activity	Receptor	Potential Effect on Receptor	Duration of Impact	Significance of Impact	Mitigation / Comments
		Human beings, traffic and transport, air quality (dust) and noise, natural resources, flora and fauna, soil, geology and hydrogeology, landscape and visual amenity.	Large scale construction works likely.	Short to medium term, permanent, direct impact once construction commences.	xx	Follow best practice guidelines.
	Creation of flood storage area (cont'd)	Flora and fauna	Opportunities for environmental enhancements in flood storage area.	Long term (on completion of flood storage area), secondary impact.	++	NA
		Agricultural land and landscape character.	Loss of prime agricultural land to flood storage.	Long term (permanent), direct impact.	x	Balance between loss of land to flooding versus loss of land to flood storage facility. Will require discussion with landowners.
	Decommissioning of Welches Dam PS.	Natural resources	Pumps no longer required so no need to use fossil fuels or electricity.	Long term (permanent), secondary impact once scheme is operational.	+	Cheaper running costs and more environmentally sustainable system.

Stage of Implementation	Description of Activity	Receptor	Potential Effect on Receptor	Duration of Impact	Significance of Impact	Mitigation / Comments
		Architectural heritage	Welches Dam PS may fall into disrepair unless maintained as a listed building.	Long term (reversible in short term), secondary impact once PS is abandoned.	x	Liaise with English Heritage and local community groups.
		Flora and fauna, particularly bird populations	No pumping of water onto the Ouse Washes.	Long term (permanent), direct impact.	+	NA
Flood Storage (Disused Quarries)	Use of disused quarries for flood storage.	Human beings	Reduced risk of flooding once operational.	Long-term (ie. 25-100 years), permanent, direct impact.	++	NA
			Land not returned to agricultural use, possibly affecting landowners' livelihoods.	Long-term (ie. 25-100 years), permanent, secondary impact.	x	Planning permission required. Compensation may be paid to landowners. Extraction companies do not need to re-instate land.
			Potential for water sport facilities to be integrated into scheme.	Long-term, reversible, secondary impact.	+	Benefit to local community.
		Land use.	Use of land already damaged / disturbed.	Long term, direct impact.	++	Synergy between EA Strategy and Mineral Planning Authority.
		Water, flora and fauna, land use, human beings.	Storage volume not guaranteed.	Medium to long term (permanent), direct impact.	x	Liaise with Minerals Planning Authority and extraction company.

Stage of Implementation	Description of Activity	Receptor	Potential Effect on Receptor	Duration of Impact	Significance of Impact	Mitigation / Comments
		Land use and landscape character.	Land not returned to fenland / agricultural land.	Long-term (permanent), direct impact.	x	Liaise with landowners and extraction company.
		Flora and fauna	Potential for creation of habitat in flood storage area.	Long term (permanent), secondary impact.	++	NA
		Flora and fauna, particularly bird populations	No pumping of water onto the Ouse Washes.	Long term (permanent), direct impact.	+	NA
		Natural resources.	Re-instatement of area after extraction not needed.	Long-term (permanent), direct impact.	+	NA
	Decommissioning of Welches Dam PS	Land use, flora and fauna, natural resources.	Small pumping station required to pump water out of flood storage.	Long- term (permanent), direct impact.	x	Use renewable or “green” energy if possible.
		Architectural heritage	Welches Dam PS may fall into disrepair unless maintained as a listed building.	Long term (reversible in short term), secondary impact.	x	Liaise with English Heritage.

Key to table (significance of impacts):

XXX	Major negative	-/+	Negligible impact	+++	Major positive
XX	Moderate negative			++	Moderate positive
X	Minor negative			+	Minor positive

2.7 Choice of Preferred Strategic Option (PSO)

2.7.1 PSO Evaluation

2.7.1.0.1 Following the February 2004 workshop, a further workshop was held 30th November 2004 with the Environment Agency, Natural England (known as English Nature at the time of the consultation), a representative of the local IDBs and Atkins. All technical, economic and environmental issues along with health and safety issues were considered and Option 4(c) was identified as the PSO. This option is to refurbish Welches Dam PS with a design life of 25 years as a short term measure and, phase in flood storage over the next 15 to 20 years to accommodate the flood flow so that Welches Dam PS can then be decommissioned. The scoring matrices for the PSO and option H&S risk assessment, agreed by the Strategy Team, is detailed in *Appendix E* (with further explanation in DSR volume 1, Section 10). Details of the workshop and consultations undertaken throughout the option selection process are discussed in 2.6.1 of this report and are presented in Volume 3, of the DSR. A final Consultation was undertaken in March – May 2006. Comments made were generally supportive and overall the positive views expressed at the beginning of the option selection process were reflected in this final consultation.

2.7.1.0.2 As detailed in Section 0, a further assessment of the economics and modelling was undertaken for a range of differing pumping capacities at Welches Dam PS and flood risks (and hence flood storage needed in the future). Table 2-9 demonstrated that the pumping capacity of 10 cumecs [Option 4(c) sub-option 3] is the most economic solution.

2.7.1.0.3 The flood storage reservoir and any associated environmental enhancements, such as habitat and recreation, will be provided as a part of the remediation for the site by the mineral extraction companies. The remediation will also include clay sealing of the reservoirs to deal with groundwater issues. The arrangements for this provision and the subsequent agreements with landowners is subject to negotiation between the parties involved (Environment Agency, Cambridgeshire County Council, the quarrying firms and the landowners). Cambridgeshire County Council have confirmed that remediation will be included for in the planning permission granted to the quarrying firms. An action plan has been included in appendix K detailing how the flood storage will be progressed.

2.7.1.0.4 Should the storage option no longer be viable, the contingency is that after 20 to 25 years, Welches Dam PS is renewed. This is effectively reverting to option 3 ‘Sustain’ as an alternative strategy, which is the next highest ranking economic option. The refurbishment of Welches Dam PS is a common short term measure to the PSO 4(c) and Option 3, this is therefore a low risk approach for the Environment Agency to take.

2.7.1.0.5 The Welches Dam refurbishment works undertaken in 1998 have a number of residual weaknesses which are; complexity of automated starting, a reliance on diesel drives (requiring significant maintenance) and the potential for diesel spillage between the station building and the suction intake. The PSO short term refurbishment works address all the above by converting the pumps to electric drives, which are a more reliable automated start requiring much less maintenance, and removing the need for any diesel storage or transfer in the pumping station building.

2.7.2 Defra Priority Score

2.7.2.0.1 The preferred option has a Defra priority score of 25, as summarised in Table 2-16, which demonstrates the economic viability of the Strategy and its importance to the community.

Table 2-16: Preferred Option Priority Score

Criteria	Score
Economic score	14.1
Base people score	*0.8*
Risk factor	*0*
Affluence factor	*0*
People score	0.8
BAP area creation	
SSSI area protection	*3.3*
Other habitat protection	*4.7*
Heritage	*2*
Environmental Score	10.0
Total Priority Score	25

2.7.3 Sensitivity of Economic Decision Making

2.7.3.0.1 The economic sensitivity analysis undertaken (including for climate change and reduction in benefits) is detailed in Appendix F in Volume 2 of the DSR. This determines how robust the appraisal results are to the underlying assumptions within the analysis and, consequently, whether an error in that assumption could affect the decision rule and choice of preferred option.

2.7.3.1 Deferred Scheme

2.7.3.1.1 A sensitivity analysis was run to determine how delaying the scheme costs by 10 years would affect the benefit-cost ratio of the preferred option. This also delays the benefits (i.e. increases the damages) of implementing each of the 'Do Something' options.

2.7.3.2 Climatic Change

2.7.3.2.1 The effect of climate change for the PSO has been assessed, in line with climate change impacts Oct 2006 guidance, by increasing the volume of water in Compartment 1 (i.e. only compartment to flood under the preferred option). Each design event was increased by 20% and run through the drainage model which is a conservative interpretation of the guidance.

2.7.3.2.2 Due to the nature of the catchment and the fact that the majority of land and property within the area are considered 'written off', it is fair to assume that there will be no increase in the present value damages for the 'Do Nothing' scenario. However, there are effects on the MLS, which are discussed in section 2.3.10

2.7.3.2.3 The iterative approach taken for this strategy allows the Environment Agency to appropriately adapt the Preferred Option in line with improving scientific information on climate change.

2.7.3.3 Reduced Benefits

2.7.3.3.1 The main assumption was the extent to which properties within the flood risk area depreciated in value. In the analysis a 50% depreciation was assumed. Sensitivity tests were undertaken assuming a 25% reduction, 10% reduction and 0% reduction in property value. It was deemed unnecessary to test the sensitivity of the present value costs as they were felt to be robust with a 60% Optimism Bias factor.

2.7.3.3.2 In addition, consideration has been given to the impact of an IDB not renewing its assets and thereby ceasing to effectively operate. To test this scenario a 50% reduction of benefit area and PVd value has been calculated and the Benefit-Cost ratio

remains greater than 1. This is an unlikely scenario given the IDB agreement to the Strategy (*Appendix H* letter refers).

2.7.3.4 Delayed 'Do Nothing'

2.7.3.4.1 A sensitivity analysis has been undertaken to determine the scheme viability should the sluice not fail until between years 15 and 20. The majority of the damages would therefore not be realised until year 15.

2.7.3.5 Social Equity

2.7.3.5.1 The effect of social equity was considered by appraising the distribution of social classes across the district in order to assess vulnerability. In accordance with MCM guidance, weighted factors are only recommended where AB, D or E social class groups are predominant. The table below shows the vunerablility data for each ward.

Table 2-17: Vulnerability analysis based on Social Class

Ward	AB	C1	C2	D	E
Outwell and Upwell	17%	28%	19%	18%	18%
Sutton	24%	30%	20%	15%	13%
Manea	16%	26%	23%	19%	15%
Upwell, Outwell and Delph	14%	27%	21%	21%	15%
Chatteris East	17%	28%	21%	19%	16%
Scheme Average	**17%**	**28%**	**21%**	**19%**	**16%**

2.7.3.5.2 In addition, as actual average house prices for the area have been used in the damage calculations (MCM damage data has only been used for the 4 properties affected by 'overtopping') it is deemed inappropriate to undertake a weighting factor for social class.

2.7.3.6 Sensitivity Results

2.7.3.6.1 The results of the sensitivity tests undertaken for the strategy study are given in Table 2-18. The effects would be the same for each of the non preferred strategic options although the benefit cost ratios would be lower.

Table 2-18: Economic Sensitivity Tests

Sensitivity	'Do Nothing' (PVd)	Benefit/Cost Ratio	Defra Priority Score
Base Case	216,000	7.5	25
Deferred Scheme	216,000	8.5	28
Climatic Change	216,000 *	7.5	25
Reduced Benefits (25% Depreciation)	183,000	6.4	22
Reduced Benefits (10% Depreciation)	163,000	5.6	21
Reduced Benefits (0% Depreciation)	149,000	5.2	20
Delayed 'Do Nothing' Damages	138,000	4.8	19

* Excludes effect on adjacent MLS catchment which is £36m. See *Table 2-3*

2.7.3.7 Recommendation of PSO

2.7.3.7.1 It is recommended that the PSO is option 4(c), Sub option 3; maintain/improve the current flood risk standard by developing flood storage reservoir solutions as after use of proposed local mineral abstraction sites which are included in Cambridgeshire County Council's Area Action Plan and are currently the subject of a planning application. It is estimated that it will take 20 years for sufficient sites to become available and Welches Dam PS needs to be refurbished to maintain protection for the

interim period after which time it will be decommissioned. Other strategy works and studies proposed within the first five years include flood storage follow on studies and option investigations, IDB PS instrumentation and Cranbrook drain leakage PAR.

2.7.3.7.2 The PSO will provide the most cost-effective and environmentally sound solution, in the long term, by sustaining the SoP at a 1 in 25 (4%) chance of occurrence in any given year, which is the minimum indicative standard of flood protection for the catchment (Land Use band B). Climate change effects on the capacity of present system within the next 20 years will be accommodated by the existing surplus capacity of the system. Long term climate change will be accommodated by appropriate sizing of the future storage reservoirs.

2.7.3.7.3 The PSO has potential for long term environmental benefit as detailed in Table 2-12.

2.7.3.7.4 Health and safety considerations have been an integral part of the decision process. In the comparison of options the Health & Safety risk of the PSO is moderate/low, the health and safety risks are primarily due to the construction activities involved in the implementation of the PSO. The assessment of options is as detailed in Appendix E.

2.7.3.7.5 The Flood Warning Service will be reviewed at regular intervals in line with the Flood Warning Investment Strategy (2003/4 to 2012/13) and the Flood Warning levels of service.

2.8 Other Considerations

2.8.0.0.1 Gravity drainage through the Old Bedford Sluice is important to the catchment and the implementation of the PSO. The problems associated with the gravity drainage have not been included as part of this Strategy, but are to be investigated as part of the Tidal Ouse Strategy study, which is to be completed in 2008. It is recommended that the Tidal Ouse Strategy work be used to inform the design for the replacement of the Old Bedford Sluice and Lock and the revision of the Strategy in Year 5.

2.8.0.0.2 In brief, the gravity drainage is being compromised by high riverbed levels in the Tidal River Ouse. These high bed levels result in high water levels during the low water part of the tidal cycles and thus insufficient hydraulic head for the Old Bedford Sluice to operate. This is aggravated by local siltation at the sluice. Climate change may also lead to an accelerated rise in sea level resulting in a general rise in low water levels. In recognition of the poor gravity drainage, provision for a small pumping station, as detailed in Section 2.3.8, has been included in the long term investment plan for the PSO.

3 Project Plan

3.0.0.0.1 This strategy study has shown that in the medium to long term the PSO is to maintain existing structures and develop flood storage reservoirs so that the Welches Dam PS can be decommissioned by Year 25. The key activities are shown in the implementation plan in Table 3-1.

3.0.0.0.2 The Whole Life cash cost of the PSO is £83.2 million [PVc £28.7 million based on July 2007 costs]. The benefit/cost ratio is 7.5 (incorporating a 60% optimism bias) with a Defra priority score of 25.

Table 3-1: Implementation Plan

Time frame	Year	Activity identified in strategy (excluding normal operation & maintenance works)
Short Term	1 to 5 yrs	• Flood Risk Management Strategy approval • Flood Storage 'high level' technical and environmental follow on study • Flood Storage option liaison and negotiations (mineral extraction is part of a planning application) • IDB pumping station (water levels and pump hours) monitoring equipment installed, and annual data collection following installation • Cranbrook Drain leakage control measures / Low Bank stability PAR • Welches Dam PS refurbishment, PAR, design and implementation
Medium Term	6 to 25 yrs	• Regular review of Flood Risk Management Strategy, triggered by ongoing monitoring of the drainage system, liaison with local mineral extraction plans, outcomes of CFMP reviews • Flood storage option liaison and negotiations • Cranbrook Drain leakage control measures / Low Bank stability implementation • Old Bedford Sluice and Lock replacement, PAR, design and implementation • Flood storage option feasibility study, PAR, design and implementation • Annual IDB pumping station data collection
Long Term	26 to 100 yrs	• Regular review of Flood Risk Management Strategy, triggered by ongoing monitoring of the drainage system, liaison with local mineral extraction plans, outcomes of CFMP reviews • Annual IDB pumping station data collection • Refurbishment and replacement of IDB and Environment Agency major assets

Note: See SEA report (Volume 3) for related SEA/EIA activities.

3.1 Implementation

3.1.0.0.1 Following approval of the PSO, PARs for each individual element of work will be prepared.

3.1.0.0.2 A follow on study report should be produced to inform a future project appraisal for flood storage.

3.1.0.0.3 Following completion of the first 5 years work plan, the need to review the strategy should be considered.

3.1.0.0.4 The whole life costs are summarised on Table 3-2

Table 3-2: Whole Life Cost of Strategy

Item	Welches Dam PS. £k. First 5 Yrs	Studies and minor works. £k. First 5 Yrs	Total £k
Agency Cost (including surveys)	25	15	40
Preliminary costs	0	10	10
Consultant Fees	150	115	265
Construction costs	1,500	32	1,530
Environmental enhancement costs	20	0	20
Cost Consultant	5	0	5
Compensation	0	0	0
Contingency @ 60%	1,020	103	1,120
Inflation @ 5% per annum	267	32	
Total Capital Cost	**2,990**	**307**	
Future Construction cost (incl. contingency @ 60%)			24,700
Environmental Enhancement Costs			240
Maintenance costs over period of strategy			55,200
Whole Life cash cost (including maintenance but without inflation)			83,200

*excludes residual value of assets at 100 years.

3.1.0.0.5 The table below is a breakdown the cost estimates, not including contingency, for the construction and maintenance works for the whole scheme.

Table 3-3: Construction Cost items

Works	Cost (£k)	Asset Life (years)	Years in which work Occurs	Total Cost (inc 60%)
Refurbish Welches Dam (10 cumec)	1,700	20	5	2,720
Replace Old Bedford Sluice and Lock (new structure)	2,050	100	10	3,280
Construct channel from storage area to the Counter Drain and related infrastructure (i.e. small pumping station)	1,710	100	20	2,740
Refurbishment of flood storage pumping station	105	20	40, 60, 80	504
Replace Sutton Gault Culvert	630	100	25	1,010
Replace Welney Gate	525	100	20	840
Construct new small pumping station to evacuate flows through Old Bedford Sluice and Lock (climatic change)	550	80	50	880
Construct new Mepal PS (IDB)	840	80	65	1,340
Refurbish Mepal PS (IDB)	625	20	5, 25, 45, 85	4,000
Construct new Purls Bridge PS (IDB)	340	80	75	544
Refurbish Purls Bridge PS (IDB)	125	20	15, 35, 55, 95	800
Construct new Glenhouse PS (IDB)	840	80	75	1,340
Refurbish Glenhouse PS (IDB)	520	20	15, 35, 55, 95	3,330
Construct new Cock Fen PS (IDB)	370	80	50	592
Refurbish Cock Fen PS (IDB)	225	20	10, 30, 70, 90	1,440
Construct new Upwell Farm PS (IDB)	315	80	45	504
Refurbish Upwell Farm PS (IDB)	55	20	5, 25, 65, 85	352

Works	Cost (£k)	Asset Life (years)	Years in which work Occurs	Total Cost (inc 60%)
Construct new Lake Farm PS (private landowner)	260	80	50	416
Refurbish Lake Farm PS (private landowner)	34	20	10, 30, 70, 90	218
Cranbrook Drain leakage control	400	100	6	640
IDB monitoring Equipment	37	-	2	59
Pre-feasibility Study and Liaison (flood storage)	30	-	5	48
Feasibility Study and Liaison (flood storage)	85	-	10	136
Future Environmental Enhancement Costs	150	-	-	240
			Total Scheme Cost	28,000
			Cost Assign to years 1-5 works (Table 3.2)	3,000
			Future Construction cost (incl. contingency @ 60%)	26,000

3.2 Risk & Sensitivity Analysis

3.2.1 High Level Risks of Strategy Study

3.2.1.0.1 The 'High Level' risks associated with the Strategy Study have been assessed and Table 3-4 summarises the analysis. This high level risk assessment should form the basis of risk registers for the individual elements of the Strategy Study and should be reviewed when the strategy is under review.

3.3 Financial Contributions

3.3.0.0.1 Capital works implementation of each individual element of the strategy will be funded by the relevant authority, e.g. refurbishment of Welches Dam PS will be undertaken by the Environment Agency, IDB pumping station monitoring equipment will be installed by the relevant IDB.

3.3.0.0.2 The operation and maintenance costs of Welches Dam PS will continue to be funded on the current 24% Environment Agency, 76% IDB basis in accordance with the long standing local precept arrangement. The split in contributions reflects the ratio of upland catchment area controlled by the Environment Agency and lowland catchment area controlled by the IDBs of Sutton/Mepal and Manea/ Welney. This funding arrangement will be subject to review in subsequent strategy reviews.

3.3.0.0.3 The Environment Agency would seek for the RSPB or Wildlife Trust to take on responsibility for the maintenance of any habitat that is created by the future flood storage, the cost of which for 20 ha is estimated at £11,800 pa.

3.4 Procurement/Project Management

3.4.0.0.1 It is recommended that the production of the PARs (for the implementation of each of the strategy activities in the first five years) should be completed by a consultant on the National Engineering and Environmental Consultancy Agreement (NEECA) framework, with the addition of a framework contractor and a framework cost consultant. A review is required to determine the procurement strategy and whether there is justification to directly allocate this work to the same team that prepared the strategy or a need to undertake a mini-competition.

Table 3-4: 'High Level' Risk Analysis

No	Risk	Mitigation measures. Strategy study stage	Future mitigation measures	Initial Probability Rating	Residual Probability Rating following mitigation
1	Cost estimate reliability	60% optimism bias applied to economic assessment – DSR *Appendix F* Sensitivity analysis in economic assessment - DSR *Appendix F*	Financial risk assessment at PAR/ Detailed Design stage for all works	High	Low
2	Technical viability assumptions of storage option.	Undertake follow on studies.	Review PSO	Medium	Low
3	Storage reservoir does not get constructed or is delayed	Maintain regular contact with Cambridge County Council.	Review PSO	Medium	Low
4	Welches Dam PS fails early	Maintain regular maintenance procedures	Ensure Welches Dam PS refurbishment is implemented	High	Low
5	Environmental pressure to avoid any pumping to Ouse Washes	Current effect of Welches Dam PS modelled (See SEA report, *Section 6*) and found not to be significant	Review SEA as a part of the PSO review.	Low	Low
6	Changes in regional/national catchment management	Current catchment management plans reviewed as a part of the study (SEA)	Continued liaison with Agency and Natural England as a part of strategy review process	Low	Low
7	Flood storage area becomes designated site	Follow on studies to review if area can be set aside for habitat development	Continued liaison with Agency and Natural England as a part of strategy review process	Low	Low
8	Design and modelling assumptions are incorrect	QA procedures	Collect more data and review	Medium	Low

Table 3-5: Key Staff

Organisation	Nominated Representative	Title
Environment Agency	Chris Allwork	Project Executive
Environment Agency	Sadia Moeed	Agency Project Manager
Environment Agency	Pat Sones	Agency Consultant
Environment Agency	Lesley Clarke	National Environmental Assessment Service Officer
Environment Agency	Neville Bussingham	Technical Support Team Member 1. Operations Delivery.
Environment Agency	Anthony Clayton	Asset Systems Management. Technical Specialist.
Environment Agency	Bill Steel	Operations Engineer (MEICA)
Middle Level Commissioners	David Thomas [also representing IDBs]	Chief Engineer
Natural England	Jonathan Graham	Conservation Officer
Atkins	John Sheppard	Framework Consultant

3.4.0.0.2 The PAR for each of the strategies individual activities will identify the respective procurement strategy.

4 Defra/WAG Project Appraisal Report – Data Sheet

Entries required in clear boxes, as appropriate, shaded boxes are for Defra use.

GENERAL DETAILS

Authority Project Ref. (as in forward plan):	ACC451/002A (IMAN000629)	LDW/CPW
Project Name (60 characters max.):	Cranbrook/Counter Drain Flood Risk Management Strategy	
Promoting Authority: Defra ref (if known)		
Name	Environment Agency	
RE Region:		
Emergency Works: *(Y/N)*	N	
Strategy Plan Reference:		LDW/CPW
River Basin Management Plan		
Shoreline Management Plan:		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:	2007	
Estimated duration in months:	N/A	
Contract type	N/A	

Direct labour, Framework, Non Framework, Design/Construct

COSTS

	APPLICATION (£)	Defra ADJUSTMENT (£)
Appraisal:	N/A	
Costs for Agency approval:	N/A	
Total Whole Life Costs:	83,200,000	

For breakdown of costs see Table in Section 2.4

CONTRIBUTIONS:

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

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)	Complete (date)	Days
Senior Engineer:		/ /	/ /	
Regional Engineer:		/ /	/ /	

Entries required in clear boxes, as appropriate, shaded boxes are for Defra use.

LOCATION - to be completed for all projects

EA Region/Area of project site (all projects):	Anglian / Central	Ref.
Name of watercourse (fluvial projects only):	Cranbrook/Counter Drain	
District Council Area of project (all projects):	Fenland, East Cambridgeshire, Huntingdonshire, Kings Lyn and West Norfolk	Ref.
Grid Reference (all projects):	TL468856	

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

Specific town/district to benefit:

DESCRIPTION

Brief project description including essential elements of proposed project/study (Maximum 3 lines each of 80 characters)

Cranbrook/Counter Drain Flood Risk Management Strategy

Postcode zones of protected property wholly or partially within proposed benefit area

CB6	PE14	PE15	PE28	PE38					

DETAILS

Design standard (chance per year):	4%		yrs
Existing SoP (chance per year)	4%		yrs
Design life of project:	100 yrs		yrs
Fluvial design flow (fluvial projects only):	10 m^3/s		m^3/s
Tidal design level (coastal/tidal projects only):	NA		m
Length of river bank or shoreline improved:	NA		m
Number of groynes (coastal projects only):	-		
Total length of groynes* (coastal projects only):	NA		m
Beach Management Project? *Y/N*	N		
Water Level Management (Env) Project? *Y/N*	N		
Defence type (embankment, walls, storage etc	Strategy		

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

ADDITIONAL AGREEMENTS:

Maintenance Agreement(s):		Not Applicable/Received/Awaited	
EA Region Consent (LA Projects only):		Not Applicable/Received/Awaited	
Non Statutory Objectors: Y/N			
Date Objections Cleared:			

Entries required in clear boxes, as appropriate, shaded boxes are for Defra use.

ENVIRONMENTAL CONSIDERATIONS

Natural England (or equivalent) letter:	Received	Not Applicable/Received/Awaited	
Date received	28/09/06		

Sites of International Importance (*Y/N* for each)
Answer Y if project is within, adjacent to or potentially affects the designated site

Special Protection Area (SPA):	Y		
Special Area of Conservation (SAC):	Y		
Ramsar Site	Y		
World Heritage Site	N		
Other (Biosphere Reserve etc)	N		

Sites of National Importance (*Y/N* for each)
Answer Y if project is within, adjacent to or potentially affects the designated site

Environmentally Sensitive Area (ESA):	N		
Site of Special Scientific Interest (SSSI):	Y		
National/Regional Landscape Designation:	N		
National Park/The Broads	N		
National Nature Reserve	N		
AONB, RSA, RSC, other	N		
Scheduled Ancient Monument	Y		
Other designated heritage sites	N		

Other Environmental Considerations

Listed structure consent	N	Not Applicable/Received/Awaited	
Water Level Management Plan Prepared? *Y/N*	Y		
FEPA licence required? *NA/R/A*	NA		

Compatibility with other plans

Shoreline Management Plan	NA	Yes/No/Not Applicable	
River Basin Management Plan	NA	Yes/No/Not Applicable	
Catchment Flood Management Plan	Yes	Yes/No/Not Applicable	
Water Level Management Plan	Yes	Yes/No/Not Applicable	
Local Environment Agency Plan	Yes	Yes/No/Not Applicable	

SEA/Environmental Impact Assessment

SEA	Agency voluntary	
Statutory required/Agency voluntary/not applicable		
EIA	NA	
Yes (schedule 1); Yes (schedule 2); SI1217; not applicable		
SEA/EIA status	Final	
Scoping report prepared/draft/draft advertised/final		

Other agreements	Detail	Result	(Not Applicable/Received/Awaited for each)

Entries required in clear boxes, as appropriate, shaded boxes are for Defra use.

Costs, benefits & scoring data

(Apportion to this phase if part of a strategy)

Local authorities only: for projects done under Coast Protection Act 1949, please separately identify:
FD = Benefits from reduction of asset flooding risk; CE = Benefits from reduction of asset erosion risk

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

Land Area

Total area of land to benefit:	ha		ha	
of which present use is:	FD	CE	FD	CE
Agricultural:	8737ha	ha	ha	ha
Developed:	316ha	ha	ha	ha
Environmental/Amenity	ha	ha	ha	ha
Sched. for development:	ha	ha	ha	ha

Property protected

	Number		Value (£'000s)		Number		Value (£'000s)	
	FD	CE	FD	CE	FD	CE	FD	CE
[1]Resid.	286		46,900					
Comm./ind.	22		3,610					
Other: (description below)	0		0					
Description:					Description:			

Costs and Benefits

[1]Present value of total project whole life costs (£'000s):	28,701	
Project to meet statutory requirement? *Y/N*		

	£'000s		£'000s	
	FD	CE	FD	CE
Present value of urban benefits:	187,000			
Present value of agricultural benefits:	28,900			
Present value of environmental/amenity benefits:	0			
[1]Present value of total benefits (FD & CE)	216,000			
Net present value:	187,000			
Benefit/cost ratio:	7.5:1			:1
			Category U/UA/AU/EU etc:	
Base date for estimate:	July 2007			
Project Appraisal Guidance used: *Y/N*	Y			
PAG Decision rule stages III and IV applied: *Y/N*	Y			

Other Priority Scoring DETAILS[1]

Economics			**People**			**Environmental**		
Non-works study, eg coastal process (Y/N)?	N		Risk*:	N/A		BAP net gain (Ha):	0	
			Vuln**:	3374		SSSI protected (Ha):	2519	
						Other habitat (Ha):	5350	
						Heritage sites***:	9No.(1 or2*)	

*(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):	**N**		
Reason (max 100 chars):			

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

PRIORITY SCORE CALCULATION FLOWCHART

Economic score

	Benefits (£'000s)		Costs (£'000s)		Economic Score
Divide	216,000	by	28,700	multiply by 2 and subtract 1 =	14.1

Economic score = (benefits / costs * 2) –1 (Max is 20)

People Score

No of residences		Cost (£'000s)		Base People Score		Risk factor very high = 2 high = 1	Affluence factor: 1 to 300 301 to 1500 1501 to 6664 6665 to 8114 8115 to 8414	Add: +2 +1 no adjustment -1 -2		People Score
308	multiplied by 75, divided by	28,701	=	0.8	plus	0	plus	0	=	0.8

(Max is 8) (Max. is 12)

People score = (number of residences protected * 75 / cost) + risk factor + vulnerability factor

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)	(2519	multiplied by 1.5)								
(	(0)	plus	(3778)	plus	5439.9)	multiplied by 25 divided by	28,700	plus	2	=	10.0

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 =	25

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. (Max is 44)
Please note there is an Internet Score Calculator at http://www.defra.gov.uk/environ/fcd/policy/grantaid.htm

5 Recommendations/Approval Sign Off - Defra

5.0.0.0.1 Scheme of Delegation (SoD) A9 Approval is sought for the preferred strategy which is to improve the current service level by refurbishing Welches Dam Pumping Station in the short term and developing Flood Storage, as after-use of mineral abstraction sites, in the medium term. This will allow the decommissioning of Welches Dam P S . Over the strategy period, capital and maintenance works will be required to the Old Bedford Sluice and other assets in the system as detailed in table 3-3 of this document. The Flood Warning Service will be reviewed at regular intervals in line with the Flood Warning Investment Strategy (2003/4 to 2012/13) and the Flood Warning levels of service. The indicative whole life cost is £83,200k (including £10,500k contingency).

Department for Environment Food and Rural Affairs. *(only required for projects for submission to Defra)*

• *Study/Strategy/AIP to first 5 years work/Scheme recommended for:- further study/rejection/approval for:- Fin.Mem. agreement/agreement/approval at a cost of	

Senior Engineer	Name		Signature	
			Date	

*Study/Strategy/AIP to first 5 years work/Scheme accepted/recommended for:-
further study/rejection/approval for:-
Fin.Mem. agreement/agreement/approval at above cost.

Regional Engineer	Name		Signature	
			Date	

*Study/Strategy/AIP to first 5 years work/Scheme accepted/recommended for:-
further study/rejection/approval & submission to DEFRA for:-
Fin.Mem. agreement/agreement/approval at above cost.

Chief Engineer	Name		Signature	
			Date	

* Select as appropriate.

6 Appendices

6.0.0.0.1 A Detailed Strategy Report (DSR) has been prepared which details the development of the strategy and the technical, economic, environmental and consultation process for the strategic options considered in three volumes:

a. Cranbrook / Counter Drain Flood Risk Management Strategy Volume 1 – DSR (which includes Appendix A)
b. Cranbrook / Counter Drain Flood Risk Management Strategy Volume 2 – DSR Appendices B to F
c. Cranbrook / Counter Drain Flood Risk Management Strategy Volume 3 – DSR Appendix G Strategic Environmental Assessment Report

6.0.0.0.2 The DSR in turn informed this Strategy Appraisal Report (SAR).

6.0.0.0.3 Table 6-1 provides details of where information relating to this SAR is provided.

Table 6-1: Summary of Information Provided as Appendices

Checklist of Appendix information [PAR template v7]	**Provided in**	**Volume**
• Outline Plan and Sections of proposed works, other drawings as required (electronic files, hard copies available if requested)	Appendix A and DSR	This Volume *Appendix A* & B of Volume 1 & 2 of DSR
• Benefit cost comparison of the strategic options	Appendix C	This Volume
• Benefit cost comparison for the preferred strategic option for a range of capacities & flood risks	Appendix D	This Volume
• Options/issues/risk & score matrix to identify the preferred strategic option & health & safety risk assessment of the strategic options	Appendix E	This Volume
• List of relevant reports available for inspection	Appendix F	This Volume
• Natural England letter of Support	Appendix G	This Volume
• IDB (Middle Level Commissioners) letter or support	Appendix H	This Volume
• Detailed Strategy Report Summary	DSR	Volume 1 of DSR
• Technical Report	DSR	Volume 2 of DSR
• Appropriate photographs	DSR	*Appendix B* of Volume 2 of DSR
• Cost breakdown	DSR	*Appendix E* of Volume 3 of DSR
• Economic appraisal with data and detailed workings using Defra spreadsheets in FCDPAG3 Annex A, or compatible.	DSR	*Appendix F* of Volume 2 of DSR
• List of Consultees and responses.	SEA report	*Volume 3* of DSR
• SEA/EIA Scoping Report and EAP, Indicative Landscaping Plan (ILP)	SEA report	*Volume 4* of DSR
• Sustainability Register	SEA report	*Volume 3* of DSR