

## Project Appraisal Report

Authority Scheme Reference

DEFRA CPW/LDW Number

Promoting Authority

Wyre Borough Council

Project Name

Fylde Headland



APPROVAL HISTORY SHEET	
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## **1 EXECUTIVE SUMMARY**

### **1.1 The Problem**

People and properties in Wyre are at risk of flooding from both 24.4km of tidal frontages and from 14.6km of critical ordinary watercourses.

It is estimated that the costs associated with the risks of flooding to assets within the Fylde Headland is some £745 million. This is a summation of the (tangible) Do Nothing Damages associated with flooding from both the coast and the watercourses in this area. Assets within the Headland that are at risk from flooding include:

- ?? 106,000 people
- ?? 25,500 properties
- ?? 1,500 industrial units
- ?? 2,750 hectares of land, including 825 hectares of high quality agricultural land
- ?? The loss of various significant environmental designated sites.

The hinterland within Wyre is low lying and bounded at the coastal fringe by raised coastal defences that are coming to the end of their useful life. These defences and the current maintenance regime are insufficient to ensure the continuing economic and social prosperity of the Wyre community.

Within the hinterland, water drains to the coast via the River Wyre through a series of critical ordinary watercourses. In many areas, Wyre BC has similar responsibility as a riparian owner in its capacity as the Land Drainage Authority for many of these critical ordinary watercourses. As the Land Drainage Authority, Wyre Borough Council is obliged to ensure adequate passage of this surface water. Recent flooding has caused major damage and identified the need to implement a suitable cause of action for each of these watercourses to prevent flooding on a large scale.

Wyre Borough Council has produced a strategy study for both coastal defences and land drainage issues. In each, a course of action has been developed that best achieves the council's strategic objectives and ultimately aims to reduce the risk of property loss and injury resulting from flooding. In each case, the strategies are compatible with and build upon higher level plans.

### **1.2 Outline Preferred Solution**

The preferred options from the Coastal Defence Strategy and the Land Drainage Strategy are outlined in Appendix C, which also includes long and short term programmes for their implementation.

The preferred option for both strategies is Option 5 - Strategy. In both cases this option incorporates a combination of actions appropriate to the needs of either the coastal / estuarine and critical ordinary watercourse frontages.

The Coastal Defence Strategy preferred option is a combination of maintain, sustain and improve, except for the management units Shard Bridge to Bankfield Farm and Bankfield Farm to Cartford Bridge where the preferred option is to retreat the existing line of defence. Appendix C outlines the preferred option in more detail.

The preferred option for the Land Drainage Strategy is again a combination of maintain, sustain and improve for all units, and these are outlined in more detail in Appendix C. The development of this combination of levels of service, targets the differing needs of the various frontages in terms of land-use and levels of service provision in terms of indicative standard.

In essence therefore, the strategy options are a combination of maintain, sustain and improve for coastal frontages and reaches of the watercourses considered. The selection of the approach for each sub-section is based on the most appropriate solution for that area.

### 1.3 Total Scheme Costs

In each case, scheme costs have been developed for the Strategy Options for Coastal Defence and Land Drainage. The Strategy Options considered have a scheme life of 100 years.

	<b>Capital Costs (£k)</b>	<b>Other Cost (£k)</b>	<b>Sub-Total, ie all Capital Costs (£k)</b>	<b>Maintenance (£k)</b>	<b>Total Costs (£k)</b>
Coastal	123,381	6,580	129,961	26,089	156,050
Land Drainage	20,984	1,124	22,108	7,500	29,608
<b>Total</b>	<b>144,365</b>	<b>7,704</b>	<b>152,069</b>	<b>33,589</b>	<b>185,658</b>
60% Optimisation Bias			91,241		111,395
<b>Total</b>			<b>243,310</b>		<b>297,053</b>

It is believed that the capital elements of the scheme will be grant eligible.

### 1.4 Opportunity for Partnerships

The opportunity for partnerships will be investigated as the schemes progress. Riparian owners will be consulted where they are considered to be a significant benefactor. Already, various monitoring initiatives are being investigated to ensure the environmental compatibility of each frontage option.

### 1.5 Economic Benefit

The economic analyses for both the individual Coastal Defence and Land Drainage Strategies, and the combined strategy are summarised in Tables 1.1 to 1.3 below:

**Table 1.1 Economics Summary Table for Coastal Defence**

Option	1	2	3	4	5
	Do Nothing	Maintain	Sustain	Improve (200)	Strategy
<b>PV Costs</b>	-	53,044	66,842	84,457	60,815
<b>Optimism Bias (60%)</b>		31,827	40,105	50,674	36,489
<b>? pv Costs (PVc)</b>		84,871	106,946	135,131	97,304
<b>PV Damages (PVd)</b>	332,092	148,862	74,317	18,242	27,145
<b>With FLAIR update</b>	664,184	297,723	148,634	36,484	54,289
<b>PV Damage Avoided</b>		366,461	515,550	627,700	609,895
<b>Net Present Value</b>		281,590	408,604	492,569	549,080
<b>Average Benefit Cost Ratio</b>		4.32	4.82	4.65	6.27
<b>Incremental BCR over previous option</b>			6.75	3.98	0.47
<b>Incremental BCR over maintain option</b>			6.75	5.20	19.58

In all cases, the schemes have been ranked in increasing NPV. However, in this case, the Strategy Option has the highest BCR and there is incremental merit to increase expenditure over the Maintain option.

**Table 1.2 Economics Summary Table for Land Drainage**

Option	1	2	3	4	5
	Do nothing	Maintain Existing	Sustain	Improve	Strategy
<b>PV Costs</b>		8,427	11,059	12,242	10,821
<b>Optimism Bias (60%)</b>		5,056	6,635	7,345	6,493
<b>? pv Costs (PVc)</b>	-	13,483	17,694	19,587	17,313
<b>PV Damages (PVd)</b>	432,197	5,852	1,890	718	1,920
<b>With FLAIR update</b>	864,393	11,705	3,780	1,435	3,840
<b>PV Damage Avoided</b>		852,689	860,614	862,958	860,554
<b>Net Present Value</b>		839,206	842,919	843,370	843,240
<b>Average Benefit Cost Ratio</b>		63.24	48.64	44.06	49.70
<b>Incremental BCR over previous option</b>			1.88	1.24	NA
<b>Incremental BCR over maintain option</b>			1.88	1.68	2.05

In this case, all of the options have extremely high benefit cost ratios and there is economic merit in increasing expenditure from Maintenance to the Strategy Option. These options have been ranked in increasing Net Present Value order.

**Table 1.3 Combined Economics**

Option	1	2	3	4	5
	Do Nothing	Maintain Existing	Sustain	Improve	Strategy *
<b>PV Costs</b>	-	63,865	77,662	95,278	71,636
<b>Optimism Bias (60%)</b>		38,319	46,597	57,167	42,982
<b>? pv Costs (PVc)</b>		102,185	124,260	152,445	114,618
<b>PV Damages (PVd)</b>	764,289	150,781	76,237	20,162	29,065
<b>With FLAIR update</b>	1,528,578	301,563	152,474	40,324	58,129
<b>PV Damage Avoided</b>		1,227,015	1,376,104	1,488,254	1,470,449
<b>Net Present Value</b>		1,124,830	1,251,844	1,335,809	1,398,813
<b>Average Benefit Cost Ratio</b>		12.01	11.07	9.76	12.83
<b>Incremental BCR over previous option</b>			6.75	3.98	NA
<b>Incremental BCR over maintain option</b>			6.75	5.20	19.58

\* denotes preferred option (highest value)

From the above, it can be seen there is a clear need for the works and the Strategy Options provide the highest benefit cost ratio and the greatest incremental benefits over the maintain option. The Strategy Options represent the most advantageous option for each scheme length whilst maintaining the overall standard of protection to the area at risk. In this way the optimum use of resources to provide protection both economically, socially and environmentally can be demonstrated. The high priority score attracted by the overall strategy shows this.

The combination of the two strategies makes assessment of how the benefits would be reduced when one considers that flooding of a particular property could occur from either coastal or fluvial flooding. This uncertainty can be tested by taking **only** damages associated with coastal flooding and demonstrating that the Strategy Option still represents the preferred **combined** option and remains economically viable. Additionally, the scheme priority remains unchanged.

**Table 1.4 – Combined Economics, without Land Drainage Damages.**

	1	2	3	4	5
Optic 1	Do Nothing	Maintain Existing	Sustain	Improve	Strategy *
<b>PV Costs</b>	-	63,865	77,662	95,278	71,636
<b>Optimism Bias (60%)</b>		38,319	46,597	57,167	42,982
<b>? pv Costs (PVc)</b>		102,185	124,260	152,445	114,618
<b>PV Damages (PVd)</b>	332,092	150,781	76,237	20,162	29,065
<b>With FLAIR update</b>	664,184	301,563	152,474	40,324	58,129
<b>PV Damage Avoided</b>		362,622	511,711	623,861	606,055
<b>Net Present Value</b>		260,437	387,451	471,416	534,419
<b>Average Benefit Cost Ratio</b>		3.55	4.12	4.09	5.29
<b>Incremental BCR over previous option</b>			6.75	3.98	NA
<b>Incremental BCR over maintain option</b>			6.75	5.20	19.58

The sensitivity table shown above is based on the removal of properties that could potentially have been counted twice i.e. in both strategies. This is a very conservative case. All properties within the Do Nothing Land Drainage Damages are considered as flooded and hence they would not be part of the Coastal Strategy figures. A further more realistic case was undertaken with Land Drainage Do Nothing Damages reduced by a factor of 4. This is shown in section 2.6.3. In each case the priority score and economic case remains unaffected.



## 1.6 Priority Score

The priority score of the scheme is presented in Appendix J, and summarised below:

??	Economic score	20
??	People score	9
??	Environmental score	1
	Total	30

## 1.7 Environmental Impact

A Strategic Environmental Assessment has been carried out for the Coastal Defence Strategy, at which time the impacts of the implementation for the Strategy Option were identified. The preferred option has incorporated the main findings of that assessment. English Nature and the Environment Agency have been involved in the development of the strategy from the early stages. The Strategic Environmental Impact Assessment forms one of the core documents in the Coastal Defence strategy. Both English Nature and the Environment Agency have reviewed the Coastal Defence strategy and provided letters confirming that they concur with its findings and recommendations. (See Appendix H ).

In additional, further environmental assessment is being carried out as part of the first phase of construction works, i.e. Cleveleys. A design competition has been held as part of this scheme, the parameters of which were developed from the feedback from consultation with the general public. This will form part of planning conditions and ensure appropriateness of the final solutions. It is intended that all further phases of works will develop the strategic environmental assessment in this way on a scheme-by-scheme basis.

Various environmentally sensitive issues were identified as part of the Land Drainage Strategy. This will be scrutinised further as recommended schemes within the Land Drainage Strategy are developed and in consultation with the Environment Agency on critical ordinary watercourses. There are no designated sites within the Land Drainage Strategy boundaries.

## 1.8 Intangible Benefits

No intangible benefits have been quantified, although there would be significant intangible loss associated with the loss of a community such as Wyre. However, it was felt that the case for works is sufficiently robust when measuring tangible benefits alone.

## 1.9 Key Stakeholders

Other than Wyre Borough Council and its residents, there are various organisations that would benefit from the implementation (or otherwise) of the preferred option. These include The Environment Agency, Lancashire County Council, English Nature, English Heritage, United Utilities and a large number of other organisations owning or managing assets in the Fylde Headland area.

### 1.10 Residual Risk

Following the implementation of the Strategy Option, the present value damages associated with each scheme is estimated as

		Adjusted to reflect update in FLAIR Values
?? Coastal Defence	£27,145,000	£54,289,000
?? Land Drainage	£1,920,000	£3,840,000
<b>Total</b>	<b>£29,065,000</b>	<b>£58,129,000</b>

In each case, the indicative standard is met at each frontage, or catchment and the risk of these residual damages is considered acceptable and appropriate to the land use being considered.

### 1.11 Current Status of the Proposal

This Headland PAR is submitted to unify the outcome of the Coastal Defence and Land Drainage Strategies in order to obtain Defra approval of Wyre Borough Council's proposals for implementing their strategies, to reduce the risk of flooding to an acceptable level. The strategies have already been submitted to Defra, but have required updating to reflect recent changes in the appraisal of projects. These updates have been made and incorporated within this Headland PAR.

It is recommended that the Strategy Options be implemented as indicated within the Coastal Defence Strategy and the Land Drainage Strategy. These strategies will secure existing coastal and fluvial defences and reduce the risk of flooding throughout the Fylde Headland over the next 100 years. Each strategy identifies sequential schemes of work and this report demonstrates that this work is economically justified, technically viable and environmentally acceptable. Grant aid is therefore sought from Defra to support these works.

## 2 BUSINESS CASE

### 2.1 Introduction and Background

Approval in principle is sought from Defra for the Coastal Defence and Land Drainage Strategy Plans covering the coastline and the critical ordinary watercourses along and within Wyre Borough Council. This area is referred to here as the Fylde Headland.

The Fylde Headland is located on the north-west coast of England, at the south western end of Morecambe Bay (Appendix B figure B1). The River Wyre estuary runs along the eastern edge of the headland, with coastal waters to the north and west. The headland is a low lying urbanised area which is particularly vulnerable to both tidal and fluvial flooding. The total length of the frontage from the Blackpool and Wyre Borough Council boundary, round the tip of the headland to the tidal limit of the estuary at Cartford Bridge is 24.4km.

This PAR document contains the main findings of the two strategies of the Fylde Headland: from the North in Fleetwood (including the estuary), southwards through Wyre Borough, and onwards to its boundary with Blackpool Borough, Appendix B figure B1.

Flooding from both tidal frontages and from critical ordinary watercourses in the River Wyre catchment is considered within this PAR. It builds upon the findings of the Formby Point to River Wyre Shoreline Management Plan (SMP) for the coastline, and the Coastal Defence Strategy (WBC, Nov 2002), and the Land Drainage Strategy (WBC, Sep 2003). Tables 2.1 and 2.2 illustrate the preferred options outlined in both of these strategies.

**Table 2.1 Coastal Frontages SMP Divisions and Policies**

<b>Cell 11b</b>	<b>Preferred Option</b>		
<b>Zone</b>	<b>Short Term</b>	<b>Medium Term</b>	<b>Long Term</b>
<b>CPU 2 Rossall Point to Anchorsholme Park</b>			
<b>Borough Boundary to Jubilee Gardens</b>	Hold	Hold	Hold
<b>Jubilee Gardens to Five Bar Gate</b>	Hold	Hold	Hold
<b>Five Bar Gate to Rossall Hospital</b>	Hold	Hold	Hold
<b>Rossall Hospital to Chatsworth Ave</b>	Hold	Hold	Hold
<b>Chatsworth Ave to Rossall Point</b>	Hold	Hold	Hold
<b>CPU 1 Rossall Point to Fleetwood Ferry</b>			
<b>Rossall Point to Marine Lakes</b>	Hold	Hold	Hold
<b>Marine lakes to Fleetwood Pier</b>	Hold	Hold	Hold
<b>Fleetwood pier to Fleetwood ferry</b>	Hold	Hold	Hold

**Table 2.2 Wyre Estuary SMP Divisions and Policies**

<b>Cell 11b</b>	<b>Preferred Option</b>		
<b>Frontage</b>	<b>Short Term</b>	<b>Medium Term</b>	<b>Long Term</b>
<b>EPU 1 Fleetwood/ Knott End to Stanah)</b>			
<b>1 – a: Fleetwood to Kneps Farm Stanah.</b>	Hold	Hold	Hold
<b>1 – b: Waderbank</b>	Hold	Hold or Retreat	Hold or Retreat
<b>EPU 2 Hambleton/Waderbank to Cartford Bridge</b>			
<b>2 – a: Skippool Left &amp; Right Bank</b>	Hold	Hold	Hold
<b>2 – b: Bankfield Farm to windy Harbour</b>	Hold	Hold or Retreat	Hold or Retreat
<b>2 – c: Left Bank : Little Eccleston to Cartford Bridge.</b>	Hold	Hold or Retreat	Retreat

Within the area at risk from flooding there are:

- ?? 2,750 hectares of land;
- ?? 25,500 properties;
- ?? 1,500 industrial units;
- ?? 825 hectares of high quality agricultural land;
- ?? 22.8km of public highway.

**Table 2.3 Land Drainage Watercourses and Policies**

<b>Land Drainage</b>	<b>Preferred Option</b>		
<b>Watercourse</b>	<b>Short Term</b>	<b>Medium Term</b>	<b>Long Term</b>
<b>Copse Brook</b>	Maintain	Sustain	Sustain
<b>Burn Drain</b>	Maintain	Sustain	Sustain
<b>Royles Brook</b>	Maintain	Sustain	Sustain
<b>Hillylaid Pool</b>	Sustain	Sustain	Sustain
<b>Oldfield Carr Lane</b>	Maintain	Improve	Improve
<b>Garstang Culverts</b>	Maintain	Maintain	Maintain
<b>Over Wyre</b>	Monitor	Maintain	Maintain

The Land Drainage Strategy falls within the zone at risk from flooding, although flood events would occur separately. However, the Land Drainage Strategy identifies the following within its flood risk area:

- ?? 17,500 properties;

- ?? 540 industrial units;
- ?? 22.8km of public highway;
- ?? 825ha of high quality agricultural land.

There are various designated sites within the Fylde Headland, these are summarised as:

- ?? SSSI and cSAC – from Rossall Point along the length of the estuary;
- ?? Various Biological sites of environmental value and watercourses supporting nationally important species such as water voles.

Much of the economy in Wyre Borough and within the Fylde Headland is heavily dependent upon tourism, which in turn is reliant on competent and functional coast protection structures and flood defence along the critical ordinary watercourses.

The economic appraisals for both strategies have been carried out in accordance with Defra's PAG suite of documents. The economics for both strategies have been updated to incorporate increases in scheme life from 50 to 100 years, a change in discount rate, and an increase in flood damage cost.

## **2.2 Problem**

### **2.2.1 History of Flooding – Coastal**

The coastal defences have been constructed in many phases since the late 19<sup>th</sup> Century, when natural embankments suffered from erosion and overtopping. Defences were gradually added in the 1920's, 1950's, and 1980's following inundation of the hinterland with major flooding. Flooding occurred in 1927, 1952, and 1977. In addition to this, a major collapse of the coastal defence occurred in February 1997 when failure of 100m of bullnose crest occurred at Cleveleys.

Many of the coastal structures are coming to the end of their useful lives and the Coastal Defence Strategy Study identified that the current policy of maintenance is insufficient in terms of keeping pace with the rate of decline. In addition, the present standard of Coastal Defence for the area is lower than the indicative standard shown in Defra's PAG suite of documents.

### **2.2.2 History of Flooding – Critical Ordinary Watercourses**

Critical ordinary watercourses intersect much of the urban area of Wyre. There are a number of areas that suffer regular flooding (Appendix B Figure B1). Historically, problems have been rectified in the short to medium term by the construction of flood assist pumping stations such as Stanah, Royles Brook and New Lane pumps. However areas that once offered storage against inundation have been developed upon, and a significant number of the watercourses have been culverted over the last fifty years.

The strategy has identified that over 75% of the open watercourses that once existed within the urban areas of Wyre have now been lost or culverted, significantly reducing storage capacity and increasing the reliance on the remaining critical ordinary watercourses. The system is considered to be at capacity and unable to cope with further demands placed on it from future development and climate change.

In addition, many of the land drainage watercourses are suffering erosion and collapse. Many of the structures and pumping stations are coming to the end of their useful lives. The Land Drainage Strategy Study identified that the current policy of maintenance is insufficient in terms of keeping pace with the rate of decline. In addition, the present standard of land drainage for the area is lower than the indicative standard shown in Defra's PAG suite of documents.

### 2.2.3 Condition of Existing Coastal Defences

The coastal defences are maintained by Wyre Borough Council, the EA, ABP and NPL Estates Ltd, together with smaller riparian owners. The existing standard of defence varies but is generally below the indicative standard for this area, (i.e. 1% - 0.33% - Land Use B)

A 100m section of bullnose at the Cleveleys boundary was damaged in February 1997 during a storm event. This was repaired following the instigation of emergency works. Since that time, the condition of the existing seawall has been assessed and the risk (and consequence) of collapse, failure and breach has been analysed.

A fuller description of the condition survey is presented in Section 4 of the Coastal Defence Strategy. An extract of the basis of the condition survey, the defence lengths and the scoring system is outlined below and presented in Tables 2.4 and 2.5.

The detailed investigation of the existing defences has allowed a risk assessment to be undertaken and estimations of structural life expectancy for each structure to be prepared. The methodology for the risk assessment is based upon the multiple of the consequences of and likelihood of failure. A scoring system has been developed to quantify the risk of failure. The maximum score is 900. 600-900 is classed as a high risk, 300-599 medium risk and 0-299 low risk. However low risk elements will still require maintenance works to prevent sequential failure of the defences.

**Table 2.4 Coastal Frontage Summary of Condition Survey**

Zone	Highest Risk	Life Expectancy	General Description
<b>CPU 2 Rossall Point to Anchorsholme Park</b>			
<b>Borough Boundary to Jubilee Gardens</b>	600	10	1930s mass concrete wall now life expired and vulnerable to failure during extreme events.
<b>Jubilee Gardens to Five Bar Gate</b>	324	10	High beach levels to protect 1930s mass concrete wall showing cracking and general ageing, aprons buried, groyne fields full.
<b>Five Bar Gate to Rossall Hospital</b>	375	15	Concrete defences supplemented by military and school installations. Aprons subject to wear and low beach levels.
<b>Rossall Hospital to Chatsworth Ave</b>	450	10	2 level promenade and RC walls constructed in 1980s subject to an extensive maintenance programme. Lower aprons and groynes in poor condition.
<b>Chatsworth Ave to Rossall Point</b>	240	15	RC upper walls constructed in 1980s, protected by concrete aprons and groynes constructed 1948.
<b>CPU 1 Rossall Point to Fleetwood Ferry</b>			
<b>Rossall Point to Marine Lakes</b>	216	20	High beach levels and growing embryonic dune system, greater exposure and lower beach levels as the defence orientation moves westerly.
<b>Marine lakes to Fleetwood Pier</b>	108	25	High beach levels expose only upstand of sea wall which protects leisure buildings immediately behind.
<b>Fleetwood Pier to Fleetwood ferry</b>	135	25	High accreting beach levels and RC wall exposed to water only during extreme events.

**Table 2.5 Estuary Frontage Summary of Condition Survey**

Frontage	Highest Risk	Life Expectancy	General Description
<b>EPU 1 Fleetwood/ Knott End to Stanah)</b>			
<b>1 – a: Fleetwood to Kneps Farm Stanah.</b>	120	25	Fleetwood Docks structures consist of piled dock frontages, cobbled revetment and concrete harbour walls. Although showing signs of distress in locations these are minor in terms of protection against erosion or flooding.
<b>1 – b: Waderbank</b>	270	15	Consists of redundant railway embankments protecting industrial low risk land or the high ground of Fleetwood Tip.
<b>1 – c: Burrows Marsh to Hackensall Sewage Works</b>	720	5-10	Stanah embankments poorly constructed and of unacceptable profile, ICI embankments of greater profile but substantially undermined leaving potential H & S risks.
<b>EPU 2 Hambleton/Waderbank to Cartford Bridge</b>			
<b>2 – a: Skippool Left &amp; Right Bank</b>	180	20	Earth embankments leading to sluice structure which prevents flanking of the sluice and the protection of large areas of farmland propagated through the Main and Horsebridge Dyke systems.
<b>2 – b: Bankfield Farm to Windy Harbour</b>	72	20	Well-maintained embankment and protecting farmland and holiday park
<b>2 – c: Left Bank : Little Eccleston to Cartford Bridge.</b>	72	20	Well-maintained embankment protecting farmland.

The life expectancies of coastal defences along the northern facing frontage of the Fylde Headland are higher than those along the west frontage: 20-25 years and 10-15 years respectively. However a number of defences are life expired along the west frontage. Defences along the north frontage have suffered little exposure due to higher beach levels; however their resistance to failure is in question should beach levels fall.

The life expectancies of defences along the estuary frontage are generally higher than the coastal defences. These defences were built in the 1840's and have been raised and strengthened over time.

For much of the western frontage, the risk of breach is unacceptable and threatens the prosperity of the urban community. In addition, there is an unacceptable risk of flooding resulting from the low current standard of defence. This problem will worsen as sea levels rise and beach levels lower.

#### **2.2.4 Consequences of Flooding - Coastal**

Ultimately, this would result in the loss of:

- ?? 25,500 properties;
- ?? 150 industrial units;
- ?? 22.8km of public highway;
- ?? 825 hectares of high quality agricultural land;

?? The Rossall Point SSSI (and cSAC).

The tangible loss associated with flooding to assets within the 750 hectares of the Fylde Headland is estimated as £745 million

The multitude of frontages, with their varying conditions, standards of service and differing owners can only be managed by the implementation of a strategic approach. This approach must meet the following objectives:

- ?? To provide an appropriate level of coastal defence to prevent coastal erosion and flooding of properties and the low lying hinterland;
- ?? To provide sustainable coastal defences which utilise natural defence mechanisms wherever possible;
- ?? To enhance the natural environment and increase the potential for recreation and tourism;
- ?? To provide a 'blue-print' for future monitoring and programming of maintenance works;
- ?? To increase the understanding of the shoreline and to focus future consultations in a strategic manner;
- ?? To aid co-ordination and to consolidate information gathered within higher-level plans.

## 2.2.5 Condition of Existing Land Drainage System

Like the coastal frontages, many of the defences along the watercourses are the responsibility of different organisations. These include Wyre BC, Riparian Owners, ABP, Blackpool Transport, and Network Rail (formerly British Rail). There are also surface water sewers discharging into the watercourses that are maintained by United Utilities and British Waterways.

Existing standards of service vary both for the River Wyre itself and for the critical ordinary watercourses within the Wyre catchments. It is estimated that existing standards vary between 4% and 2%. The main issue regarding the land drainage defences, however, is the combination of effects that would result from withdrawing maintenance, along with the low standard of service and the condition of the defences.

The condition of the defences is described in Table 6.1 of the Land Drainage Strategy and reproduced along with the condition of the Trash Screens in Table 6.2.

## 2.2.6 Future Scenario – Structures

Watercourse structures have been assessed for future life expectancy should the Do Nothing option be adopted. Structures include culverted watercourses, screens, retaining walls and pumping stations. There are no known embankments on ordinary watercourses. This assessment is based on the existing structural condition, changes in watercourse channels together with the physical conditions acting on the structure now and in the future should the Do Nothing option be adopted. The minimum life expectancies for each structure are listed in Table 2.6 below:

**Table 2.6 Service Life Expectancy of Watercourse Structures**

Structure	Life Expectancy following Do Nothing
Pumping Stations	Immediate failure following failure of power supply.
Screens	Failure through blockages within six months.
Retaining	Collapse of gabions and supporting



Structure	structures within five years.
Outfalls	Failure of tidal flaps within six years.
Culverts	Initially made redundant by the blocking of screens. Culverts would over time, silt up reducing flow significantly, failure of screens would result in blockages within culverts within ten years.

The withdrawal of all maintenance would result in:

- ?? the rapid deterioration and consequent breach of defences;
- ?? failure of pumping stations;
- ?? blockages of watercourses;
- ?? collapse of watercourse channels;
- ?? health and safety issues (i.e. fly tipping and other clearance responsibilities);
- ?? failure of WBC to fulfil its responsibilities to undertake the required maintenance work to convey water passage;
- ?? failure of WBC to meet its obligations as agent to the Highways Agency.

### 2.2.7 Consequence of Flooding – Land Drainage

The consequences of flooding are outlined in Table 2.7 below. Flooding occurs when the storage areas and discharge capabilities of the outfalls and pumping stations are exceeded. Failure of the pumping stations would quickly reduce the outfall ability of the drainage system. Failure of screen and culverts would result in localised flooding whilst the water found its way back into the watercourse having passed around the obstruction.

**Table 2.7 Consequences of Flooding**

Structure	Flooding Consequences	Time to Take Effect
Pumping Stations	Flooding to low lying areas of Thornton, Cleveleys and Fleetwood during periods of heavy rainfall and/or high tide levels.	Stanah 6 months Royles Brook 1 year Springfield immediately
Screens	Widespread long term flooding	1 to 6 weeks
Non Return Flaps	Various locations throughout Borough	6 months to 2 years
Culverts	Various locations throughout Borough	1 to 7 years
Bank Stability	Various locations throughout Borough	1 to 5 years
Open Watercourse Blockages	Widespread flooding of large areas of the urban core	1 to 3 months dependant on weather conditions

## 2.3 Option Selection

### 2.3.1 Do Nothing

#### a) General

Ultimately the consequences of doing nothing will affect the same assets within Wyre Borough Council, e.g., loss or damage to people, property and infrastructure by flooding or loss of land. However, the mechanism of the flooding can be via the coastal frontage, or from the critical ordinary watercourses.

The individual strategies have identified the consequences of withdrawing any intervention activity to the coastal and flood defences separately. However, it is extremely unlikely that coastal flooding will occur simultaneously with fluvial flooding. The only overlap of consequences arises with the likely write-off implications associated with the separate strategies.

In each strategy, the defences were assessed for future life expectancy should 'Do Nothing' be adopted and the minimum life expectancies for the discrete management units or catchments were determined.

#### b) Coastal Frontage

Failure of coastal structures can occur in a number of ways: by erosion of salt marshes; by failure of structural elements, such as aprons or wave walls due to wave action; and finally, by overtopping by severe storms exceeding the present service provision.

The majority of the coastal structures protect a thin strip of high ground. These are often historically, protected shingle ridges. Failure of the coastal structure would lead to rapid erosion of the ridges and inundation of the low lying hinterland.

The extent of flooding was determined as follows:

- Identify properties type and location;
- Create digital terrain model using LIDAR;
- Develop reservoirs and spill ways from coastal frontage;
- Determine credible breach scenarios;
- Use flow analysis software to estimate water quantities flowing into spill ways;
- Estimate depths of flooding and therefore damages.

In the Do Nothing scenario, the structures most at risk on the west facing coastline will fail within five years. For much of the west facing coastline, this could expose United Utilities main Fylde Coast interception sewer. The sewer itself is located beneath the seawall at a low level. Loss of the wall would increase the risk of damage to the sewer thus increasing the risk of causing major pollution of the coastal area. Following the failure of the shingle bank, failure of the frontline defences would rapidly expose the low lying hinterland. Continual flooding would render much of the area uninhabitable. Access to other areas would also be lost, rendering these remaining areas uninhabitable.

Along the north facing coastline, loss would occur at a slower rate. Emergency access in the short term would be lost. Buildings on the reclaimed seafront would flood regularly. As sea-levels rise, the promenade would be lost, exposing various leisure facilities and making them unusable within ten years. The coastline would retreat due to loss of groynes etc, damaging outfalls and increasing pollution.

Along the estuary, embankments would be overtopped, leading to their eventual failure, i.e. at Stanah, failure would occur with events greater in severity than 1:10 years. After failure, flooding and loss would occur in the Thornton and Cleveleys area, which would quickly become uninhabitable.

## c) Land Drainage

The Do Nothing option for land drainage would have wide reaching and immediate impacts. The systems would quickly fall into disrepair, resulting in failure of pumping stations, blockages to screens and collapse of watercourse channels. Problems concerning health and safety and fly tipping and other associated public health concerns would also result.

In addition, Wyre Borough Council would also fail in its responsibilities under the Land Drainage Act (1991) as riparian owners, and as agent to the Highways Agency.

The life expectancies of the various watercourse structures are summarised in Table 2.2.

Failure of the system to discharge and remove water would result in localised flooding as water found its way back to the watercourse by passing obstructions. This would result in access problems. The ground water would rise, in many cases above the surface.

Eventually, continued widespread flooding would occur throughout the Borough resulting in damage and loss. The Land Drainage Strategy has identified these for each watercourse being considered.

## d) Summary of Losses associated with Doing Nothing

Losses associated with the Do Nothing option for both coastal flooding and land drainage are summarised in Table 2.8:

**Table 2.8 Do Nothing Losses**

A set	Coastal flooding	Land Drainage
Area of Flood (Ha)	2,750	3,450
Property Value	£1,375 million	£860 million
No. of Properties	25,500	17,500
Industrial Units	1,500	540
Highway	22.8km	22.8km

### 2.3.2 Scope of Options Considered

## a) Coastal Defence

The Coastal Defence Strategy considered the following courses of action at each frontage along the 24km of coastline.

Option	Description
1	Do Nothing
2	Maintain – maintain the fabric of the coastal defence structures in line with current council policy
3	Sustain – Undertake capital works to ensure that the present fabric maintains its present level of service as sea levels rise and beach levels fall over the strategy period.
4	Improve – undertake capital works to provide a consistent 1:200 year standard of protection throughout the strategy period.

5	Proposed Strategy – Selected actions in line with current standard of protection, the indicative standard, and achievement of best value for money.
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b) Land Drainage

The following options were investigated within the Land Drainage Strategy:

Option	Description
1	Do Nothing – Withdrawn all actions to maintain/improve current defences.
2	Maintain – Continuance of current regime of maintenance, clearance, and reactive capital replacement.
3	Sustain – Continuance of current maintenance regime but with improvements to the present fabric of flood defence assets.
4	Improve – Capital Improvements to all assets to achieve a consistent level of service (1 in 100 years).
5	Proposed Strategy – Selected actions in line with current standard of protection, the indicative standard, and achievement of best value for money.

## 2.4 Environmental Impact Assessment

### 2.4.1 The Current Status of Environment Impact Assessment Process

a) Baseline SEA for the Coastal Strategy

At the outset of the Strategy Study, the significance of the natural and human environment in determining strategic options was recognised. A Strategic Environmental Assessment (SEA) was commissioned by the Council and undertaken by Halcrow, as an integral part of the Strategy Study, to ensure the appropriate level of consideration was given to environmental factors.

The SEA is presented in the Wyre Borough Council Coastal Defence Strategy and comprises:

- ?? A description of the baseline environment, concentrating on aspects of the environment that are relevant to, or may be affected by, coastal protection and flood defence plans.
- ?? Consultation with relevant statutory bodies and other organisations with an interest in the coastal zone.
- ?? Establishing specific environmental objectives that the adopted coastal management strategy should aim to fulfil.
- ?? Appraisal of specific Strategy Options, to evaluate the types of environmental impacts and benefits that they will generate.
- ?? Recommendation of the most acceptable Strategy Option(s).
- ?? Conclusions as to the positive and negative environmental implications of the proposed option.
- ?? Identification of environmental issues that need to be addressed (for example, generic mitigation measures) as part of the implementation of the preferred option.

The findings of this study are included in a stand-alone Strategic Environmental Assessment report.

The strategy area encompasses Morecambe Bay at the Northern end of the coastal defences and within the river corridor. The Bay is classed as internationally important due to its habitats and bird population. The bay is the second largest in the UK, with the largest continual inter-tidal area in the whole of Britain. As a whole, the bay is designated as a Special Area of Conservation (SAC) for its internationally important habitats (large shallow inlets and bays, inter-tidal mudflats and sandflats, pioneer and established saltmarsh, vegetated shingle and embryonic shifting dunes.) and as a Special Protection Area (SPA) for its internationally important bird populations.

The Wyre Estuary itself is designated as Nationally Important and is an integral part of the overall Morecambe Bay complex.

One of the main objectives of the Strategy Study is to protect human life and the developed environment. Details of the spatial location of important residential, industrial, commercial and recreational sites together with information on coastal activities that may interfere with natural coastal processes, such as dredging or offshore sand extraction, are required to act as a framework in which Strategic Options could be assessed.

#### b) Consultation

A key part of the strategic environmental assessment process was consultation with statutory bodies and interested parties. This allowed specific concerns relating to the potential for coastal works to be documented and addressed at an early stage. The methods adopted for consultation involved:

- ?? An initial consultation document explaining the purpose of the coastal strategy, current assumptions and information required. This was sent to over 50 consultees.
- ?? Publication of this document on the Council's web site requesting views and comments.
- ?? Circulation of reports to consultees at key stages of the process.
- ?? Public exhibitions of the strategy findings.
- ?? The creation of an environmental forum to discuss the issues raised.

The consultation responses are tabulated within the SEA.

The forum included representatives from English Nature, Environment Agency, North West Tourist Board, Lancashire County Council and the Wildlife Trust. Through this forum, important issues were raised and approval at each stage of the strategy's development has been reached.

#### c) Agreed Objectives

On the basis of the environmental baseline information and the views expressed by consultees, environmental objectives have been defined for the coastal frontages. These provide a basis for the evaluation of strategic options put forward. It should be noted that a number of objectives conflict with each other and therefore inclusion of an objective does not necessarily mean that it will be met by the coastal strategy.

Objectives have been split into:

- ?? General objectives (those applying to all or much of the study area);
- ?? and Specific objectives (those applying to individual coastal sections)

d) The Key Objectives were used to assess technically feasible options for each (coastal) Management Unit. Key Environmental Objectives are as follows:

- ?? Land Use and Economic Assets: The protection of the public, property, roads, agriculture and infrastructure assets where sustainable, feasible and economically viable.
- ?? Geomorphology (Coastal): No aggregate removal from areas having adverse effects. Allow free functioning of the sediment process. Consider coastal squeeze on estuary frontage mudflats, saltmarsh and sand dunes.
- ?? Nature Conservation: Maintain favourable condition of designated areas in situ where possible.
- ?? Special area of conservation: Considering cSAC SSSI and RAMSAR habitats, and in particular the intertidal, shingle and dune areas of the north facing coast and the intertidal and saltmarsh of the estuary. Where possible, ensure habitats are secured or maintained until recreated elsewhere. Where feasible, coastal defence should contribute to Biodiversity Action Plan advancement targets in particular dune system.
- ?? Landscape quality should be protected and enhanced by the removal or mitigation of coastal defence elements that detract from landscape quality.
- ?? Tourism and recreation: Protect significant visitor attractions and recreational resources. Conserve integrity of coastal footpaths and incorporate pedestrian and cycle routes where possible.
- ?? Fisheries: Maintain access to the shoreline for anglers and avoid impacts on fishing areas.
- ?? Land Drainage and Water Quality: Ensure coastal defence work does not affect land drainage. Avoid works that affect designated bathing waters or result in re-suspension of material during tourist season.
- ?? Cultural Heritage: Provide mitigation in terms of a watching brief and assessment in areas known or high potential archaeological value. Protect listed buildings and avoid interference with record shipwrecks or other marine NMR sites.

#### **2.4.2 Land Drainage Environmental Impact Assessment**

a) Land Drainage Issues

A consultation process was undertaken by Wyre Borough Council and included:

- ?? Parish Councils,
- ?? Environment/recreational bodies,
- ?? Major Riparian owners.
- ?? Public Exhibitions of the strategy document and findings at key stages.

Individuals who had experienced flooding were contacted and invited to raise issues that could be addressed within the Land Drainage Strategy. Various specific issues were raised that have been dealt with as part of the assessment of that particular sub-catchment. Other more general issues included:

- ?? climate change;
- ?? insurance;
- ?? sustainable development;
- ?? sustainable drainage;

- ?? improved co-operation between parties involved with drainage issues;
- ?? opportunities for environmental and recreational use of watercourses;
- ?? better use of legislative powers;
- ?? watercourses and SUDS within public open spaces.

b) Land Drainage Strategy Objectives

As has been described in section 2.3 of this PAR, objectives were derived following this consultation process (i.e. generic and specific) which have been used to steer the decision making process within the Land Drainage Strategy. The objectives raised include:

- ?? The protection of public, property, roads agriculture infrastructure, where sustainable, feasible and when economically viable;
- ?? Maintenance of designated areas, securing of habitats and contribution, where possible, to Biodiversity Action Plans;
- ?? Protect landscape quality;
- ?? Protect and promote tourism/recreation assets;
- ?? Maintain access to watercourses for anglers;
- ?? Protect/enhance water quality;
- ?? Allow for protection, monitoring and where possible, enhancement of cultural and heritage features.

### **2.4.3 Approval Status of Coastal and Land Drainage Strategies**

There is strong support within Wyre Borough Council for both the Coastal Defence and Land Drainage Strategies. This support has promoted the completion of the strategies and the necessary consultation process. The case for improvement works to the coastal defences and along the various watercourses and critical structures is strong. As such, the Council has demonstrated its commitment to the development of the preferred strategies by including the first five years works within their capital programme.

The Coastal Defence Strategy has been developed through the Council's Scrutiny committee and was submitted to full Council and adopted on 29<sup>th</sup> April 2004. The Land Drainage Strategy has progressed through the scrutiny committee and was submitted to and adopted by full Council on the 6th September 2004. Wyre Borough Council is fully committed to backing and implementing these two strategies.

For expediency reasons, a scheme PAR for coastal works is currently underway to progress the first part of the Coastal Defence Strategy, which consists of works to safeguard the town of Cleveleys. Further consultation has been undertaken to determine more precisely the nature of the proposed options at Cleveleys. This resulted in a design competition being held to determine Environmental Improvements to meet the requirements and aspirations of the public within the coastal defences. The success of this process and the close involvement of the public in the development of the coastal defences will guide the future development of both strategies.

### **2.4.4 Compatibility with Higher Level Plans**

a) Coastal Defence Strategy

The SEA carried out for the Coastal Defence Strategy undertook a review of high level plans such as the Shoreline Management Plan (SMP), the EA's Local Environmental Action Plan (LEAP), Lancashire County Council's Development Plan and Wyre Borough Council's Local Plan. This provided continuity and avoided repetition between these plans and the Coastal Defence Strategy.

The SMP identified various areas for further investigation, which were subsequently implemented in the intervening time, or incorporated within the coastal strategy. In addition, the coastal strategy confirmed and developed the policy options for the coastal units.

The LEAP identified five issues which were incorporated to the strategy appraisal of options.

The Lancashire Structure Plan developed policies for protection of areas at risk from flooding, inappropriate development and treatment and disposal of waste water. All of these were considered when appraising the various strategic options.

The Wyre Borough Plan (adopted 5 July 1999), caters for the 106,000 (and rising) population within its boundaries. Its aims were made part of the Coastal Defence and Land Drainage Strategies' objectives. The updated Wyre Borough Plan (2004) took account of the findings of both strategies, and included issues papers on flood risk.

#### b) Land Drainage Strategy

Main rivers are those which are critical to the drainage of the land and are listed on the definitive maps held by Defra. The Environment Agency (EA) carries out maintenance on these watercourses at the public expense. Ultimate responsibility remains with the riparian owner. The EA is not necessarily liable to make up any shortfall in maintenance. The EA in this region currently maintains 240km of main river, of which 159km are within the Wyre area.

As part of the High Level Target 1, for which Wyre Borough Council produced its Policy Statement on Flood and Coastal Defence (see Section 2.2.3), a list of critical ordinary watercourses was produced. A total of 7.72km of open critical ordinary watercourses and 6.83km of culverted critical ordinary watercourses were defined. These were reviewed as part of the Land Drainage Strategy.

Local Environment Action Plans (LEAPs) were produced for the Wyre catchment. These have been discontinued, in favour of themed local contributions for each operational area, with greater emphasis on partnership working and sustainable development. The issues raised were incorporated in the appraisal of options within the Land Drainage Strategy.

EA Catchment Flood Management Plans are due for completion in 2007/8. Clearly, the outcome of this land drainage strategy should feed in to the catchment management plans and equally, the review of this strategy will incorporate the findings of the completed catchment management plan.

Regional Planning Policy Guidance Review 1999 – 2003 (issued 03/03), indicated that local authorities should apply the precautionary principle making use of indicative flood plan maps, SMPs, estuary management plans and LEAPs and to apply the sequential approach set out in PPG25.

The policies identified in the Lancashire Structure Plan in relation to development affected by flood risk (coastal and river) and the impact of that development on the landscape were considered.

The aims of the Wyre Local Plan were used to develop the objectives of the Land Drainage Strategy and the plan's policies were used to appraise the Land Drainage options.

#### **2.4.5 FEPA License**

A FEPA License is required for the ensuing coast protection works identified in the strategy, and is currently being sought as part of the Cleveleys Coast Protection Scheme.



## 2.5 Scheme Costs

### 2.5.1 Coastal Defence Strategy Costs

The Coastal Defence Strategy costs are presented in Appendix E and summarised in Table 2.9. They are presented in two formats. Sheet 1 identifies the costs per year at each Coastal Strategy frontage for each option. Sheet 2 updates these costs in the following way.

- ?? Extends the strategy life from 50 to 100 years.
- ?? Changes the discount factor from 6% to 3.5%, 3.0% and 2.5% in line with recent Defra guidance.
- ?? Identifies future capital and maintenance works beginning year 49 to year 99. Typically, maintenance continues at the level identified for each option. Capital works are taken as 50% of the estimated value (years 0-49) but 50 years after the capital works to reflect realistic scheme lives of new works.
- ?? Updates the capital scheme costs to January 2005 prices.

**Table 2.9 Coastal Defence Strategy Costs for 100year Scheme Life.**

Option	Capital (£k)	Maintenance (£k)	Other (£k)	Total (£k)	PV Total (£k)
1 – Do Nothing	-	-	-	-	-
2 – Maintain Existing defences	146,883	16,981	7,833	171,698	53,044
3 - Sustain Existing Defences	162,809	26,516	32,561	221,887	66,841
4 - Improve Defences to a 1:200yr Standard	168,452	30,496	33,690	232,639	84,457
5 - Strategy Option	123,381	26,089	6,580	156,050	60,815

?? The above costs include construction, maintenance, design and supervision fees and compensation.

The risk associated with variation in these costs was investigated by increasing and decreasing the costs and delaying capital works by 5 years. In each case, the preferred option remained the Strategy Option and the economic result remained significantly greater than 1.

### 2.5.2 Land Drainage Strategy Costs

A breakdown of the Land Drainage Strategy costs is presented in Appendix E, and summarised in Table 2.10 below:

**Table 2.10 Land Drainage Strategy Costs for 100-year Scheme Life.**

Option	Capital (£k)	Maintenance (£k)	Other (£k)	Total (£k)	PV Total (£k)
1 – Do Nothing	-	-	-	-	-
2 – Maintain	14,679	7,500	770	22,956	8,427
3 – Sustain	21,170	7,500	1,142	29,812	11,059
4 – Improve to 1:200 year standard	23,253	7,500	1,262	32,015	12,242
5 – Strategy Option	20,984	7,500	1,124	29,608	10,821

The scheme costs are made up of estimates of all forms of capital, maintenance, design and supervision of works to achieve the implementation of each strategy option. The capital costs have been estimated over a scheme life of 100 years, with discount factors as per recent Defra guidance.

In each case, the scheme costs are increased by 60% optimism bias. This is shown in the summary economics tables in Section 2.7.

## 2.6 Benefits of Options

### 2.6.1 Scheme Benefits Associated with Coastal Defence Works

#### a) General

The scheme benefits arise from the reduction in damages associated with undertaking works, measured against the Do Nothing Options. Damages along the coastal frontage include those which would occur with a breach, and those that would occur as a result of overtopping. For each option, the risk of breach and overtopping was assessed. The consequential damage was assessed as the aggregation of these damages (and their associated likelihoods – i.e. risk).

The damages have been estimated by determining depth-damage data for flooding caused by overtopping, and property values should they be written off i.e. following a breach of structure.

Property data was collected which included its position. Lidar data was used to create a digital terrain model, and in turn the property levels were therefore determined.

A hydrodynamic model was used to assess flooding associated with various scenarios, i.e. breaches entailing differing water quantities and at different locations. In this way, flood damages were estimated for both write-off and depth-damage flooding for each option.

This data was further updated in the following ways:

- ?? Extend the scheme life from 50 to 100 years
- ?? Adjust the discount factor in line with recent Defra guidance
- ?? Enhance FLAIR depth damage flood values by a factor of 2 to reflect more realistic values. It should be noted that property prices have risen by 70% over the period 2002 to 2005.

The properties can be separated into reservoirs being at risk from flooding from breaches in different frontages, based on a single event. The extent of flooding to each reservoir was examined as part of the hydrodynamic analysis modelling undertaken for the Coastal Defence Strategy Study.

#### b) Do Nothing Damages

The Do Nothing Damages contain the risk of overtopping of the current structures; in combination with the risk that breaching occurs over its remaining life. Should breaching occur, properties within the flood reservoirs, i.e. below the 1 in 5 year flood level, are written off.

The probability of breach within the residual life of the structure is taken as increasing exponentially with time. Following a breach, write off occurs and overtopping damages cease.

The Do Nothing Damages are summarised in Appendix D and have a Present Value (PV) of £333,092k before enhancement of FLAIR values.

## c) Option 2 Maintain Only – Damages

With this option, the risk of breach remains, but the minimum existing life of the structure is extended from 5 years to 15 years. After this time, the fabric of the coastal structure is repaired to its present standard, with no allowance for sea level rise. The structure would be below the indicative standard for this area, i.e. at an unacceptable risk of overtopping. Damages associated with overtopping damage would therefore also continue. Only this time, repairs would be made following breach, meaning that write off of properties would not occur. The damages associated with Option 2 – Maintain, are shown in Appendix D and have a present value of £148,862k before enhancement of FLAIR values.

## d) Option 3 – Sustain Only – Damages

The risk of breaching for Option 3 is the same as for Option 2. However, when works are carried out, some extra effort is made to increase the standard of defence in line with sea level rise. Consequently, the PV damages decrease with time due to the discount rate.

The damages associated with this course of action are presented in Appendix D and have a Present Value of £74,317k before enhancement of FLAIR values.

## e) Option 4 – Improve to a 200 Year Standard – Damages

It has been necessary to understand the implication of uniformly raising the standard of defence across the whole of the (coastal) strategy area, at least to a standard within Defra's indicative range.

Improving the defences to this standard removes the risk of breach and significantly reduces the damages associated with overtopping water.

The PV Damages associated with Option 4 - improving to a 1 in 200 year standard are estimated at £18,282k. The calculations are presented in Appendix D

## f) Option 5 – Strategy Option

This option selects the most appropriate solution for each frontage. It optimises the spend, targeting resources at the most vulnerable locations, and matches the spend profile with the Borough Council's ability to pay. In addition, this option selects the most appropriate options for each frontage, in terms of its technical and environmental benefits, without compromising the target standard for the whole catchment area. The sub-options applied to each frontage are summarised in Table 2.11:

**Table 2.11 Option 5 Sub Options**

<b>Location (Management Unit)</b>	<b>Sub-Option</b>	<b>PV Damages</b>
<b>Borough Boundary to Jubilee Gardens</b>	Improve	3,786
<b>Jubilee Gardens to Five Bar Gate</b>	Sustain	6,793
<b>Five Bar Gate to Rossall Hospital</b>	Sustain	1,383
<b>Rossall Hospital to Chatsworth Ave</b>	Improve	2,938
<b>Chatsworth Ave to Rossall Point</b>	Maintain	197
<b>Rossall Point to Marine Lakes</b>	Sustain	497
<b>Marine lakes to Fleetwood Pier</b>	Sustain	413
<b>Fleetwood pier to Fleetwood ferry</b>	Sustain	577
<b>Fleetwood ferry to Fleetwood Docks</b>	Maintain	175

<b>Fleetwood Docks to ICI Boundary</b>	Maintain	196
<b>ICI Boundary to Stanah</b>	Improve	9,697
<b>Stanah to Shard Bridge</b>	Maintain	121
<b>Shard Bridge to Bankfield farm</b>	Retreat	236
<b>Bankfield farm to Cartford Bridge</b>	Retreat	136
<b>Total PV Damages</b>		<b>£27,145k</b>

The economic assessment of the above coastal defence options is summarised in Table 2.12:

**Table 2.12 Summary of Coastal Defence Economic Benefits**

<b>Option</b>	<b>1 – Do Nothing</b>	<b>2 – Do minimum</b>	<b>3 – Sustain</b>	<b>4 – Improve (200)</b>	<b>5 – Strategy</b>
<b>PV Damages (£k)</b>	332,092	148,862	74,317	18,242	27,145
<b>PV Damages with 100 % FLAIR Increase</b>	664,184	297,723	148,634	36,484	54,289
<b>PV Benefit</b>	-	366,461	513,550	627,700	609,895

### 2.6.2 Scheme Benefits Associated with Land Drainage Strategy

#### a) General

The Do Nothing Damages arise due to the areas flooded by the various watercourses. The damages have been calculated as per the failure scenarios identified in the Land Drainage Strategy Plan. These have been updated to reflect the recent changes in discount rate and scheme life. The increase for damage value associated with the increase in FLAIR depth damage data is undertaken globally during the economic benefit calculations.

In summary, the damages associated with each option arise from flooding from the following catchments.

#### b) Land Drainage Damages

**Table 2.13 PV Damages (Land Drainage)**

<b>Option</b>	<b>1 Do Nothing</b>	<b>2 Maintain</b>	<b>3 Sustain</b>	<b>4 Improve (200)</b>	<b>5 Strategy</b>
<b>PV Damages (£k)</b>	432,197	5,852	1,890	718	1,920
<b>PV Damages with 100 % FLAIR Increase.</b>	864,393	11,705	3,780	1,435	3,840
<b>PV Benefit</b>	-	852,689	860,614	862,958	860,554

### 2.6.3 Aggregated Coastal and Land Drainage Damages

Damages can accrue from both coastal and land drainage flooding. The options for each are similar, but not identical. However, there is merit in combining the Do Nothing and the Strategy Options, as they are compatible. The aggregated damages are summarised in Table 2.14:

**Table 2.14 Summary Damages for Both Strategies.**

Coastal Defence Damages		Land Drainage Damages	
Option	PV Damages (+ 100 % FLA R Update) (£)	PV Damages (+ 100 % FLA R Update) (£)	Option
1 – Do Nothing	664,184	864,393	1 – Do Nothing
2 – Maintain	297,723	11,705	2 – Maintain
3 – Sustain	148,634	3,780	3 – Sustain
4 – Improve to 1:200 year standard	36,484	1,435	4 – Improve to 1:200 year standard
5 – Strategy Option	54,289	3,840	5 – Strategy Option

The damages, and therefore benefits arise from a combination of both depth damage flooding and property write-off. A coarse assumption is that some 50% of the properties are at risk from write off from both sources of flooding.

Additionally, a further conservative estimate of the combined damages for the Fylde Headland can be made as follows, i.e. as approximately 50% of the houses overlap in terms of appearing in both strategies and therefore, only 50% of the damages would accrue from property write off. (Option 1a)

Or,

$(\text{Coastal Defence Strategy Damages})/4 + (\text{Land Drainage Strategy Damages})/4 =$  approximate combined Headland flood damages. (Option 1b)

But not less than the lower of the two combined estimates.

The combined benefits are shown in Tables 2.15 & 2.16 below.

**Table 2.15 Combined Headland Benefits**

Option	Coastal Defence (£k)	Land Drainage (£k)	Combined (£k)	Reduction
1	664,184	864,393	1,528,578	
1a	617,374	779,807	1,443,991	84,587

\* Only 50% of property write-offs accrue.

**Table 2.16 Combined Headland Benefits**

Option	Coastal Defence (£k)	Land Drainage (£k)	Combined (£k)	Reduction
1	664,184	864,393	1,528,578	
1b	664,184	206,654	870,838	657,740

\* Reduction in Land Drainage Damages / 4 (Worst Case)

**Table 2.17 Combined Headland Sensitivity Analysis**

Option	1	2	3	4	5
	Do Nothing	Maintain Existing	Sustain	Improve	Strategy
<b>PV Costs</b>	-	63,865	77,662	95,278	71,636
<b>Optimism Bias (60%)</b>		38,319	46,597	57,167	42,982
<b>? pv Costs (PVc)</b>		102,185	124,260	152,445	114,618
<b>PV Damages (PVd)</b>	435,419	150,781	76,237	20,162	29,065
<b>With FLAIR update</b>	870,838	301,563	152,474	40,324	58,129
<b>PV Damage Avoided</b>		569,275	718,364	830,514	812,709
<b>Net Present Value</b>		467,091	594,104	678,070	741,073
<b>Average Benefit Cost Ratio</b>		5.57	5.78	5.45	7.09
<b>Incremental BCR over previous option</b>			6.75	3.98	NA
<b>Incremental BCR over maintain option</b>			6.75	5.20	19.58
				<b>Highest BCR &amp; iBCR</b>	

A more conservative approach would be to take only the property damages associated with the Coastal Defence Strategy for the combined event. This is shown in the table below:

**Table 2.18 Combined Economics, without Land Drainage Damages.**

Option	1	2	3	4	5
	Do Nothing	Maintain Existing	Sustain	Improve	Strategy *
<b>PV Costs</b>	-	48,103	76,314	92,824	66,068
<b>Optimism Bias (60%)</b>		28,862	45,788	55,694	39,641
<b>? pv Costs (PVc)</b>		76,965	122,102	148,518	105,709
<b>PV Damages (PVd)</b>	332,092	148,862	74,317	18,242	27,145
<b>With FLAIR update</b>	664,184	297,724	148,634	36,484	54,290

<b>PV Damage Avoided</b>		366,460	515,550	627,700	609,894
<b>Net Present Value</b>		289,495	393,448	479,182	504,185
<b>Average Benefit Cost Ratio</b>		4.76	4.22	4.23	5.77
<b>Incremental BCR over previous option</b>			3.30	4.25	NA
<b>Incremental BCR over maintain option</b>			3.30	3.65	8.47

## 2.7 Choice of Preferred Option

### 2.7.1 General

Clearly, the preferred options for reducing the risk of flooding to properties and people within the Fylde Headland fall into 2 parts, that from the coastline and that from critical ordinary watercourses.

In both cases, there is a strong economic argument for promoting the Strategy Options identified. There is also a case for combining the strategies to show clear economic case for adopting this course of action.

## 2.7.2 Economic Results

### a) Coastal Defences

#### 2.19 Coastal Defence Costs and Benefits (£k)

Option	1 Do Nothing	2 Maintain	3 Sustain	4 Improve (200)	5 Strategy
<b>PV Costs</b>	-	53,044	66,842	84,457	60,815
<b>Optimism Bias (60%)</b>		31,827	40,105	50,674	36,489
<b>? pv Costs (PVc)</b>		84,871	106,946	135,131	97,304
<b>PV Damages (PVd)</b>	332,092	148,862	74,317	18,242	27,145
<b>With FLAIR update</b>	664,184	297,723	148,634	36,484	54,289
<b>PV Damage Avoided</b>		366,461	515,550	627,700	609,895
<b>Net Present Value</b>	-	281,590	408,604	492,569	549,080
<b>Average Benefit Cost Ratio</b>		4.32	4.82	4.65	6.27
<b>Incremental BCR over previous option</b>			6.75	3.98	NA
<b>Incremental BCR over maintain option</b>			6.75	5.20	19.58*

\* Preferred Option

Full economics tables are presented in Appendix D. The analysis has been carried out in accordance with the Defra PAG 3 document and incorporates the recent changes to discount rates and scheme life assessments. In addition recent guidance on FLAIR values and optimism bias have been incorporated.

Using the PAG 3 decision rule, the strategy option clearly represents the preferred option in economic terms as it produces the highest benefit cost ratio (BCR), i.e. 6.27. This is significantly greater than unity, reflecting the vast number of assets at risk within the study area.

The Strategy Option identifies courses of action that are more appropriate to the needs of each frontage. It is not therefore appropriate to consider the incremental benefit cost ratio which is used ostensibly to justify changes in expenditure to achieve indicative (or higher) standards of protection. The Strategy Option already achieves this function. Furthermore, the PV Costs Option 5 – Strategy are less than the PV Costs for Option 4 – Improve (200 yr.)

In accordance with PAG 4, various assessments of risk to the selection of the preferred option were examined in the Coastal Defences Strategy Study.

Increases in costs would affect all options (excluding Do Nothing) similarly. In addition, the benefit cost ratio is significantly greater than 1. An increase in costs by a factor of 6 would be required to affect the economic viability of the preferred option.



Similarly, it is necessary to assess the impact of delaying the works. Any delays greater than 5 years would be politically unacceptable as this would extend beyond the residual life of the remaining structures.

Delaying the works decreases scheme costs by approximately 25%. It increases the damages significantly as structures fail. The estimated resulting BCR is marginally less than that for the main economic case, but has none of the major political implications associated with delaying the works.

The main economic analysis makes allowances for sea level rise at 4mm/yr as damages etc increase. Therefore, the coastal strategy option remains the preferred option.

### 2.7.3 Land drainage

**Table 2.20 Land Drainage Costs and Benefits (£k)**

Option	1	2	3	4	5
	do nothing	Maintain Existing	Sustain	Improve	Strategy
<b>PV Costs</b>		8,427	11,059	12,242	10,821
<b>Optimism Bias (60%)</b>		5,056	6,635	7,345	6,493
<b>? pv Costs (PVc)</b>		13,483	17,694	19,587	17,313
<b>PV Damages (PVd)</b>	432,197	5,852	1,890	718	1,920
<b>With FLAIR update</b>	864,393	11,705	3,780	1,435	3,840
<b>PV Damage Avoided</b>		852,689	860,614	862,958	860,554
<b>Net Present Value</b>		839,206	842,919	843,370	843,240
<b>Average Benefit Cost Ratio</b>		63.24	48.64	44.06	49.70
<b>Incremental BCR over previous option</b>			1.88	1.24	NA
<b>Incremental BCR over maintain option</b>			1.88	1.68	2.05*

It can be seen from the above Table 2.20 that the highest benefit cost ratio is achieved by Option 2 – Maintain, achieving a figure of 63.24, followed by Option 3 and 5 – Sustain / Strategy, with a benefit cost ratios of 48.64 and 49.70 respectively. There is incremental benefit in increasing the level of expenditure from Maintain to the Strategy option (iBCR of 2.05). The Strategy Option (Land Drainage) clearly meets the scheme objectives by matching more appropriate solutions (in terms of standard of service and timing) to each catchment. In addition, the BCR figures all greatly exceed unity demonstrating the definite merit in implementing this strategy. Equally, the high benefit cost ratio removes the need for complicated risk assessment as the need for the works is clearly robust, with the outcome being beneficial.

It is therefore recommended that Option 5 - Strategy is adopted as it specifically targets improvements based on the needs of the catchment in terms of applying the appropriate improvement approach for each frontage and is the most economically viable option.

Other options are rejected as they do not fully meet the stated objectives of the Land Drainage Strategy. Residual risks will remain, over and above the standards of service provided at the various locations. In the case of the strategy scenario, the residual PV damages remain at £3,840k. However, generally, the individual standard is met at the various catchments, so it is felt that this residual risk is acceptable.

Where possible, the solution will utilise sustainable methods, and best practice will be used with the maintenance and improvement works. The maintenance of the various catchment watercourses forms an integral part of the Land Drainage Strategy Option.

Part of the strategy involves the recommendation that further studies are implemented, including the need for environmental monitoring along with the upgrade of various facilities and assets. In addition, it is recommended that a maintenance protocol be established and agreed with the various riparian owners.

### 3 PROJECT PLAN

#### 3.1 Coastal Defence Strategy

The strategy objectives will be met by Option 5 – Strategy in that:

- ?? An appropriate level of coast protection and sea defence will be provided, preventing erosion and inundation affecting vast assets and over 50,000 people.
- ?? The works are sustainable, in that they will accommodate predicted rise in sea level and where possible have endeavoured to use appropriate materials, including recycling.
- ?? The Strategy Option builds upon the results of major consultation with local people and statutory organisations to ensure that the works are sympathetic to the needs of the community and environmentally acceptable.
- ?? The strategy outlines a programme of future monitoring to ensure that the conclusion and recommendations, and ultimate implementation can be tested in the future.
- ?? The Strategy Option incorporates the findings of other higher level plans ensuring a consistency and compatibility of approach.

The construction methods envisaged for the first coastal scheme will involve the construction of a new revetment apron over the existing structure. This will require a steel sheet pile toe to protect against coastal erosion. In addition, the deck will be raised and a rear reinforced concrete splash wall will be constructed. The finished details of this arrangement have been the subject of a consultation exercise and a design competition. The outcome of these will be incorporated into the finished seawall. In addition, the final solution will be subject to planning constraints, i.e. achieving minimum aesthetic standard. Allowance has been made within the strategy for the potential for scour rock and beach nourishment to be used in the future, should beach levels fall.

The design of the finished apron has been influenced by physical model testing to ensure its efficiency in reducing overtopping quantities to a minimum. In addition, the final solution will be influenced by the technical input from a selected contractor (Birse CL) who will assist in ensuring that the solution will be practical and compatible with its working methods.

Ongoing environmental monitoring will be carried out, along with scheme PAR impact assessments and ongoing consultation. In this way the preferred options will reflect the needs of the community, and will be appropriate within the headland environment. A similar process is envisaged for the remaining improvement sections. The strategy will be reviewed before the implementation of the next phase of schemes ensuring lessons learnt from the first five years work are incorporated into the strategy and that the strategy findings are still valid.

At other frontages, the maintain/sustain options will continue the ongoing practices already in place. The construction sequencing is summarised in Appendix C.

The management of the coastal defences will continue to be carried out by Wyre Borough Council in its capacity as the Coastal Authority. The capital and maintenance expenditure over the strategy period for the coastal defence works is estimated at £156,050,000 over 100 years excluding optimisation bias of £86,613,000.

### 3.2 The Land Drainage Strategy

The objectives of the Land Drainage Strategy have been met in that:

- ?? The main aim of the strategy has been achieved in that Option 5 – Strategy reduced the risk of flooding to vast assets and over 35,000 people, to an acceptable level. This is done in a systematic and sympathetic way. The need for the works is clearly identified, with real and tangible benefits being realised as a consequence of the works.
- ?? The existing standard of service of the critical ordinary water courses was established as a result of surveying, mapping and consultation. Consequently, the risk of flooding within Wyre was also determined.
- ?? In addition, a systematic assessment of each catchment was identified to determine the most effective cause of action to meet these objectives.
- ?? Various environmental initiatives will be investigated as part of the ongoing implementation of the Land Drainage Strategy itself.
- ?? The preferred option has considered and incorporated the requirements of various higher level plans ensuring consistency and compatibility.
- ?? The strategy has identified where the bulk of risk lies (i.e. per catchment) and identified how best to reduce this risk to acceptable levels.

The approach to implementing the Land Drainage Strategy Option varies depending on location and timing. However, there will be continued maintenance and improvement of facilities such as pumping stations, trash screens, systematic clearing of channels and culverts and bank improvements. Storage options will also be investigated.

The defence standard varies per location, but meets the indicative standards associated with the particular catchment. Sea level rise has been considered within the study, in that water egress is affected. Storage options will incorporate sustainability as part of their implementation. Further study of environmental issues will be undertaken as part of the implementation of option 5. The future maintenance of the watercourses forms as integral part of the Land Drainage strategy.

It is anticipated that much of the future management of the identified watercourses will be carried out jointly by the Environment Agency (EA) and Wyre Borough Council as Agents to the EA, following the en-maining of critical ordinary watercourses. The capital and maintenance expenditure over the strategy period for the Land Drainage works is estimated at £29,608,000 over 100 years excluding optimisation bias of £17,765,000.

## 4 RECOMMENDATIONS/ SIGN OFF

### 4.1 Operating Authority

\*Study/Strategy/AIP to first 5 years work/Scheme - recommended for submission to DEFRA for agreement/approval<sup>#</sup> at a cost of

£

Project Engineer

Name		Signature	
		Date	

\*Study/Strategy/AIP to first 5 years work/Scheme - accepted/recommended for:- submission to DEFRA for agreement/approval<sup>#</sup>

Project Manager

Name		Signature	
		Date	

\*Study/Strategy/AIP to first 5 years work/Scheme - accepted/recommended for submission to DEFRA for agreement/approval<sup>#</sup>

Project Executive

Name		Signature	
		Date	

\* select as appropriate but at least one option must be selected from the options.

# select as appropriate.

### 4.2 Department for the Environment Food and Rural Affairs.

\*Study/Strategy/AIP to first 5 years work/Scheme recommended for:- further study/rejection/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/agreement/approval

Regional Engineer

Name		Signature	
		Date	

\*Study/Strategy/AIP to first 5 years work/Scheme accepted/recommended for:- further study/rejection/agreement/approval.

Chief Engineer

Name		Signature	
		Date	

\* Select as appropriate.

## 5 APPENDICES

- A. List of reports produced and available for inspection
- B. Location/Benefit area Map
- C. Outline Plan and sections of proposed works
- D. Economic appraisal
- E. Cost breakdown
- F. Expenditure Profile
- G. *Risk register* **Not Applicable**
- H. List of Consultees
- I. Environmental Impact Assessment – **Not Used – See Reference 2 in Appendix A**
- J. Defra Priority Score

**APPENDIX A:**

List of reports produced and available for inspection

## Appendix A

### List of reports produced and available for inspection

Reference	Originating Organisation	Document Title	Sub-Title	Date
1	Wyre Borough Council	Land Drainage Strategy	Final document	August 2004
2	Wyre Borough Council	Wyre Flood and Coastal Defence - Strategy Plan -	Final Approved Document	March 2004
3	Wyre Borough Council	Cleveleys Promenade	Scheme Appraisal Report	Sept 2002
4	Wyre Borough Council	Wyre Flood and Coastal Defence Strategy Study	Coastal Breach Modelling & Benefit Appraisal Report.	November 2002
5	Wyre Borough Council	Strategic Environmental Assessment		July 2001
6	Wyre Borough Council	Proposed Strategy Study for Flood Defence & Coast Protection	Consultation Document	Dec 2000
7	Environment Agency	Wyre Estuary Shoreline Management Plan	- Final Plan Document	Dec 2002
8	Halcrow	Cleveleys Frontage	Environmental Impact Assessment Scoping	July 2004
9	HR Wallingford	Cleveleys Coastal Defence	Improvements - Two dimensional physical model study to assess the performance of the proposed revetment cross-sections,	July 2004



**APPENDIX B:**

Location/Benefit area Map

Figure B1 – Watercourses & Catchments

Figure B2 – Coastal defence Strategy Management Units.

## **APPENDIX C:**

Outline Plan and sections of proposed works

Appendix C1 Proposed Management Policies and Works for Coastal Defences.

Appendix C2 – Coastal Defence Strategy Long Term Programme of Works.

Appendix C3 – Coastal Defence Strategy 5-Year Implementation Plan.

Appendix C4 – Proposed Management Policies and Works for Land Drainage.

Appendix C5 – Land Drainage Strategy Long Term Programme of Works.

Appendix C6 – Land Drainage Strategy 5-Year Implementation Plan.

**APPENDIX D:**

Economic appraisal

Appendix D1– Summary of Coastal Defence Economics.

Appendix D2 – Summary of Land Drainage Economics

**APPENDIX E:**

Cost breakdown

Appendix E1 - Coastal Defence Strategy Cost Breakdown

Appendix E2 – Land Drainage Strategy Cost Breakdown

## **APPENDIX F:**

### **Expenditure Profile**

- Appendix F1 - Coastal Defence Strategy Option Expenditure Profile.
- Appendix F2 - Coastal Defence Strategy Option Expenditure Profile Including Optimisation Bias.
- Appendix F3 – Land Drainage Strategy Option Expenditure Profile.
- Appendix F4 - Land Drainage Strategy Option Expenditure Profile Including Optimisation Bias.

## APPENDIX G:

*Risk register* **Not Applicable**



## **APPENDIX H:**

### List of Consultees





**APPENDIX I:**

Environmental Impact Assessment

*Not Used – See Reference 5 in Appendix A*



**APPENDIX J:**

Defra Priority Score



