

Strategy Appraisal Report

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NWC013F

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number

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authority

Wyre Borough Council

Strategy
name

Wyre Urban Core Strategy



Rossall Point, Fleetwood Floods February 1977

Date

February 2013

Version

V3.0

StAR for *Wyre Urban Core Strategy*

Version	Status	Signed off by:	Date signed	Date issued
V1.0	For LPRG Submission			20/09/2012
V2.0	For LPRG Review			14/12/2012
V3.0	For LPRG Sign Off			18/02/2013

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For technical approval of the business case

Wyre Borough Council :

Project name: Wyre Urban Core Strategy

Approval Value: £425,000k

Sponsoring Director: David Jordan Director of Operations

Non-financial scheme of delegation

Part 11 of the Non-financial scheme of delegation states that approval of FCERM Strategies/Complex Change Projects, following recommendation for approval from the Large Projects Review Group, is required from the Regional Director or Director, Wales and Director of Operations.

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Approval history sheet

APPROVAL HISTORY SHEET (AHS)			
1. Submission for review (to be completed by team)			
Project Title: Wyre Urban Core Strategy		Project Code: NWC013F	
Project Manager: Carl Green		Date of Submission:	
Lead Authority: Wyre Borough Council		Version No: v3.0	
Consultant Project Manager: Andrew Parsons		Consultant: Halcrow	
<i>The following confirm that the documentation is ready for submission to PAB or LPRG. The Project Executive has ensured that relevant parties have been consulted in the production of this submission.</i>			
Position	Name	Signature	Date
Project Executive	Carl Green		
	Job Title:	Head of Engineering Services	
2. Review by: Large Projects Review Group (LPRG)			
Date of Meeting(s): 8 th Nov 2012		Chairman: R Nunn	
Recommended for approval: In the sum of :£425,000k		Date:	Version No:
3. Environment Agency NFSoD approval <i>Officers in accordance with the NFSoD.</i>			
Version No: 3		Date:	
Project Approval	By: In the sum of: £	Date:	
4. Defra or WAG approval <i>(Delete as appropriate)</i>			
Submitted to Defra / WAG or Not Applicable (as appropriate)		Date:	
Version No. (if different):			
Defra/ WAG Approval: or Not applicable (as appropriate)		Date:	
Comments:			

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**NON FINANCIAL SCHEME OF DELEGATION (NFSoD) COVERSHEET FOR A FCRM
COMPLEX CHANGE PROJECT / STRATEGIC PLAN**

1. Project name	Wyre Urban Core Strategy		Start date	December 2009
			End date	January 2013
Business unit	FCERM	Programme	FDGiA	
Project ref.	NWC013F	Regional SoD ref.	Head Office SoD ref.	-

2. Role	Name	Post Title
Project Sponsor	Garry Payne	Chief Executive
Project Executive	Carl Green	Head of Engineering Services
Project Manager	Mike Pomfret	

3. Risk Potential Assessment (RPA) Category	Low	<input type="checkbox"/>	Medium	<input checked="" type="checkbox"/>	High	<input type="checkbox"/>
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4. NFSoD value	£k
Whole Life Costs (WLC) of Complex Change Project / Strategic Plan	425,000

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

6. NFSoD approver name	Post title	Signature	Date
	Regional Director/Director Wales		
	Director of Operations		
NFSoD consultee name	Post title	Signature	Date
	LPRG Chair		

1 Executive summary

1.1 Introduction and background

- 1.1.1 The Wyre Urban Core Flood Management Strategy (henceforth referred to as the Strategy) presents the business case and implementation plan for the study area and has been prepared by Wyre Borough Council (WBC) in partnership with the Environment Agency (EA).
- 1.1.2 There are no previous approved Flood and Coastal Erosion Risk Management Strategies in place for this stretch of coastline. In August 2003, a Coastal Defence Strategy was developed for the coastline and tidal river Wyre. In 2004 a Land Drainage strategy was developed and in 2005 a Headland PAR report combining the two strategies was prepared. The strategies were noted by Defra but were not fully approved. This Strategy updates the previous work undertaken from 2003 to 2005.
- 1.1.3 There are three strategic objectives:
- Develop a strategic approach to manage flood and coastal erosion risk to people, property and other assets within the strategy area over the next 100 years;
 - To minimise adverse impact caused by Strategy recommendations and seek ways of enhancing the environmental, amenity and recreational value of the Strategy area;
 - Comply with mandatory and statutory obligations including the Water Framework Directive and national and local conservation designations relevant to the Strategy.
- 1.1.4 The strategy area is 16km² and encompasses the towns of Thornton Cleveleys, Poulton and Fleetwood. It extends from Anchorsholme to the south up to the mouth of the estuary at Fleetwood and then upstream to the Catchment and borough boundary at Stanah, a distance of 10km, see Key Plan 1. The study area is highly urbanised with approximately 28,500 residences protected by the existing defences.
- 1.1.5 Within the study area, the tidal cycle and sea level rise are connected processes. They also influence the ability of inland watercourses and piped outfalls to discharge, consequently affecting fluvial and surface water flooding.
- 1.1.6 The recommendations of this Strategy align with the Wyre Catchment Flood Management Plan (CFMP) and the North West England and North Wales Shoreline Management Plan 2010 (SMP2) policies. The Strategy has also been developed and considered alongside the draft Lancashire Flood Risk Assessment
- 1.1.7 Ownership of the majority of the coastal frontage lies with Wyre Borough Council with the exception of a 600m length fronting Rossall School. The estuary frontage has two major landowners, Associated British Ports and NPL estates.
- 1.1.8 The study area contains one flood catchment area (Key Plan 1) protected by individual lengths of defences (both coastal, estuary and fluvial). These defences have been allocated sub units based on their immediate flood risk areas derived from modelling short term breaches within each frontage and along each watercourse. The summation of all the allocated sub units equates to the full catchment area to avoid double counting

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as identified in Table 1.1. Surface water flood risk overlaps with other sources of flooding. Therefore these damages have been removed from the fluvial flood risk count.

- 1.1.9 To the south of the study area is the Blackpool Council frontage. Sub Unit 0 of this strategy lies within Blackpool in order to capture the linked tidal flood risk. South of Sub Unit 0, the flood and erosion risks is captured in the adjacent Blackpool Strategy. Both strategies have been developed alongside each other to ensure benefits are not double counted. The Strategy study area boundary forms one large flood cell (up to 1 in 1000 year flood events). The boundary ends where it runs into high ground at the southern end of the study area. The coastal process boundaries are defined by the two estuaries: Wyre Estuary and Ribble Estuary, therefore there will be no impacts beyond these limits.

Table 1.1 Description of Sub Units

	Sub Area	Length	Assets Protected
0	Anchorsholme	Anchorsholme Park to Borough Boundary (384m)	3,393 properties
1	Cleveleys	Borough Boundary at Anchorsholme to Jubilee Gardens (1,038m)	5,052 properties
2	Rossall South	Jubilee Gardens to Rossall Hospital (1,741m)	3,015 properties
3	Rossall North	Rossall Hospital to Fleetwood Golf Course. (1,910m)	7,497 properties, pumping station, hospital, schools, offices.
4	Fleetwood North	Fleetwood Golf Course to Fleetwood Dock entrance (4,753m)	1,042 properties, leisure centre, Marine Hall complex, golf course.
5	Outer Estuary	Fleetwood Ferry Dock to Lagoons at NPL (3,298m)	450 properties, Major industry and retail units, including Freeport shopping outlet and fish docks.
6	Middle Estuary	Lagoons to Stanah Pumping Station Outlet (1,954m)	NPL commercial site and major urban area of Thornton 4,622 properties.
7	Royles Brook & Hillylaid Watercourse	Anchorsholme & Carleton to Stanah	3,118 properties, of which 2,600 are allocated to surface water flooding. Main substation.
8	Springfield Watercourse	Burn Drain Catchment	73 properties mostly associated with the failure of Springfield pumps. Two large caravan parks and associated facilities.
9	Copse Brook Watercourse	Rossall School to Fleetwood Docks	504 properties and major industrial and retail units.
	Total properties	23,800 in year 0	28,766 in year 100

1.2 Problem

- 1.2.1 The Strategy area contains assets at risk of flooding with present value damages of £2,214m over the next 100 years. There are currently 23,800 residential properties at risk of flooding from the sea and the tidal River Wyre with a 1 in 200 (0.5%) chance of flooding in any year. Under a Do Nothing scenario, by 2112 this would increase to 28,766 residential properties at risk from flooding. There are 6,382 residential properties at risk of flooding from inland waterways and surface water flooding with a 1 in 100 (1%) chance of flooding in any year. There are no properties imminently at risk from erosion.

- 1.2.2 The flood defence assets on the coastal and river frontages currently provide a standard of protection of between a 1 in 75 and 1 in 200 chance of occurrence, but this is reliant upon continued maintenance of existing embankments, revetment systems, sea walls, groyne fields and beach levels. In the Do Nothing case there is a high risk of failure of

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the revetments and sea walls and subsequent breaching of the sea defences within a five-year period. Beach levels on the west facing coastal frontages are lowering and this trend is anticipated to increase with sea level rise.

- 1.2.3 The main concern for the Strategy area is the poor condition of the coastal defences at Rossall, where the lower aprons and toe are failing and the higher wall has signs of spalling and cracking. It has an estimated serviceable life of 5 to 15 years and a breach is anticipated if an event with a 1 in 75 chance occurred. Properties behind the sea defences are low lying with many of the houses first floor windows level with the top of the defence.
- 1.2.4 Modelling predicts that 7,497 properties would be at risk of flooding from a breach at Rossall with an event with a 1 in 200 chance of occurring in any one year. In addition a key United Utilities pumping station is situated within 200m of the defences at Chatsworth Avenue which, if inundated, would lead to extensive sewerage flooding.
- 1.2.5 Sea defences at Anchorsholme are in very poor condition and at risk of breach, which would lead to erosion and flooding during an event with a 1 in 200 year chance of occurring to 3,393 properties. The Anchorsholme pumping station outfall structure lies within the sea defence structure and is partly exposed and at risk of damage.
- 1.2.6 The Hillylaid Pool and Royles Brook watercourses are in a poor condition with very flat gradients, significant constrictions and high risk of blockage and limited access for maintenance. Modelling has predicted that there are 3,118 properties at risk of flooding from these watercourse and from the surface water drainage network.
- 1.2.7 The most recent major flood events occurred in 1927, which resulted in the deaths of six people, and 1977 when over 1,800 properties were subjected to inundation by the sea following a breach at Rossall with flood depths over 1m above floor level in many cases.

1.3 Options considered

- 1.3.1 A long list of options was prepared and tested against each length and the SMP2 for appropriateness to provide coherent options for the whole Strategy area. The most appropriate options were then tested further for each sub length over three epochs (short 0 -10, Medium 10 – 50 and long 50 – 100).
- 1.3.2 The options considered for appraisal were Do Nothing, Do Minimum, Maintain defences at current crest height, Sustain current SoP and Improve SoP for a range of SoPs.
- 1.3.3 Options were assessed using the latest FCRM-AG guidance. Technical appraisal included river modelling in conjunction with sewer modelling from United Utilities and tidal flood modelling using the latest sea level rise and joint probability study.
- 1.3.4 Appendix F details the economic appraisal undertaken to define preferred options from the shortlisted options to manage flooding and coastal erosion in line with appropriate guidance. These recommendations are supported by the Strategic Environmental Assessment Environmental (SEA) Report addendum. Natural England is currently reviewing the SEA and Habitats Regulations Assessment (HRA) and has indicated that there will be no objection to the Strategy's recommendations once the relevant changes are made to the HRA document.

1.4 Recommended Strategy and Economic Case

- 1.4.1 Table 1.2 summarises the 100 year economic appraisal for the preferred strategy options. The standard of protection has been optimised for the Strategy as a whole flood

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cell as management options in all sub units need to be consistent. The economically optimised standard of protection is 1 in 200 (0.5%) annual chance of occurrence.

Table 1.2 Summary of Preferred Options and Economic Appraisal

	Sub Area	Details	Present Value Cost (£k)	Present Value Benefits (£k)	Benefit -Cost Ratio	Total Cash Costs (£k)
0	Anchorsholme	Urgent improvements to coastal defences - new concrete sea wall and promenade with concrete revetment toe protection. In longer term counter sea level rise through beach nourishment and management.	17,540	141,158	8.0	25,776
1	Cleveleys	Maintain newly constructed seawall followed by beach nourishment and management, using a combination of recycled material, off shore dredging and rock groyne extensions.	14,616	283,728	19.4	49,045
2	Rossall South	Concrete repairs to existing defences and beach management followed by improvement to the concrete revetments, promenade and front wall in year 15 – 20.	34,201	182,762	5.3	133,126
3	Rossall North	Urgent improvements to coastal defences - new concrete sea wall and promenade with rock revetment toe protection and rock groynes. In longer term counter sea level rise through beach nourishment and management.	91,970	981,777	10.7	138,376
4	Fleetwood North	Continue maintaining defences, timber groynes and dune management for first epoch. Sustain for future epochs through raising sea walls, strengthening aprons and enhanced management of dunes with nourishment.	10,594	30,822	2.9	26,959
5	Outer Estuary	Capital maintenance works to maintain the standard of protection, where defences are starting to fail or where voiding is present. In the second epoch strengthening measures to the lagoon area to sustain the standard.*	1,916	5,206	2.4	7,858
6	Middle Estuary	Capital maintenance works required to maintain the standard of protection, where defences are starting to fail or where voiding is present.	1,212	459,801	379	5,031
7	Royles Brook & Hillylaid Watercourse	Bank stabilisation works required urgently. Improvements to the pumping station in the second epoch. Joint work with UU to discharge water through sea wall at Anchorsholme relieving the lower system.	6,657	65,256	9.8	26,003
8	Springfield Watercourse	Construction of new channel to divert flows to gravity system in first epoch. Potential to sustain increased flows in future epochs through creation of wetland areas. Largely developer funded.	1,661	7,096	4.3	5,267
9	Copse Brook Watercourse	Works to stabilise embankments, replace retaining structures and improve culvert condition to sustain flow	1,599	34,464	21.6	7,507
	Strategy	Improve 1 in 200	181,966	2,140,370	11.8	424,948
The strategy costs for SU0 to SU4 includes:						
	Beach Management	Beach recharge, structures and associate management for SU0-4 (included in individual SU schemes)	24,106			71,760
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* There is potential for significant investment in this area with works being brought forward through development.

1.5 Implementation and Outcome Measure score

1.5.1 Over the next five years and subject to available funding, the strategy recommends construction of new sea defences at Rossall and Anchorsholme. Beach management is also recommended on the Anchorsholme to Rossall frontage (SU0 to SU4) with construction of groynes and beach recharge occurring in 2016-2018 and repeated at 20 year intervals. It is recommended that enhanced maintenance is undertaken on the Hillylaid Brook and Royles Brook watercourses.

1.5.2 Table 1-3 shows the annualised spend profile (cash cost) for the next five years and the Outcome Measure score. The Outcome Measure scores are detailed in Appendix P.

Table 1-3 Annualised Cash Spend Profile

Costs (£k)	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	Total
Sub Unit 0 - Anchorsholme							
Partnership Funding Score = 155%							
Capital	-	3,967	3,967	325	1,106	-	9,365
Non-capital	409	198	198	13	13	13	844
Optimism Bias	246	2,499	2,499	203	671	8	6,125
Sub Unit 3 – Rossall North							
Partnership Funding Score = 138%							
Capital	-	15,823	15,823	15,823	1,620	5,501	54,589
Non-capital	282	1,246	475	475	-	63	2,540
Optimism Bias	169	10,241	9,779	9,779	972	3,338	34,278
Sub Unit 7 – Royles Brook & Hillylaid Watercourse							
Partnership Funding Score = 123%							
Capital	-	-	-	-	534	-	534
Non-capital	42	43	44	98	45	46	318
Optimism Bias	25	26	26	59	348	28	511
Sub Unit 0 to 4 – Beach Management Scheme							
Partnership Funding Score = 141%							
Capital	-	125	125	125	2,281	1,637	4,293
Non-capital	40	41	42	42	43	44	252
Optimism Bias	24	100	100	100	1,394	1,009	2,727

Note: Figures above do not include inflation

1.5.3 Wyre Council has started procurement for the Anchorsholme and Rossall North schemes, with a design and build tender process underway in conjunction with Blackpool Council. Procurement will be through the Environment Agency frameworks for the works in Royles Brook & Hillylaid Watercourse.

1.5.4 Table 1-4 summarises the key risks to implementing the Strategy.

Table 1.4 Key Implementation Risks

Key Project Risk	Adopted Mitigation Measure
No funding to progress schemes before a major breach is experienced on river or coastal frontages	Continue maintenance where possible including river bank breach repairs. Failure to secure funding will require plans to be prepared by the Environment Agency and Local Authorities for affected communities to adapt. Work with local communities to update emergency plans, increase local preparedness and resilience.
Only one of the schemes in the FPCP obtains funding for construction in the MTP resulting in separate contracts and removing	The Contractors have been asked to price the projects based on two scenarios: starting construction on SU0 and SU3 concurrently and; starting construction independent of each other. Contracts will not be awarded until the funding allocation is confirmed.

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the opportunity to package work and work more efficiently.	
Only one of the schemes in the FPCP obtains funding for construction in the MTP resulting in separate contracts and removing the opportunity to package work and work more efficiently.	The Contractors have been asked to price the projects based on two scenarios: starting construction on SU0 and SU3 concurrently and; starting construction independent of each other. Contracts will not be awarded until the funding allocation is confirmed.
Unforeseen ground conditions resulting in increased construction cost.	Site investigation to be undertaken to support detailed design, reducing uncertainties over ground conditions.
Adverse public reaction to proposed options.	Appropriate consultation built into detailed design/planning stage, reducing the likelihood of public objections.
Non agreement on impacts upon internationally designated sites delays letter of support from Natural England and sign off of Habitats Regulations Assessment.	Continued liaison with Natural England, with support/evidence from ongoing studies.
United Utilities (UU) announces intention to undertake capital expenditure concurrent with coastal works.	FPCP to continue liaison with UU to reduce the risk of this occurring, seeking to identify opportunities for savings if programmes are coincident..

1.6 Contributions and Funding

- 1.6.1 The June 2011 FDGiA Partnership funding calculator scores indicate that the majority of funding for the capital works proposed in this strategy should be available through Defra Grant in Aid. However the council has been in discussions with a number of beneficiaries to provide contributions to the development of the schemes. This includes United Utilities, Lancashire County Council (the highway authority, social care and education), the housing associations, major developers and Fleetwood Town council. A funding strategy has been set up and is being led by senior members of Wyre and Blackpool councils (who are jointly procuring the years 1 to 5 coastal works). Contributions for all the recommended works in the Strategy will continue to be sought in line with the Contributions included in Appendix P. The policy aims are to seek opportunities for contributions from the public and private sector to encourage growth and regeneration and support the existing works being proposed to achieve joint benefits.

1.7 Recommendations

- 1.7.1 It is recommended that the Wyre Urban Core Strategy is approved under the Non-financial scheme of delegation to enable the flood and erosion risk to 28,500 properties over 100 years to be managed appropriately.
- 1.7.2 The Strategy Whole Life Cash Cost (excluding inflation) is £424,948k, including 60% optimism bias. Of this £90,803k is for new sea defences at Rossall and £15,491 at Anchorsholme (capital cash costs including risk, excluding inflation).
- 1.7.3 The beach management costs for SU0 to SU4 over 100 years are £71,760k (cash cost including risk, excluding inflation).

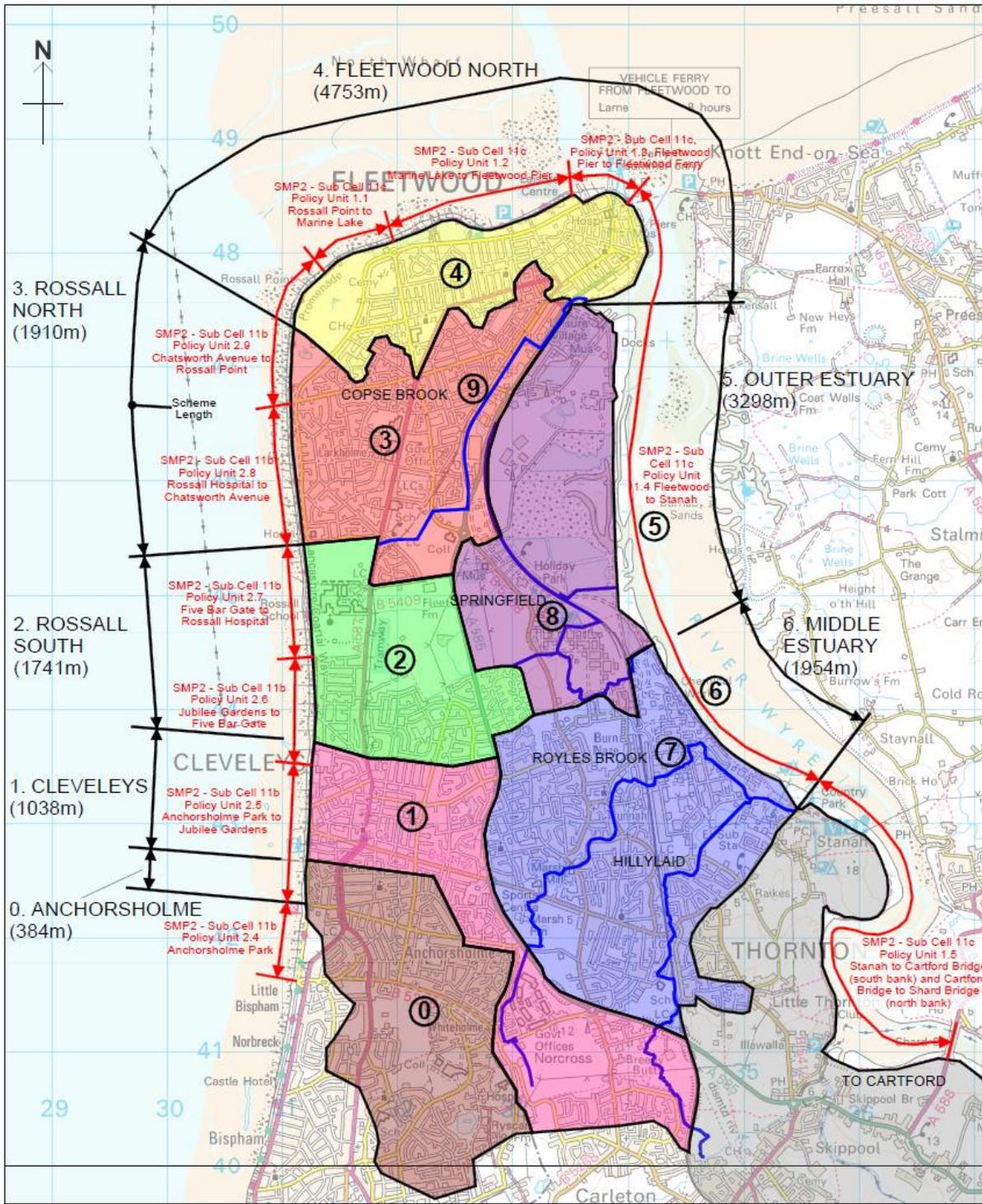
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1.8 Director Briefing Paper

Region:	North West	Project Executive:	Carl Green		
Function:	Flood Risk Management	Project Manager:	Kathryn Pye		
Project Title:	Wyre Urban Core Strategy	Code:	NWC013F		
NEECA Consultant:	Halcrow	NCF Contractor:	n/a	Cost Consultant:	n/a
The Problem:	There are currently 23,800 residential properties at risk of flooding from the sea and the tidal River Wyre with a 1 in 200 (0.5%) chance of flooding in any year. The whole area is protected by a defence system that needs to be managed strategically. The defences at Rossall and Anchorsholme are in poor condition and the beaches suffer from long term erosion.				
Assets at risk from flooding and erosion:	The urban areas and associated infrastructure of Poulton, Cleveleys, and Fleetwood including 23,800 residential properties.				
Existing standard of flood protection:	between 1 in 75 (1.33%) and 1 in 200 (0.5%) AEP	Proposed standard of flood protection:	1 in 200 (0.5%) AEP		
Description of proposed schemes:	Over the next five years the strategy recommends construction of new sea defences at Rossall and Anchorsholme and beach management on the Anchorsholme to Rossall frontage (SU0 to SU4) with construction of groynes and beach recharge. Enhanced maintenance is recommended on the Hillylaid Brook and Royles Brook watercourses.				
Costs (PVc): (100 year life inc. maintenance)	£181,966k	Benefits: (PVb)	£2,140,370k	Ave. B: C ratio: (PVb/PVc)	11.8
NPV:	£1,958,405k	Incremental B: C ratio:	4.0	Whole life cost (cash value):	£424,948k
Choice of Preferred Option:	Hold the Line of the existing defences, and in some flood cells sustaining or improving the standard of protection.				
Total cost for which approval is sought:	£ 425m whole life cost (including £161m OPTIMISM BIAS)				
Delivery programme:	<ul style="list-style-type: none"> • Improve standard of protection at Rossall North (SU3): 2018 • Improve standard of protection at Anchorsholme (SU0): 2016 • Works to Royles Brook & Hillylaid Watercourse: 2014 • Beach management scheme for coastal frontage SU0-SU4: 2016-2017 All sustain options are raised before the appropriate climate change epochs.				
Are funds available for the delivery of this project?					
External approvals:					
Defra approval:	N/A				

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Key plan 1 – strategy area and sub units



WYRE STRATEGY

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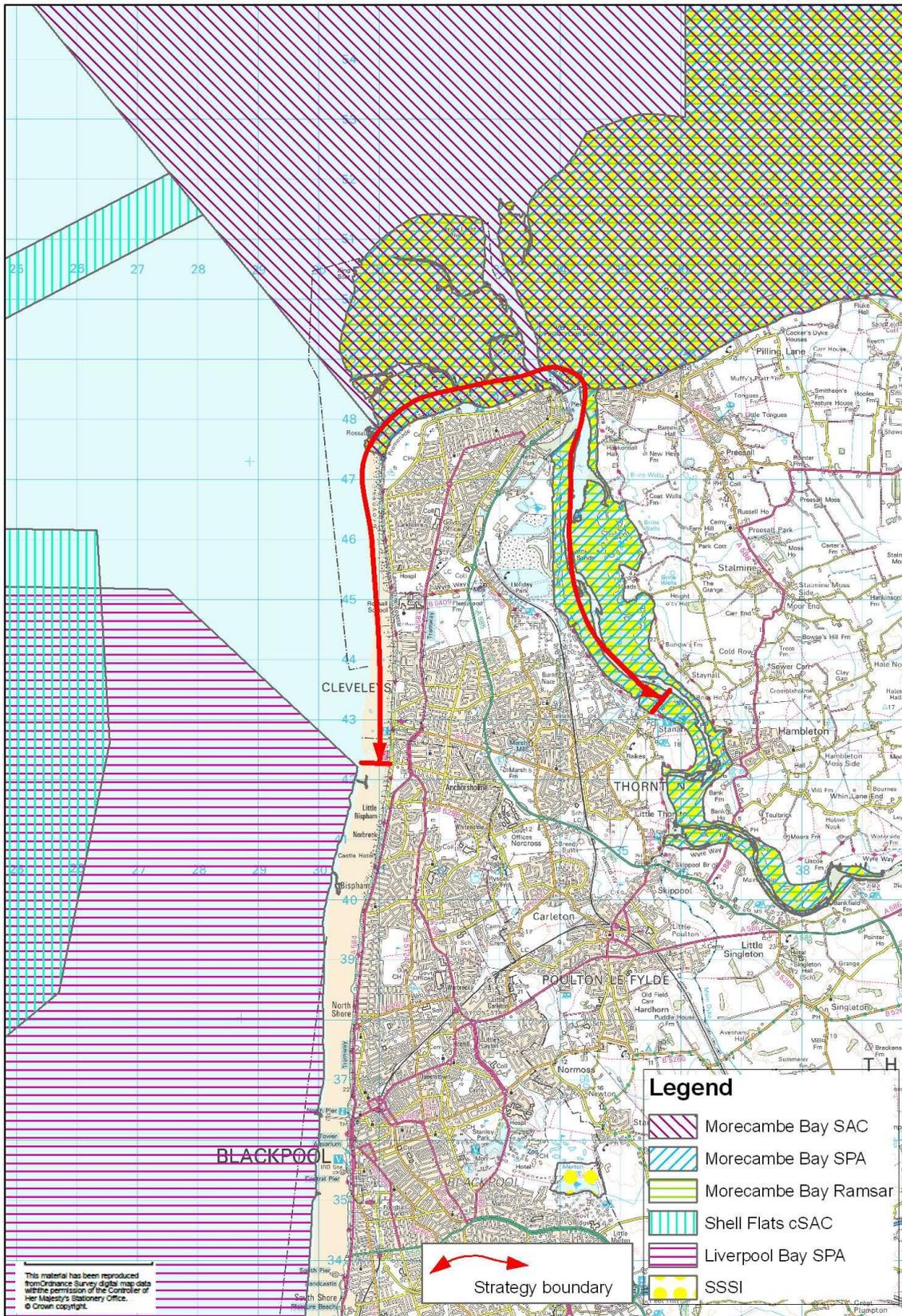


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Title: Flood Compartments
 Drawn: M. Wilkinson
 Drawing No:
 Date: 07:11:11 Scale: 1:45000

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Key Plan 2 – Environmentally Designated Areas



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2 Introduction and background

2.1 Purpose of this report

- 2.1.1 This Strategy Appraisal Report (StAR) presents the business case and implementation plan for the Wyre Urban Core Flood Management Strategy (henceforth referred to as the Strategy) and seeks approval of the Strategy.
- 2.1.2 The StAR will be presented at the Cabinet meeting of Wyre Borough Council, for approval to adopt the strategy recommendations. The Council are committed to the development of the strategy, through the promotion and implementation of the action plan and investing resources into the maintenance of the sea defence assets.
- 2.1.3 The Environment Agency North West has supported the development of this strategy and will deliver the improvement schemes on the internal watercourses, together with the investment of resources into their maintenance.
- 2.1.4 The Strategy recommends our preferred options for flood and erosion risk management for the coastline from the borough boundary with Blackpool at Kingsway, Cleveleys to the mouth of the Tidal River Wyre at Fleetwood and the left bank of the River Wyre to Stanah. The internal drainage systems outfalling to Stanah (Hillylaid and Royles Brook), to Springfield pumping station and to Fleetwood Docks tidal flap (Copse Brook) are also considered (Refer to Key Figure 1).
- 2.1.5 The appraisal has been undertaken in accordance with the Flood and Coastal Erosion Risk Management Appraisal Guidance (FCERM-AG).
- 2.1.6 A Strategic Environmental Assessment (SEA) has been undertaken in parallel with the options appraisal in order to find the preferred option and determine our Strategy. The SEA Environmental Report is provided in Appendix C.
- 2.1.7 Following Strategy approval, the priority coastal works at Rossall North, Anchorsholme and the fluvial watercourse works at Hillylaid Pool will be progressed.

2.2 Background

Strategic and legislative framework

- 2.2.1 The North West England and North Wales Shoreline Management Plan (SMP2) was adopted by Wyre Borough Council on 27 September 2010 and sets the high level policy for the coastline. This supersedes the earlier SMP1.
- 2.2.2 The Strategy frontage lies within two Sub Cells of the SMP2, 11b Southport Pier to Rossall Point (including the Douglas and Ribble Estuaries) and 11c Rossall Point to Haverigg (including the Wyre, Lune, Kent, Leven and Duddon Estuaries). These Sub Cells are further divided into individual policy units along the Strategy frontage, see Key Plan 1.
- 2.2.3 The SMP2 promotes sustainable and deliverable policies for the coastline over the next 100 years. The policies are set out over three timescales; the present day or short-term

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(0 to 20 years), the medium-term (20 to 50 years) and the long-term (50 to 100 years). Hold the Line was the preferred policy for all frontages/policy units throughout the 100 years of the SMP2, with a recognition that the policy delivery needed to be considered together strategically due to the linked coastal flood risk area. The Strategy's preferred option for the coast and for the left (west) bank of the River Wyre from Fleetwood to Stanah is in accordance with the SMP2 "Hold the Line" policy for these frontages.

2.2.4 The River Wyre Catchment Flood Management Plan (CFMP) was produced by the Environment Agency in December 2009. The Strategy's preferred option for the watercourses within this area is in accordance with the CFMP Policy Option 5 "Areas of moderate to high flood risk where we can generally take further action to reduce flood risk" for the Wyre Urban sub area.

2.2.5 The strategy is adjoined by the Blackpool and Fylde Coast Protection Strategy (Draft 2012) which takes account of the recommendations within this strategy particularly for the Anchorsholme stretch to ensure consistency across the boundary.

2.2.6 The proposed works will be promoted under the relevant terms of the Land Drainage Act 1991, Water Resources Act 1991 and the Coast Protection Act 1949.

Previous studies

2.2.7 In August 2003 a Coastal Defence Strategy was developed for the coastline and tidal river Wyre, in 2004 a Land Drainage strategy was developed and in 2005 a Headland PAR report combining the two strategies was prepared. The strategies were noted by DEFRA but were not fully approved. Their main recommendations were to implement capital works at Cleveley's sea defence and Stanah tidal flood defence embankment both of which are now completed. This Strategy is an update and continuation of the previous Strategy work undertaken between 2003 and 2005 and does not conflict with any of those findings.

Social and political background

2.2.8 The Strategy catchment (also referred to as a flood risk area or flood cell) contains some of the most deprived wards within the country at Fleetwood. The Fleetwood peninsular has historically relied heavily on its fishing and port centred businesses for employment. These industries have largely been lost requiring a greater reliance on tourism and the strategic employment site at Thornton Hillhouse. The strategy recognises this shift in emphasis and the importance in developing sustainable communities, through the visitor economy and high technology industries. The development of the coastal defences both in terms of their reduction of flood risk and their value as public realm assets in their own right has been considered in the development of the strategy. Consultation and working groups have been developed with key stakeholders during the preparation of the Strategy to ensure that these social factors and potential opportunities are recognised within the developing Strategy.

Location and designations

2.2.9 The Strategy area is located on the Fylde peninsular in the north west of England and is associated with the towns of Thornton Cleveleys, Poulton and Fleetwood as shown in Key Plan 1. The north facing coast lies within Morecambe Bay and the Wyre estuary forms the eastern boundary of the catchment area. The western boundary is part of Liverpool Bay and the Ribble estuary forms the southern end of the sediment cell some 16km away.

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2.2.10 The study area is 16km² and extends from south of the borough boundary with Blackpool at Anchorsholme up to the mouth of the Wyre estuary at Fleetwood, a coastal frontage of 9.8km and then upstream to Stanah, an estuary frontage of 5.3km. The coastal defences and tidal embankments act as a system; failure of any part could potentially result in flooding to the majority of the study area. Key Plan 1 shows how the study area has been divided to ensure flood damages are not double counted. In summary:

- Drainage of the catchment area is provided by four Main River watercourses:
- Royles Brook and Hillylaid watercourses discharges to the estuary via tidal flap assisted at high tide by a Archimedean screw pumping station at Stanah;
- Springfield watercourse discharges to the estuary via a rising main at the Hillhouse site;
- Copse Brook discharges via a tidal flap at Fleetwood Docks.

2.2.11 The strategy area is adjacent to several International, European and National designated sites and a key constraint for the strategy is the avoidance of potential impacts on the with distinctive intertidal habitats of Morecambe Bay and the Wyre estuary which support internationally important numbers of birds. The designated sites are presented in Table 2-1 and illustrated on Key Plan 2.

Table 2.1 Environmental Designations

International designations	National designations
Morecambe Bay Special Area of Conservation (SAC)	Lune Estuary Site of Special Scientific Interest (SSSI)
Morecambe Bay Special Protection Area (SPA)	Morecambe Bay SSSI
Morecambe Bay Ramsar Site	Wyre Estuary SSSI
Liverpool Bay SPA	
Shell Flats proposed Special Area of Conservation (pSAC) and Lune Deep pSAC	

2.2.12 Information from the 2001 census (available online from the National Office of Statistics) indicates that the flood plain includes a higher than average proportion of vulnerable people, as shown in Table 2-2.

Table 2.2 Vulnerable population indicators

Indicator	England wide	Wards within strategy area
Population with limiting long term illness	18%	25%
Population aged >64	16%	22%
Population aged >74	8%	10%

History of Flooding

2.2.13 Flooding has occurred on the Wyre coast throughout history. The first recorded event was the destruction of Singleton Thorpe in 1555. A list of flooding events is included in Appendix J.

2.2.14 The most recent major flood events occurred in 1927, which resulted in the deaths of six people, and 1977 when over 1,800 properties were subjected to inundation by the sea.

2.2.15 On the evening of 28th/29th October 1927 gale force winds combined with a high tide to cause severe flooding along the Fylde coast. A predicted high tide of 9.3m ACD was whipped up by a strong westerly gale and swamped the defences at Fleetwood and

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causing a breach just North of Rossall School, bringing floodwater (up to 12ft recorded depth) into the town.

2.2.16 The town of Fleetwood was cut off by road and rail, while both the gas and electricity supplies were severed. In addition, heavy rainstorms compounded the demand on the pumping out operations.

2.2.17 The floods claimed the lives of six people, including three children, who were caught in the path of the floodwater. Over 1,200 homes were seriously damaged and over 45% of the population were badly affected.



Figure 2.1 1927 flood

2.2.18 The Fylde coast was severely battered again over the evening of 11th/12th November 1977 when westerly winds gusting to 80mph whipped up a high tide of 9.9m to produce a 1.2m surge. The sea defences were swamped, resulting in breaches at Cleveleys and Rossall. Floodwater raced into over 1,800 homes along the coast and with flood depths in excess of 1m above floor level in many cases.

2.2.19 There was extensive disruption to infrastructure, with many roads impassable, while the telephone exchange at Cleveleys was flooded and the telephone network severely disrupted.



Figure 2.2 1977 flood

2.3 Current approach to flood risk management

Measures to manage the probability of flood risk

2.3.1 The current management of the coastal defence assets is guided by the Coastal Defence Strategy 2004, the Land Drainage Strategy 2005 and the Headland PAR 2006. A significant maintenance provision in excess of £430,000 is allocated to the proactive and reactive maintenance of the coastal defences by the council. This includes concrete repairs, timber groyne repairs and beach management and £115,000/year on land

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drainage assets. The majority of the coastal budget is allocated to concrete repairs to the west facing frontages, particularly the aprons, which suffer significant erosion and damage. Beach management operations have to date been limited to the repair and installation of timber groyne systems, with a limited amount of proactive improvement work to dune systems. The proactive works planned for the council's coastal frontages include:

- Maintenance and repairs of aprons, promenades and sea defence walls on western facing frontage between Cleveleys and Fleetwood Golf Club (Sub Unit 1 - 3) including repairs to the timber groyne field.
- Beach Management including removal of invasive species, dune protection and general maintenance of the sea wall and promenade on Fleetwood - North (Sub Unit 4), including protection of Ferry Dock piling.

2.3.2 The coastal frontage is monitored as part of the Cell 11 Regional Monitoring Strategy (CERMS), coordinated by Sefton Council. The data produced by the individual authorities is being shared and held in a National Database at Southampton University. As part of this regional monitoring regime the council undertakes surveys at 26 defined locations on a six monthly basis, sediment samples are also gathered at the same time. In addition inspections are undertaken for safety issues on a weekly basis and structural condition inspections are conducted six monthly and pre and post storm events by an in-house maintenance team, surveyors and engineering staff. The monitoring has identified a long term trend of beach lowering on the west facing coast, with accretion on the north facing coast and in the Wyre Estuary.

2.3.3 To date there has not been a co-ordinated Beach Management Plan for the strategy frontage, but in accordance with the action plan in the SMP2, one has now been completed and is included in Appendix D. The council has commenced a local beach monitoring programme originally based at Cleveleys to monitor the effects of the new sea defences but extended to cover the full strategy coastline. Argus video camera monitoring has been employed at Cleveleys for five years, which allows volumetric and sediment movement monitoring. This monitoring is due to be extended to the Rossall frontage and forms part of a comprehensive study including grid surveys of the coast, LiDAR, bathymetric surveys, wave monitoring and site based sediment and current monitoring. This data is currently being used to provide a comprehensive report on beach management through Lancaster University and Halcrow through numeric modelling of the coast.

2.3.4 Appendix G provides a summary report on coastal processes and Appendix D provides the Beach Management Plan. The coastal processes considered within the Beach Management Plan encompass the whole of the Fylde Peninsular from the Wyre Estuary down to the Ribble Estuary.

Measures to manage the consequences of flood risk

2.3.5 Wyre Borough Council works with its partners to provide a comprehensive emergency response, recognising the high risk of flooding within the area. The council has a team of three on standby at all times to react to and implement its well-practiced emergency response plans. In addition pumping equipment and sandbags are available to respond to events as they occur.

2.3.6 The Environment Agency provides flood warnings for the strategy area. Automated flood warnings are received by households who have signed up for coastal flood warnings. A fluvial service within the area is currently being developed.. Wyre Borough Council has also prepared a local flood warning plan which details the Council's arrangements, and identifies the responsibilities and the actions to be taken by the

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Council, in responding to a flood warning issued by the Environment Agency or to local conditions regardless whether a warning is issued. The plan forms part of the wider Multi Agency Flood Plan (MAFP) for Lancashire in the area and has assisted the council with the preparation of our Major Incident Plan, which includes actions to take during a major flood.

- 2.3.7 On-going public consultation is conducted through a variety of methods to raise awareness of flood risk and management practices. The Wyre Flood Forum is one such method that encourages community resilience through the identification of flood management issues together with education and capacity building within the local communities of Wyre.

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3 Problem definition and objectives

3.1 Outline of the problem

- 3.1.1 The urban catchment area of Wyre consisting of the towns of Fleetwood, Thornton Cleveleys and Poulton are low lying and susceptible to flooding from the sea, estuary, watercourses and surface water. The majority of the land would, without defences, have a 1 in 2 to 1 in 3 (40%) chance of flooding in any year and so relies heavily on the coastal and estuary defences to prevent inundation. The topography of the area is flat and therefore the land drainage system relies upon flood assist pumping stations in order to discharge flood water and surface water effectively from the urban area.
- 3.1.2 There are 1,100 properties at risk from surface water flooding. These properties are at risk during heavy rainfall when the drainage systems are overwhelmed and unable to outfall into the watercourse system. A number of small pumping stations have been constructed to help deal with these capacity issues but during several incidents, there has been several pump failures.
- 3.1.3 The Stanah pumping station was constructed in the early 1970s to relieve significant flooding in the Thornton Cleveley's area. This Archimedes' screw pumping station has reached the end of its design life and is in need of urgent refurbishment/replacement.
- 3.1.4 The highest impact flooding is from tidal sources, with over 28,500 properties lying within the flood plain, Flood Zone 3. Flood risk management for the tidal risk is undertaken by Wyre's Engineering Service Unit.
- 3.1.5 The current level of defence maintenance and inspection expenditure is significant due to the age and exposure of the defences, particularly on the western facing frontages, which show a year on year deterioration in condition. Between 2006 and 2009 a scheme was undertaken to improve what was then the worst section of seawall at Cleveleys. The most exposed section, Rossall North, requires significant emergency repairs, undertaken from within the annual maintenance budget on a regular basis, following damage to the existing aprons.

3.2 Consequences of doing nothing

Strategy Frontages

- 3.2.1 The strategy coastal and estuary frontages have been divided into six sub-units, as shown on Key Plan 1, with each defined by its physical characteristics, existing coastal defences and assets protected. These sub-units reflect the SMP2 policy units with minor boundary changes to better represent catchment sub divisions and scheme lengths. The internal flood risk from fluvial and surface water sources is categorised by the watercourses' three discharge locations into a further three sub-units. The table below summarises for each sub-unit the condition, residual life and standard of protection provided by the defences, together with the numbers of properties protected.

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Sub-Unit 0, Anchorsholme existing defences			
Photo		Condition and Performance	
	Condition	RL (Yrs)	No. of props protected
	Very poor	<5	3,393
	Sub-unit length (km)	Yr 0 SoP (AEP)	Yr 50 SoP (AEP)
	0.38	<4%	100%
Comments			
Existing defences in poor condition, with evidence of apron failure and undermining of the defences. Defences regularly overtop resulting in closure of the promenade road. Repair/capital works required to secure long term protection to the 3,393 properties at risk of flooding within this sub unit. These defences are adjacent to the Anchorsholme frontage in the Blackpool Strategy. Works on these defences would be planned and undertaken concurrently to reduce disruption and save money.			
Sub-Unit 1, Cleveleys			
Photo		Condition and Performance	
	Condition	RL (Yrs)	No. of props protected
	Good	50	5,052
	Sub-unit length (km)	Yr 0 SoP (AEP)	Yr 50 SoP (AEP)
	1.04	>0.5%	0.5%
Comments			
Hard defences recently replaced with new seawall/revetment system with 50 year design life. Beach levels low, however, and beach management improvements are required to secure the design beach levels for the new structures. Beach management needs to be addressed for the open coast frontage as a whole to ensure most appropriate methods adopted throughout.			
Sub-Unit 2, Rossall South			
Photo		Condition and Performance	
	Condition	RL (Yrs)	No. of props protected
	Poor - Fair	15-20	3,015
	Sub-unit length (km)	Yr 0 SoP (AEP)	Yr 50 SoP (AEP)
	1.74	1.33%	2%
Comments			
Existing hard defences are in a fair condition but showing some signs of wear and tear commensurate with their 1920's construction date. A failing timber groyne was recently successfully replaced with a rock groyne but further beach management works are required in the short/medium term to assist in maintaining healthy beach levels.			

Sub-Unit 3, Rossall North existing defences			
Photo		Condition and Performance	
	Condition	RL (Yrs)	No. of props protected
	Very Poor	<10	7,497
	Sub-unit length (km)	Yr 0 SoP (AEP)	Yr 50 SoP (AEP)
	1.91	0.5%	2%
Comments			
Condition of defences very poor with high risk of failure. Beach levels low causing undermining exacerbating condition problems. Immediate works required to provide ongoing long term flood protection with high number of properties at risk of flooding in the event of breach formation.			
Sub-Unit 4, Fleetwood North existing defences			
Photo		Condition and Performance	
	Condition	RL (Yrs)	No. of props protected
	Fair-poor*	10-15**	1,042
	Sub-unit length (km)	Yr 0 SoP (AEP)	Yr 50 SoP (AEP)
	4.75	0.5% (1.3%)	2%
Comments			
Localised issues require management but no wholesale improvement works are required in the short or medium term. Adoption of appropriate beach management plan for the whole frontage essential in maintaining current defence standards along this frontage. * Although the hard defences are considered to be in a fair-poor condition, the high beach levels continue to provide good protection to the structures and a high standard of flood defence ** Residual life would be extended with continued/improved beach management.			
Sub-Unit 5, Outer Estuary existing defences			
Photo		Condition and Performance	
	Condition	RL (Yrs)	No. of props protected
	Fair - good	15 - 30	450
	Sub-unit length (km)	Yr 0 SoP (AEP)	Yr 50 SoP (AEP)
	3.3	>0.5%	0.5%
Comments			
Defences are generally in a good condition and majority of residential properties located on high ground that are not at risk of flooding. Adoption of thorough maintenance programme most likely to be preferred approach to provide continued security against tidal inundation and erosion.			

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Sub-Unit 6, Middle Estuary existing defences				
Photo	Condition and Performance			
	Condition	RL (Yrs)	No. of props protected	
		Fair - good	15 - 30	4,622
		Sub-unit length (km)	Sop Yr 0 (AEP)	SoP Yr 50 (AEP)
3.3		>0.5%	0.5%	
Comments				
<p>Defences are generally in a good condition; the section from Stanah to NPL site has recently been improved by the Environment Agency. The defences protect significant numbers of low lying properties which are some of the lowest lying in the borough behind the new Stanah embankment, including a major sub station. The area north of the new embankment will require improvement works to the revetment on safety grounds; this work is the responsibility of NPL estates. Adoption of thorough maintenance programme most likely to be the preferred approach to provide continued protection against tidal inundation.</p>				
Sub-Unit 7, Royles Brook and Hillylaid Watercourse				
Photo	Condition and Performance			
	Condition	RL (Yrs)	No. of props protected	
		Poor	<5	3,118
		Sub-unit length (km)	Sop Yr 0 (AEP)	SoP Yr 50 (AEP)
3.3		<1%	2%	
Comments				
<p>Defences have failed in a number of areas and require urgent works if the channel is not to be significantly reduced in capacity. The system discharges under gravity at low tide with an Archimedes screw pumping station assist discharge at high flow or high water. The station has recently been improved to extend its life to 10-20 years. Significant problems exist in the upstream reaches where discharge of water is problematic due to the poor hydrological gradients. Additional alternative discharge at the downstream end in partnership with United Utilities through the sea wall should be considered as a long term option. In the first five years maintaining the design capacity of the system should be the priority.</p>				

Sub-Unit 8, Springfield Watercourse				
Photo	Condition and Performance			
	Condition	RL (Yrs)	No. of props protected	
		Poor - Fair	<10	73
		Sub-unit length (km)	Sop Yr 0 (AEP)	SoP Yr 50 (AEP)
3.1km		>10%	<100%	
Comments				
<p>The Springfield watercourse is a wholly pumped system at Calagran caravan park. The caravan park accommodates circa 3,000 people, both residents and visitors throughout the year. The system is pumped through a rising main to the estuary. This is both unsustainable due to a high carbon footprint and lack of capacity during periods of heavy rainfall which have seen the caravan site inundated with over £1.5million of damage suffered in recent years. The re-routing of flows to gravity systems together with greater storage in the existing system are likely to be the preferred approach.</p>				
Sub-Unit 9, Cope Brook Watercourse				
Photo	Condition and Performance			
	Condition	RL (Yrs)	No. of props protected	
		Poor - Fair	10 - 15	504
		Sub-unit length (km)	Sop Yr 0 (AEP)	SoP Yr 50 (AEP)
6.7		>1.3%	1.3%	
Comments				
<p>Copse Brook drains surface water from much of the Fleetwood area. It is culverted for much of its length with recent works concentrating on the de-silting and surveying of the downstream lengths of culvert. The open section of the drain has collapsed and needs urgent investment to re-establish the channel and to improve trash screen access.</p>				

Do Nothing Scenario

- 3.2.2 The do nothing option provides the baseline against which all do something options can be evaluated. Where defences currently exist the do nothing option would involve stopping all activities and actions on the foreshore including all maintenance activities and repairs of structures, allowing nature to take its course. Within this option minimal

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essential work on health and safety grounds may be necessary to make abandoned structures safe.

- 3.2.3 The consequences of doing nothing would leave the main urban area of Wyre including the towns of Poulton, Thornton Cleveleys and Fleetwood unsustainable due to frequent flooding to properties and significant damage to infrastructure. It would be uneconomical to support the main industries and significant pollution would occur to the beaches and sea around the coast including the bathing beaches and environmentally designated areas around Fleetwood. Flooding from the urban watercourses would occur on a regular basis, which together with surface water flooding would cause significant disruption to daily living.
- 3.2.4 In total, 23,800 households are at risk of flooding in a 0.5% AEP (1 in 200 years) event, increasing to 28,766 by 2112 with the predicted effects of climate change. Some 1,200 non residential properties are also at risk by 2112. Critical infrastructure within the floodplain includes Fleetwood Hospital, United Utilities infrastructure, Blackpool and Fleetwood Tramway, a fire station, ambulance station and a lifeboat station. There are a number of care homes also present within the floodplain.
- 3.2.5 Defence structures have been assessed to determine future life expectancy (residual life) should the do nothing option be adopted, see Table 3.1. This assessment is based on the existing structural condition and anticipated changes to the geographical setting, together with the physical processes acting on the structures. This includes the potential for falling beach levels, loss of saltmarsh, bank erosion or changes in channel or current directions.

3.3 Strategic issues

- 3.3.1 The properties within the flood catchment considered within this strategy are at risk from a variety of flood sources. In addition, failure of any section of the coastal defences or estuary defences could allow a route for coastal flood waters to enter the catchment, eventually flooding all properties at risk for the whole strategy area under a long-term do nothing scenario. A key reason for developing this strategy was to ensure a holistic approach to managing flood risk for the whole strategy area, which is essentially one large flood cell for extreme tidal events.
- 3.3.2 Identifying properties flooded for individual lengths of defence in isolation could lead to an over estimation of damages in the Do-Nothing case. In order to prevent any double counting the whole catchment has been split into nine sub compartments, representing six coastal lengths (the flood compartment being derived from the approximate flooding extents of a single breach within the length on three tide cycles for a 1 in 1,000 year event) and three fluvial areas derived from fluvial modelling of the three Main River outfalls. Breach locations were determined by historical events and defence condition and fluvial events based on asset failure scenarios. Although this represents a simplification of the actual situation (where properties are at risk from combined fluvial, tidal and surface water flooding) it has been accepted in previous strategies and scheme submissions that this approach represents an equitable method of apportioning flood risk throughout the catchment. Key Plan 1 shows how the sub-units have been derived.
- 3.3.3 The hydraulic modelling undertaken during the strategy development did not take into account surface water flooding. However, properties have been identified at risk from surface water flooding from the Environment Agency surface water flood maps. Where there is an overlap with fluvial or tidal flooding, double counting has been avoided by deducting the properties from the fluvial flood count.

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- 3.3.4 By taking a strategic approach a key objective of reducing risk to property and life based on priority and outcomes can be achieved through a phased implementation of schemes. This allows optimum use of available monies, whilst providing a realistic timetable for implementation.
- 3.3.5 Long term uncertainties, including climate change, population growth and demographics were considered within the strategic context. This allowed sensitivity testing to be undertaken to ensure the robustness of the economic case and a long term view on the options proposed.
- 3.3.6 The strategy implementation plan needs to allow for working with partners such as United Utilities (UU) and Lancashire County Council (LCC) (Lead Flood Authority) to manage the wider water issues through the Fylde Peninsular Water Management Group (FPWMG). This takes into account: surface water flooding; surcharge of the sewer network; ground water flooding; water storage and management; use of Sustainable Urban Drainage and; water quality issues. The Strategy has been developed alongside the Lancashire Flood Risk Assessment and has taken account of flood risks identified within this document. As an outcome of the Strategy, LCC, Wyre Council, EA and UU are working together on the Wyre Surface Water Management Plan as a key driver for partnership working.

3.4 Key constraints

Legal constraints

- 3.4.1 The majority of the coastal frontage is in the ownership of Wyre Borough Council with the exception of a 300m length which is owned by Rossall School. The council maintains this length at present but it is anticipated that legal agreements will be required when capital works are proposed in the second epoch along this length. Rossall School have been engaged in the preparation of this strategy.
- 3.4.2 Along the estuary lengths, legal agreements will be put in place with key landowners including ABP and NPL estates for the future management of the defences. This approach has been incorporated into the planning agreement for the NPL Area Action Plan and it is expected that future development will be dependent on agreements for maintenance and management of the estuary defences being in place.

Planning and development constraints

- 3.4.3 The Core Strategy for Wyre is currently being prepared. Pertinent planning and development constraints that have been taken into account in the development of this strategy include the Core Strategy's vision for Wyre in 2028. A fundamental requirement of the vision is that the River Wyre and the coast will continue to be well managed to guard against flooding. With this in place, the key aspects of the vision are that:
- The borough's main settlements of Fleetwood, Thornton, Cleveleys, Poulton-le-Fylde and the Garstang/Catterall corridor are the focus for the majority of development activity.
 - By 2028, Fleetwood will be regenerated by reconnecting a transformed seafront with the rest of the town centre. The Fleetwood-Thornton corridor will be regenerated to form a vibrant, attractive and accessible mixed use community where people live, work and undertake recreation. Hillhouse will remain a quality location for business investment and an important economic driver within the sub-region.

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- The momentum gained at Cleveleys through the regeneration of the seafront and promenade over the last five years will be sustained. An attractive seafront link to Fleetwood will be developed with modern tourist and visitor infrastructure.
- The deprived areas in Cleveleys, Fleetwood and Thornton will, by 2028, have experienced significant social, economic and physical improvement.

3.4.4 The Core Strategy also identifies key objectives which have been taken into account within this strategy, the most relevant being: Adapt to and Mitigate Against Climate Change and Flooding. This objective will be achieved through the following priority outcomes:

- Reducing Wyre’s carbon footprint through the promotion of a sustainable pattern of development.
- Identifying areas of the borough that are anticipated to be affected significantly by coastal change and ensuring that appropriate mechanisms to manage that change are developed through partnership.
- Ensuring that the risk from coastal, fluvial and localised flooding is minimised when locating new development and if development is required in areas at risk that risk is mitigated.
- Improving flood defences in Wyre in areas where people and property are already at risk from flooding or are likely to be in the future, in accordance with the council’s adopted Flood and Coastal Defence Strategy Plan and Land Drainage Strategy or successors.
- Managing surface water run off through the incorporation of sustainable drainage systems (SuDS) within new developments and conserving permeable surfaces.
- Minimising the urban heat island effect by including street trees and other landscaping and minimising exposed hard surfaces in new developments.

3.4.5 The Infrastructure Delivery Plan (IDP) forms part of the Core Strategy it seeks to establish what additional infrastructure and service needs are required to support the projected population growth and planned increase in new homes and jobs in the District to 2028. It identifies the need for new sea and flood defences to reduce the risk of flooding to communities, property, infrastructure and the natural environment. The IDP is consistent with this strategy as it identifies schemes at Rossall, Hillylaid Pool/Royles Brook /Springfield/ Copse Brook inland watercourse improvements and Jubilee Gardens to Rossall Hospital as key requirements.

Environmental constraints

3.4.6 We have undertaken a Strategic Environmental Assessment (SEA) in accordance with EC Directive 2001/42/EC on the Assessment of the Effects of Certain Plans and Programmes on the Environment (the SEA Directive). This process is documented in the SEA Environmental Report (Appendix C).

3.4.7 The strategy area is adjacent to several International, European and National designated sites, see Key Plan 2, and a key constraint for the strategy is the avoidance of potential impacts on the distinctive inter-tidal habitats of Morecambe Bay and the Wyre Estuary which support internationally important numbers of birds.

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3.4.8 We have identified the following strategies and plans that are relevant to the key constraints (further details are included in Appendix C Strategic Environmental Assessment):

- UK Biodiversity Action Plan (BAP), Lancashire BAP
- County Biological Heritage Sites

3.5 Objectives

3.5.1 The overall objective of the strategy is to produce a plan of sustainable, technically sound, environmentally acceptable and economically viable flood and erosion risk management for the study area, minimising the impacts on designated nature conservation sites and identifying opportunities for biodiversity enhancement.

3.5.2 The objectives of the strategy are closely linked to the objectives developed through the Strategic Environmental Appraisal (SEA) process, see Appendix C. In the SEA a number of objectives were developed to apply to each of the coastal, estuary and fluvial units. These were progressed from the SMP2 objectives, via General SEA objectives to more specific objectives for the units. The summary strategic objectives are to ensure that the preferred solution:

- Provides a better quality of life for those who live in and visit the area by the provision of improved flood risk management.
- Provides an economically justifiable solution for flood and erosion risk management.
- Is compatible with adjacent shoreline frontages and the natural processes present.
- Maintains and where possible enhances the natural environment and diverse habitats surrounding the study area through the implementation of an appropriate habitat management programme.
- Limits and adapts to the impacts of climate change.
- Makes wiser use of natural resources in the construction and maintenance of sea defences.
- Provides continued protection to the built environment and heritage interests within the study area.
- Supports existing economic interests and allows opportunity for further economic development through on-going and improved provision of flood defence.

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4 Options for managing flood risk

4.1 Potential FCRM measures

4.1.1 The potential FCERM measures for the Strategy included all of the available ‘high level’ options:

- Do Nothing – no further works to defences, except those required to address health and safety risks from deteriorating structures. Flood risk increases over time as a result of worsening defence condition and climate change effects. This option would not meet the strategic objectives but is included as a baseline to measure the benefits of do something options.
- Maintain – maintain the existing defences in their current form/level with no mitigation for climate change effects, so the flood risk will increase over time.
- Sustain – sustain the standard of protection, including mitigation for climate change.
- Improve – improve the standard of protection, including mitigation for climate change, with a range of standards of protection between 1.33% Annual Exceedence Probability (AEP) (1 in 75 years) to 0.2% AEP (1 in 500 years).

4.2 Long list of options

4.2.1 A long list of options considered technically suitable for providing continued and improved flood and erosion risk management for the study area was drawn up through internal workshops. Each of the long list of options was assessed by a multi-disciplinary panel of professionals (made up of consultants, client and contractor representatives) in order to identify those options to be taken forward for more rigorous assessment. The process of selecting appropriate long list options and evaluating them is fully detailed in Annex E.

4.2.2 Tables 4-1 to 4-3 presents the long list options considered for the coastal and estuary frontages and for the watercourses. Note that the “Maintain” option is considered as a do-minimum option. Not all options were considered appropriate for each frontage: a blue box indicates that it was considered potentially appropriate, a crossed box that it was not. Those taken forward to the short list appraisal are identified by a tick (✓). Reasons for rejection at this stage are provided in the tables.

4.2.3 It is recognised that appropriate methods of beach management should be considered for the coastal frontage as a whole rather than on a sub-unit basis. A beach management plan (Appendix D) is therefore being developed alongside the development of frontage specific defence options in order to make suitable recommendations for implementation of any changes/improvements to beach management and beach control structures.

4.2.4 A coastal processes report has been produced and is included in Appendix G. A beach modelling report has been produced which includes modelling undertaken to understand sediment pathways and baseline conditions and impacts of the proposed beach control structures. The shortlisted options do not pose any negative environmental impacts north or south of the coastal processes cell.

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Coastal Frontages

Table 4-1 Long list options for coastal frontages

No.	Option Description	Sub Unit					Reasons for rejection at long list stage
		0	1	2	3	4	
	Maintain (Hold the line options)						
M1	Reactive emergency repairs to structures upon failure						Not considered sustainable as a strategic approach beyond the short-term, but included within other options to deal with repairs following large flood events.
M2	Concrete repairs to promenade, seawall and revetments	✓	✓	✓	✓	✓	
M3	Concrete repairs to promenade, seawall and revetments. Repair existing groynes	✗	✓	✓	✓	✓	S0 does not have existing groynes.
M4	Concrete repairs to promenade, seawall and revetments. Beach management	✓	✗	✗	✗	✗	SU0 to SU4 requires groynes for beach management.
M5	Concrete repairs to promenade seawall and revetments, repair existing groynes and beach management	✗	✓	✓	✓	✓	S0 does not have existing groynes.
M6	Improve and reinforce dune systems in combination with reduced maintenance of hard defence structures	✗	✗	✗	✗	✓	Dune system only present in SU4.
	Sustain & Improve (Hold the line options)						
SI1	Concrete repairs to promenade, seawall and revetments with beach management and improvements to existing groyne field					✓	SU0 to SU3 would require increases to defence levels or additional beach recharge to make this option effective in the face of predicted climate change – see SI3 and SI4.
SI2	Concrete repairs to promenade, seawall and revetments with beach management and construction of new more efficient groyne field					✓	SU0 to SU3 would require increases to defence levels or additional beach recharge to make this option effective in the face of predicted climate change – see SI3 and SI4.
SI3	Concrete repairs to promenade, seawall and revetments with beach management and additional beach recharge with improvements to existing groyne field	✓	✓	✓	✓		SU4 has sufficient sediment supply without requiring additional material.
SI4	Concrete repairs to promenade, seawall and revetments with beach management and additional beach recharge and construction of new more efficient groyne field	✓	✓	✓	✓		SU4 has sufficient sediment supply without requiring additional material.

No.	Option Description	Sub Unit					Reasons for rejection at long list stage
		0	1	2	3	4	
SI5	Concrete repairs to promenade, seawall and revetments with beach management and additional beach recharge and construction of new nearshore breakwater						High capital cost and uncertain performance compared to shore connected groyne systems. SU4 has sufficient sediment supply without requiring additional material.
SI6	Concrete repairs to promenade, seawall and revetments with beach management and additional beach recharge and construction of new fishtail groyne		✓			✓	SU0, SU2, SU3 – downdrift effects from fishtail groynes would affect other frontages. (SU0 & SU4 – downdrift effects considered less of an issue/manageable).
SI7	Concrete repairs to promenade, seawall and revetments with beach management and additional beach recharge construction of headland groyne field						SU0-SU3 - downdrift effects from headland groynes would affect other frontages. SU4 has sufficient sediment supply without requiring additional material.
SI8	Combined rock (lower) & stepped concrete (upper) revetment with upper level promenade & set back flood wall			✓	✓		SU0, SU1, SU4 – rock rejected as it would compromise beach access, considered imperative for these amenity frontages.
SI9	Rock revetment with re-curved wave wall, intermediate wall and split level promenade and set back flood wall			✓	✓		SU0, SU1, SU4 – rock rejected as it would compromise beach access, considered imperative for these amenity frontages.
SI10	Seabee revetment with re-curved wave wall, intermediate wall and split level promenade and set back flood wall			✓	✓		SU0, SU1, SU4 – Seabee units would compromise beach access, considered imperative for these amenity frontages.
SI11	Stepped concrete revetment with re-curved wave wall, intermediate wall and split level promenade and set back floodwall	✓	✓			✓	SU2, SU3 – beach access less critical so rock (SI9, SI10) which have technical and cost advantages would be acceptable.
SI12	Sloped concrete revetment and re-curved wave wall, intermediate wall and split level promenade and set back floodwall	✓	✓			✓	SU2, SU3 – beach access less critical so rock (SI9, SI10) which have technical and cost advantages would be acceptable.
SI13	Combined sloped (lower) & stepped concrete (upper) revetment with spilt level promenade & set back flood wall	✓				✓	SU2, SU3 – beach access less critical so rock (SI9, SI10) which have technical and cost advantages would be acceptable.
SI14	Combined approach 1 – selection of most appropriate beach management option (Options SI1 – SI7) with most appropriate hard defence improvement option (Options SI 8 – SI13)	✓	✓	✓	✓	✓	
SI15	Combined approach 2 – Selection of most appropriate hard defence improvement option (options SI8 – SI13) and enhance, reinforce and improve existing dune systems	X	X	X	X	✓	SU0 to SU3 have a long term trend of beach lowering; hard defences are not sustainable without beach management.

No.	Option Description	Sub Unit					Reasons for rejection at long list stage
		0	1	2	3	4	
SI16	Managed Realignment						Hinterland too densely populated/developed to facilitate managed realignment without significant impacts on built assets.
SI17	Offshore Barrages/ Tidal Lagoons						Significant uncertainty over viability, limited benefits to coastal defences

4.2.5 The options report appraises each of the options listed in Table 4.1 separately. However, many of the options listed above are quite detailed rather than strategic and their comparison is not required at this stage of appraisal. So in order to keep the appraisal summary in the StAR succinct, similar options have been grouped together for the short list. These include: M2 and M3, M4 and M5, S/11 and S/12, S/13 to SI6, SI9 and SI10, SI11 to SI13.

Estuary Frontages

Table 4-2 Long list options for estuary frontages

No.	Option Description	Sub Unit		Reasons for rejection at long list stage
		5	6	
	Maintain (Hold the line options)			
M1	Reactive emergency repairs to structures upon failure			Not considered sustainable as a strategic approach beyond the short-term, but included within other options to deal with repairs following large flood events
M7	Localised reinforcement and improvement of saltmarsh			This option on its own is insufficient to maintain the existing flood defence standard. Routine repairs are required to maintain the embankment's condition and once deteriorated, embankment reconstruction will be needed.
M8	Develop maintenance regime with ABP & NPL which involves maintenance to existing earth embankments and revetments	✓	✓	
	Sustain & Improve (Hold the line options)			
SI16	Localised reinforcement and improvement of saltmarsh in combination with improvements to existing earth embankments	✓	✓	
SI17	Enhance and raise existing earth embankments (no work to revetments)	✓	✓	

No.	Option Description	Sub Unit		Reasons for rejection at long list stage
		5	6	
SI18	Enhance and raise existing earth embankments and revetments	✓	✓	
SI19	Reinstate river control structures (copper-tailed groyne)		✗	Likely to exacerbate erosion of far riverbank.
SI20	Managed Realignment			Hinterland too densely populated/developed to facilitate managed realignment without significant impacts on built assets.
SI21	Offshore Barrages/ Tidal Lagoons			Significant uncertainty over viability, limited benefits to estuary defences

Watercourses

Table 4-3 Long list options for watercourses

No.	Option Description	Sub Unit			Reasons for rejection at long list stage
		7	8	9	
	Maintain (Hold the line options)				
M9	General maintenance improvements to existing watercourses and pumping stations	✓	✓	✓	
	Sustain & Improve (Hold the line options)				
SI20	Maintain and improve watercourses and pumping stations and improve watercourse capacity by dredging the channel				Insufficient space to dredge the channel to a suitable depth that will increase the capacity enough to reduce flood risk. Environmental impacts associated with regular dredging.
SI21	Maintain and improve watercourses and pumping stations and improve watercourse capacity by engineering the channel	✓		✓	Rejected for SU8 as costs far exceed potential benefit.
SI22	Improve the hydraulic efficiency of the watercourses by improving online pumping capacities	✓			Rejected for SU8 as anticipated performance is inferior to SI26. Rejected for SU9 as existing weaknesses in the fluvial system will undermine any benefits from improved pumping capacities.
SI23	Maintain and improve watercourses and pumping stations and construct new flood water storage ponds	✓	✓	✓	
SI24	Maintain and improve watercourses and pumping stations and	✓	✓		Rejected for SU9 due to area being heavily urbanised limiting

No.	Option Description	Sub Unit			Reasons for rejection at long list stage
		7	8	9	
	redirect flow to safer areas				opportunities to redirect flow.
SI25	Maintain and improve watercourses and pumping stations and open up culverts			✓	Rejected for SU7 due to proximity of housing limiting opportunities to open up culverts.
SI26	Maintain and improve watercourses and pumping stations and redirect flows to gravity outfall systems		✓		Not suitable for SU7 and SU9 as gravity flow is insufficient.
SI27	Maintain and improve watercourses and pumping stations and outfall efficiency	✓	✓	✓	

4.3 Options rejected at preliminary stage

- 4.3.1 Tables 4-1 to 4-3 summaries the reasons for rejection of some options at the long list stage. In those sub units where the defences have reached the end of their design life, options focussed solely on beach management have been ruled out. This is because, in these circumstances, beach management can help to optimise the maintenance requirements alongside defence replacement but will not be able to maintain the defence standard on its own. Full details are available in Appendix E Options Assessment Report.
- 4.3.2 The Strategy findings concluded that the defences in SU0 and SU3 are at the end of their design life and require replacement. This work is required regardless of beach management.

4.4 Options shortlisted for appraisal

- 4.4.1 The shortlisted options below have been appraised alongside the Do Nothing option, in which no further works would be undertaken and the existing defences would deteriorate over time, resulting in failure. The Do Nothing option provides the baseline for the economic appraisal.
- 4.4.2 The relative cost of options was also taken into consideration within the appraisal, alongside environmental, technical and sustainability issues. This is summarised for each sub unit in Section 5.5 of this report.

Approach to Climate Change

- 4.4.3 Flood propagation modelling has been undertaken by Civil Engineering Solutions Ltd (CES) in order to identify the risk of flooding to the hinterland (see separate report in strategy Appendix J). The inundation modelling outputs have been used to predict the likely flood extent and associated flood water depths for a series of extreme wave overtopping and water level events.
- 4.4.4 In the coastal modelling undertaken, sea level rise allowances were calculated using the 2006 guidance and then adjusted to take account of the 2011 guidance change factors. Sea level rise has been catered for within the modelling with allowances for sea level rise in years 0, 5, 8, 25, 50 and 99 using latest EA predictions. Climate change is discussed in the Economics Report.
- 4.4.5 The fluvial modelling uses the 2006 climate change guidance but the results have been compared against the 2011 guidance which has been used in the PAR modelling and provides a good comparison.
- 4.4.6 Sediment transport is highly dependent on wave height and storm direction. At the Cleveleys to Rossall frontage there is a very strong northerly transport so it is unlikely to be very sensitive to climate change. Work was done in the CETaSS study to support the SMP2 by modelling sediment transport under both sea level rise and surges and found increased sediment transport into Morecambe Bay for both.
- 4.4.7 So it is likely that climate change will just make the existing problems of beach lowering a bit worse, not fundamentally change the issues. The flexible nature of beach management solutions, whereby quantities of recharge can be varied to suit actual situation and the rock groynes can be reconfigured, so the adopted approach is considered appropriate.

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4.4.8 The strategic options have been developed for the 100 year appraisal period, with a staged precautionary approach to the predicted effects of climate change incorporated into the Sustain and Improve options. Working on a serviceable lifespan of 50 years for the majority of defence types, the initial capital works cost estimates assume defences will be designed to accommodate the first 50 years of sea level rise in accordance with the recommended change factor. At the end of the 50 year life, interventions are planned to rehabilitate/refurbish the defences to extend their lives to the next 50 years. Again, cost estimates include an allowance for sea level rise in the second phase of the works.

4.4.9 This approach results in the initial standard of protection afforded being greater than the design standard; the standard of protection falls towards the design standard over time. As there is a greater degree of confidence in the climate change predictions over the next 30 to 50 years (compared to longer term predictions) this offers the opportunity for the works for the second 50 years to be tailored to suit more up to date predictions available at that time. Regular reviews of the strategy (every ten years or so) will allow a forward look to the variation of new climate change predictions, allowing intervention to accommodate significant changes in predictions to be accelerated or delayed as necessary.

Coastal Frontages

4.4.10 The options shortlisted for each of the coastal sub units are presented in Table 4-5. The majority of the options feature engineering works to repair/reinforce or replace the existing defence structures along the coastline, sometimes in combination with beach control structures and beach management.

4.4.11 The Maintain options (M2 to M6) feature repair works to the existing structures, aiming at extending their useful life and maintaining their current form and level. There will be no reduction to flood risk; indeed, this will increase over time in response to the predicted effects of climate change.

4.4.12 The Sustain and Improve Options seek to maintain/reduce the risk of overtopping and breaching of the defences, thereby maintaining/reducing the risk of flooding to the people, property and infrastructure in the hinterland. In addition to direct benefits such as reduced property damage, there is also a reduced risk of loss of life to those living in the floodplain. A further benefit includes improvements to the amenity value of the frontages achieved by replacing poor condition structures with more visually appealing, good condition defence structures. The amenity value can be further enhanced by landscaping along sections of the frontage, linked to the defence improvements.

Table 4-4 Shortlisted options – Coastal Frontages

Option No	Option description & PV cost* for each shortlisted sub unit					Summary details
M2 M3	Repairs to existing hard assets (revetment, promenade seawalls) and groyne (where present)					<ul style="list-style-type: none"> Proactive repairs to existing hard structures Frequency and cost of repairs increase over time due to ageing assets and climate change effects. Repairs to groyne will increase efficiency in trapping sediment leading to some increase in beach levels. Residual life of defences is extended and breach risk is reduced delaying onset of DN
	SU0	SU1	SU2	SU3	SU4	
PVc £m	4.8	6.6 - 9.3	20.5 - 22.7	62.9 - 85.8	9.9 - 10.7	

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Option No	Option description & PV cost* for each shortlisted sub unit					Summary details
						<ul style="list-style-type: none"> damages to Year 20. SoP falls over time.
M4 M5	Repairs to existing hard assets (revetment, promenade seawalls, groynes) <u>and</u> beach management					<ul style="list-style-type: none"> As M2/M3 plus: Proactive beach management (recycling of sediment etc) reduces wave impact on hard structures, with some reduction in maintenance effort. SoP falls over time.
	SU0	SU1	SU2	SU3	SU4	
	PVc £m	7.3	7.9	20.1	52.0	
M6	Improve and reinforce dune systems in combination with reduced maintenance of hard defence structures					<ul style="list-style-type: none"> Dunes are reinforced with appropriate measures (sand fencing, marram grass, improved pedestrian management). Improved dune conditions reduce the maintenance on the hard defences to the rear. Only suitable over part of the frontage, to be considered in combination with other options. SoP falls over time.
	SU0	SU1	SU2	SU3	SU4	
	PVc £m					
S/11 S/12	Concrete repairs to promenade, seawall and revetments with beach management and improvements to groyne field					<ul style="list-style-type: none"> Proactive repairs to existing hard structures in conjunction with beach management. Improvements to existing groyne field or construction of new more efficient groynes improves the retention of sediment leading to increased beach levels. SoP sustained or improved.
	SU0	SU1	SU2	SU3	SU4	
	PVc £m					
S/13 S/14 S/16	Phased significant concrete repairs to promenade seawall and revetments with beach management and improvement to groyne field <u>plus</u> additional beach recharge					<ul style="list-style-type: none"> As S11/S12 plus: Additional beach recharge increases currently denuded beaches. Improvements to existing groyne field or construction of new more efficient groynes improves the retention of sediment leading to increased beach levels. SoP sustained or improved.
	SU0	SU1	SU2	SU3	SU4	
	PVc £m	19.7	17.3	36.0	105.6	
S/18	Combined rock (lower) & stepped concrete (upper) revetment with upper level promenade & set back flood wall					<ul style="list-style-type: none"> Construction of new defence over existing hard defences. Lower rock revetment dissipates wave energy on the structure, reducing overtopping and beach scour. Upper stepped revetment with promenade allows pedestrian access along the frontage, steps through lower rock allows access to beach. Set back flood wall restricts landward flow of overtopping water. SoP sustained or improved.
	SU0	SU1	SU2	SU3	SU4	
	PVc £m			54.0	98.9	
S/19 S/110	Lower amenity value revetments (rock or Seabee) with re-curved wave wall, intermediate wall, split level promenade and set back flood wall					<ul style="list-style-type: none"> Construction of new defence over existing hard defences. Rock/Seabees dissipates wave energy on the structure reducing beach scour and overtopping. Recurved wave wall improves overtopping performance.
	SU0	SU1	SU2	SU3	SU4	

Option No	Option description & PV cost* for each shortlisted sub unit					Summary details
PVc £m			40.3	112.0		<ul style="list-style-type: none"> Split level promenade allows pedestrian access along the frontage, steps through rock allows access to beach. Intermediate and set back flood walls restricts landward flow of overtopping water. SoP sustained or improved.
S/I11 S/I12 S/I13	High amenity value concrete revetments with re-curved wave wall, intermediate wall and split level promenade and set back flood wall					<ul style="list-style-type: none"> Construction of new defence over existing hard defences. Stepped/sloped concrete revetment provides defence against wave/tide action. Recurved wave wall improves overtopping performance. Split level promenade allows pedestrian access along the frontage, steps through rock allows access to beach. Set back flood walls restricts landward flow of overtopping water. SoP sustained or improved.
	SU0	SU1	SU2	SU3	SU4	
PVc £m	18.4 - 19.2	15.4			25.8- 38.9	
S/I14	Combined approach 1 – selection of most appropriate beach management option (Options S/I1 – S/I7) with most appropriate hard defence improvement option (Options S/I 8 – S/I13)					<i>SU0, SU1, SU4 – High amenity value concrete revetment plus beach management</i> <i>SU2, SU3- Lower amenity value hybrid concrete/rock revetment with beach management</i> <ul style="list-style-type: none"> SoP sustained or improved. Degree of expenditure on amenity access appropriate to current use of frontage
	SU0	SU1	SU2	SU3	SU4	
PVc £m	17.6	15.4	34.2	92.0	38.9	
S/I15	Combined approach 2 – Selection of most appropriate hard defence improvement option (options SI8 – SI13) and enhance, reinforce and improve existing dune systems					<i>SU4 - High amenity value concrete revetment plus beach management</i> <ul style="list-style-type: none"> SoP sustained or improved. Degree of expenditure on amenity access appropriate to current use of frontage
	SU0	SU1	SU2	SU3	SU4	
PVc £m					10.6	

*PVc is provided for the 0.5%AEP (1 in 200 year) standard of protection

Estuary Frontages

4.4.13 The options shortlisted for each of the estuary sub units are presented in Table 4-6. The options feature works to maintain or improve the existing embankment and revetment structures along the west bank of the Wyre Estuary. This will reduce the likelihood of breaching and reduce the occurrence/effects of overtopping of the defences. There are no risk to life benefits associated with the options for the estuary sub units.

Table 4-5 Short listed options – Estuary Frontages

Option No	Option description & PV cost* for each shortlisted sub unit	Summary details
M8	Develop maintenance regime with ABP & NPL which involves maintenance to existing earth embankments and	<ul style="list-style-type: none"> Work with other defence operators/owners in the estuary to develop and agree appropriate maintenance regime. SoP falls over time.

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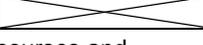
Option No	Option description & PV cost* for each shortlisted sub unit	Summary details
Pvc £m	revetments	
	SU5 SU6	
	2.1 1.3	
S16 PVc £m	Localised reinforcement and improvement of saltmarsh in combination with improvements to existing earth embankments	<ul style="list-style-type: none"> Localised reinforcement/improvements to the saltmarsh will help to reduce wave energy In the region. Raising and widening the existing earth embankments will improved flood defence performance. SoP is sustained over time or reduces.
	SU5 SU6	
	1.9 1.2	
Pvc £m	Enhance and raise existing earth embankments (no work to revetments)	<ul style="list-style-type: none"> Raising and widening the existing earth embankments will improved flood defence performance. Regular maintenance to combat scour will be required as the option doesn't feature work to existing revetments or inter-tidal area to reduce wave energy. SoP is sustained over time or reduces.
	SU5 SU6	
	2.4 1.8	
Pvc £m	Enhance and raise existing earth embankments and revetments	<ul style="list-style-type: none"> Raising and widening the existing earth embankments will improved flood defence performance. Work to existing revetments will provide continued scour protection to the embankments and reduce future maintenance requirements (compared to S17). SoP is sustained over time or reduces.
	SU5 SU6	
	3.1 2.8	

*Pvc is provided for the 0.5%AEP (1 in 200 year) standard of protection

Watercourses

4.4.14 The options shortlisted for each of the watercourse sub units are presented in Table 4-6. The majority of the options seek to manage flood risk by works to the existing channel, pumping stations and other drainage infrastructure.

Table 4-6 Short listed options – Watercourses

Option No	Option description & PV cost for each shortlisted sub unit	Summary details
Pvc £m	M9 General maintenance improvements to existing watercourses and pumping stations	<ul style="list-style-type: none"> General maintenance and improvements to watercourses and pumping stations. Burden of maintenance likely to increase over time. SoP falls over time.
	SU7 SU8 SU9	
	3.8 1.3 1.3	
Pvc £m	S/I21 Maintain and improve watercourses and pumping stations and improve watercourse capacity by engineering the channel	<ul style="list-style-type: none"> Engineering the channel will improve the ability to discharge water during storm events. SoP is sustained over time or improved.
	SU7 SU8 SU9	
	7.2  1.6	
Pvc £m	S/I22 Improve the hydraulic efficiency of the watercourses by improving online pumping capacities	<ul style="list-style-type: none"> Improving the pumping capacities will assist in draining the channel during storm events. SoP is sustained over time or improved
	SU7 SU8 SU9	
	6.9  	
S/I23	Maintain and improve watercourses and pumping stations and construct new flood	<ul style="list-style-type: none"> Engineering the channel will improve its ability to discharge water during storm events.

Option No	Option description & PV cost for each shortlisted sub unit			Summary details
PVc £m	water storage ponds			<ul style="list-style-type: none"> Improving pumping capacities will assist in draining the channel during storm events. New flood storage ponds will improve flood storage available during storm events. SoP is sustained over time or improved
	SU7	SU8	SU9	
	6.9	1.9	1.8	
S/124 PVc £m	Maintain and improve watercourses and pumping stations and redirect flow to safer areas			<ul style="list-style-type: none"> Engineering the channel will improve its ability to discharge water during storm events. Improving the pumping capacities will assist in draining the channel during storm events. Redirecting the flows away from populated/built up areas will reduce flood damages to properties. Areas exist within SU7 and SU8 for the collection of flood waters during events. SoP is sustained over time or improved
	SU7	SU8	SU9	
	6.9	1.9		
S/125 PVc £m	Maintain and improve watercourses and pumping stations and open up culverts			<ul style="list-style-type: none"> Engineering the channel will improve its ability to discharge water during storm events. Improving the pumping capacities will the channel will assist in draining the channel during storm events. Opening up culverts removes restrictions to flow during storm events. SoP is sustained over time or improved.
	SU7	SU8	SU9	
			1.9	
S/126 PVc £m	Maintain and improve watercourses and pumping stations and redirect flow to gravity outfall systems			<ul style="list-style-type: none"> Engineering the channel will improve its ability to discharge water during storm events. Improving the pumping capacities will assist in draining the channel during storm events. Within SU8 the provision of a new connection with Copse Brook will help to alleviate pressures on Springfield pumping station whilst providing a more efficient method of draining the catchment. SoP is sustained over time or improved
	SU7	SU8	SU9	
		1.7		
S/127 PVc £m	Maintain and improve watercourses and pumping stations and outfall efficiency			<ul style="list-style-type: none"> Engineering the channel will improve its ability to discharge water during storm events. Improving the pumping capacities will assist in draining the channel during storm events. SU7 – rectify the current capacity issues by replacement of failed piling, stabilisation of collapsed embankments at Kneps Farm and future replacement of Stanah Pumping Station and direction of flows at the upstream end. SU8 – construct 150m of new channel connecting the northerly outfall channel to the southerly section allowing more efficient discharge. SU9 – investigate the replacement of the complex outfall at Fleetwood harbour (currently difficult to maintain due to it confined space nature). SoP is sustained over time or improved
	SU7	SU8	SU9	
	6.7	1.9	1.9	

5 Options appraisal and comparison

5.1 Technical issues

- 5.1.1 The strategy development has been supported by a number of ongoing and previous studies on sediment movements, numerical and physical modelling and monitoring. This provides increased confidence that the complex natural systems are understood as much as possible, providing confidence in the prediction of the impact of the options considered. A list of key studies is provided in Appendix B.
- 5.1.2 Using these studies, the options have been developed to a conceptual design stage, with advice from the ECI Contractor, Birse Civils, on construction and buildability issues. The options have used the latest available information from the Coastal Flood Boundaries project (SC060064, Environment Agency, 2011) for design conditions, alongside an allowance for climate change from the Defra 2006 guidance.
- 5.1.3 All of the options considered feature conventional construction types, well tested and understood in the field of FCERM. The options seek to make best use of the existing assets, building on top of them to reduce breakout and waste where possible.

5.2 Environmental assessment

- 5.2.1 On the basis of the environmental baseline and the views expressed by consultees, environmental objectives were defined for the strategy frontages. These provided a basis for the evaluation of strategic options put forward. The inclusion of a particular objective does not mean that it will necessarily be met by the strategy; indeed a number of objectives conflict with each other.
- 5.2.2 Objectives have been formulated to take account of practical as well as legal constraints. Objectives are only put forward where an initial screening indicates that the types of actions required to meet them are likely to be technically feasible and environmentally sustainable, which as a minimum is taken to mean that:
- Interventions would have a reasonable chance of being successful over a fifty year timescale;
 - Interventions would not interfere with natural processes in such a way as to bring about loss or damage to other statutorily designated sites or other nationally important features;
 - There would not be a requirement for continued, excessive and increasing input of natural and financial resources.
- 5.2.3 The Strategic Environmental Assessment (Appendix C) considers the options as detailed in the flow chart in Figure 5-1.

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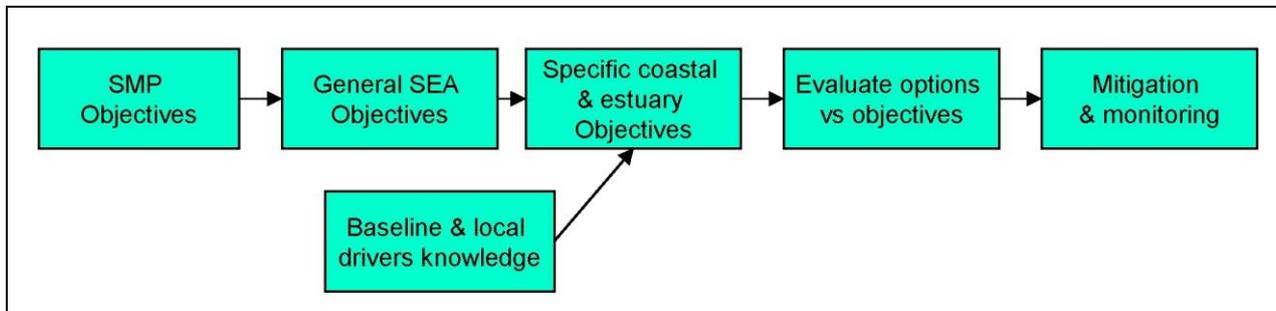


Figure 5-1 SEA Options assessment flowchart

Table 5-1 Key environmental impacts, mitigation and opportunities

Key positive impacts	Key negative impacts	Mitigation/enhancement opportunity
Do Nothing		
	Failure of defences causing flooding and erosion to people, property and infrastructure.	
	Disruption/loss of inter-tidal mudflat and sandflat habitats, coastal and dune grassland.	
	Potential reduction in the number of overwintering and breeding birds for which area has been designated Spa, Ramsar.	
	Potential release of pollutants into water bodies/wider environment.	
Maintain Options		
	Continued flood risk to people, property and infrastructure, increasing over time with climate change effects.	
	Potential release of pollutants into water bodies/wider environment	
Sustain Options		
Flood risk sustained at current level with the effects of climate change mitigated.	Existing structures may need significant works/alterations resulting in visual impacts from different construction forms	Localised enhancement of saltmarsh within works
Beach management/recharge options improve the amenity value of the frontages.	Potential impacts upon tourism due to recharge campaigns.	Plan recharge campaigns outside peak tourism season.
Improve Options		
Flood risk reduced and the effects of climate change mitigated.		Localised enhancement of saltmarsh within works
Beach management/recharge options improve the amenity value of the frontages.	Potential impacts upon tourism due to recharge campaigns.	Plan recharge campaigns outside peak tourism season.
Improved aesthetics of coastal strip following replacement of poor condition defences.		Potential links to art initiatives along the Fylde coast.

Water Framework Directive

5.2.4 We have completed an assessment for compliance with the Water Framework Directive (WFD) (Appendix M), which requires projects and plans to take it and its objectives into account when undertaking works in the water environment. Its main objectives are to prevent deterioration in the status of aquatic ecosystems and try to achieve at least good status for all water bodies by 2015 and, where this is not possible and subject to the criteria set out in the WFD, aim to achieve good status by 2021 or 2027.

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5.2.5 There are a number of water bodies relevant to the study area which have been considered within the WFD Assessment. They are set out in Table 5-2 and their hydro-morphological designation and Current Status/Potential are also provided.

Table 5-2 Water bodies within the Study Area

Rivers			
Hillylaid Pool	GB112072066160	Heavily Modified	Moderate Potential
Hillylaid Pool	GB112072066120	Heavily Modified	Moderate Potential
Wyre (tidal)	GB112072066190	Heavily Modified	Good Potential
Thistelton Brook	GB112072066110	Heavily Modified	Moderate Potential
Transitional			
Wyre	GB531207212200	Heavily Modified	Moderate Potential
Coastal			
Morecambe Bay & Duddon Sands	GB641211170000	Heavily Modified	Moderate Potential
Cumbria	GB6412116300002	Not designated	Moderate Status
Mersey Mouth	GB6421226300001	Heavily Modified	Moderate Potential
Groundwater			
West Lancashire Quaternary Sand and Gravel Aquifers	GB41202G912700	Not designated	Good

5.2.6 All of the water bodies Status Objectives are to achieve Good Ecological Potential (GEP) by 2027, except for the Cumbria Coastal water body and the West Lancashire Quaternary Sand and Gravel Aquifers Groundwater, whose Status Objectives are to achieve GEP by 2015.

Mersey Mouth Coastal Water Body

5.2.7 The Mersey Mouth Coastal water body contains the Anchorsholme, Cleveleys, Rossall South and Rossall North sub-units. This is a heavily modified water body and so the strategy has been assessed against the agreed WFD mitigation measures. The only potential conflicts relate to beach management aspects and particularly the sourcing of material for beach nourishment. However, the strategy is considered to be compliant because it is assumed that nourishment can be sourced from areas of excess on the beach or from an appropriate and licensed site for which mitigation of any impacts is assumed to be already incorporated within the operating conditions of the dredging licence.

Cumbria Coastal Water Body

5.2.8 A small stretch of Fleetwood North sub-unit lies within the Cumbria coastal water body. This water body is classified as a natural system, so does not have any WFD mitigation measures against which the proposed works can be assessed. However, it needs to be ensured that the works do not lead to a deterioration in the current status of the water body nor hinder it in achieving its required status by 2027. The preferred option is to maintain the current defences and continue with the existing maintenance regime during current and future epochs, which is a continuation of current management and will maintain the status quo and will not lead to any deterioration in the current status of the water body.

Morecambe Bay and Duddon Sands Coastal Water Body

- 5.2.9 The Morecambe Bay and Duddon Sands Coastal water body, which is classed as heavily modified, contains most of the Fleetwood North sub-unit and the Outer Estuary sub-unit. It is considered that, as the preferred option of maintain for the current and future epoch within the Fleetwood North reach is a continuation of current management and will maintain the status quo, this will not lead to any deterioration in the ecological potential of the water body and is unlikely to conflict with the WFD objectives.

Wyre Estuary Transitional Water Body

- 5.2.10 The Wyre Transitional water body contains Outer and Middle Estuary sub-units. The preferred option for both sub-units for both epochs is for maintenance of existing earth embankments and revetments alongside saltmarsh improvements. This means that the proposed options will not contribute to the mitigation measure of “removal of hard bank reinforcement/revetment or replacement with soft engineering solution”, as there will not be any removal or replacement. However, it is not considered that this mitigation measure is applicable to this stretch of the water body, given the high value assets behind the current defences that should be afforded continued protection. Also, there is a risk of contamination from landfill sites and the ICI site containing mercury behind the flood defences. In addition, there is also limited land available for the use of soft engineering defences, so maintenance of existing defence is the only suitable option in this area.

Hillylaid Pool Water Body

- 5.2.11 Royles Brook and Hillylaid watercourse lie within the Hillylaid Pool water body. The options for these watercourses do not conflict with the mitigation measure which relates to appropriate techniques for invasive species as, although the preferred options would not contribute directly to implementing this mitigation measure, they may contribute indirectly by reducing the risk of flooding and thus the likelihood of invasive species spreading along the watercourse.

West Lancashire Quaternary Sand and Gravel Aquifer Ground Water Body

- 5.2.12 The whole of the Fylde peninsular is underlain by the West Lancashire Quaternary Sand and Gravel Aquifer water body, which is currently of good status. The risk of retreat of the coastline through erosion over time and potential saline intrusion into groundwater, or flooding of inland areas, which may also result in some percolation into the underlying aquifer of contaminants in flood waters, will not occur, as there are no coastal reaches within the groundwater body that have a preferred option of Do Nothing. Instead, the preferred options will maintain, sustain and improve protection and will therefore protect the groundwater body from saline intrusion and the potential mobilisation of contaminants and there will be no impact upon the environmental objectives for this water body. Also, any potential impacts of options upon the groundwater body are considered to be negligible and due to the nature and scale of the works, the preferred options are unlikely to create new pathways for potential contaminants to enter the groundwater body.

Summary

- 5.2.13 Therefore, The WFD Assessment concludes that the implementation of the Strategy preferred options are not expected to cause deterioration in the status of any waterbodies within the strategy area or prevent them from achieving their objectives.

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Therefore, further assessment of the Strategy, against the conditions listed in Article 4.7, is not required.

- 5.2.14 In addition the Strategy recommendations will, if implemented, help to meet one of the WFD objectives through mitigating the effects of floods and droughts.

Habitats Regulations Assessment

- 5.2.15 We have completed a Habitats Regulations Assessment for the proposed strategy. Natural England have considered this and indicated that there will be no objection to the Strategy's recommendations once the relevant changes are made to the document.

5.3 Social and community impacts

- 5.3.1 Any improvements to the condition of the defences throughout the strategy area will reap benefits in terms of reduced health and stress impacts within the floodplain.
- 5.3.2 Improvements to the conditions of the defences in conjunction with the beach management works will greatly improve the visual appearance of the coastal strip and contribute towards key aspects of the Wyre Core Strategy's vision in 2028.
- 5.3.3 Public events including exhibitions at local libraries and community centres and talks to local groups have taken place to gauge opinion and support of the Strategy and scheme proposed at Rossall. Questionnaires were also distributed to the local community to seek views on how the area around the coastal frontages are utilised. 2,500 public consultation leaflets on the Rossall scheme were produced and distributed in 2011. Websites have been created for Cleveley's and Rossall's seafronts which exhibit proposed and completed coastal defence schemes. The Fylde Coastal Partnership have created a website asking the local community to pledge its support for the Rossall scheme. There has been no negative feedback during the consultation process. Planning permission for the Rossall scheme will be submitted in November 2012 and further consultation will take place as part of this. Consultation risk included in Table 7.4 and Consultation Strategy included in Appendix .

5.4 Option costs

- 5.4.1 Costs for management options, including maintenance works (revenue) and capital works, have been developed by Wyre Borough Council with assistance from Birse Coastal (Birse Civils Ltd). A full options assessment process has been undertaken to identify the preferred engineering option for each of the 10 sub-units and for each of the flood defence scenarios being considered. This process is outlined in the Wyre Flood and Coastal Defence Strategy Study, Options Assessment Report – See Appendix E.
- 5.4.2 Present value (PV) costs were calculated over a 100-year assessment period. Cost estimates have been built up to include all future costs associated with:
- Capital works costs
 - Maintenance costs
 - Professional fees
 - Site Investigation
 - Environmental Enhancements

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- Landowner compensation
- Land drainage
- Risk (between 60% optimism bias)

5.4.3 In accordance with current Defra and HM Treasury guidelines, costs (and benefits) have been discounted at the approved rates (3.5% for years 0-30, 3.0% for years 31-75, and 2.5% thereafter). These are summarised in Tables 5-3 to 5-5, with full cost breakdowns available in Appendix N. The costs presented in Tables 5-3 to 5-5 are representative of options that would reduce flood risk to a 1 in 200 (0.5%) chance of occurring in any year. In these tables, options that feature similar technical solutions have been grouped together to avoid repetition. As such, the Pvc presented is the highest for the grouping of technical solutions being presented. Crossed out are options that are not technically suitable for the frontage. (As the strategy area is one large benefits area, optimisation is undertaken on the suite of preferred technical options, see Section 6.2). The base date for the costs is Q1 2012.

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Table 5-3 Shortlisted Option Costs/Benefits for Coastal Frontages (Sub Units 0 to 4)

Option No	Option description	Option costs and benefits* (£m)					
		£m	SU0	SU1	SU2	SU3	SU4
M2 M3	Repairs to existing hard assets (revetment, promenade seawalls) and groynes (where present)	PVc	4.8	9.3	22.8	85.8	10.7
		PVb	120	201	125	596	14.7
M4 M5	Repairs to existing hard assets (revetment, promenade seawalls, groynes) and beach management	PVc	7.3	7.9	20.1	52.1	8.9
		PVb	120	201	125	596	14.7
M6	Improve and reinforce dune systems in combination with reduced maintenance of hard defence structures	PVc					9.8
		PVb					14.7
S/I1 S/I2	Concrete repairs to promenade seawall and revetments with beach management and improvements to groyne field	PVc					11.6-14.1
		PVb					31
S/I3 S/I4 S/I6	Phased significant concrete repairs to promenade seawall and revetments with beach management and improvement to groyne field <u>plus</u> additional beach recharge	PVc	19.7	18.6	36.1	105.9	
		PVb	141	284	183	930	
S/I8	Combined rock (lower) & stepped concrete (upper) revetment with upper level promenade & set back flood wall	PVc			54.0	98.9	
		PVb			183	930	
S/I9 S/I10	Low amenity value revetments (rock or Seabee) with re-curved wave wall, intermediate wall, split level promenade and set back flood wall	PVc			40.4	112.6	
		PVb			183	930	
S/I11 S/I12 S/I13	High amenity value concrete revetments with re-curved wave wall, intermediate wall and split level promenade and set back flood wall	PVc	19.1	15.4			48.4
		PVb	141	284			31
S/I14	Combined approach 1 – selection of most appropriate beach management option (Options S/I1 – S/I7) with most appropriate hard defence improvement option (Options S/I 8 – S/I13)	PVc	17.5	14.6	34.2	92.0	38.9
		PVb	141	284	183	930	31
S/I15	Combined approach 2 – Selection of most appropriate hard defence improvement option (options S/I8 – S/I13) and enhance, reinforce and improve existing dune systems	PVc					10.6
		PVb					31

*Costs and benefits for S/I options are those for the 0.5%AEP (1 in 200 year) standard of protection. Costs include 60% Optimism Bias.

Table 5-4 Shortlisted options – Estuary Frontages (Sub Units 4 and 5)

Option No	Option description	Option costs and benefits* (£m)		
		£m	SU5	SU6
M8	Develop maintenance regime with ABP & NPL which involves maintenance to existing earth embankments and revetments	PVc	2.1	1.3
		PVb	5.2	460
S16	Localised reinforcement and improvement of saltmarsh in combination with improvements to existing earth embankments	PVc	1.9	1.2
		PVb	5.2	460
S117	Enhance and raise existing earth embankments (no work to revetments)	PVc	2.4	1.8
		PVb	5.2	460
S118	Enhance and raise existing earth embankments and revetments	PVc	3.1	2.8
		PVb	5.2	460

*Costs and benefits for S/I options are those for the 0.5%AEP (1 in 200 year) standard of protection. Costs include 60% Optimism Bias.

Table 5-5 Shortlisted options – Watercourses (Sub Units 7 to 9)

Option No	Option description	Option costs and benefits* (£m)			
		£m	SU7	SU8**	SU9
M9	General maintenance improvements to existing watercourses and pumping stations	PVc	3.9	1.3	1.3
		PVb	57	1.6	31
S/I21	Maintain and improve watercourses and pumping stations and improve watercourse capacity by engineering the channel	PVc	7.2		1.6
		PVb	65		34
S/I22	Improve the hydraulic efficiency of the watercourses by improving online pumping capacities	PVc	6.9		
		PVb	65		
S/I23	Maintain and improve watercourses and pumping stations and construct new flood water storage pond	PVc	6.9	1.9	1.7
		PVb	65	7.1	34
S/I24	Maintain and improve watercourses and pumping stations and redirect flow to safer areas	PVc	6.9	1.9	
		PVb	65	7.1	
S/I25	Maintain and improve watercourses and pumping stations and open up culverts	PVc			1.9
		PVb			34

Option No	Option description	Option costs and benefits* (£m)			
		£m	SU7	SU8**	SU9
S/I26	Maintain and improve watercourses and pumping stations and redirect flow to gravity outfall systems	PVc		1.7	
		PVb		7.1	
S/I27	Maintain and improve watercourses and pumping stations and outfall efficiency	PVc	6.7	1.9	1.9
		PVb	65	7.1	34

*Costs and benefits for S/I options are those for the 0.5%AEP (1 in 200 year) standard of protection. Costs include 60% Optimism Bias.

5.5 Options benefits (Damages avoided)

- 5.5.1 Flood damages have been calculated in accordance with the Defra and Environment Agency guidance FCERM-AG and Supplementary Guidance Notes and use flood damage data from the Multi Coloured Manual (MCM) (Middlesex Flood Hazard Research Centre 2010 update). Values in the MCM have been updated to Q1 2012 using the Consumer Price Index. The analysis also takes into account the latest guidance in “Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities”, Sept 2011.
- 5.5.2 The present value (PV) damage of the baseline Do Nothing option is approximately £2.2 billion over the 100 year strategy appraisal period. The damages comprise recurring flood damages to residential and non-residential properties, with PV damages being capped using the average market value for each category. The dominant mechanism within the strategy area is flooding; no erosion damages are included as these are negligible in comparison to the flood risk damages. Damages to caravans within SU8 are included.
- 5.5.3 The monetised PV damages for each Do Something option comprise property and risk to life damages avoided in comparison to the baseline Do Nothing scenario and are included in Table 5-6. Additional non-monetised benefits have not been included in the economic appraisal.
- 5.5.4 Separate cost benefit assessments have also been undertaken for each of the sub-units shown in Key Plan 1 in order to apportion benefits and property numbers to the discrete sub-areas. Full details of the economic appraisal are contained in the Economics Report in Appendix F and this section contains a summary only.

Table 5-6 Summary of options present value (PV) damages and benefits for strategy

	Damage (PVd) (k)	Damage Avoided (k)	Benefits (PVb) (k)	Key non-monetised benefits
Do nothing	2,220,885	-	-	Avoidance of flood damage to transportation links (roads, tramway, railway), cars, and infrastructure for utilities are NOT included. Benefits relating to recreation, amenity and tourism have NOT been valued.
Maintain	609,086	1,611,799	1,611,799	
Sustain	294,653	1,926,232	1,926,232	
Improve 1.33% AEP	113,866	2,107,019	2,107,019	
Improve 1% AEP	95,711	2,125,174	2,125,174	
Improve 0.5% AEP	80,515	2,140,370	2,140,370	
Improve 0.33% AEP	68,666	2,152,219	2,152,219	
Improve 0.2% AEP	66,335	2,154,550	2,154,550	

6 Selection and details of the preferred option

6.1 Selecting the preferred option

- 6.1.1 The shortlisted options for each sub-unit were compared against the Strategic Objectives, environmental issues and economic indicators, leading to the identification of the preferred option. This is detailed in full in Appendix E, and the results summarised in Table 6-1 to Table 6-9 below. In all instances, the option identified was the economically and environmentally preferred option (with mitigation where necessary) and provided the best fit against the Strategic Objectives.
- 6.1.2 The summary results in Tables 6-1 and 6-9 below present the option selection for the shortlisted options. In these tables, options that feature similar technical solutions have been grouped together to avoid repetition. As a result, the PVC, PVb, ABCRs and iBCRs are based on the highest cost option (to be conservative) within the grouping and are not directly comparable with the economic results presented in Appendix F. The iBCRs are based on moving from a Maintain option to a Sustain/Improve option, rather than being calculated sequentially along the options in the tables. Note that the metrics presented for the Sustain/improve options are for the 0.5% AEP (1 in 200 year) standard of protection.

Coastal Frontages

Table 6-1 Sub Unit 0 - Anchorsholme

Option No.	Description	PVc £m	PVd £m	PVb £m	ABCR	iBCR	Selection discussion
0	Do Nothing	-	147	-	-	-	<p>This frontage requires immediate intervention. Initial Leading Option is M2/M3 with highest ABCR of 24.9. However, current SoP is only 1: in 25 yrs so iBCRs for S/I Options only need to be >1 to justify next higher option.</p> <p>The S/I 3-5 options involve replacing sections of the coastal defence in 15 year phases and rely on extensive beach management to minimise wave attack. As a result, this option becomes quite expensive.</p> <p>The S/I 11-13 options only provide a 25 year life before major works are needed again to extend their residual life. This is because there is no beach management in place to help retain the beach and reduce wave attack and</p>
M2 M3	Repairs to existing hard assets (revetment, promenade, seawalls) and groynes (where present)	4.8	27	120	24.9	-	
M4 M5	Repairs to existing hard assets (revetment, promenade seawalls, groynes) and beach management	7.3	27	120	16.4	-	
S/I3 S/I4 S/I6	Phased significant concrete repairs to promenade, seawall and revetments with beach management and improvements to groyne field plus additional beach recharge	19.9	6	141	7.2	1.4	
S/I11 S/I12 S/I13	New concrete revetments with re-curved wavewall, intermediate wall and split level promenade and set back flood wall	19.1	6	141	7.4	1.5	
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Option No.	Description	PVc £m	PVd £m	PVb £m	ABCR	iBCR	Selection discussion
S/I14	New coastal defence consisting of new revetments, seawall and promenade with beach management (new groynes and beach recharge).	17.5	6	141	8.0	1.7	erosion. As a result, the options are costly. The new hard defences in S/I14 will address the low residual life of the existing hard asset (<5 years), whilst new groynes and beach recharge will provide protection against wave impact and overtopping on structures.

Table 6-2 Sub Unit 1 - Cleveleys

Option No.	Description	PVc £m	PVd £m	PVb £m	ABCR	iBCR	Selection discussion
0	Do Nothing	-	300	-	-	-	Current SoP >0.5%AEP falling to 0.5% by Year 50. This frontage has a recently implemented scheme with 50yr residual life. However, beach levels are low and so several beach management options have been considered to reduce overtopping and wave impact. The option selection considers alternative ways of maintaining the SoP. Initial Leading Option is M4/M5 with highest ABCR. SoP at point of intervention is 0.5%AEP so iBCR>3 required. S/I3-6 options focus heavily on beach management proving to be costly. Options S/I 11-12 don't provide any beach management and as a result need to replace the coastal defence sooner and provide toe protection. S/I14, new defence combined with beach management, has the lowest cost and highest iBCR so is selected as the preferred option.
M2 M3	Repairs to existing hard assets (revetment, promenade seawalls) and groynes (where present).	9.3	99	201	21.7	-	
M4 M5	Repairs to existing hard assets (revetment, promenade, seawalls, groynes) and beach management.	7.9	99	201	25.4	-	
S/I3 S/I4 S/I6	Maintain promenade, seawall and revetment. New rock groynes and beach recharge from Year 4-5 and every 10 years to keep pace with sea level rise.	18.7	16	284	15.2	8.8	
S/I11 S/I12	New concrete revetment and wave wall in Year 25 and 75 with rock armour protection every 5 years to counteract lowering beach levels.	15.4	16	284	18.5	13.4	
S/I14	New rock groynes in Year 4. New concrete revetment and wave wall to keep pace with sea level rise in Year 50 plus beach recharge every 20 years.	14.6	16	284	19.4	15.5	

Table 6-3 Sub Unit 2 – Rossall South

Title	Wyre Urban Core Strategy					
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Option No.	Description	PVc £m	PVd £m	PVb £m	ABCR	iBCR	Selection discussion
0	Do Nothing	-	194	-	-	-	<p>This frontage requires intervention in the next 15-20 years to stop defences failing. The initial leading option is M4/M5 with highest ABCR. Current SoP is 1:75yrs falling to <1:75yrs with climate change. iBCR>1 required under decision rule for considering S/I options in the future.</p> <p>The S/I 3-6 options involve replacing sections of the coastal defence in 10 year phases and rely on extensive beach management to minimise wave attack and erosion. Options S/I8-10 replace the coastal defence in Years 15 and 65 but don't include beach management. As a result, these options become quite expensive. A new groyne field combined with beach recharge in S/I14 will increase beach levels (addressing the trend of lowering) providing protection against overtopping and reducing wave impact on structures. The existing defences will be replaced at the end of their residual life in year 50. This option has the highest ABCR and iBCR, showing it to be the most economic option and is therefore selected as the preferred option.</p>
M2 M3	Repairs to existing hard assets (revetment, promenade, seawalls) and groynes (where present).	22.8	69	125	5.5	-	
M4 M5	Repairs to existing hard assets (revetment, promenade, seawalls, groynes) and beach management.	20	69	125	6.2	-	
S/I3 S/I4 S/I6	Concrete repairs to promenade, seawall and revetments with beach management. New timber groynes and beach recharge in year 5 plus every 10yrs thereafter. Replacement of defence in Year 50.	36	11	183	5.1	4.3	
S/I8 S/I9 S/I10	Concrete repairs to promenade, seawall and revetments with defence replacement in years 15 and 65.	54	11	183	3.4	1.8	
S/I14	Concrete repairs to promenade, seawall and revetments with beach management (groynes and recharge) from 5yr plus every 20yrs thereafter. Defence replacement in year 50.	34.2	11	183	5.3	5.0	

Table 6-4 Sub Unit 3 – Rossall North

Option No.	Description	PVc £m	PVd £m	PVb £m	ABCR	iBCR	Selection discussion
0	Do Nothing	-	1,005	-	-	-	This frontage requires immediate intervention.

Option No.	Description	PVc £m	PVd £m	PVb £m	ABCR	iBCR	Selection discussion
M2 M3	Repairs to existing hard assets (revetment, promenade seawalls) and groynes (where present)	85.8	290	715	8.3	-	Initial Leading Option is M4/M5 with highest ABCR. Current SoP is 1:200yrs (0.5% AEP) for overtopping but only 1:75 (1.3%AEP) against breach with poor condition defences with high breach risk. SoP<1:75 over time with the effects of climate change so iBCR>3 required under decision rule for considering S/I options today. Actual S/I Options iBCRs>>3. S/13-6 focus heavily on providing beach management to extend the life of the new coastal defence. These options however are very expensive. Options S/18-10 don't provide any beach management and as a result, require the defence revetment to be replaced every 30years due to the increased wave attack. S/114 provides a new defence combined with beach management to maximise the life of the new structures. This option is the most cost beneficial, has the highest ABCR and iBCR, and has therefore been selected as the preferred option.
M4 M5	Repairs to existing hard assets (revetment, promenade seawalls, groynes) <u>and</u> beach management	52.1	290	715	13.7	-	
S/13 S/14 S/16	Significant repairs/ replacement of coastal revetment in years 3 and 53 with beach management every 10 years. New timber groyne field in Years 4 and 54 <u>plus</u> repairs and beach recharge every 10 years.	106	23	982	9.3	13.3	
S/18 S/19 S/110	New concrete revetments and repairs to wavewall and promenade in Years 2-4. Replaced every 30 years thereafter.	98.9	23	982	9.9	20.3	
S/114	New coastal defence consisting of new revetments, wavewall and promenade in Years 2-4 with beach management. New rock groynes in Year 4, repaired every 10 years and beach recharge every 20 years.	92	23	982	10.7	43.1	

Table 6-5 Sub Unit 4 – Fleetwood

Option No.	Description	PVc £m	PVd £m	PVb £m	ABCR	iBCR	Selection discussion
0	Do Nothing	-	37	-	-	-	This frontage requires intervention in the next 15-20 years. This frontage has a SoP >0.5%AEP falling to 0.5% AEP by year 50. After year 50, intervention is needed to maintain the existing SoP.
M2 M3	Repairs to existing hard assets (revetment, promenade seawalls) and groynes (where present)	10.7	22.3	14.7	1.4	-	

Option No.	Description	PVc £m	PVd £m	PVb £m	ABCR	iBCR	Selection discussion
M4 M5	Repairs to existing hard assets (revetment, promenade seawalls, groynes) and beach management	8.9	22.3	14.7	1.7	-	Initial Leading Option: S/I15 with highest ABCR (2.9) showing it to be the most economic option.
M6	Dune reinforcement in year 4 with additional heavy dune maintenance every 10 years and full reinforcement in year 54. New timber groynes in year 5 then maintained every 10 years and replaced in year 50. Repairs to concrete aprons.	9.6	22.3	14.7	1.5	-	New groynes along this frontage in combination with dune management will strengthen the defences and reduce flood risk, whilst retaining the amenity value of the frontage. S/I15 is selected as the preferred option.
S/I1 S/I2	Replacement of groyne field in year 4. Groynes maintained every 10 years and fully replaced in year 54. Beach recharge every 10 years from year 5 onwards. Concrete repairs to hard defences in year 16 then repeated every 20 years	14.1	6.2	30.8	2.2	4.8	
S/I11 S/I12 S/I13	New hard defences constructed in years 3 and 4. Hard defences replaced every 30 years.	48.4	6.2	30.8	0.6	0.4	
S/I14	New hard defences constructed in years 3 and 4. Hard defences repaired every 10 years. Beach recharge in year 5 and repeated every 10 years with new groynes constructed in year 45	38.9	6.2	30.8	0.8	0.6	
S/I15	Dune re-inforcement in year 4 with additional heavy dune maintenance every 10 years and full reinforcement in year 54. New timber groynes in year 5 then maintained every 10 years and replaced in year 50. Repairs to concrete aprons and seawall in year 6.	10.6	6.2	30.8	2.9	-110*	

*Negative iBCR arises from S/I15 having lower PVc than M2/M3.

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Estuary Frontages

Table 6-6 Sub Unit 5 – Outer Estuary

Option No.	Description	PVc £m	PVd £m	PVb £m	ABCR	iBCR	Selection discussion
0	Do Nothing	-	5.2	-	-	-	<p>This frontage has a high SoP (>0.5%AEP) falling to 0.5% AEP by year 50. No immediate capital works are required.</p> <p>Initial Leading Option is M8 with highest ABCR.</p> <p>Due to lack of urgency for immediate work, differential benefits have not been calculated for the S/I options, which means that the decision rule cannot be strictly applied. However, it can be assumed that additional future analysis would result in increased benefits being identified for the S/I options.</p> <p>Acknowledging that future effort will be required to demonstrate an additional £4m PVb over Option M8, Option S/I16 has been selected as this better meets the strategy objectives. It is the most economic of options within the S/I range.</p> <p>This option achieves all the strategy objectives and reduces flood risk.</p> <p>S/I16 is selected as the preferred option.</p>
M8	Develop maintenance regime with ABP & NPL which involves maintenance to existing earth embankments and revetments	2.1	-	5.2	2.4	-	
S/I16	Localised reinforcement and improvement of saltmarsh in combination with improvements to existing earth embankments in Year 50.	1.9	-	5.2	2.7	-	
S/I17	Enhance and raise existing earth embankments (no work to revetments)	2.4	-	5.2	2.1	-	
S/I18	Enhance and raise existing earth embankments and revetments	3.1	-	5.2	1.7	-	

Table 6-7 Sub Unit 6 – Inner Estuary

Option No.	Description	PVc £m	PVd £m	PVb £m	ABCR	iBCR	Selection discussion
0	Do Nothing	-	460	-	-	-	<p>This frontage has a high SoP (>0.5%AEP) falling to 0.5% AEP by year 50. No immediate capital works are required.</p> <p>The lowest cost option has been selected.</p>
M8	Develop maintenance regime with ABP & NPL which involves maintenance to existing earth embankments and revetments	1.3	-	460	361	-	

Option No.	Description	PVc £m	PVd £m	PVb £m	ABCR	iBCR	Selection discussion
SI16	Localised reinforcement and improvement of saltmarsh in combination with improvements to existing earth embankments	1.2	-	460	379	-	Current SoP is >1:200yrs falling over time with the effects of climate change. SoP at point of intervention <1:75yrs.
SI17	Enhance and raise existing earth embankments (no work to revetments)	1.8	-	460	255	-	Of the S/I Options. S/I16 has the highest ABCR (217) – this option achieves all the strategy objectives and reduces flood risk.
SI18	Enhance and raise existing earth embankments and revetments	2.8	-	460	161	-	S/I16 is selected as the preferred option.

Watercourses

Table 6-8 Sub Unit 7 – Royles Brook & Hillylaid

Option No.	Description	PVc £m	PVd £m	PVb £m	ABCR	iBCR	Selection discussion
0	Do Nothing	-	68.7	-	-	-	This frontage immediate requires intervention; residual life of defences <5 years.
M9	General maintenance improvements to existing watercourses and pumping stations	3.9	11.7	57	14.6	-	Initial Leading Option: M9 with highest ABCR (14.6).
S/I21	Maintain and improve watercourses and pumping stations and improve watercourse capacity by engineering the channel	7.2	3.4	65.3	9.0	2.5	Current SoP is >1:100yrs, (<0.1%AEP) but falling over time with deteriorating defence condition. iBCR>1 required for consideration of higher options. Actual iBCRs of higher options >1.
S/I22	Improve the hydraulic efficiency of the watercourses by improving online pumping capacities	6.9	3.4	65.3	9.4	2.7	
S/I23	Maintain and improve watercourses and pumping stations and construct new flood water storage pond	6.8	3.4	65.3	9.6	2.8	Of S/I Options, S/I27 has the highest ABCR (9.8) – this option achieves all the strategy objectives and reduces flood risk.
S/I24	Maintain and improve watercourses and pumping stations and redirect flow to safer areas	6.9	3.4	65.3	9.4	2.7	
S/I27	Maintain and improve watercourses and pumping stations and outfall efficiency	6.7	3.4	65.3	9.8	3.0	S/I27 is selected as the preferred option.

Table 6-9 Sub Unit 8 – Springfield

Opti on No.	Description	PVc £m	PVd £m	PVb £m	ABCR	iBCR	Selection discussion
0	Do Nothing	-	7.1	-	-	-	<p>This frontage requires intervention in the next 10 years.</p> <p>Initial Leading Option: S/I26 with highest ABCR (4.3), showing it to be the most economic option.</p> <p>S/I26 meets (or has the potential to meet) all the strategy objectives.</p> <p>S/I26 is selected as the preferred option.</p>
M9	General maintenance improvements to existing watercourses and pumping stations	1.6	5.5	1.6	1.2		
S/I23	Maintain and improve watercourses and pumping stations and construct new flood water storage pond	1.9	-	7.1	3.7	8.9	
S/I24	Maintain and improve watercourses and pumping stations and redirect flow to safer areas	1.8	-	7.1	3.8	9.9	
S/I26	Maintain and improve watercourses and pumping stations and redirect flow to gravity outfall systems	1.7	-	7.1	4.3	15.2	
S/I27	Maintain and improve watercourses and pumping stations and outfall efficiency	1.9	-	7.1	3.7	9.1	

Table 6-10 Sub Unit 9 – Copse Brook

Opti on No.	Description	PVc £m	PVd £m	PVb £m	ABCR	iBCR	Selection discussion
0	Do Nothing	-	35.7	-	-	-	<p>This frontage requires intervention in the first 15 years.</p> <p>Initial Leading Option: M9 with highest ABCR (23.7).</p> <p>Current SoP >1:75yrs (AEP<1.3%) falling over time due to deteriorating condition of defences. SoP at point of intervention is <1:75yrs (>1.3%AEP). iBCR>1 required for consideration of higher options. Actual iBCRs of higher options >>>1. Of the S/I Options considered, S/I21 has the highest ABCR, showing it to be the most economic of the S/I options.</p> <p>S/I21 is selected as the preferred option.</p>
M9	General maintenance improvements to existing watercourses	1.3	4.9	30.8	23.7	-	
S/I21	Maintain and improve watercourses and improve watercourse capacity by opening culverted constrictions	1.6	1.2	34.5	21.6	12.3	
S/I23	Maintain and improve watercourses and pumping stations and construct new flood water storage pond	1.7	1.2	34.5	19.9	8.6	
S/I25	Maintain and improve watercourses and open up culverts	1.9	1.2	34.5	18.1	6.2	
S/I27	Maintain and improve watercourses and pumping stations and outfall efficiency	1.9	1.2	34.5	18.1	6.2	

6.1.3 The preferred options in Tables 6-1 to 6-10 have been combined together for a range of return periods to optimise the standard of protection provided for the strategy area. Table 6-11 presents the cost-benefit analysis for the range of standards considered.

Table 6-11 Cost Benefit Assessment

	PV Costs (£k)	PV Benefits (£k)	Av. Benefit/Cost Ratio	Incremental BCR	Option for Incremental Calculation
Do Nothing	-	-	-	-	-
Maintain Minimum) (Do	102,462	1,611,799	15.7	-	-
Sustain	166,720	1,926,232	11.6	4.7	Maintain
Improve 1.33% AEP	174,350	2,107,019	12.1	23.7	Sustain
Improve 1% AEP	178,150	2,125,174	11.9	4.8	Improve 1.33% AEP
Improve 0.5% AEP	181,966	2,140,370	11.8	4.0	Improve 1% AEP
Improve 0.33% AEP	186,550	2,152,219	11.5	2.6	Improve 0.5% AEP
Improve 0.2% AEP	197,246	2,154,550	10.9	0.2	Improve 0.33% AEP

6.1.4 All of the options considered have Benefit Cost Ratios (BCRs) greater than unity. Following the decision process in FCERM-AG, Maintain has the highest ABCR (15.7) and is identified as the initial leading option. We then start considering the incremental BCRs (iBCRs) of the next highest options. In accordance with the decision process, we step through to the Improve 0.5% AEP (1 in 200 year) option, with the iBCRs being greater than three. However, the iBCR of the next higher option, Improve 0.33% AEP (1 in 300 year) standard is not greater than the value of five required by the decision process. The preferred option is identified as Improve 0.5% AEP (1 in 200 years) and has BCR of 11.8.

6.2 Sensitivity testing

6.2.1 Due to a lack of detailed residential property data within the strategy area, the flood damages were based on an adapted depth damage curve from the MCM, derived to suit a 'typical' residential property, and an average residential value of £165k was adopted for all properties (for the purposes of capping). Following completion of the benefits assessment for the whole strategy area using this data, a more detailed assessment was carried out for Sub Unit 3 Rossall North, using actual residential property data (types and values) and the associated depth damage curves. The results of the analysis indicated that the strategy benefits may be underestimated by around 6% if the housing mix in Sub Unit 3 were representative of the whole strategy area. However, Rossall North is one of the more deprived areas and household values are not considered to be representative of the whole benefits area. In any case, an underestimation of benefits would result in a higher benefit cost ratio, strengthening the economic justification for the strategy.

6.2.2 The economic assessment considers costs and benefits for works to reduce the risk from both fluvial and tidal events. However, the primary function of the strategy is to review the overall business case for the tidal flood defence system. A second cost benefit assessment was undertaken, removing costs and benefits associated with the fluvial systems within the strategy. The preferred option selection remained unchanged, i.e. Improve to a 0.5% (1 in 200 year) AEP, although the BCR was slightly lower. This reduction is unsurprising as the cost of protection per household is generally higher for coastal schemes compared to fluvial schemes.

6.2.3 Full details of both sensitivity tests are provided in Appendix F Economics Report.

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6.3 Details of the preferred option

Table 6-12 Summary of Preferred Options for Strategy

Sub Unit	Option Ref	Option Details			PV cost (£k)
		Short term (0-10yrs)	Medium term (10-50yrs)	Long term (50-100yrs)	
0	SI14	New hard defences, rock groynes and beach recharge	Groyne repairs 10yr frequency, beach recharge 20 yr frequency	Groyne repairs 10yr frequency, beach recharge 20 yr frequency	10,963
1	SI14	Beach recharge and structural maintenance	Groyne repairs 10yr frequency, beach recharge 20 yr frequency. Major rebuild of seawalls/revetments yr 50.	Groyne repairs 10yr frequency, beach recharge 20 yr frequency	9,135
2	SI14	Beach recharge and structural maintenance	Groyne repairs 10yr frequency, beach recharge 20 yr frequency. Major rebuild of seawalls/revetments yr 50.	Groyne repairs 10yr frequency, beach recharge 20 yr frequency	21,376
3	SI14	New hard defences, rock groynes and beach recharge	Groyne repairs 10yr frequency, beach recharge 20 yr frequency	Groyne repairs 10yr frequency, beach recharge 20 yr frequency	57,481
4	SI5	Dune reinforcement and new groynes	Groyne and dune repairs 10yr frequency	Further dune reinforcement/groyned replacement 50 years after installation. Groyne and dune repairs 10yr frequency	6,621
5	SI6	Saltmarsh and minor/localised embankment improvements*	Maintenance/repairs to flood defences	Saltmarsh and minor/localised embankment improvements 50 yrs after initial scheme. Maintenance/repairs to flood defences	1,197
6	SI6	Saltmarsh and minor/localised embankment improvements	Maintenance/repairs to flood defences	Saltmarsh and minor/localised embankment improvements 50 yrs after initial scheme. Maintenance/repairs to flood defences	758
7	SI27	Engineer the channel by removing debris and siltation in the culverted sections and undertaken repairs to the collapsed sections of open watercourse	Engineer the channel by removing debris and siltation in the culverted sections and undertaken repairs to the collapsed sections of open watercourse. Replacement of Stanah pumping station, periodic maintenance.	Replacement of M&E kit at pumping station and periodic maintenance.	4,161
8	SI26	Construct new gravity connection with Copse Brook	Periodic channel maintenance and new small capacity pumping station	Periodic channel maintenance and M&E upgrade to new pumping station	1,038
9	SI21	Engineer the channel by removing debris and siltation in the culverted sections and undertaken repairs to the collapsed sections of open watercourse	Periodic channel maintenance	Periodic channel maintenance	999
Sub Total					113,729
Optimism Bias (60%)					68,237
Total					181,966

* There is potential for significant investment in this area with works being brought forward through development.

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Technical aspects

- 6.3.1 Capital works are required at three Sub Units in the first five years of the strategy to address key weaknesses in the current defences – Anchorsholme (SU0), Rossall North (SU3) and Royles Brook and Hillylaid Watercourse (SU7).
- 6.3.2 At both Rossall North and Anchorsholme, the new defence structures will be construction upon the existing defences, which are in a very variable condition. There is the risk of voiding underneath the current structures which could lead settlement when loaded by the new defences. This may be less of an issue along the lower Rossall North section, where the rock armour will articulate to a certain degree to accommodate movement. Ground investigations will be undertaken as part of the detailed design stage and tests can be undertaken at stages through construction to test the integrity of the underlying defence prior to loading, with voids being filled as necessary.
- 6.3.3 The beach management along the coastal frontages will require a suitable source of sediment. The ECI Contractor (Birse Coastal) has been advising on suitable sources and their associated costs. Agreement of the proposed source will be required by Natural England and the Environment Agency.

Environmental aspects

- 6.3.4 Capital schemes at Anchorsholme and Rossall North will require a Marine Licence for Construction. Planning permission will be required as the works fall under Schedule 2 Category 10(m). Both of these will be supported by scheme level Environmental Impact Assessments (EIA) and Habitat Regulations Assessments (HRAs).
- 6.3.5 Construction works have the potential to cause disruption to local residents and business; however, application of good site practice and considerate working hours in conjunction with strong community liaison will reduce the risk of noise and traffic issues. Baseline surveys are recommended to help identify noise limits for site works. Vibration monitoring may be required for piling works in close proximity to houses – this will be determined during the scheme development stage.
- 6.3.6 There are enhancement opportunities at the Rossall North scheme, with a wide area of land to the rear of the defence which could be landscaped, offering additional amenity/recreation benefits to the scheme. This will be investigated further at scheme development stage. There is also the opportunity to link the new defences to various art initiatives along the Fylde coast.
- 6.3.7 A Water Framework Directive Assessment has been undertaken (available in Appendix M) concluding that taking into account the mitigation identified within the proposed strategy, the preferred options will not compromise the ability to comply with the Water Framework Directive.

Costs of the preferred option

- 6.3.8 Table 6-2 presents the summary costs of the preferred option for the strategy units featuring early year deliverables. Full cost breakdowns are provided in Appendix N.

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Table 6-13 Costs of Preferred Option for Sub Units 0, 3 and 7 (cash, exclusive of Optimism Bias)

Cost	2012/13 (£k)	2013/14 (£k)	2014/15 (£k)	2015/16 (£k)	2016/17 (£k)	2017/18 (£k)	Future Years (£k)	Total (£k)
Sub Unit 0 - Anchorsholme								
Capital	0	3,967	3,967	326	1,106	-	4,717	14,081
Non-Capital	409	198	198	13	13	13	1,185	2,029
Total	409	4,165	4,165	338	1,119	13	5,902	16,110
Sub Unit 3 – Rossall North								
Capital	-	15,823	15,823	15,823	1,620	5,501	23,461	78,050
Non-Capital	282	1,246	475	475	-	63	5,894	8,435
Total	282	17,069	1698	16,298	1,620	5,564	29,355	86,485
Sub Unit 7 – Royles Brook and Hillylaid Watercourse								
Capital	-	-	-	-	534	-	2,448	2,982
Non-Capital	42	43	44	98	45	46	12,952	13,271
Total	42	43	44	98	579	46	15,400	16,252
Other Strategy Sub Units								
Capital	-	-	-	-	3,618	5,779	105,417	114,815
Non-Capital	230	235	240	518	249	251	30,207	31,931
Total	230	235	240	518	3,868	6,031	135,624	146,746
Strategy Total	964	21,511	20,746	17,252	7,185	11,653	186,281	265,593

Table 6-14 Costs of Preferred Beach Management Option for Sub Units 0 – 4 (cash, exclusive of Optimism Bias)

Beach Management (Sub Units 0 to 4) included in the costs above								
Capital	-	125	125	125	2,281	1,637	36,154	40,447
Non-Capital	40	41	42	42	43	44	4151	4,404
Total	40	166	167	167	2,324	1,681	40,305	44,850

Contributions and funding

6.3.9 The majority of funding for the works proposed in this strategy will be through Defra Grant in Aid. However, Wyre Borough Council has been in discussions with a number of beneficiaries to provide contributions to the development of the schemes. This includes United Utilities, Lancashire County Council (the highway authority, social care and education), the housing associations, major developers and Fleetwood Town council.

6.3.10 A funding strategy has been set up and is being led by senior members of both Wyre and Blackpool councils (who are jointly procuring the works in the first five years under

the Fylde Peninsular Programme). This Contributions Strategy is provided in Appendix P together with the Partnership Resilience Funding Calculator Scores. The Strategy aims to seek opportunities for contributions to encourage growth and regeneration and support the existing works being proposed to achieve joint benefits.

6.4 Summary of preferred strategy

Table 6.14 Summary of preferred strategy

Sub Unit	SoP	PV Costs (£k)			Cash Costs (£k)		
		Capital	Non-capital	Total	Capital	Non-capital	Total
0 – Anchorsholme	0.5% AEP	9,837	1,125	10,963	14,081	2,029	16,110
1 – Cleveleys		8,024	1,111	9,135	26,902	3,752	30,653
2 – Rossall South		17,598	3,777	21,376	69,986	13,218	83,204
3 – Rossall North		53,548	3,934	57,481	78,050	8,435	86,485
4 – Fleetwood North		5,716	905	6,621	14,262	2,588	16,850
5 – Outer Estuary		157	1,040	1,197	923	3,988	4,911
6 – Middle Estuary		278	479	785	1,641	1,503	3,144
7 – Royles Brook & Hillylaid Watercourse		1,632	2,528	4,161	2,982	13,270	16,252
8 – Springfield Watercourse		430	607	1,038	796	2,496	3,292
9 -Copse Brook Watercourse		174	825	999	304	4,387	4,692
Sub total		97,396	16,333	113,729	209,927	55,666	265,593
Optimism Bias (60%)				68,237			159,356
Strategy Total				181,966			424,948
Including:							
Beach Management		13,411	1,655	15,066	40,072	4,779	44,850
Optimism Bias (60%)				9,039			26,910

7 Implementation

7.1 Project planning

Phasing and approach

- 7.1.1 The appraisal and supported modelling of coastal processes and flooding has clearly shown that a strategic approach to the management of the defences to reduce tidal flood risk is required and that beach management needs to be undertaken strategically on the open coast.
- 7.1.2 The first phase of coastal works from the strategy therefore comprises capital schemes at Anchorsholme (SU0) and Rossall North (SU3), plus beach management. These schemes will be delivered under the Fylde Peninsula Coastal Programme (FPCP). Wyre Borough Council is working with Blackpool and Fylde Councils to ensure coherence of delivery of works along the coast, seeking efficiencies, environmental benefits and savings from packaging the schemes in the two adjacent strategies.
- 7.1.3 The first phase of works to the watercourses will be a scheme for Royles Brook and Hillylaid Watercourse; this will be delivered by the Environment Agency as part of their capital programme for main river works.

Programme and spend profile

- 7.1.4 Table 7.1 presents the key dates for the appraisal and delivery stages for the three priority schemes arising from the strategy.

Table 7.1 Key dates

Activity	Date
Sub Unit 0 - Anchorsholme	
Commence detailed appraisal	Dec 2012
Approval	July 2013
Construction start	Oct 2013
Construction completion	July 2016
Sub Unit 3 – Rossall North	
Commence detailed appraisal	Dec 2012
Approval	July 2013
Construction start	Jan 2014
Construction completion	Mar 2018
Sub Unit 9 – Royles Brook & Hillylaid Watercourse	
Commence detailed appraisal	Jan 2013
Approval	Apr 2014
Construction start	Dec 2016
Construction completion	Dec 2019
Beach management	
Commence detailed appraisal	Complete BMP by January 2014
Approval	May 2014
Construction start	2017
Construction completion	2017
Ongoing beach management	2018 onwards

- 7.1.5 There are no known environmental constraints on the construction phase programme at present. This will be confirmed as the schemes progress through the detailed design phase with mitigation to reduce the impacts of any constraints adopted as necessary.

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Table 7.2 Annualised spend profile and OM partnership funding score

Costs (£k)	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	Total
Sub Unit 0 - Anchorsholme							
Partnership Funding Score = 155%							
Capital	-	3,967	3,967	325	1,106	-	9,365
Non-capital	409	198	198	13	13	13	844
Optimism Bias	246	2,499	2,499	203	671	8	6,125
Sub Unit 3 – Rossall North							
Partnership Funding Score = 138%							
Capital	-	15,823	15,823	15,823	1,620	5,501	54,589
Non-capital	282	1,246	475	475	-	63	2,540
Optimism Bias	169	10,241	9,779	9,779	972	3,338	34,278
Sub Unit 7 – Royles Brook & Hillylaid Watercourse							
Partnership Funding Score = 123%							
Capital	-	-	-	-	534	-	534
Non-capital	42	43	44	98	45	46	318
Optimism Bias	25	26	26	59	348	28	511
Sub Unit 0 to 4 – Beach Management Scheme							
Partnership Funding Score = 141%							
Capital	-	125	125	125	2,281	1,637	4,293
Non-capital	40	41	42	42	43	44	252
Optimism Bias	24	100	100	100	1,394	1,009	2,727

Note* Figures do not include inflation

Outcome measures contributions

- 7.1.6 The implementation of the works recommended in this Strategy will depend on adequate funds being available. Under the Flood and Coastal Erosion Resilience Partnership Funding (FCERPF) policy, the funding will be expected to be made up from Flood Defence Grant in Aid (FDGiA) together with external contributions. The amount of FDGiA money available depends on the outcomes delivered by the works.
- 7.1.7 Outcome measure scores have been calculated for the preferred option selected for the strategy area as a whole and for each of those sub-units where a need for capital schemes has been identified in the first five years following adoption of this strategy. The FDGiA calculator published by Defra and the Environment Agency in June 2011 has been used to calculate the scores. This is included in Appendix P. As the analysis is being undertaken for the overall strategy, rather than for specific schemes, the “benefit period” used by the FDGiA calculator has been taken to be 100 years, the appraisal period for the strategy.
- 7.1.8 As noted in Section 6.3.11, the majority of funding for the works proposed in this strategy will be through Defra Grant in Aid.
- 7.1.9 A local levy contribution has been agreed for the Royles Brook & Hillylaid scheme.

Table 7-3 Medium term outcome measures contributions

Outcome Measure	SU0 – Anchorsholme	SU3 – Rossall North	SU7 – Royles Brook & Hillylaid WC	Beach Management
OM1 Economic Benefit				
PV Benefits (£k)	141,158	981,777	65,256	141,158
PV Costs (£k)	17,540	74,726	10,700	17,540
Benefit Cost Ratio	8.0	10.7	6.1	8.0
OM2 Households at risk (Nr)	3,393	7,497	1,903	1,915
OM2b Households moving Risk Bands (Nr)	1803	6,377	1,903	1,167
OM2c Households at risk in Deprived Areas (Nr)	216	2,774	-	91
OM3 Households at reduced risk of coastal erosion (Nr)	-	-	-	-
OM4 Improved condition of SSSI (ha)	-	-	-	-
OM5 BAP Habitat (ha)	-	-	-	-
Raw Score	155%	135%	123%	141%
Contributions (£)	NIL	2,000	70	NIL
PF score	155%	138%	123%	141%

7.2 Procurement strategy

- 7.2.1 The Strategy has been developed in-house by Wyre Borough Council with support provided by Halcrow Group Ltd. Birse Coastal fulfilled the Early Contractor Involvement (ECI) role and assisted with works cost estimates and construction/buildability advice.
- 7.2.2 Procurement of the appraisal and delivery phases for the coastal works in SU0 and SU3 (Rossall North and Anchorsholme) is underway with a tender process to identify the Preferred Bidder for a design and build contract. The Preferred Bidder will be selected by the end of November 2012, after which the schemes will undergo detailed design (supported by further investigations as necessary) leading to an anticipated construction start in May 2013. The Contractors will be asked to provide prices for the construction of the projects as separate contracts as if not constructed in parallel. They will also be asked to provide a price for constructing the projects concurrently or in parallel demonstrating the cost saving that this will provide if monies can be secured for both within the same timeframe.
- 7.2.3 For the watercourse works in SU7, the Environment Agency will use their Framework Suppliers to carry out capital works and local Operations Delivery teams to undertake maintenance activities, as appropriate. The PAR will be completed in early 2013, leading to construction financial year 2013/14.

7.3 Delivery risks

High level risk register

- 7.3.1 The key risks to the implementation of the strategy are listed in Table 7.4 along with the mitigation measures identified to date. There is a combined FPCP Risk Register that is

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reviewed by Blackpool, Wyre and Fylde Councils on a regular basis. A copy of this is provided in Appendix I.

Table 7.4 High level risk schedule and mitigation

Key project risk	Adopted mitigation measure
No funding to progress schemes before a major breach is experienced on river or coastal frontages.	Work with local communities and local authorities to secure external funds and developer contributions. Continue maintenance where possible including river bank breach repairs. Failure to secure funding will require plans to be prepared by the Environment Agency and Local Authorities for affected communities to adapt. Work with local communities to update emergency plans, increase local preparedness and resilience. Continue annual maintenance.
Only one of the schemes in the FPCP obtains funding for construction in the MTP resulting in separate contracts and removing the opportunity to package work and work more efficiently.	The Contractors have been asked to price the projects based on two scenarios: starting construction on SU0 and SU3 concurrently and; starting construction independent of each other. Contracts will not be awarded until the funding allocation is confirmed.
Unforeseen ground conditions resulting in increased construction cost.	Site investigation to be undertaken to support detailed design, reducing uncertainties over ground conditions.
Adverse public reaction to proposed options.	Appropriate consultation built into detailed design/planning stage, reducing the likelihood of public objections.
Non agreement on impacts upon internationally designated sites delays letter of support from Natural England and sign off of Habitats Regulations Assessment.	Continued liaison with Natural England, with support/evidence from ongoing studies.
United Utilities (UU) announces intention to undertake capital expenditure concurrent with coastal works.	FPCP to continue liaison with UU to reduce the risk of this occurring, seeking to identify opportunities for savings if programmes are coincident.

Safety Plan

- 7.3.2 At the strategy level the consideration of health, safety and environmental risks has been paramount in the appraisal of options. Options assessment has included assessment of buildability, operation and maintenance and risks to the public access the defences and adjacent beaches.
- 7.3.3 During the PAR development for the coastal works, Wyre Borough Council will be the Client under the CDM Regulations, with the CDMc role being fulfilled by Blackpool Council. The Preferred Bidder team identified via the current procurement process for the delivery phase will act as Principal Contractor and Designer for the priority schemes as they move forward.
- 7.3.4 During the PAR development for the watercourse works the Environment Agency will be the Client under the CDM Regulations, with the CDMc role being fulfilled by framework suppliers.
- 7.3.5 Public Safety Risk Assessments will be established prior to construction of the schemes.

Appendix A Project appraisal report data sheet

Entries required in clear boxes, as appropriate.

GENERAL DETAILS

Authority Project Ref. (as in forward plan):

Project Name
(60 characters
max.):

Wyre Urban Core Strategy

Promoting Authority: Defra ref (if known)
Name

Wyre Borough Council

Emergency Works:

No Yes/No

Strategy Plan Reference:

Wyre Urban Core Strategy

River Basin Management Plan

North West

System Asset Management Plan

N/A

Shoreline Management Plan:

North West and North Wales SMP2

Project Type:

Strategy Plan

Shoreline Management Study/ Preliminary Study/ Strategy Plan/Prelim. Works to Strategy/ Project within Strategy/Stand-alone Project/
Strategy Implementation/Sustain SOS. 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:

2013

Estimated duration in months:

Various

Contract type*

Design/Construct

(*Direct labour, Framework, Non Framework, Design/Construct)

COSTS

Appraisal:

APPLICATION (£000's)

Costs for Agency approval:

Total Whole Life Costs (cash):

For breakdown of costs see Table in Section 2.4

CONTRIBUTIONS

Windfall Contributions:

NIL

Deductible Contributions:

NIL

ERDF Grant:

NIL

Other Ineligible Items:

NIL

LOCATION - to be completed for all projects

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

North West

Name of watercourse (fluvial projects only):

N/A

District Council Area of project (all projects):

Wyre Borough Council

EA Asset Management System Reference:

Grid Reference (all projects):

SD330450

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

DESCRIPTION

Specific town/district to benefit:

Fleetwood, Rossall, Anchorsholme

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

Strategy for coast, estuary and three watercourses for flood risk management for the next 100 years.
Leading to four main schemes for intervention:

Improve standard of protection at Rossall North (SU3): 2018, rock revetment, concrete seawall
Improve standard of protection at Anchorsholme (SU0): 2016, concrete revetment
Works to Royles Brook & Hillylaid Watercourse: 2014, improvements to outfalls/M&E
Beach management scheme for coastal frontage SU0-SU4: 2016-2017

DETAILS

Design standard (chance per year):

1 in 200

yrs

Existing standard of protection (chance per year)

1 in 75

yrs

Design life of project:

100

yrs

Fluvial design flow (fluvial projects only):

N/A

m³/s

Tidal design level (coastal/tidal projects only):

+6.3 (Yr 0)

mODN

Length of river bank or shoreline improved:

16,000

m

Number of groynes (coastal projects only):

35 (est.)

Total length of groynes* (coastal projects only):

3,700

m

Beach Management Project?

Yes

Yes/No

Water Level Management (Env) Project?

No

Yes/No

Defence type (embankment, walls, storage etc)

Walls/revetments/beach structures

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

ADDITIONAL AGREEMENTS:

Maintenance Agreement(s):

Not applicable

Not Applicable/Received/Awaited

EA Region Consent (LA Projects only):

Awaited

Not Applicable/Received/Awaited

Non Statutory Objectors:

No

Yes/No

Date Objections Cleared:

N/A

Other:

Not applicable

Not Applicable/Received/Awaited

ENVIRONMENTAL CONSIDERATIONS

Natural England (or equivalent) letter:

Awaited

Not Applicable/Received/Awaited

Date received

-

SITES OF INTERNATIONAL IMPORTANCE

(Answer Y if project is within, adjacent to or potentially affects the designated site)

Special Protection Area (SPA):

Yes

Yes/No

Special Area of Conservation (SAC):

Yes

Yes/No

Ramsar Site

Yes

Yes/No

World Heritage Site

No

Yes/No

Other (Biosphere Reserve etc)

No

Yes/No

SITES OF NATIONAL IMPORTANCE (Answer Y if project is within, adjacent to or potentially affects the designated site)

Environmentally Sensitive Area (ESA):	No	Yes/No
Site of Special Scientific Interest (SSSI):	Yes	Yes/No
National/Regional Landscape Designation:	No	Yes/No
National Park/The Broads	No	Yes/No
National Nature Reserve	Yes	Yes/No
AONB, RSA, RSC, other	No	Yes/No
Scheduled Ancient Monument	No	Yes/No
Other designated heritage sites	No	Yes/No

OTHER ENVIRONMENTAL CONSIDERATIONS

Listed structure consent	N/A	Not Applicable/Received/Awaited
Water Level Management Plan Prepared?	No	Yes/No
FEPA licence required?	Awaited	Not Applicable/Received/Awaited
Statutory Planning Approval Required	Yes	Yes/No/Not Applicable

COMPATIBILITY WITH OTHER PLANS

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

SEA/ENVIRONMENTAL IMPACT ASSESSMENT

SEA	Statutory required	Statutory required/Agency voluntary/not applicable
EIA	For future schemes	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)
	N/A		

Costs, benefits and 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: FRM = Benefits from reduction of asset flooding risk; CERM = 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)

LAND AREA

Total area of land to benefit:	1,600		Ha
of which present use is:	FRM	CERM	
Agricultural:	0		Ha
Developed:	1,600		Ha
Environmental/Amenity:	180		Ha
Scheduled for development			Ha

PROPERTY & INFRASTRUCTURE PROTECTED

	Number		Value (£'000s)	
	FRM	CERM	FRM	CERM
¹ Residential	28,766		4,740,205	
Commercial/industrial	tbc		tbc	
Critical Infrastructure	tbc		tbc	
Key Civic Sites				
Other (description below):				
Description:				

costs and Benefits

¹ Present value of total project whole life costs (£'000s):	£181,966	
Project to meet statutory requirement? Y/N	N	
	Value (£'000s)	
	FRM	CERM
Present value of residential benefits:	1,849,273	
Present value of commercial/industrial benefits:	99,701	
Present value of public infrastructure benefits:	Inc above	
Present value of agricultural benefits:	NIL	
Present value of environmental/amenity benefits:	NIL	
¹ Present value of total benefits (FRM & CERM)	£2,140,370*	
	*includes emergency services and risk to life	
Net present value:	£1,958,404	
Benefit/cost ratio:	11.8	
Base date for estimate:	2012 Q1	
FCERM-AG Decision Rule stage 3 applied	No	Yes/No
FCERM-AG Decision Rule stage 4 applied	No	Yes/No

OTHER OUTCOME MEASURE SCORING DETAILS

Super Output Area No*: Indicate if deprived: Yes/No
 (*as ranked by Indices of Multiple Deprivation)

Risk: VH, H or N/A

	Wetland	Saltmarsh/ Mudflat	
Net gain of BAP habitat:	NIL	NIL	Ha
SSSI protected:	NIL		Ha
Other Habitat:	NIL		Ha
Heritage Sites:	II		"I or II" , "II or other" or "N/A"

Exemption Details (if exempt from OM scoring system)

Exempt from Scoring:	<input type="text" value="NO"/>	Yes/No
Reason (max 100 chars):		

Outcome measure prioritisation priority score

Stage 1 - Calculate individual scores

Ref	Description	Project contributions (including adjustments)		Targets	Individual scores
OM1	Present value of Whole Life Benefits (£000s)	<input type="text"/>		Divided by <input type="text" value="3,700,000"/>	Gives OM1 individual score <input type="text"/>
		o1		t1	s1
OM2	Number of households moved from any flood / coastal erosion probability category to a lower one (households)	<input type="text"/>	Minus o2b <input type="text"/>	Divided by <input type="text" value="100,000"/>	Gives OM2 individual score <input type="text"/>
		o2	o2b	t2	s2
OM2b	Number of households moved from the very significant or significant flood probability category to the moderate or low flood probability category; or equivalent coastal erosion probability categories (households)	<input type="text"/>	Minus o3 <input type="text"/>	Divided by <input type="text" value="3,700,000"/>	Gives OM2b individual score <input type="text"/>
		o2b	o3	t2b	s2b
OM3	Number of households in deprived communities at reduced flood risk (households)	<input type="text"/>		Divided by <input type="text" value="9,000"/>	Gives OM3 individual score <input type="text"/>
		o3		t3	s3
OM5	The number of hectares Biodiversity Action Plan habitat created, net of compensatory habitats (Hectares)	<input type="text"/>		Divided by <input type="text" value="800"/>	Gives OM5 individual score <input type="text"/>
		o5		t5	s5

Not used (out of date template)

Stage 2 - Calculate overall OM prioritisation score

Score

Outcome Measure prioritisation score (total of individual scores divided by whole life cost)

(s1 + s2 + s2b + s3 + s5)

Divided by

Project whole life costs

Multiplied by
1,000,000

OM prioritisation score