Strategy approval report – PFP edit.

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StAR for Suffolk Estuarine Strategies, Blyth

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1.0 Introduction and Background

1.1 This Strategy Approval Report (StAR) is for the Flood Risk Management Strategy for the Blyth Estuary in Suffolk, from its tidal limit at Blyford Bridge to the coast at Southwold Harbour (Figure 1). The strategic objectives for this StAR are to:

a. develop a strategic approach to managing the flood risk to property and other assets around the estuary over the next 100 years.
b. comply with all statutory obligations arising from national and international nature conservation designations and related legislation in the area.

1.2 The Blyth Estuary is 11km long with about 17km of flood defences which can be divided into three sections. The upper section is confined to a river by low embankments (which are failing due to storm surges in 2006 and 2007). The middle section is an area of estuarine mudflats with some fringing saltmarsh. The lower section is a confined river flowing between reclaimed agricultural land, with Southwold Harbour at its seaward end. The estuary is in the Suffolk Coasts and Heaths Area of Outstanding Natural Beauty (AONB). Intertidal areas are part of the Minsmere to Walberswick Special Protection Area (SPA) and Ramsar sites. Two areas of freshwater habitat are also in the SPA; Tinker's Marsh and Hen Reedbeds.

1.3 The defences are primarily earth embankments, many with wave or toe protection. There are also some concrete walls within the harbour at the estuary mouth. These are either harbour quay structures that are the responsibility of the Harbour Authority or set back defences. In general, the defences are near the end of their useful life and need replacing if they are to be sustained into the future. To consider whether major works could be justified, a FRM strategy that includes the whole estuary has been developed. Work on the Suffolk Estuarine Strategies, Blyth (the Strategy) commenced in 2003. Three rounds of public consultation have been held, with the final consultation on the draft Strategy between 27th September 2007 and 29th February 2008.

1.4 The 1998 Suffolk Shoreline Management Plan (SMP) covers the adjacent open coast but not the estuary. The policy for the Southwold shore, which lies to the north of the estuary, is to Hold the Line. To the south of the estuary, the Suffolk SMP policy is Managed Realignment of the shingle bank. The Environment Agency has approved a project for this section of coast (Walberswick – Dunwich). Following damage during storm surges in 2006 and 2007, the Environment Agency has withdrawn maintenance from the shingle ridge, and this is now functioning naturally. It continues to provide front-line protection from waves and normal tides, but is subject to breaching during winter storms. This Strategy provides the third and final part of the essential planning for flood risk management on this coast. The strategy complies with the East Suffolk Catchment Management Plan (CFMP), which recommends a reduction in flood management intervention in Suffolk estuaries.

1.5 For this Strategy, the Blyth Estuary has been subdivided into 14 flood cells, each bounded by embankments, cross banks or other landscape features. These flood cells are shown in Figure 2.

1.6 Works identified by this Strategy will be undertaken under the Environment Agency's powers under Section 165 of the Water Resources Act (1991).

2.0 Problem

2.1 Flood Defence embankments in the Blyth Estuary protect 670ha of mostly grazing land. There are 86 residential and commercial properties within the 1 in 300 year (0.33%) Annual Exceedance Probability (AEP) floodplain. Most are near the mouth of the estuary on the edge of Southwold and Walberswick. There is a third cluster of properties upstream at Blythburgh, and a few isolated properties in other areas. At the harbour, there are 21 properties in front of the defences. Detailed levels surveys confirm that only 29 properties are below the level of the current defences, with a 1 in 20 year (5%) and 1 in 5 year (20%) AEP.

2.2 The A12, which is the main road between Great Yarmouth and London, crosses the flood plain on a bridge and embankment at Blythburgh. The road currently floods for 24 hours or more during surge tides with a return period of about 1 in 10 years (10%) AEP, causing significant disruption and diversions. The A12 diversion route is an increase of approximately 5 miles to the length of a journey. The A1095 (the main road into Southwold), also crosses the floodplain and has a similar level of protection. Much of the estuary and its floodplains are designated under the Habitats Regulations. There is a network of public rights of way on banks around the estuary, including the Suffolk Coasts and Heaths Path, which crosses the estuary at the Bailey Bridge (a former railway bridge). This is an important link between Southwold and Walberswick. The harbour supports a number of local businesses and is important for tourism and boating.

2.3 Studies undertaken at the start of the Strategy showed that, of the 14 flood cells around the estuary, eight had a Standard of Protection (SoP) of 1 in 1 year (100%), four had defences with a SoP of 1 in 5 year (20%) and two had a SoP of 1 in 20 year (5%), all against overtopping. Of these defences, three subsequently failed during storm surges in 2006 and 2007, and there was some damage to defences fronting two further cells. The residual life of the defences is 10 years or less for half of the defences, and 20 years or less for the other half. As sea level rises, the SoPs will continue to fall even if the existing height of embankments can be maintained.

2.4 Hydrodynamic modelling showed that failure of the embankments protecting either of the two larger areas of grazing marsh (Tinkers Marsh and Reydon Marsh) would significantly increase the tidal flow through the estuary mouth and harbour. The implications are particularly severe with the loss of Reydon Marsh, which would increase the tidal volume by 52%. A full breach in either bank would increase current speeds and erosion in the harbour, which already experiences flow velocities of up to 6 knots and requires careful navigation.

2.5 Most of the public water supply for Southwold comes from groundwater on the edge of the Blyth floodplain. There is a potential for saline intrusion into this supply as a result of flooding. Also, there are sewerage pumping stations and electrical distribution apparatus located within the floodplain.

3.0 Options

3.1 A wide range of options have been considered. An initial options consultation process was undertaken in February 2004. A second round of consultation occurred in December 2004, when an Options Short listing Consultation Document was issued. The Preferred Option Consultation report was issued in September 2005, but it was widely criticised. The key issues of concern were the impacts on navigation of the proposed sill near Bailey Bridge and opposition to managed realignment on the south shore. A review of the initial Preferred Option was undertaken, which resulted in a draft Strategy, which was issued for consultation in September 2007.

3.2 From a longer list of options considered the following were taken forward for further consideration:

a. Option 1: No Active Intervention
b. Option 2: Do Minimum
c. Option 3: Sustain (Hold the Line) for 100 years (1 in 5 year, 20% SoP)

d. Option 9: Adaptation (Managed Withdrawal over 20 years), default to No Active Intervention
e. Option 9A: Adaptation + Secondary Defences

3.3 Options 9 and 9A have been appraised in line with the Environment Agency guidance note 'Withdrawal of Maintenance from uneconomic Sea Defences' (see Appendix I).

4.0 Recommended Strategy

4.1 The Preferred Strategic Option is Option 9A, which maintains existing defences to the end of their estimated residual life (subject to review if there is significant damage) and provides secondary defences for a number of areas using local funding. The priorities for providing defences are 1) along the line of Buss Creek to maintain the integrity of defences around the harbour (Town Marshes) and for properties along Ferry Road (flood cell 1), and 2) to protect the A1095 and Hen Reedbeds (flood cell 5-6).

4.2 We expect third parties to maintain some of the banks around the estuary once the Environment Agency has ceased maintenance work. This would not compromise the FRM objectives, but any proposals to strengthen the banks will be reviewed thoroughly by the local Development Control team prior to approval of any consents.

4.3 The preferred option will result in the failure of flood embankments round the estuary in the short-medium term (6-20 years), resulting in the following key effects:
a. loss of 264 ha of grazing land;
b. increased flow velocities at the mouth (potentially double) and erosion to the Harbour area, thereby threatening its use for navigation, and loss of 110 moorings;
c. tidal inundation of 93 ha of freshwater habitats within the SPA;
d. increase of 81 ha of tidal habitats in the SPA (and 12 ha subtidal);
e. increased flood risk to 29 properties unless secondary defences are provided;
f. increased flooding of infrastructure, including the A12, A1095, footpaths, and possible threat to water supply at Southwold

4.3a Draft proposals were presented at the Anglian Eastern RFDC meeting in September 2008. Most of the recommendations were approved, including the recommendation 'to note and support the implementation proposals'. However, the recommendation to support the Preferred Option was not carried. After the meeting there was some confusion as to what recommendations had and had not been approved. The situation was, therefore, discussed again at the next meeting on 16th January 2009, when it was confirmed that the RFDC supported the recommendation to continue with the internal review process.

4.4 The Environment Agency supported Suffolk County Council's application to Department for Transport (DfT) to raise the A12 embankment. This funding has now been approved. It is also in discussion with Essex & Suffolk Water with regards to climate change proofing of the water supply and the potential for partnership funding.

5.0 Economic Case and Priority Score

5.1 The Preferred Option has a Benefit Cost Ratio (BCR) >1. Although the Priority Score and Outcome Measures (OM)(Table 1.1) are quite low and make this Strategy appear unaffordable within the current funding regime, the majority of the costs incurred for withdrawing maintenance are statutory requirements to replace designated habitats which are not governed by the prioritisation system. See Table 2.20, for the detailed OM scores. The Environment Agency is working with other interested parties to identify all potential funding sources available to manage the Estuary over the short (5yrs), medium (20yrs) and long term. This will enable various stakeholder objectives to be combined and delivered in a more cost effective way. The Anglian Eastern Regional Flood Defence Committee (RFDC), which considered the draft strategy proposals on 26th September 2008, supported this action.

Table 1.1 – Economic Case and Priority Score

Flood cell	1-4	5-6	7	10	11	12	Total
Present Value benefits (£k)	22,600	16,600	2	4,800	1,500	300	45,800
Present Value costs (£k)	4,010	6,550	16	636	1,457	165	12,800
Net present value	18,600	10,050	-14	4,160	43	135	33,000
Benefit Cost Ratio	5.64	2.54	0.13	7.55	1.03	1.82	3.57
Cost per residential property (PV)	251	1,310	0	58	0	82	376
Defra Priority Score	10.57	4.20	-0.74	15.40	1.06	3.71	6.46
Outcome Measure Score	1.52	0.69	0.04	2.69	0.28	0.61	5.83

6.0 Environmental and Social Considerations

6.1 A Strategic Environmental Assessment (SEA) was undertaken. The report was made available to inform the consultation on the draft Strategy. Copies were sent to the statutory consultees, made available in local libraries, and on the Suffolk Estuarine Strategies website.

6.2 During consultation on the draft strategy, more than 100 letters and emails were received. A consultation report summarised the issues raised and explained how the comments had been taken into consideration. Detailed discussions were held with key consultees, including land-owners, local authority officers and councillors, the Blyth Estuary Group (a group of local people formed in response to the strategy) and nature conservation NGOs. The Preferred Option incorporates a number of changes in response to them:

a. inclusion of secondary defences in the Preferred Option to protect property subject to availability of local funding, be it Local Levy or private funding;
b. confirmation that landowners could maintain defences after Environment Agency withdrawing maintenance, subject to necessary permissions being obtained;

6.3 A Habitats Regulations Assessment (HRA) was completed to ensure the Strategy complies with the Habitats Regulations. A range of other significant environmental considerations were taken into account. New freshwater habitats will need to be provided to compensate for losses that are expected to occur in years 2-10 of this strategy. Sites for this habitat creation are already available and others are being secured through the Regional Habitat Creation Programme, and a case will be made to the Secretary of State to confirm that the compensation measures proposed are adequate.

6.4 The environmentally preferred option is a variant of Option 3 (Sustain, Table 2.4). However, the Preferred Option (9A – Adaptation + Secondary Defences) also came out favourably in the 21-100 year time period as it allows the estuary to develop more naturally.

7.0 Risks

7.1 The five key delivery risks are presented in Table 1.2.

8.0 Implementation

8.1 Following approval, landowners, key stakeholders and the public will be informed of the timetable for withdrawal of maintenance, in accordance with standard Environment Agency procedures. It is expected that some landowners will wish to take on maintenance.

Table 1.2 – Key delivery risks

Risk	Mitigation
Stakeholders continue to oppose the Preferred Option and raise a legal challenge.	Maintain dialogue and develop partnerships for providing defence improvements.
Availability of Local levy funding to implement secondary defences.	Develop proposals and seek approval from RFDC.
Compensatory habitat requirements change.	Maintain dialogue with Natural England and agree acceptance criteria for new habitats
The case for Imperative Reasons of Overriding Public Interest (IROPI) is rejected.	Maintain effective dialogue with Natural England and Defra and develop sound business case.
Banks breach in advance of secondary defence construction: widespread inundation.	Monitor embankments regularly.

8.2 The Preferred Option will be implemented in phases. In year 0, the Environment Agency will issue formal notices to withdraw maintenance to landowners in flood cells 5 , 6, 7 and 12. It is anticipated that the notices to flood cell 7 will take effect in year 2, with notices to flood cells 5, 6 and 12 taking effect in year 10. Maintenance will be withdrawn from the remaining flood cells in year 20, providing the next Strategy review continues to recommend this course of action.

8.3 Opportunities to partner with local organisations such as the Blyth Estuary Group who may wish to manage the defences around the estuary will be explored. The Area FRM teams will be involved in future discussions on managing of defences while any secondary defence work will be taken forward by developing PARs at the appropriate times.

8.4 The cost of the Strategy to the Environment Agency over the 100 year appraisal period is shown in Table 1.3. Costs of £14,600k will also potentially be incurred by third parties as a result of the Strategy.

Table 1.3 – Summary of costs for Preferred Option (£k)

£k	Flood Cells 1-4	Flood Cells 5-6	Flood cell 11	Flood cell 12	Total
Costs pre StAR					**590**
Habitat replacement	0	1,890	792	0	**2,680**
Secondary defences construction	651	1,480	0	53	**2,180**
60% Optimism Bias (36.5% of project)	391	2,020	475	32	**9,100**
Inflation @ 5% per annum	656	2,320	130	54	
Total capital cost	1,700	7,710	1,400	139	
Future construction					**7,250**
Maintenance over period of Strategy					**3,930**
Whole life cash cost					**25,100**

Notes: Numbers do not add due to rounding. See explanation of costs in Table 2.6.

9.0 Contributions and Funding

9.1 Several secondary defences are proposed subject to the availability of local funding. RFDC levy funding will be available to help meet the costs of providing some or all of these defences, but contributions from other local funding sources will be sought. These may include contributions from beneficiaries as well as local authority funds.

10.0 Status

10.1 New intertidal habitats may be formed due to the policy of withdrawal of public funding for maintenance, leading to a BAP contribution. However, landowners may decide to maintain or rebuild defences, and thus the timescale for this habitat creation is uncertain.

11.0 Recommendations

11.1 Strategic (A9) approval is recommended for the Suffolk Estuarine Strategies, Blyth for the whole life cost of £25,100k (£9,100k of which is optimism bias) over the next 100 years.

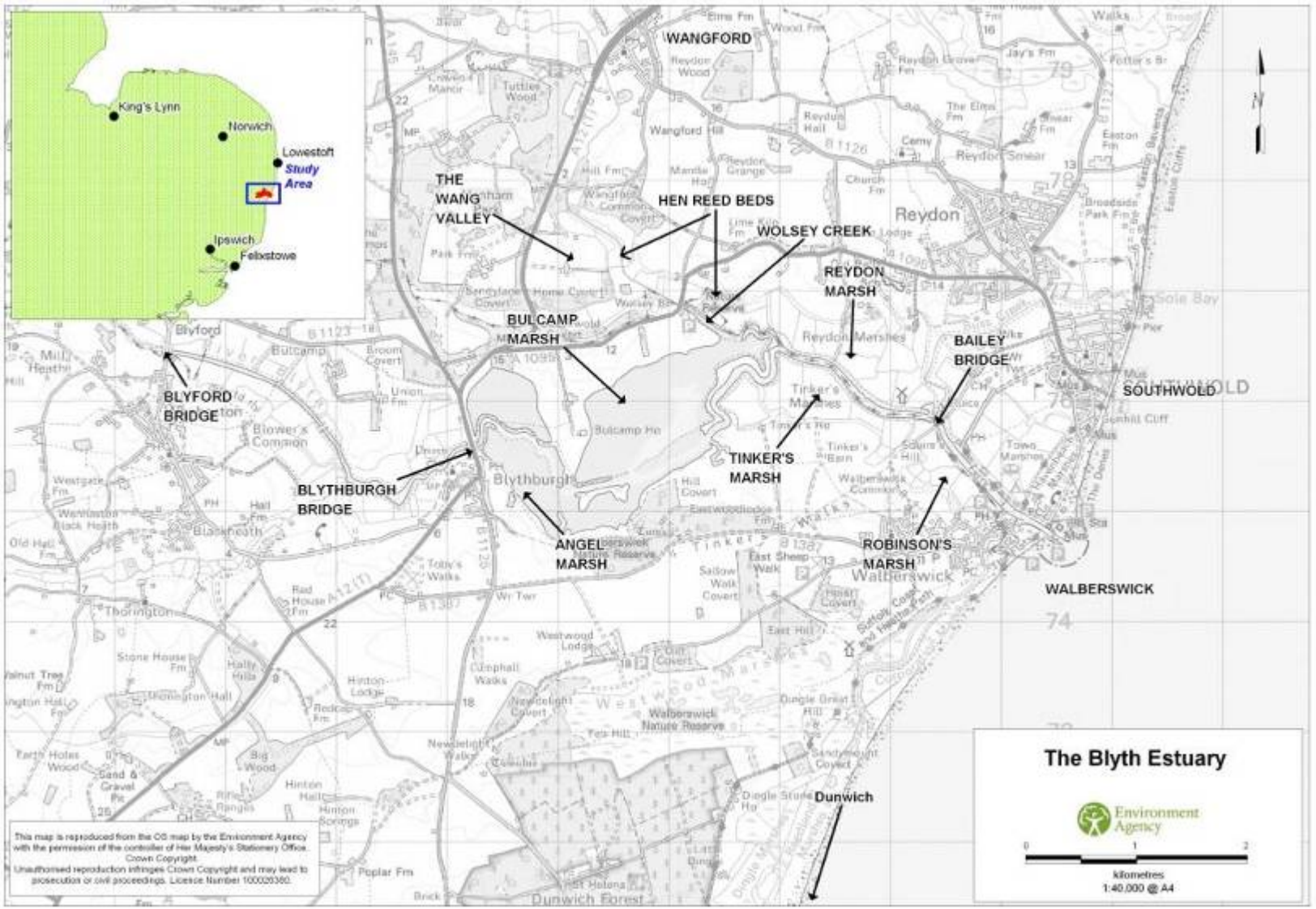

Figure 1 – Marsh Locations

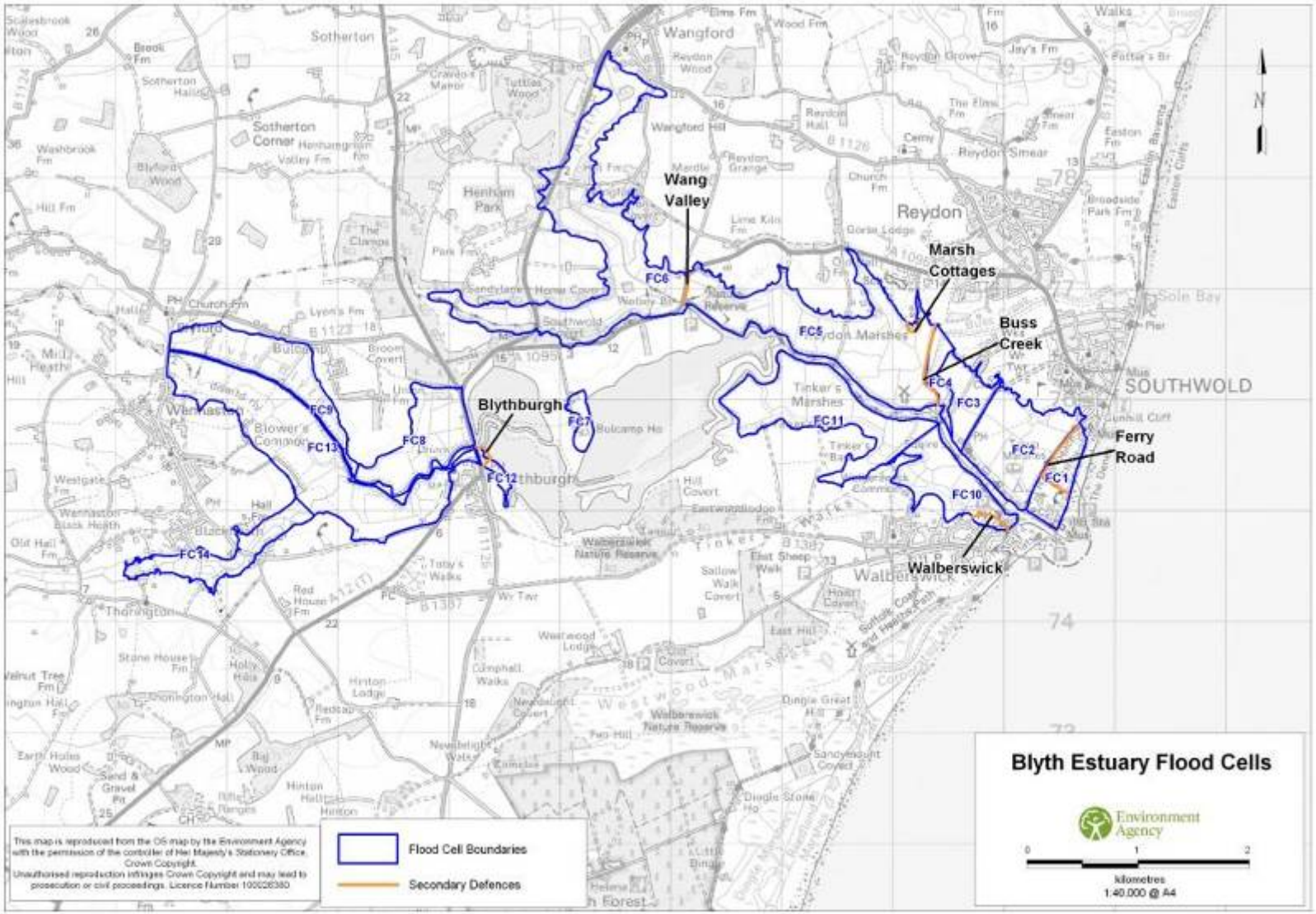

Figure 2 – Blyth Estuary flood cells and secondary defences

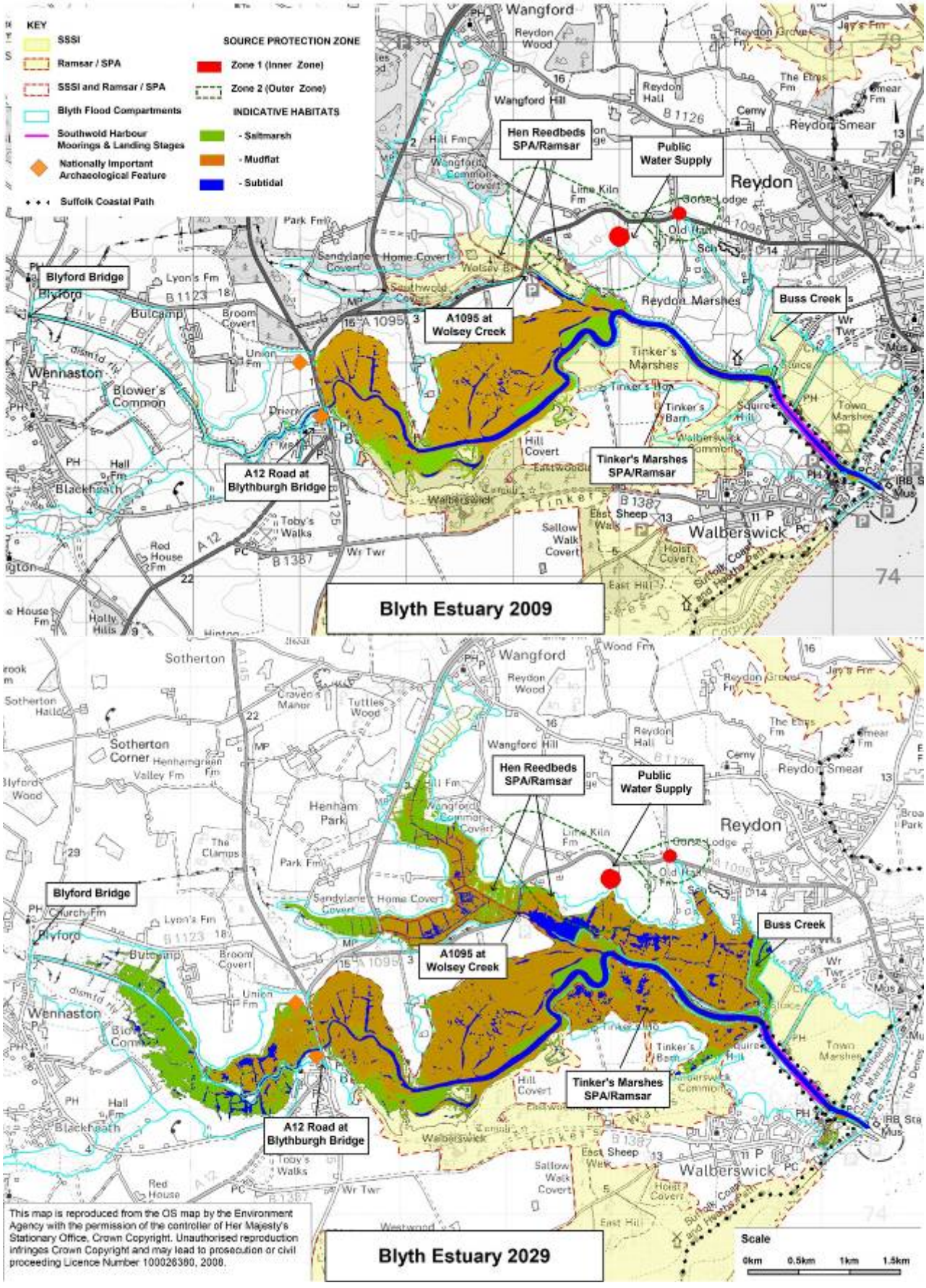

Figure 3 – Key Spatial Environmental Constraints

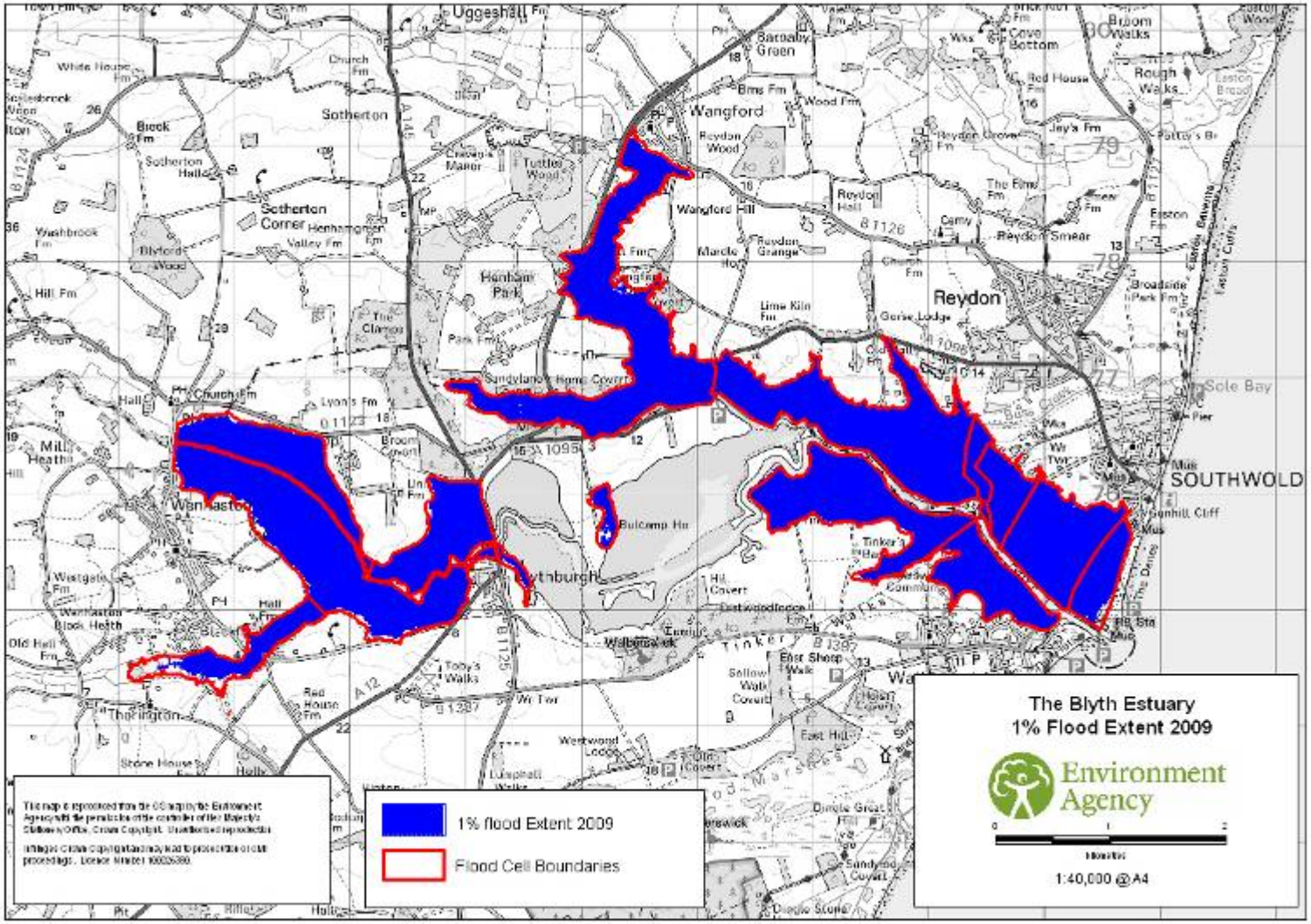

Figure 4 – Blyth Estuary 1% flood extents in 2009

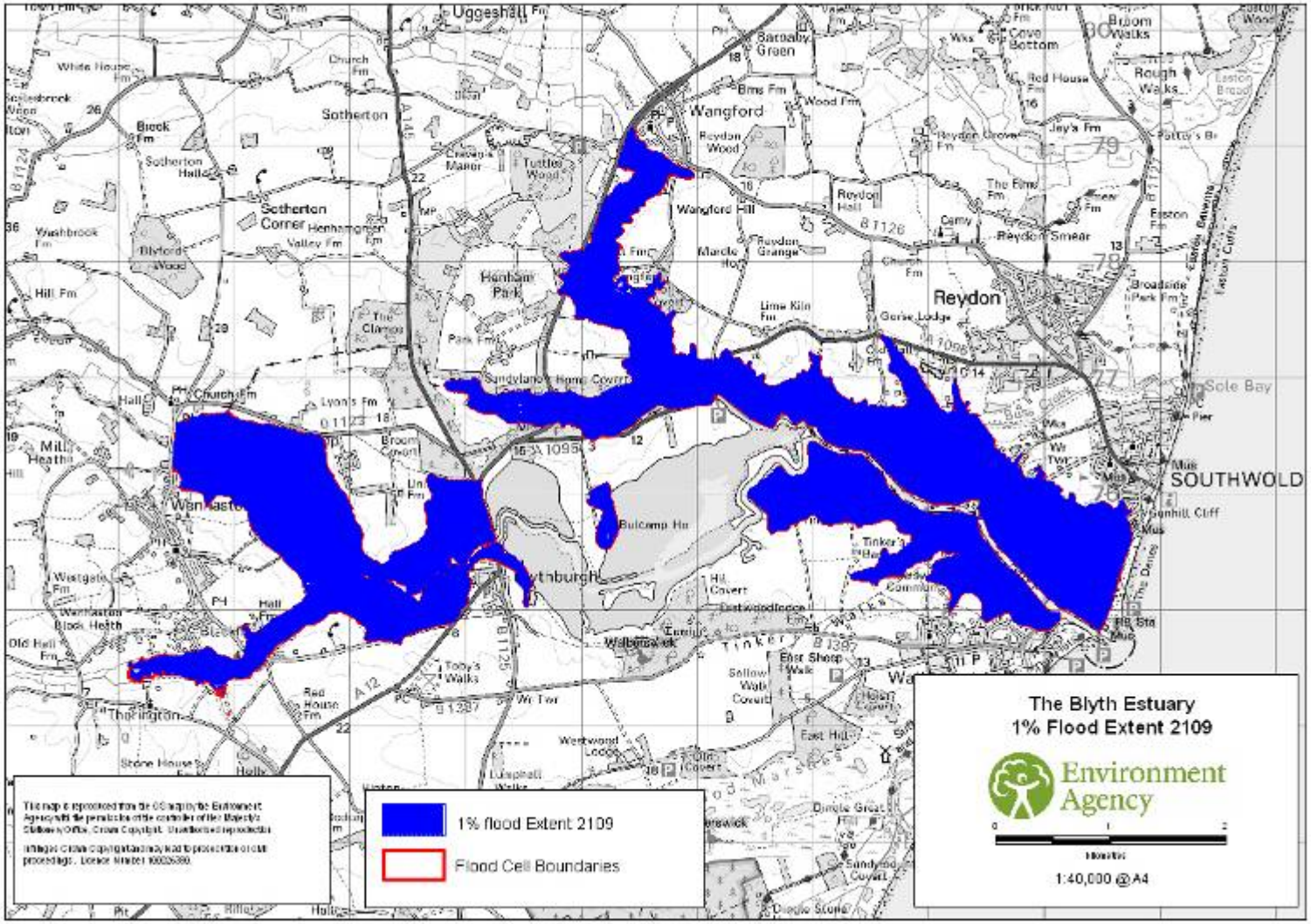

Figure 5 – Blyth Estuary 1% flood extents in 2109

2 BUSINESS CASE

2.1 Introduction and Background

Strategic Context

2.1.1 A scheme for flood and coastal erosion risk management that holds the existing line, as recommended in the SMP, has been implemented north of the mouth of the Blyth for the Southwold frontage. The works identified for this frontage included a terminal groyne to replace the northern harbour arm at Southwold in case of failure. These works will only be implemented if failure of the harbour arm is anticipated.

2.2 Problem

Table 2.3 – Properties at risk in the Blyth Estuary 1 in 300 yr (0.33%) floodplain

Flood cell	Properties within 1 in 300 yr floodplain		Properties within 1 in 300 yr floodplain which are protected by existing defences to the SoPs stated in Table 2.2	
	Residential	Commercial	Residential	Commercial
1-4	19	14	15	2
5-6	10	2	4	1
7	3	0	1	0
10	14	2	4	0
12	3	0	2	0
13	19	0	0	0
8, 9, 11, 14	0	0	0	0
Total	**68**	**18**	**26**	**3**

Table 2.3a – Assets in the Blyth Estuary 1 in 300 yr (0.33%) floodplain

Asset	Flood cell					
	1-4	5-6	7	10	12	8,9,11,13,14 (failed)
Roads		A1095				A12
Designated habitat[1] protected by existing defences (Ha)	76*	45 17*	0	0	0	48 14*
Wastewater Pumping Stations	3	1		1		1
Abstraction points		4				5
Water supply boreholes		Y				
Water&Elec. Apparatus	Y	Y				Y
Moorings	63			47		
Agriculture	Dunes, grazing marsh, golf course	Grazing marsh, intensive dairy farm, reed bed, nature reserve, sheep enterprise	Grazing marsh	Grazing marsh	Mudflats/ grazing marsh	Grazing marsh
Other	Caravan park					

[1] Denotes SPA/Ramsar & SSSI unless otherwise stated
* Denotes SSSI only designation

2.2.16 Most of the public water supply for the Southwold area comes from groundwater on the edge of the Blyth floodplain. The geology of this water source is complex, and there is a risk it would suffer saline contamination if the local floodplain is permanently inundated. Temporary inundation as a result of overtopping is unlikely to negatively affect the aquifer. There are also potable water and wastewater pumping stations as well as electrical distribution apparatus located within the floodplain.

2.2.17 The present estuary configuration causes high velocities to occur within the harbour mouth and, to a lesser extent, within the lower canalised section of the estuary, as tidal water flows through this section to inundate the mudflat area in the central estuary each tide. These high velocities are causing gradual erosion of the flood defence embankments in the canalised section (flood cells 1 - 5 and 10).

2.2.18 Based on estuary flow modelling, the failure of the Tinker's Marsh (flood cell 11) flood defence in 2007 is predicted to increase velocities in the canalised section of the lower estuary by 22% once the breach has fully developed. This is because the 64ha increase in estuary area will increase the tidal volume entering and leaving the estuary each tide.

2.2.19 If the existing defence to Reydon Marsh (flood cell 5) fails it is estimated that the estuary area will increase by 105ha, and maximum velocities in the canalised section will increase 52% above the values experienced prior to 2006. It is likely that this will dramatically increase erosion rates in the canalised section and through the harbour mouth. The erosion pressure is expected to be most severe on the banks as the estuary attempts to widen since its hard bed prevents it deepening.

2.2.20 Sailors, fishermen and the ferry boat operators who use the harbour are currently at risk because of the high velocities experienced at some states of the tide. These difficulties increased following the breaches at Tinker's Marsh (flood cell 11) in 2007 and will worsen if other upstream defences fail, especially the bank protecting Reydon Marsh (flood cell 5).

2.2.22 Work undertaken during the development of this Strategy suggests that the estuary is a small net exporter of sediment. However, some other studies show accretion in at least some areas, although this is not necessarily inconsistent with the findings of the modelling studies. An independent study by Kenneth Pye Associates was undertaken to provide clarification. A technical response to this review is presented in Appendix M. The conclusions of this study do not change the Strategy because:

a. the primary driver for the preferred Strategy is that it is unaffordable to maintain the current defences in present circumstances (see section 2.7.15);
b. the decision to withdraw from some of the defences before year 10 is based on their poor condition at the time of assessment, which could be extended by strengthening works undertaken by the Agency or local landowners (see section 2.7.16); and
c. the Strategy recommends future review of withdrawal of maintenance timing depending upon how the defences have performed (see section 3.12).

Impact of climate change on estuarine behaviour

2.2.23 At present the rate of sedimentation appears to be sufficient to keep pace with rising sea levels. However, if the rate of sea level rise increases, there will be a point in time when this is no longer the case. It is not clear from the available evidence when this will occur, although if the rate of sea level rise is in line with current predictions, it is likely to happen at some point over the 100 years of this strategy. When that happens, the tidal volume of the estuary will increase, thereby increasing both velocities and erosion in the artificially narrow outer part of the estuary. If the estuary plan area increases because of failure or removal of some defences, the effect of sea level rise on tidal volume will be even greater.

2.3.14 Sustaining the current SoP for greater than 20 years will be very challenging due to the effects of climate change. More heavily engineered structures will be required which are designed to withstand a higher frequency of flooding and a higher rate of erosion due to sea level rise, possible increased storminess and greatly increased current speeds. Despite the rebuilding, these new flood defences are anticipated to fail in approximately year 50, at which point they would require further raising and strengthening to sustain the existing standard of protection for the remainder of the strategy period.

Adaptation Strategy (Option 9)

2.3.15 When it became apparent that a No Active Intervention or Do Minimum option might become the outcome of the Strategy, an Adaptation option was developed to implement a withdrawal within the guidelines of the Environment Agency's 'Withdrawal of Maintenance from Uneconomic Sea Defences' which is included as Appendix I. Costs for this Option include those incurred by the Environment Agency during the formal notice period, a contribution to the construction of a new terminal groyne at Southwold and works that the Environment Agency is required to undertake by law or to meet high level targets. Similar to Option 2, Option 9 will maintain the approximate SoP set out in Table 2.2 until failure of the defence. The differences between Option 2 and Option 9 with regards to withdrawal period and cost are set out in Table 2.4a below.

Table 2.4a – Cost differential between Option 2 and Option 9

Flood cell	Expenditure Category	Option 2		Option 9	
		Cash Cost (£)	Expenditure Years	Cash Cost (£)	Expenditure Years
1-4	Maintenance & liaison with residents	9041	0-4	20809	0-1
		7969	5-9	24238	2-4
		3840	10-14	22969	5-9
				15469	10-19
	Habitat maintenance	128	5-14	768	20-99
		768	15-99	0	NA
	Terminal groyne	463144	15	463140	20
	Compensatory habitat	1986000	15	1986000	20
	Withdrawal year		**15**		**20**
5-6	Maintenance & liaison with residents	12210	0-7	16210	0-9
	Habitat maintenance	13864	5-99	13864	5-99
	Terminal groyne	463140	8	463140	10
	Compensatory habitat	1887000	5	1887000	5
	Withdrawal year		**8**		**10**
7	Maintenance & liaison with residents	2067	0-7	4067	0-1
	Withdrawal year		**8**		**2**
10	Maintenance & liaison with residents	7501	0-14	9501	0-1
				10358	2-4
				12501	5-9
				10001	10-19
	Habitat maintenance	384	15-99	384	20-99
	Compensatory habitat	49500	15	49500	20
	Withdrawal year		**15**		**20**

Flood cell	Expenditure Category	Option 2		Option 9	
		Cash Cost (£)	Expenditure Years	Cash Cost (£)	Expenditure Years
11	Maintenance	0	NA	0	NA
	Habitat Maintenance	6144	2-99	6144	2-99
	Compensatory habitat	792000	2	792000	2
	Withdrawal year		**NA**		**NA**
12	Maintenance & liaison with residents	2111	0-7	4111	0-9
	Withdrawal year		**8**		**10**

2.3.16 During the notice period for Option 9 routine maintenance will be undertaken and minor slips, washouts and breaches repaired. However, any major breaches of the defences such as those that require helicopter transport to remedy would not be repaired. Consultation will likely be required with many of the affected landowners, occupiers and infrastructure owners to help them adapt during the notice periods which are outlined in Table 3.1.

2.3.17 As with Option 2, the economic assessment of Option 9 excludes the cost of works that infrastructure owners undertake to mitigate damage to their assets arising from the withdrawal of maintenance of flood defences. These costs are estimated to be in the range £13m – £20m including optimism bias (see Table 2.6). However, the damages associated with not relocating these works have been included in the economic assessment.

Adaptation & Secondary Defences (Option 9A)

2.3.21 In addition to the Options described above, this Strategy has investigated the potential to construct secondary defences for communities located within the flood-prone areas that may result from the implementation of Option 9. Results of this investigation are summarised below. Further information is available in Appendix H.

2.3.22 These works are dependent on attracting funding from the Anglian Eastern Region Flood Defence Committee Local Levy funds and probably also additional funding from the local community (e.g. Local Authorities or action groups). The cost and benefits of these works are included within this Strategy as Option 9A. The Environment Agency is in discussions with other potential funding bodies and those with an interest in the future of defences in the estuary.

Secondary Defences for flood cells 1-4

2.3.25 Flood cells 1-4 are protected from flooding from flood cell 5 by two cross banks at Buss Creek. The withdrawal of maintenance from flood cell 5 in year 10 will, once the defences breach, allow tidal waters to reach the existing earth embankment on the west side of the creek on all tides. This embankment has an average level close to the 1 in 5 year (20%) AEP water level but is a steep sided embankment and has no erosion protection. A second embankment on the east side of Buss Creek is lower and in worse condition. If these embankments fail before maintenance is withdrawn from flood cells 1-4, it will put at risk the properties protected by these embankments as well as Town Marsh SSSI and tourism at Southwold Harbour.

2.3.26 To prevent this, the Buss Creek west bank is assumed to be strengthened in year 10. The economic viability of this scheme is assessed up to the anticipated withdrawal of maintenance from flood cells 1-4 in year 20. An improved 1 in 10 year (10%) SoP, which is close to the SoP of the existing defences, and erosion protection will be provided.

2.3.27 The defences protecting flood cells 1-4 along the north bank of the Blyth are expected to come to the end of their useful life in approximately 20 years. At this time, Withdrawal of Maintenance from these assets is likely to take place as the significant investment required is unlikely to be affordable on present investment criteria. To continue protection, a secondary defence could be developed along Ferry Road Southwold by raising an existing bank running parallel to and west of the road. This secondary defence would be closed by a cross bank to the dunes about 300m north of the existing river frontage, thus allowing the estuary to move northward. This would protect would protect 15 residential and 1 commercial property along Ferry Road, but would not protect the caravan park or the 15 properties in front of the current defences. Several other properties built on the dunes at the seaward end of Ferry Road would also be at risk of erosion if the estuary moved north once the harbour wall failed. A 1 in 10 year (10%) SoP is recommended.

Secondary Defence for flood cell 5

2.3.28 Marsh Cottages are subject to inundation if the flood cell 5 embankment breaches after maintenance is withdrawn in year 10. In this Option, a secondary defence with a 1 in 10 year (10%) SoP will be provided to protect these properties at that time.

Secondary Defence for flood cell 6

2.3.29 When maintenance is withdrawn from flood cell 5, flood cell 6 is liable to flood across the A1095 as there is no hydraulic division between the two flood compartments. An embankment of around 420m length on the east side of the A1095 would protect: the road, the 30ha section of Hen Reedbeds west of the road (designated as SPA), 10ha of reedbed not included in the international designation, 2 residential properties and the water supply for a quarry. This embankment would also reduce the risk of inundation of the A12 at two low points between Wangford and the Blyth causeway.

Secondary Defence for flood cell 12

2.3.32 There are two properties behind an existing embankment in flood cell 12. Strengthening of the existing embankment fronting these properties and providing a short cross bank to the A12 will provide an improved 1 in 10 year (10%) SoP for these two properties.

Table 2.5 – Option Cost Summary by flood cell (£k)

Flood cell	Option	Whole Life Cash Cost excl. Opt. Bias	PV Cost excl. Opt. Bias	PV Cost incl. Opt. Bias
1-4	2	297	561	897
	9	646	923	1,477
	9A	6,476	2,503	4,005
	3	17,136	6,904	11,046
5-6	2	3,339	2,749	4,398
	9	3,437	2,786	4,457
	9A	6,723	4,094	6,551
	3	22,213	10,185	16,296
7	2	21	19	30
	9	10	10	16
	9A	10	10	16
	3	841	248	397
10	2	224	144	230
	9	349	229	367
	9A	1,146	398	636
	3	4,700	1,780	2,848
11	2	1,394	911	1,457
	9	1,394	911	1,457
	9A	1,394	911	1,457
	3	11,277	6,065	9,704
12	2	21	19	30
	9	52	45	72
	9A	291	103	165
	3	867	331	530

Note: Preferred option is shaded

Preferred Option Costs

2.4.6 The northern harbour arm is expected to fail in year 50, requiring construction of a new terminal groyne for all Options. The capital costs only for this new groyne are considered in the economic appraisal for this Strategy. However, they are not included in the SoD approval cost for this Strategy as they have previously been justified within the Southwold Coastal Strategy. The costs for the terminal groyne have been divided in half between flood cells 1-4 and flood cell 5. If the Harbour Authority can find benefits for repairing the arm then the Environment Agency will be able to asses whether there is a joined up way to address the harbour issues and the coastal issues together. If there is no funding for maintenance of the arm for navigation purposes then building a new terminal groyne would be a more cost effective way of securing the coastal frontage than trying to maintain the arm for purely FRM benefits.

2.4.7 Costs of £14,567k are also likely to be incurred by third parties to protect or replace their infrastructure assets. It is assumed that the owners of Hen Reedbeds and Tinker's Marsh will incur all maintenance costs for those assets until withdrawal. These costs are not included in the totals for this StAR as they are not borne by the Environment Agency.

Table 2.6 – Summary of Costs for Preferred Option (£k)

£k	Flood cells 1-4 (yr 1-10)	Flood cell 5-6 (yr 1-10)	Flood cell 11 (yr 1-2)	Flood cell 12 (yr 1-10)	Total
Costs pre StAR					**590**
Habitat replacement	0	1,887[A]	792[B]	0	**2,679**
Secondary defences construction	651[C]	1,480[C]	0	53[C]	**2,185**[D]
60% Optimism Bias (35.7% of project)	391	2,020	475	32	**9,088**[E]
Inflation @ 5% per annum	656	2,323	130	54	
Total capital cost	1,698	7,710	1,397	139	
Future construction					**7,251**[F]
Maintenance over period of Strategy					**3,925**[G]
Whole life cash cost					**25,128**

[A] Compensatory habitat for Hen Reedbeds SPA, replacement for Reydon Marsh BAP (yr 5)
[B] Replacement habitat for Tinker's Marsh SPA (yr 2)
[C] Flood cells 1-4 (Buss Creek – yr 10), flood cells 5-6 secondary defences (yr 10), flood cell 12 secondary defence (yr 10)
[D] Costs for Southwold Terminal Groyne are not included as they are justified in the Southwold Coastal Strategy.
[E] Includes optimism bias for maintenance and future construction
[F] Replacement BAP habitat in flood cells 1-4 and 10 (yr 20), flood cell 10 secondary defence (yr 20), flood cell 1 (Ferry Road) secondary defence (yr 20), future raising of flood cells 1-4, 5, 6, 10 and 12 secondary defences.
[G] Habitat maintenance, maintenance of existing embankments and secondary embankments for life of strategy or until withdrawal

2.5 Benefits of Options

Damages Calculation Methodology

2.5.5 The loss of 110 moorings in the Blyth Estuary is included in the assessment with a write off value of £3,539k. These losses were distributed between flood cells 2, 3 and 10 in accordance with the number of moorings adjacent to each flood cell. These moorings are written off when the adjacent defences fail. This cost is included as a damage in the economic assessment.

2.5.6 If maintenance of flood defences is not continued, the tourism value of the estuary could be reduced. However, in the long term the development of new features as a result of some options may lead to no net change in the tourism value. To represent the national value of tourism in the Blyth Estuary, a value of £4.19 per person (based on information in the MCM) at 2005 prices, was assigned to each of the 126,000 visitors to the estuary each year, as reported by Suffolk County Council. An annual average damages PV of £1,583k has been added to Option 1 to account for this reduction. Approximately 95% of this value was divided equally between Southwold (flood cells 1-4) and Walberswick (flood cell 10 and adjacent study area), with the remainder assigned to flood cell 6. Further assessment concluded that

a. 50% of the Southwold tourism value was assigned to sea front related activities in flood cell 1.
b. 50% of the Southwold tourism value was assigned to activities along the estuary banks of flood cells 2-4.
c. if the harbour wall and estuary mouth was abandoned in flood cell 1, the tourism value of the remaining dunes was assumed to amount to 25% of the total Southwold tourism value.
d. the majority of intangible tourism benefits in Walberswick were associated with beach tourism and activities east of Ferry Road which are outside this Strategy area. The proportion assigned to the estuary activities and boat moorings of flood cell 10 was

set at 25% of the Walberswick total.

Option benefit assessment

2.5.9 The Option 1 damages take account of a rise of 0.6m in sea levels over 100 years, as in the original FCDPAG3 guidance. Use of the older guidance does not impact those options with a lifespan of less than 50 years as the difference between old and new estimates of sea level rise is only approximately 65mm. However, there is an underestimate of damages over 100 years (Option 3 and 9A). Also, increased sea levels will increase damages in the period after 2150 as some additional properties will enter the floodplain, resulting in new damages, up to capping values, for those properties whose damage is not already capped. The effect of this on the PV of damages is small as they are heavily discounted.

2.5.11 The PV damages for the Preferred Option are presented in Table 2.7, along with the PV damages avoided. Both sets of damages are presented with and without the assumed intangible damages associated with tourism. Approximately 69% of the total damages in flood cells 1-4 and 27% of the damages in flood cell 10 are a result of these intangibles. Similarly, 65% of the damages avoided in flood cells 1-4 are related to intangibles.

Table 2.7 – Preferred Option damages in each flood cell (£k)

Flood cell	PVd incl. intangibles	PVd excl. intangibles	PV Damages Avoided incl. intangibles	PV Damages Avoided excl. intangibles
1-4	11,765	5,780	22,581	5,883
5-6	10,371	10,128	16,634	14,609
10	10,640	7,808	4,803	2,379

2.6 Environmental and Social Assessment

Introduction

2.6.4 The Preferred Option will require the Environment Agency to undertake a range of works over the lifetime of the Strategy. These can be categorised as maintenance works to existing flood defences; improvement works to retreated defences; coastal protection works through the provision of a rock groyne on the coast; and, works to replace and compensate for freshwater SPA and Ramsar habitat (see Section 2.6.16).

Environmental Impacts

2.6.15 The Environment Agency will refrain from taking any actions that may exacerbate flood risk in the Blyth Estuary and will not unreasonably withhold permission from landowners or others who may wish to maintain the defences protecting their property. Natural England has indicated that they will follow a similar policy.

Table 2.8 – Key environmental and social impacts directly affecting option selection[A]

Option	Key positive impacts	Key negative impacts
1 No Active Intervention	▪ Short term reduction in water levels and flood risk. ▪ Increase in area of saltmarsh and mudflat in the short term and associated nature conservation, recreation and water quality benefits in the medium term.	▪ Failure of defences leading to short term loss of freshwater SPA and Ramsar habitats; waterside Public Right of Way (PRoW) network and harbour facilities. ▪ Defence failure may also lead to saline contamination of a potable groundwater abstraction. ▪ Loss of grazing marsh BAP habitat. ▪ Loss of access, and potential damage to, a Grade II listed drainage pump. ▪ Reduced SoP for 29 properties. ▪ Greater erosion risk for 21 properties.
2 Do Minimum	▪ As above with short term delay in the onset of effects.	▪ As above with short term delay in the onset of effects.
3 Sustain (Hold the Line)	▪ Maintenance of flood protection, access to PRoW network and harbour facilities, moorings and navigation. ▪ Protection to potable groundwater abstraction. ▪ SoP maintained for all properties.	▪ Significant construction impacts on freshwater SPA/Ramsar features & future coastal squeeze of intertidal SPA/Ramsar features. ▪ Visual impact of FRM structures on AONB.
8 Hold the Northern Line	▪ As above with reduction in flood risk; and, ▪ Expansion of intertidal mudflat and saltmarsh over short and medium term.	▪ Tidal inundation of freshwater SPA & Ramsar at Tinker's Marshes. ▪ Loss of waterside PRoW & harbour facilities in the medium to long term. ▪ Reduced SoP for 7 properties. ▪ Increased erosion risk for 6 properties.
9 Adaptation	▪ Short term maintenance of flood protection, access to the PRoW network harbour facilities and moorings in the lower estuary. ▪ Expansion of mudflat and saltmarsh. BAP habitat over short and medium term & associated nature conservation, recreation and water quality benefits.	▪ Failure of defences leading to loss of freshwater SPA and Ramsar habitats in the short term. ▪ Defence failure may lead to saline contamination of a potable groundwater abstraction. ▪ Loss of waterside PRoW network along current alignment and harbour facilities in the medium term. ▪ Loss of grazing marsh BAP habitat. ▪ Reduced SoP for 29 properties [B]. ▪ Greater erosion risk for 21 properties in the medium term. ▪ Loss of access, and potential damage to, a Grade II listed drainage pump

[A] short term = 0-20 yrs, medium term = 21-50 yrs, long term = 51-100 yrs

[B] For Option 9A, Adaptation + Secondary Defences, the SoP will increase for 11 properties (7 of which are not currently protected by the defences – i.e. not included in the 29 properties) and decrease for 2 properties over the long term. There will be greater erosion risk for 21 properties in the medium term.

Key Issues in the choice of the Preferred Option

2.7.16 Landowners and affected infrastructure owners are being consulted to consider a partnership approach to maintaining a defence at Reydon Marsh. Through this initiative, it may be possible to identify a low-cost option that potential funding partners can afford.

2.7.17 Opportunities to provide economic and affordable protection for residential property in flood cells 1, 5, 6, 10 and 12 have been investigated and are included within option 9A to mitigate the effects of the Preferred Option. These embankments would protect the majority of the properties that directly benefit from the existing defences.

2.7.18 The Preferred Option has not been welcomed by the local community and has led to the formation of local pressure groups, though environmental organisations including Natural England have been more supportive, subject to resolution of specific concerns.

2.7.19 The local council officials, elected representatives and infrastructure owners generally understand that within the funding and appraisal constraints imposed on the Environment Agency the Preferred Option is the likely outcome. These organisations, however, strongly oppose the policy and legal framework within which the Strategy was developed, and are likely to challenge it using whatever methods are available to them. The opposition centres around two issues:

a. The assessment does not take local economic issues such as tourism into account in an adequate manner, as it is done on a national basis, and
b. The approach of the appraisal method is the “beggar my neighbour” philosophy of transferring costs from one publicly funded body, the Environment Agency, to others such as local councils or private utility companies, which are all under pressure to minimise costs.

Recommendation

2.7.22 Further, the Environment Agency should include construction of a new terminal groyne at Southwold in its Medium Term Plan. The timing of this work should be planned in consultation with the Harbour Authority before the existing Southwold Northern Harbour Arm is abandoned or anticipated to fail.

2.7.23 The Environment Agency will continue close liaison with local authorities, landowners, tenants, infrastructure owners, Harbour Authority, and highways and footpath officers, to provide advice and assistance in their adaptation to the change in circumstances associated with the withdrawal of maintenance. It is likely that third parties will seek to maintain some of the banks around the estuary once the Environment Agency has ceased maintenance work. While this would not compromise the FRM objectives, any request to improve the banks by third parties should be reviewed thoroughly by the Environment Agency prior to approval being granted.

2.7.24 The Environment Agency will continue to investigate opportunities of working in partnership with the Local Authorities and all other third parties for economical mitigation of the effects of withdrawal of maintenance on property owners and the footpath and transport network. This is to try and deliver acceptable solutions by joint funding schemes where affordable.

2.8 Other Considerations

Health and safety

2.8.1 The following public safety issues have been identified for this Strategy:

a. During storm surges the risk of breach of defences that are not maintained will increase and pose threats to people, livestock and property within the floodplain.

The risk is primarily in the flood cell behind the breach site but extends to adjacent flood cells if the cross banks are overwhelmed;

b. Public footpaths along embankments that are no longer maintained by the Environment Agency will deteriorate and are likely to breach unless maintained by the landowner;
c. Increased difficulty for navigation and mooring within the Harbour and canalised estuary particular at times of spring tide;
d. Increased risk of saline contamination of public water supply from Reydon Marsh that provides summer drinking water supply to Southwold;
e. Occasional inundation of the A1095 Southwold to Blythburgh road and damage to its formation that may cause it to break up;
f. Occasional flooding of the A12 between Blythburgh and Wangford and of the access route to the Suffolk County Council landfill site.

Sustainability

2.8.2 Implementation of the Preferred Option will assist in the long term sustainable management of the UK coastline in the face of sea level rise by removing the economic burden of maintaining unaffordable flood defences from the national budget. While this will have long term benefits for the sustainable management of the UK coastline it will cause local economic difficulties while local residents and businesses adapt to the loss of existing economic and housing assets before the end of their economic life.

2.8.3 The existing poor condition of the Reydon Marsh (flood cell 5) flood defences and their short residual life may cause particular difficulties for the Highways Authority and for the water supply utility. Maintenance will be withdrawn in 10 years subject to the outcome of close monitoring and events, with the proviso that a serious event could result in a shorter life but favourable events could allow us to maintain for somewhat longer. It is intended to provide as much notice as is technically possible to these infrastructure providers to develop appropriate mitigation measures. This time is also required for the Environment Agency to develop replacement habitat for the anticipated loss of the Hen Reedbeds SPA.

Planning Policy and Development Control

2.8.4 The planned progressive withdrawal of maintenance from the Blyth Estuary over the next 20 years is to be included by local authorities in their Local Development Plans. These should prohibit any development within the floodplain that relies implicitly or explicitly on the presence of the estuary defences. They must take account of the anticipated widening of the estuary mouth in the medium to long term and the uncertainty at this time whether this enlargement will take place to the north or south of the existing entrance. Before planning policies are modified, Environment Agency Development Control officers will object to all developments that are not compatible with this Strategy.

3. STRATEGY PLAN

3.1 The Preferred Option has been appraised against the Strategic objectives, as below:
a. develop a strategic approach to managing the flood risk to property and other assets around the estuary over the next 100 years.
b. comply with all statutory obligations arising from national and international nature conservation designations and related legislation in the area.

3.2 The management approach for the Blyth Estuary is recommended to be Phased Withdrawal over a period of 20 years, with provision of a number of secondary defences to be funded locally. The implementation programme for the Strategy is shown in Table 3.1.

3.3 The Strategy will also involve the continued operation of the existing flood warning system, with a local campaign to raise awareness of the changing flood risk arising from the Strategy and to improve take up of the continuing flood warning system.

Table 3.1 – Key implementation stages of the Strategy

Year	Activity
2009	Issue notice to withdraw maintenance from flood cells 7 in 2011. Issue notice to withdraw maintenance from flood cells 5, 6 and 12 in 2019. Issue preliminary notice to withdraw maintenance from all other flood cells in 2029. Sourcing of replacement habitat via Anglian RHCP.
2011	Withdraw maintenance from flood cell 7.
2019	Construct secondary defences in flood cells 1-4 (Buss Creek), 5-6 and 12. Withdraw maintenance from flood cells 5, 6 and 12.
2019 – 2024	Review Strategy with respect to updated guidance and historical maintenance costs.
2029	If confirmed in Strategic Review, withdraw maintenance on all remaining flood cells (1-4 and 10). Construct secondary defence in flood cell 1 (Ferry Road) and 10.
2030 - 2109	Continue maintenance of approved secondary defences to flood cells 1, 5, 6, 10, 12 and raise when required.

3.12 The proposal to withdraw maintenance from flood cells 1-4 and 10 is provisional and will be subject to review during the scheduled strategic review in 10-15 years.

3.13 When a major breach of existing defences occurs, the consequences are not always predictable. In particular, cross banks that have not previously been tested as flood defences will become front line defences. The cross banks at Buss Creek will become a primary defence for the 10 years anticipated between withdrawal of maintenance at Reydon Marsh (flood cell 5) and the final withdrawal from Havenbeach, Town, Woodsend and Botany Marshes (flood cells 1-4). The Strategy proposes to strengthen this defence, but this is subject to availability of local funding.

3.14 The breaching of Tinker's Marsh and Reydon Marsh is expected to cause a 50% increase in tidal velocities in the canalised estuary and Harbour which will increase erosion pressure on remaining flood defence assets during the 10 years these defences are maintained. This will also affect the harbour quay wall and harbour arms that are owned by the Harbour Authority.

3.15 The long term coastal geomorphology consequences of the potential loss of the harbour arms and their replacement by a terminal rock groyne to protect Southwold are expected to lead to significant landward migration of the Dunwich to Walberswick coastline. Preliminary estimates in the draft SMP2 suggest a tenfold increase in the erosion rate at Corporation Marsh Walberswick compared with that predicted by the Dunwich to Walberswick Coastal Strategy. The southern extent of this realignment is uncertain but is expected to include the Dunwich cliffs.