The Humber Flood Risk Management Strategy
Consultation Document August 2005

planning for the rising tides
Key issues

Key issues affecting the need for and scope of a strategy include:

Condition and standard of defences
Although the existing defences are in reasonable condition and provide an adequate standard of protection, both the condition and the standard will reduce with time through natural deterioration and because of estuary processes, including the rise in sea levels.

Assets protected
The defences protect large numbers of people and major concentrations of residential, industrial and commercial property together with nationally important port infrastructure and extensive areas of highly productive and versatile agricultural land.

Justification for works
Nevertheless there are significant areas of the tidal floodplain that contain relatively small numbers of people and few properties and where, as a result, it will be difficult to justify the cost of repairing or improving the defences.

Sea level rise
Sea levels in the estuary are expected to rise relative to the land at an average rate of 6 mm per year over the next 50 years (and possibly at a higher rate subsequently).

Loss of inter-tidal habitat
As sea levels rise the presence of a system of defences around the estuary will result in the loss of about 600 ha of inter-tidal habitat due to coastal squeeze.

Habitats Regulations
The SPA/SAC designations within the estuary mean that, to comply with the obligations imposed by the Habitats Regulations*, where we cannot say that there won't be any loss of inter-tidal habitat resulting from a decision to continue managing the defences (whether due to coastal squeeze or to repair or improvement works) we will need to provide compensatory habitat as close to the location of the loss as possible.

Strategic realignment of defences
Realigning the defences at selected sites is the only way of providing this replacement habitat within the estuary and appropriate sites can only be identified through an estuary-wide (strategic) approach.

Impact of realigning defences
Maintaining or moving defences in the middle or outer parts of the estuary (seaward of the Humber Bridge) will have little effect on overall estuary processes or on the defences elsewhere, however doing so further landward could affect water levels.

Creating flood storage
Creating flood storage landward of the Humber Bridge, either by moving the defences or by allowing sections to overtop during extreme events, will lower flood levels and so reduce flood risk nearby. This may allow us to delay works that are intended to improve standards of protection. Suitable flood storage sites can only be identified and their benefits assessed through a strategic approach.

* The Conservation (Natural Habitats etc) Regulations 1994

Strategy objectives

Overall objectives
1. To develop a coherent and realistic plan for the estuary’s flood defences that is:
   • compatible with natural estuary processes;
   • compatible with adjacent developments, including preferred options for adjoining lengths of frontage; and
   • sustainable, taking into account future changes in the environment (human, built or natural), in sea levels or in the climate.

2. To ensure that all proposals are:
   • compatible with natural estuary processes;
   • technically feasible;
   • economically viable;
   • environmentally appropriate; and
   • socially acceptable.

Detailed Objectives

<table>
<thead>
<tr>
<th>To maintain and, where possible, enhance public safety, health and security</th>
<th>To protect people and their property from the adverse effects (physical and psychological) of flooding</th>
</tr>
</thead>
<tbody>
<tr>
<td>To respond to natural processes and to avoid contamination and erosion</td>
<td>To ensure proposals do not have adverse effects on wider estuarine processes</td>
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<tr>
<td>To protect and, where possible, provide opportunities for economic development and employment (including protection of existing land uses where appropriate)</td>
<td>To ensure that ‘contaminated sites’ are prevented from having an adverse effect on the estuary</td>
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<tr>
<td>To protect high quality agricultural land from flooding</td>
<td>To protect areas of employment from the adverse effects of flooding and provide a secure environment for economic activity and development</td>
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<tr>
<td>To ensure there are no adverse effects on navigation (e.g. on channels, deepwater docks and beacons etc)</td>
<td>To prevent adverse impacts of flooding on road and rail infrastructure</td>
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<td>To minimise adverse effects on the European site and ensure direct losses are compensated</td>
<td>To address the adverse effects of ‘coastal squeeze’ on the European site</td>
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<tr>
<td>To minimise adverse effects on undiscovered or buried archaeology</td>
<td>To protect designated archaeological and historic features within the floodplain</td>
</tr>
<tr>
<td>To ensure that characteristic and valuable landscapes are protected and enhanced and that recreational/amenity features are protected and promoted where possible</td>
<td>To protect and where possible enhance landscape, amenity and recreational values</td>
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</table>
In 1997 we began to develop a co-ordinated approach to managing the flood defences surrounding the Humber Estuary and the lower reaches of its main tributaries, the Yorkshire Ouse and the Trent. This led to the publication, in September 2000, of the Humber Estuary Shoreline Management Plan (HESMP), which defined the problem, identified the key issues, reviewed the options available and set out overall flood defence policies. It was based on a sound understanding of the physical processes taking place within the estuary and took into account the resulting economic, environmental and social impacts.

The HESMP indicated that a major programme of improvement works would be needed to counter the effects of sea level rise and to ensure that appropriate standards of protection are maintained. It also pointed out that in some places the defences will need to be realigned, either to make them more sustainable or to counter the effects of sea level rise, and supported the creation of new inter-tidal habitat to maintain the estuary’s conservation status.

Since the HESMP was published the implications of sea level rise and compliance with the Habitats Regulations have been clarified and a set of sites that will meet the various realignment needs over the next 50 years has been identified. A long-term programme of the works needed to manage the defences over the same period has been drawn up. We have reviewed plans for the next 15 years and confirmed priorities. Using this information we have developed our broad framework for managing the estuary’s defences into a comprehensive strategy covering the next 50 years. The works for the next 5 years have been assessed in greater detail. The need for a strategy and the way in which it has been developed are set out in Sections 1 and 2 of this document. Section 3 describes the strategy itself and the works to be carried out during the next 15 years while Section 4 states what will happen next. Section 5 sets out the implications for each of the compartments into which the floodplain has been divided for management purposes.
Section 1

**why have a strategy?**

**Land use and development**

The estuary’s defences protect nearly 90,000 ha of land from flooding, about 85% of which is farmed and is among the best and most productive agricultural land in the country. More than 300,000 people live or work in the floodplain, mostly in the towns and cities that occupy about eight per cent of its area. The floodplain also contains major concentrations of industrial and commercial properties, particularly between North Killingholme, Immingham and Grimsby, near Hull and at Goole and Flixborough. These include power stations generating much of the country’s electricity, refineries producing much of its oil and the country’s largest port complex, which handles over 80 million tonnes of cargo each year. Future development aims for the area are set out in current structure and local plans, which are due to be replaced by a new system of Regional Spatial Strategies and Local Development Frameworks. The Yorkshire and Humber Assembly’s Regional Economic Strategy indicates that the estuary, its assets and its hinterland are integral to the delivery of sustainable economic growth for the area. Substantial areas of the floodplain near Hull and Immingham have been earmarked for industrial development, and there are increasing pressures for residential development in various places on the floodplain.

**Flood defences and defence standards**

The floodplain is protected from flooding by a mixture of soft and hard tidal defences with a total length of about 235 km. The line of almost all these defences was established more than 100 years ago, although the defences themselves were largely rebuilt in the 1950s and 60s following the 1953 East Coast surge. During storms the defences are subject to a combination of high water levels and large waves, which can cause soft defences to be washed out and fail if too large a volume of water washes over the crest. Defences may fail for other reasons as well, such as undermining due to erosion of the foreshore or a layer of weak soil in the foundations. If defences fail large volumes of water can flow through the resulting gap at high tide leading to extensive flooding on the floodplain. The inflow will reduce, and may cease, as the tide falls but can recur on following high tides until the breach is sealed. Although the defences are generally in reasonable condition and provide an adequate standard of protection this is not the case everywhere, as shown on the maps on the next page. Repairs are needed in some places while elsewhere works are needed to improve the standard. Further works will be needed in the future to maintain, repair or improve the defences as they deteriorate. Altogether the defences protect some 60,000 residential or commercial properties and extensive areas of agricultural land valued at around £7 billion.
“Sea levels have risen relative to the land at an average rate of about one mm per year over the last 4000 years, although over the last 100 years the rate has almost doubled.”

Estuary processes and future changes

The Humber is a very dynamic estuary with a tidal range of up to six metres near the mouth at Spurn Head. High water levels vary along the estuary, being up to one metre higher (and one hour later) at Goole than at Spurn. Severe storms can raise water levels by up to 1.5 metres above normal and result in waves up to four metres high near the mouth, although upstream of the Humber Bridge waves are rarely more than one metre high.

Sea levels have risen relative to the land at an average rate of about one mm per year over the last 4000 years, although over the last 100 years the rate has almost doubled. About 6 million tonnes (dry weight) of sediment enter the estuary each year, most of it from the North Sea and the eroding Holderness Coast with less than three per cent from the rivers. Much of the material brought in from the sea returns on the subsequent tide but it appears that enough stays to ensure that the estuary remains roughly in balance. Nevertheless the foreshore is eroding and threatening the defences in places, particularly along the Immingham frontage, near Winteringham and in the rivers (where regular works are needed to protect the banks).

In the future sea levels around the UK are predicted to rise more rapidly and severe storms to become more frequent, increasing the risk of tidal flooding on the coast and near estuaries. In the Humber, the rate of rise is expected to average about six mm per year over the next 50 years, so that sea levels will be about 300 mm higher than they are now. As a result there will be a dramatic reduction in the standard of protection provided by the estuary’s defences. In addition, model studies of the estuary indicate that seaward of Trent Falls the inter-tidal area in front of the defences (the area between high and low water) will decrease by up to 600 ha over the same period due to the predicted rise in sea level, a phenomenon known as ‘coastal squeeze’.

Coastal squeeze

Where there are no flood defences, inter-tidal habitats (e.g. saltmarsh and mudflats) can respond to sea level rise by migrating inland. Where existing defences prevent this migration, inter-tidal habitats reduce in area due to the resultant ‘coastal squeeze’. The Government is expected to maintain the area of inter-tidal habitat within European Sites (sites designated under the European Habitats Directive 1994), so it is necessary to compensate for the effect of ‘coastal squeeze’ by providing replacement habitat or moving the defences so habitat migration can continue.

The model studies also indicate that moving defences located seaward of the Humber Bridge will have little effect on estuary processes or defences elsewhere. Modifying defences landward of the bridge however, would lower flood levels if extra flood storage is created as a result. The lower levels could postpone the need for other works.
Natural and historic environment

The Humber's inter-tidal area is currently estimated to be about 10,000 ha, of which more than 90% is mudflat or sandflat and the remainder is largely saltmarsh. The estuary and the adjacent coastline also contain significant areas of reedbeds, beaches, sand dunes and saline lagoons. Up to 160,000 waterfowl visit the estuary each year placing it among the top ten European and the top five UK estuaries for birds.

As a result much of the inter-tidal foreshore of the estuary and the adjacent coastline has been designated under the Habitats Regulations (1994) as a Special Protection Area (SPA) for its wildfowl and wading bird interest while the whole estuary is being considered as a Special Area of Conservation (SAC) under the same regulations. These designations require any developments (including flood defence works) that might significantly affect the area’s conservation status to be examined rigorously through the preparation of an Appropriate Assessment. If this shows the effects would be adverse, alternative solutions must be sought. If there are none, the development will be refused unless there is over-riding public interest, in which case compensatory habitat needs to be provided.

The Humber has seen intense human activity from the earliest times. As a result the estuary and its floodplain contain a complex array of historic buildings, settlements, landscapes and archaeological sites that are an important focus for education, tourism and recreation and contribute strongly to the region’s identity. Some of its more important features are covered by designations that have statutory backing. Developments that would affect them adversely would normally be refused unless there is over-riding justification.

Managing coastal habitats

In the HESMP we proposed that a Coastal Habitat Management Plan (CHaMP) would be prepared to assess the implications of the Habitats Regulations on the management of the estuary’s flood defences. This indicates that about 700 ha of new inter-tidal habitat is likely to be needed to replace the losses that will occur over the next 50 years. About 600 ha of this requirement is due to the effects of coastal squeeze with the balance compensating for unavoidable encroachment of repair or improvement works onto the foreshore and for disturbance while undertaking the works.

Managing flood risk

The potential impact of climate change on flooding in the UK has been examined in the Foresight Report ‘Future Flooding’, which points out that not only is the frequency of flooding likely to increase in the future but the consequences are also likely to become greater as people become more affluent and there is more pressure to develop in the floodplain. The Government has responded to this in a Consultation Paper ‘Making Space for Water’, which stresses the need to adopt sustainable approaches to managing these risks and to consider flood warning and the control of development in the floodplain as well as the provision of flood defences. It also points out that the cost of managing flood risk is likely to increase significantly in the future and suggests that alternative sources of funding, including contributions from developers and other beneficiaries, may need to be found.

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Section 2

The strategy is aimed at achieving objectives originally set out in the HESMP.

It has been developed in three stages:
- Defining the problem
- Developing the proposals
- Delivering the strategy

Objectives
The overall objectives of the strategy have not changed since we published our initial plan, the HESMP, in 2000. They are set out on page three. The detailed objectives are based on those set out in the HESMP but revised in the light of recent legislation and guidance, in particular that relating to the preparation of Strategic Environmental Assessments.

The development process

Defining the problem (1997-2000)
The problem was defined as the HESMP was being developed, and its main features are summarised in the list of key issues on page two. The first step was to learn about the people and property at risk in the area, about the defences protecting them, about the way the estuary behaves and how this influences the flooding that can occur and about the natural and historic environment that might be affected. The information led to the broad policies for managing the estuary’s defences set out in the HESMP.

Developing the proposals (2001-2004)
Further studies were commissioned to convert the broad management proposals set out in the HESMP into a detailed strategy. These focused in particular on improving our understanding about how the estuary is likely to behave in the future, on identifying sites for managed realignment and on drawing up a programme of the works needed on each defence frontage over the next 50 years (and anticipating that further works will be needed for the following 50 years, when sea levels will rise by a further 300 mm). The results allowed a detailed strategy for managing the defences over the next 100 years to be developed.

Delivering the strategy (2004-2005)
The long-term programme sets out the case for undertaking the strategy but does not provide the detail needed to obtain approval for the works to begin. Undertaking the works will be easier and more economical if they are packaged together rather than dealt with independently and the strategy provides an opportunity to do this. Additional studies to provide the necessary detail were undertaken, resulting in a package of works that is planned to begin on site in about two years, during the financial year 2007/08. This covers all the capital, maintenance and monitoring works that will be needed to manage the defences over this period (with an allowance for unexpected events) and the preparations for continuing to manage them in the future.
Consultations
Consultation with key stakeholders and the public has been a fundamental part of developing the strategy since it began. The main ways of doing this are outlined in the table below. The consultation and information documents that have been published are listed on page 51.

Principal findings
The principal findings of the studies undertaken while developing the strategy are summarised below. Overall findings:
• the value of assets in the flood plain mean it is essential to continue managing the estuary’s defences;
• generally the defences are likely to remain on their present alignment but there will be places where they will need to be moved;
• it is necessary to create new inter-tidal habitat to maintain the estuary’s conservation status.

Findings related to strategic and long-term programme issues:
• 600 ha of inter-tidal habitat is predicted to be lost due to coastal squeeze over the next 50 years if sea levels rise at an average of six mm per year;
• to compensate for this loss and for the direct effect of the proposed flood defence works, about 720 ha of new habitat could be needed over the same period to comply with the Habitats Regulations;
• realigning defences in the middle or outer parts of the estuary (seaward of the Humber Bridge) will have little effect on estuary processes or defences elsewhere but doing so further inland (and increasing the volume of flood storage as a result) will lower extreme water levels;
• nine potential managed realignment sites with a total area of about 1900 ha have been identified and selected for further consideration;
• seven of these sites will provide sufficient new inter-tidal habitat to comply with the Habitats Regulations for at least the next 50 years, and one of them (Alkborough) is upstream of the Humber Bridge and will reduce water levels further upstream during an extreme event by up to 100 mm;
• two sites will not provide new inter-tidal habitat but will provide flood storage so will also reduce water levels during an extreme event;
• all the estuary’s defences are likely to need repair or improvement at some time during the next 50 years;
• although a good economic case can be made for works on most of the defences, there are a number of places where this is difficult because the value of the assets at risk is low;
• these places will suffer from a declining standard of protection as the defences deteriorate and sea levels rise so that, in due course, it may be necessary to consider alternative approaches such as secondary defences, flood proofing etc;
• the cost, in today’s prices, of managing the defences over the next 100 years is likely to be about £1 billion;
• these findings are based on our best assessment of what is likely to happen in the future but the strategy needs considerable flexibility to allow for the inevitable uncertainty of these predictions.

Findings related to the first (5-year) work package:
• works at five sites, shown on the map on page 21 and including the managed realignment at Alkborough, have already been approved or are so urgent that they need to be progressed before the strategy is adopted;
• works at seven sites, also shown on page 21 and including a second managed realignment scheme at Donna Nook, are incorporated in the first five-year package;
• the cost of this package is estimated to be about £80 million at today’s prices, including an allowance for unexpected or currently undefined schemes (e.g. works needed to maintain the coastal lagoons at Easington, which are protected under the Habitats Regulations);
• once the package has been approved, planning permission will need to be obtained for each scheme individually, providing an opportunity for all those affected to examine and comment on the detailed proposals;
• although the provision of additional flood storage upstream of the Humber Bridge (after the Alkborough scheme is completed) is unlikely to be worthwhile in the immediate future it could become increasingly important in the longer term (15 years or more from now).
Overall strategy
The overall strategy for managing the estuary’s defences over the next 100 years is summarised below.

1. Protect people and property by maintaining a sustainable line of defences around the estuary.

   - Continue managing the defences where this is sustainable, taking into account technical, environmental economic and social issues, including the impact of estuary processes and sea level rise. In general the defences will remain on their existing alignment unless there is good reason for moving them.

2. Consider realigning the defence line locally (managed realignment)

   - The main reasons for moving the defences are likely to be:
     - (a) To compensate for inter-tidal habitat lost as a result of the strategy and so maintain the estuary's conservation value. The CHaMP concludes that about 700 ha of new inter-tidal habitat will need to be created over the next 50 years to comply with the Habitats Regulations. This is a legal requirement, so if the habitat is not created it will not be possible to continue managing the defences.
     - (b) To provide flood storage that will help manage water levels during serious floods. Model studies show that providing flood storage upstream of the Humber Bridge can lower peak water levels during an extreme event. This will increase the standard of protection provided by the defences nearby and allow any works needed as a result of sea level rise to be postponed.
     - (c) Where the cost of maintaining the existing defences will be greater than the value of the resulting damage. Economic studies show that at some places round the estuary it will be difficult to justify maintaining the defences because the costs will be too high.

3. Examine other ways of limiting flood risk to people and property at a level that is fair and reasonable

   - Our target standard of protection is 100 years. Where this cannot be justified we will seek alternative ways of providing as high a standard to as much of the area as possible, for example by protecting villages and other property clusters by building secondary lines of defence or by supporting flood-proofing for individual houses.

The implications of each element of the strategy are summarised below. Most of the defences around the estuary will be maintained on their existing alignment and managed to provide at least a 100 year standard of protection. The places where this may not happen are shown on the map on the next page and discussed in the following sections.

Summary of the Humber Flood Risk Management Strategy

<table>
<thead>
<tr>
<th>Section</th>
<th>Short term (1 – 5 years)</th>
<th>Medium term (6 – 15 years)</th>
<th>Long term (15 years +)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Improve defences on basis of condition and consequence (i.e. combination of urgency and standard priority score).</td>
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</tr>
<tr>
<td>2 (a)</td>
<td>Implement Alkborough and Donna Nook realignment schemes.</td>
<td>Implement Skeffling and consider Welwick realignment schemes.</td>
<td>Implement Welwick, Goxhill and Keyingham realignment schemes, implement washland flood storage scheme at Flixborough, consider differential standards for selected defences to provide flood storage beside Ouse/Trent.</td>
</tr>
<tr>
<td>2 (b)</td>
<td>Implement storage aspects of Alkborough realignment scheme.</td>
<td>Consider washland flood storage scheme at Goxhill.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Agree appropriate approaches at Easington, Halton Marshes.</td>
<td>Agree appropriate approaches at Sunk Island, Goxhill.</td>
<td>Agree appropriate approaches at Winteringham, beside Ouse/Trent.</td>
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</tbody>
</table>
Replacing lost inter-tidal habitat (managed realignment)
In June 2002 we published a consultation document (see page 51) listing twelve potential managed realignment sites in addition to the one already identified at Paull Holme Strays. Following discussions with the landowners and tenants living near these sites we published a second document, in July 2003, saying we were no longer considering three of them but we continued to be interested in the other eight (two of them were moved slightly so they could be joined together and become one). Six of these will provide new inter-tidal habitat that can be used to comply with the Habitats Regulations.

Managed realignment to create new habitat is necessary for us to manage the estuary’s defences effectively and we believe that these six sites are the best places around the estuary for doing this. One of them, at Alkborough, is already being built and the others will be built in sequence over the next 50 years or so. The precise timing will depend on a number of factors, including the actual rate of sea level rise and the willingness of owners to make their land available, but the earliest dates by which we are likely to need each site are shown in the table on the next page.

Managed realignment sites
- Completed or under construction
- Proposed for habitat creation (by Agency)
- Proposed for habitat creation (by APM)
- Proposed for flood storage (by Agency)

Areas for habitat creation, flood storage or where protection standard likely to fall below baseline
- Floodplains
- Urban areas
- Areas where some defences may be left low to provide flood storage
- Areas where it may be difficult to justify improving the defences

Managed realignment sites
<table>
<thead>
<tr>
<th>Site</th>
<th>Likely timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Donna Nook (South bank)</td>
<td>Within 5 years</td>
</tr>
<tr>
<td>Skeffling (North bank)</td>
<td>10 to 15 years from now</td>
</tr>
<tr>
<td>Welwick (North bank)</td>
<td>More than 20 years</td>
</tr>
<tr>
<td>Keyingham (North bank)</td>
<td>More than 30 years</td>
</tr>
<tr>
<td>Goxhill (South bank)</td>
<td>More than 40 years</td>
</tr>
</tbody>
</table>

Flood storage (managed realignment and differential standards)
Three of the eight sites identified in our July 2003 document will provide flood storage that is predicted to lower peak water levels by up to 100 mm or more for significant distances along the Ouse and the Trent. One of these, at Alkborough, is already being built and will also provide new inter-tidal habitat. Further studies are required to confirm the other two will be effective.

If they are built, they will be designed to act as washlands and so should not flood very often, making it possible to continue using them for agriculture. The construction timing will again depend on a number of factors, including the actual rate of sea level rise and the willingness of owners to make their land available, but the most likely dates are shown in the table above.

Another way of providing flood storage in the future could be to provide differential standards of protection; raising defences protecting areas (such as villages) where flooding would cause major damage but leaving them at their present level where the damage would be less serious (such as farmland). These farmland areas would flood more frequently than at present but the flooding would be managed to minimise the overall risk to people and property. This approach is not being examined seriously at present but may need to be considered in 20 to 30 years time beside the Ouse, between the Ouse and the Trent and between Whitton and Winteringham. There are significant flood warning and development control issues to be addressed before it can be taken forward.
Low standards of protection

There are two places, near Easington and at Halton Marshes, where works are needed soon but will be very difficult to justify because the economic value of the property in the area protected is low. In both places the defences are being threatened by erosion. At Easington the situation is further complicated because an area nearby is designated under the Habitats Directive for its saline lagoons and shingle banks. Further studies and detailed consultations with landowners and others affected will begin shortly to determine the best way forward at both sites.

At Skeffling the proposed managed realignment project will be a means to as much of the area as possible (such as building secondary defences around the villages or flood-proofing of individual properties) will need to be considered.

Works planned for the next 15 years

For managing the defences the estuary floodplain has been divided into twelve Management Units (MUs), numbered 1 to 3, 4a to 4e and 5 to 8. Each unit is sub-divided into up to four flood cells (FCs). The improvement works planned in each cell during the next 15 years are summarised in the tables on pages 22 and 23, and shown on the map opposite. Further information is given for each unit separately between pages 28 and 49.

The cost of these works and the other activities needed to manage the defences over the next 15 years is likely to be about £210 million. These activities fall into four main categories, as follows.

Urgent or emergency works

The works shown in blue on the tables are going ahead before the strategy is approved. Apart from Alkborough, this is because they are too urgent to be delayed (Alkborough is a special case, as discussed in the next section). From past experience there are a number of reasons why a section of the defences could need to be repaired at very short notice and an allowance for these emergency works is included in the strategy.

Strategic works

Some of the works are included because they deliver benefits across the estuary rather than just to the areas they protect. The managed realignment at Alkborough falls into this category and is being built in partnership with English Nature, North Lincolnshire Council and Associated British Ports (which is why it is going ahead before the strategy is approved). The two habitat creation schemes (at Donna Nook and Skeffling) and the flood storage scheme at Goole also fall into this category.

Improvement works

All the other works shown on the tables will improve the condition or standard of the existing defences on specific frontages and deliver benefits to a particular area of the estuary’s floodplain. The works have been prioritised so that those that are most urgent and best justified will be carried out first.
## Works during next 15 years in Management Units 1 to 4b (North bank of Estuary and of River Ouse)

<table>
<thead>
<tr>
<th>MU</th>
<th>Flood cell</th>
<th>Name</th>
<th>Description of works/Preferred option</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/1a</td>
<td>Kilnsea (Spurn Road)</td>
<td>Do nothing: coastal defences threatened by erosion and likely to be destroyed within 5 to 10 years. Local consultations needed to establish long-term implications.</td>
</tr>
<tr>
<td>1</td>
<td>1/1c</td>
<td>Kilnsea (Kilnsea Village)</td>
<td>Do nothing/Hold the line: Localised erosion protection. Local consultations needed to establish long-term approach.</td>
</tr>
<tr>
<td>1</td>
<td>1/1</td>
<td>Kilnsea (Eastington Lagoons)</td>
<td>Hold the line: Managed realignment: Hold the line in preferred option on flood defence grounds but realignment may be necessary for habitat protection (and may provide flood defence benefits as well). Study needed to inform decision.</td>
</tr>
<tr>
<td>1</td>
<td>1/2</td>
<td>Skegness Managed realignment: Create 169ha of inter-tidal habitat, with minor hold the line works south of the site.</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1/3</td>
<td>Sunk Island Managed realignment: Low maintenance with limited (Do minimum) rock toe protection works. Managed realignment linked with ABP’s site at Wicken to create 321ha of inter-tidal habitat planned but not needed in next 15 years. Consider long-term implications of falling defence standards as sea levels rise.</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1/3</td>
<td>Sunk Island (Withern Bank)</td>
<td>Hold the line: Managed realignment: Maintenance/Do minimum along part of defence. Managed realignment likely to be carried out by ABP as part of compensatory habitat creation for harbour development at Ingoldmells in next 15 years.</td>
</tr>
<tr>
<td>1</td>
<td>1/3</td>
<td>Stone Creek to Paul Prime</td>
<td>Hold the line: Managed realignment: Maintenance works, no capital works likely during next 15 years. Managed realignment to create 165ha of inter-tidal habitat at Keyingham planned but unlikely to be needed for at least 30 years.</td>
</tr>
<tr>
<td>2</td>
<td>2/1a</td>
<td>Hull East (Paul Village)</td>
<td>Hold the line: Repair existing defences, new cross bank to separate east end of defence and consider works to improve Branhurst Drain outfall.</td>
</tr>
<tr>
<td>2</td>
<td>2/1b</td>
<td>Hull East (Victoria Dock village)</td>
<td>Hold the line: Maintenance works, study to confirm need for capital works in next 15 years.</td>
</tr>
<tr>
<td>2</td>
<td>2/2</td>
<td>Hull West (Hull Barrier to Victoria Pier)</td>
<td>Hold the line: Consider improving existing defences and building new defences. Discussions needed with Kingston upon Hull City Council (and others) to assess potential development implications.</td>
</tr>
<tr>
<td>2</td>
<td>2/3</td>
<td>Hull West (Albert Dock to St Andrews Quay)</td>
<td>Hold the line: Consider improving existing defences and building new defences. Discussions needed with Kingston upon Hull City Council (and others) to assess potential development implications.</td>
</tr>
<tr>
<td>2</td>
<td>2/3</td>
<td>Hessle</td>
<td>Hold the line: Consider new sea wall west of Humberside Bridge, top protection and refurbish secondary embankment. Study to confirm works needed in next 15 years.</td>
</tr>
<tr>
<td>2</td>
<td>2/4</td>
<td>North Ferriby</td>
<td>Hold the line: Maintenance works, no capital works likely during next 15 years.</td>
</tr>
<tr>
<td>3</td>
<td>3/1</td>
<td>Brough (BAE works to East Clough)</td>
<td>Hold the line: Raise and improve existing embankment (landward side) with local realignment at Watson Bank Clough, new cross bank from Watson Bank Clough to high land, maintain remainder of defences and provide new outfall.</td>
</tr>
<tr>
<td>3</td>
<td>3/2</td>
<td>Brough Haven to Witherness Lock</td>
<td>Hold the line: Maintenance works, possibly with minor works to provide consistent standard at Crabby Farm, Defences improvements (embankment widening and raising as necessary) planned but not during next 15 years.</td>
</tr>
<tr>
<td>4a</td>
<td>4a/1</td>
<td>Saltmarsh (Bank House Slips)</td>
<td>Hold the line: Repair of existing bank and storing for erosion protection.</td>
</tr>
<tr>
<td>4a</td>
<td>4a/1</td>
<td>Saltmarsh (Blacktoft to Yakelbed)</td>
<td>Hold the line: Bank raising and local erosion protection works. Consider implications of providing differential standards and allowing controlled overtopping in rural areas to increase flood storage.</td>
</tr>
<tr>
<td>4a</td>
<td>4a/1</td>
<td>Saltmarsh (Sunshill)</td>
<td>Hold the line: Managed realignment: Maintenance and bank raising with localised erosion protection. Consider creation of washland area to provide flood storage by building retained defences and allowing controlled overtopping.</td>
</tr>
</tbody>
</table>

## Works during next 15 years in Management Units 4c to 8 (South bank of River Ouse, River Trent and South bank of Estuary)

<table>
<thead>
<tr>
<th>MU</th>
<th>Flood cell</th>
<th>Name</th>
<th>Description of works/Preferred option</th>
</tr>
</thead>
<tbody>
<tr>
<td>4b</td>
<td>4b/1</td>
<td>Goole</td>
<td>Hold the line: Maintenance works, no capital works likely during next 15 years except urgent works described below.</td>
</tr>
<tr>
<td>4b</td>
<td>4b/1</td>
<td>Goole (Goole slip)</td>
<td>Hold the line: Urgent works to improve embankment stability by driving sheet piles along existing berm. Currently investigating need for additional works.</td>
</tr>
<tr>
<td>4c</td>
<td>4c/1</td>
<td>Goole Fields (Old Goole)</td>
<td>Hold the line: New concrete wall (Goole Hall to existing sheet piling) and removing infilled defences/damaged works.</td>
</tr>
<tr>
<td>4c</td>
<td>4c/1</td>
<td>Goole Fields (Skeffling)</td>
<td>Hold the line: New rock toe to prevent overtopping, install sheetpiles in existing bong, new concrete wall to crest of bank and repair of existing revetment.</td>
</tr>
<tr>
<td>4d</td>
<td>4d/1</td>
<td>Crowle</td>
<td>Hold the line: Managed realignment: Maintenance works, no capital works likely during next 15 years except at Boxhynde and Amcotts as described below. Consider implications of providing differential standards and allowing controlled overtopping in rural areas to increase flood storage.</td>
</tr>
<tr>
<td>4e</td>
<td>4e/1</td>
<td>Gannett to Flinsborough</td>
<td>Hold the line: Raise and strengthen embankments between Naven House and Flinsborough. Study of need for stability improvements to other reaches required.</td>
</tr>
<tr>
<td>4e</td>
<td>4e/3</td>
<td>Flinsborough</td>
<td>Hold the line: Managed realignment: Maintenance works, no capital works likely during next 15 years. Possible site for washland area to provide flood storage by allowing controlled overtopping but not needed during next 15 years.</td>
</tr>
<tr>
<td>5</td>
<td>5/1</td>
<td>Whippett to Winteringham</td>
<td>Hold the line: Maintenance works, no capital works likely during next 15 years. Consider implications of providing differential standards and allowing controlled overtopping in rural areas to increase flood storage.</td>
</tr>
<tr>
<td>5</td>
<td>5/2</td>
<td>Winteringham Rips</td>
<td>Hold the line: Managed realignment: Consider building new embankment at east end of cell and realigning A1077. Discussions needed with North Lincolnshire Council and others to assess implications, including possible loss of one property. Possibly raise existing embankment to west but not needed during next 15 years.</td>
</tr>
<tr>
<td>5</td>
<td>5/3</td>
<td>Ferrybridge to South Ferry Cliff</td>
<td>Hold the line: Maintenance works, no capital works likely during next 15 years.</td>
</tr>
<tr>
<td>6</td>
<td>6/1</td>
<td>Barton-Cleve to Barton Haven</td>
<td>Managed realignment/ Hold the line: Maintenance works, ABP plan to raise part of defences to create compensatory habitat for harbour development at Ingoldmells but no other capital works likely during next 15 years.</td>
</tr>
<tr>
<td>6</td>
<td>6/2</td>
<td>Barton Haven to Barrow Haven</td>
<td>Hold the line: Maintenance works, no capital works likely for next 15 years.</td>
</tr>
<tr>
<td>6</td>
<td>6/3</td>
<td>Barton Haven to East Halton Skitter</td>
<td>Hold the line: Managed realignment: Maintenance works, to capital works likely during next 15 years. Managed realignment to create 138ha of inter-tidal habitat at South Ferriby planned or likely to be needed for next 40 years. Consider long-term implications of falling defence standards as sea levels rise.</td>
</tr>
<tr>
<td>7</td>
<td>7/1</td>
<td>Halton and Killingholme Marshes (Halton Marshes)</td>
<td>Hold the line: Do minimum: Sheet pile toe protection with rock wedge for south-west end of reach. Consider no longer maintaining defences along remainder of reach (So East Halton Skitter), accepting defences will fail and building cross bank to prevent flooding to south. Discussions needed with landowners, North Lincolnshire Council and others to confirm choice.</td>
</tr>
<tr>
<td>7</td>
<td>7/1</td>
<td>Halton &amp; Killingholme Marshes (Halton Marshes)</td>
<td>Hold the line: Sheet pile toe protection with rock wedge to prevent breaches and undermining bank and affecting its stability. Local crest raising.</td>
</tr>
<tr>
<td>7</td>
<td>7/1</td>
<td>Halton &amp; Killingholme Marshes (Halton Marshes)</td>
<td>Hold the line: Sheet pile toe protection works with local crest raising and outfall realignment.</td>
</tr>
<tr>
<td>7</td>
<td>7/2</td>
<td>Invermorrin to River Freesney (North of Middle Drain)</td>
<td>Hold the line: Sheet pile toe protection to prevent channel movements undermining bank and affecting its stability. Local crest raising.</td>
</tr>
<tr>
<td>7</td>
<td>7/2</td>
<td>Invermorrin to River Freesney (South of Middle Drain)</td>
<td>Hold the line: Sheet pile toe protection works with local crest raising and outfall realignment.</td>
</tr>
<tr>
<td>7</td>
<td>7/3</td>
<td>Grimsby Docks</td>
<td>Hold the line: Consider refurnishing existing defences and utilising flood storage in the docks, with some realignment at south-east end of flood cell. Discussion needed with ADB to confirm management of defences and protection to docks.</td>
</tr>
<tr>
<td>8</td>
<td>8/1</td>
<td>Cleethorpe and Grimsby</td>
<td>Hold the line: Defences managed by NE Lincolnshire Council.</td>
</tr>
<tr>
<td>8</td>
<td>8/2</td>
<td>Tetney to Saltfleet Haven (Donna Nook)</td>
<td>Hold the line: Managed realignment: Managed realignment to create 138ha of inter-tidal habitat at Donna Nook. Review of water level/wave height predictions needed to resolve anomalies and confirm need for works on adjacent frontages.</td>
</tr>
</tbody>
</table>

## Notes

- **Blue** works planned before year 1 of strategy, which is assumed to start in April 2007.
- **Yellow** works planned in years 1 to 5.
- **Green** works planned in years 6 to 15.
- **No colour** only maintenance work by year 15.
### Approving the strategy

We are now making our final preparations for submitting the strategy and the first five years of work for approval and this consultation is a key step in the process. All comments about our proposals will be taken into account when preparing the final submission for internal approval. After consultation the strategy will be submitted to Defra. It also needs to be sanctioned by Treasury. The timetable we are working to is shown below.

Meanwhile we will be completing the Urgent Works that are being undertaken on the Ouse and Trent and building the managed realignment scheme at Alkborough.

Once the approvals have been obtained we will begin drawing up the final designs and getting planning approval for the works on each of the frontages in the five-year package. As the works will affect sites designated under the Habitats Directive this will involve preparing Environmental Impact Assessments and Appropriate Assessments for each scheme and submitting them to the Local Planning Authority for approval. A full consultation process will be undertaken for each scheme separately, allowing those who will be directly affected to comment on the detailed proposals.

We cannot give firm dates for these detailed consultations. In principle, however, we expect to start the first schemes in the summer of 2007 and so will aim to work to the timetable given above.

<table>
<thead>
<tr>
<th>Scheme</th>
<th>Detailed consultation</th>
<th>Start work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stallingborough Phase 1</td>
<td>mid 2006</td>
<td>mid 2007</td>
</tr>
<tr>
<td>Swinefleet</td>
<td>mid 2006</td>
<td>late 2007</td>
</tr>
<tr>
<td>BAE works (Brough) Phase 2</td>
<td>late 2006</td>
<td>mid 2008</td>
</tr>
<tr>
<td>Old Goole</td>
<td>early 2008</td>
<td>early 2009</td>
</tr>
<tr>
<td>Donna Nook Managed Realignment</td>
<td>mid 2008</td>
<td>mid 2009</td>
</tr>
<tr>
<td>Halton &amp; Killingholme Marshes*</td>
<td>mid 2009</td>
<td>mid 2010</td>
</tr>
<tr>
<td>Paull Village</td>
<td>late 2010</td>
<td>late 2011</td>
</tr>
</tbody>
</table>

* Parts of this site will require earlier repairs
"A draft SEA has been produced and is being issued for public consultation at the same time as this document"

### Organisations sent a copy of the SEA

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Countryside Agency</th>
<th>Humber INCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>English Nature</td>
<td>ABP Ltd</td>
<td>RSPB</td>
</tr>
<tr>
<td>English Heritage</td>
<td>Internal Drainage Boards</td>
<td>Wildlife Trusts</td>
</tr>
<tr>
<td>Local Authorities</td>
<td>GOYH</td>
<td>BASC</td>
</tr>
<tr>
<td>Defra</td>
<td>Yorkshire Forward</td>
<td>Water Companies</td>
</tr>
<tr>
<td></td>
<td>Humber Forum</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crown Estates</td>
<td></td>
</tr>
</tbody>
</table>

If you would like a copy of the SEA please ask for one as described inside the back cover. The directions there also tell you how you can send any comments you may have back to us.

Their environmental implications. We have commissioned an SA for the strategy, which has been carried out by an independent group using an approach developed by the Yorkshire and Humber Regional Assembly. This provides a fresh view of the strategy from outside and, among other things, has highlighted the importance of developing (and implementing) a long-term communications plan that sets out how we will address the following consultation issues:

- influencing National/Agency policy; in particular to ensure fair treatment for those who will be seriously affected by increased flood risk as sea levels rise;
- influencing Regional and Local planners; to ensure that development plans and planning decisions recognise flood risk issues and the implications of the strategy;
- informing the public; to ensure that all those who will be affected by the strategy and by future increases in flood risk are aware of this and of what they can do about it.

### Flood risk management

The current strategy focuses on managing the existing flood defences, as this is currently the most effective way of reducing the overall flood risk from the estuary. In future, however, it will become increasingly important to improve and co-ordinate other ways of reducing flood risk, in particular:

- flood warning arrangements; both the prediction and possible extent of flooding and how the resulting warnings are distributed;
- control of floodplain development; how to avoid the increased risk resulting from unnecessary development in the floodplain.

Ensuring both of these activities are integrated with the flood defence aspects of the strategy and so overseeing the transition from a flood defence to a comprehensive flood risk management strategy is another key task for the future. It will involve strengthening our links with the local planning authorities, helping them draw up strategic flood risk assessments in accordance with PPG 25 ‘Planning and flood risk’ (soon to be replaced by PPS 25) and exploring opportunities to gain multiple benefits by land use management, for example from managed realignment schemes or through creating buffer zones.

### Other issues to be addressed

Inevitably there are a number of other tasks relating to the strategy that have yet to be completed. The more important of these are as follows:

- historic environment; although we have carried out a desk assessment of the Humber’s historic environment, identifying areas of high, medium and low potential, we will need to undertake more detailed studies (including excavations) at all sites where our proposals may have an adverse effect;
- land drainage; we recognise that land drainage will be affected by rising sea levels and have made allowance in our estimates for improving outfall structures; we now need to identify in more detail the actions that will need to be taken;
- power generation and barrages; earlier studies have shown that building a tidal barrage across the Humber is not worthwhile as the cost (including the disruption to shipping) will be greater than the value of the energy generated; increased demand for renewable energy and the development of efficient small-scale generating units means that it may be worth reviewing tidal stream power opportunities in the estuary;
- financing arrangements; both the Government and the Agency are interested in examining alternative arrangements for procuring and financing flood defence works; these are likely to include using Private Finance Initiative (PFI) approaches for procuring a proportion of the work, and seeking selective financial contributions from large-scale developers or potential beneficiaries;
- interaction with the coastal SMP; beyond Hawkins Point the estuary is effectively part of the North Sea coastline so decisions made within the estuary strategy will affect the coastal SMP (HECAG), which is due to be reviewed in 2006; there is also the possibility that decisions about the coast will affect the way the estuary needs to be managed;
- review and update strategy; the strategy will need to be reviewed at intervals of about five years to determine whether the assumptions on which it is based are still valid and to re-assess the programme of works;
- Water Framework Directive; this will be introduced in stages over the next 10 years and will have a major impact on how the estuary is managed; we need to prepare ourselves for the changes that will result.

### Strategic Environmental Assessment (consultation arrangements)

Strategic Environmental Assessment (SEA) is a process designed to acknowledge the environmental implications of large projects. Although development of the strategy began well before there was any statutory requirement for a formal SEA to be carried out, we are promoting best practice by undertaking such an assessment. A draft SEA has been produced and is being issued for public consultation at the same time as this document. Copies have been sent to the organisations listed on this page and further copies are available on request.

### Sustainability Appraisal (future consultations)

Sustainability Appraisals (SA) look at the broad impact of projects, considering their social as well as economic and environmental implications.
Section 5

Unit 1 Easington to Paull

Land use and development
Low-lying land behind the defences extends inland for up to 7.5 km. The main land use is agriculture with farms and villages scattered throughout, mainly near the landward edge of the defended area.

Flood cells and flood defences
The unit is divided into four flood cells (1/1 to 1/4). Flood cell 1/1 (Kilnsea) is at risk of flooding from two sides, the estuary and the open sea. Apart from a short length of wall, most of the defences consist of clayembankments, some with gabion baskets on the crest and mostly with rock revetments on the seaward side.

Estuary and coastal processes
The unit is seaward of the Humber Bridge so re-aligning the defences will have little impact on conditions elsewhere. Hawkins Point is exposed to relatively large waves but these reduce towards Paull and towards Kilnsea (where the shore is sheltered by Spurn Head). The foreshore between Hawkins Point and Paull appears to be eroding but this is not currently threatening the defences. The coastline between Easington and Spurn Head is being eroded and is retreating at a rate of about 2 m per year.

Natural and historic environment
All of the estuary defences are fronted by land designated as SPA, Ramsar and SSSI and currently being considered for designation as SAC. Lagoons designated as SAC front most of the coastal defences between Easington and Kilnsea. These lagoons are being squeezed by the eroding coastline and their environmental value will be significantly reduced unless the defences are moved to allow them to retreat. Spurn Head is designated as a Heritage Coast site and there are small SNI and Wildlife Trust sites within the unit.

There is a small area of high archaeological potential near Kilnsea and an area of medium potential by Patrington. The field and settlement pattern on Sunk Island, which was reclaimed from the 15th century onwards, is important and the unit contains nationally important World War II defensive works.

Works in the next 15 years
The defences to flood cell 1/2 will continue to deteriorate but it will be difficult to justify improving them. The managed realignment at Skeffling (planned to be built during this period, subject to further discussions with landowners and others affected) will avoid this difficulty, however, and will reduce the overall flood risk. The other defences will continue to provide reasonable protection and no other works are planned for this period apart from necessary maintenance and some minor toe protection works near Hawkins Point.

Long-term prospects
The protection provided by the defences will continue to deteriorate. Justifying improvement works will be difficult, however, due to the relatively small number of people at risk and alternatives (such as secondary defences around the villages) will need to be considered. The proposed managed realignment sites at Welwick and Keyingham will provide good standard defences along these frontages, and may make it possible to justify improvements to the other frontages.

<table>
<thead>
<tr>
<th>Flood cell</th>
<th>No of Properties</th>
<th>Indicative Range*</th>
</tr>
</thead>
<tbody>
<tr>
<td>FC 1/1</td>
<td>61</td>
<td>2.5 to 20</td>
</tr>
<tr>
<td>FC 1/2</td>
<td>10</td>
<td>2.5 to 20</td>
</tr>
<tr>
<td>FC 1/3</td>
<td>690</td>
<td>10 to 100</td>
</tr>
<tr>
<td>FC 1/4</td>
<td>3207</td>
<td>10 to 100</td>
</tr>
</tbody>
</table>

* On average, the lowest period in years between events likely to cause flooding

Standard of protection
The number of properties at risk in each flood cell and the indicative range of protection standard suitable for the land use (based on Defra guidance) is shown in the table above.

Works in the next 5 years
In flood cell 1/1 the coastal defences near Kilnsea are being threatened by erosion, and could be breached within five to ten years, but possibly as little as two years. There is no economic justification for realigning or replacing these defences so they are likely to be abandoned. Detailed consultations with those affected are needed to determine the best way forward. These consultations will start as soon as possible.

The defences near Easington are satisfactory but are preventing the coastal lagoons from moving as the shoreline retreats. The estuary defences provide a low standard of protection but are in reasonable condition. Overall, the flood risk in this area is high and the issues are particularly complex. Again those affected will be consulted as soon as possible.

The defences to the remaining flood cells will be maintained where justified but no capital works are planned. The standard of protection to flood cell 1/2 is low but improvements are difficult to justify as the number of people at risk is small. Flood cells 1/3 and 1/4 have a reasonable standard. Associated British Ports (ABP) is planning to realign a short length of the defence near Welwick to create compensatory habitat for harbour development at Immingham.
Unit 2 Paull to North Ferriby

Land use and development
The tidal floodplain nominally extends up to 24 km inland and contains Kingston upon Hull, which occupies about one third of the unit’s area. The remainder of the area is largely medium grade agricultural land located behind the city. Hull’s industry is dominated by port-related activities but many of the dock areas west of the River Hull are being or have been developed for general industrial or commercial usage. There is also a large chemical works and other related industries at Salt End.

Flood cells and flood defences
The unit is divided into four flood cells (2/1 to 2/4). Most of the defences protect urban land and consist of concrete or masonry retaining walls or steel sheet pile walls with some embankments (with rock revetments) at the eastern end. Much of Hull is at risk of flooding from the River Hull as well as from the estuary. A separate flood defence strategy is being developed for the river, which is protected by high water levels in the estuary by the Humber Tidal Surge Barrier. Associated British Ports (ABP) and Kingston upon Hull City Council are each responsible for parts of the defences.

Estuary processes
The unit is seaward of the Humber Bridge so re-aligning the defences will have little impact on conditions elsewhere.

Natural and historic environment
All of the defences are fronted by land designated as SPA, Ramsar and SSSI and currently being considered for designation as SAC. An area between the Humber Bridge and North Ferriby is a country park and there are a number of SNCI sites within the unit.

There are two areas of high archaeological potential, at Hull and North Ferriby. Hull has sites dating from prehistoric and Roman times as well as the medieval and later town centre together with other features. There are Iron Age sites at North Ferriby and Middle Bronze Age boats were found on the eroding foreshore there. There are important historic structures at Paull and Hessle but the remainder of the unit is generally of medium potential.

Flood cell
No of Properties
Indicative Range *
FC 2/1 6442** 100 to 300***
FC 2/2 775** 100 to 300
FC 2/3 35 10 to 100
FC 2/4 39 10 to 100

** On average, the lowest period in years between events likely to cause flooding
*** Excluding properties where the risk of flooding from the River Hull is greater than from the estuary
**** A lower range (10 to 100 years) applies to Paull at the east end of the cell

Standard of protection
The number of properties at risk in each flood cell and the indicative range of protection standard suitable for the land use (based on Defra guidance) is shown in the table above.

Works in the next 5 years
Some sections of the Paull Village defences are to a low standard. The defences will be improved to provide an appropriate standard of protection to the residential properties in the village. Some individual property-proothing may be appropriate. The defences to the remainder of the unit will be maintained but no capital works are planned. A study of the standard of protection provided by the existing defences at Victoria Dock (currently thought to be lower than desirable) will be carried out to assess whether they will need to be raised later.

Development and other pressures on the dock areas west of the River Hull indicate that the defences here may need to be improved. Discussions will be held with the City Council and others to assess the implications and agree what should be done.

Works in the next 15 years
Improvement works to the defences between the Hull Barrier and Victoria Pier and between the Albert Dock and St Andrews Quay may be carried out during this period, depending on the outcome of the discussions with the City Council and others.

Some of the foreshore structures at Hessle need improvement or are subject to erosion and the area would benefit if they were improved. This may be difficult to justify, however, as only a small number of properties are at risk. The options will be examined and works put in hand if a sufficiently strong case can be made. The standard of protection to North Ferriby is toward the upper end of the indicative range and no works are planned during the next 15 years.

Long-term prospects
All the defences to this unit will continue to be maintained and the majority will be improved as necessary to provide a high standard of protection throughout the 100-year life of the strategy. If the improvement works at Hessle prove difficult to justify the flood risk to low-lying properties near the shore will increase.
Land use and development
The area extends up to 10 km inland from the defences and is mostly medium or high grade agricultural land, with farms spread throughout and containing several small villages, generally some distance inland from the defences. The largest village is Brough, which contains the British Aerospace works and airfield. There is a water recreation area at Welton Pits.

Flood cells and flood defences
The unit is divided into two flood cells (3/1 and 3/2). Most of the defences consist of clay embankments, generally with some rock revetment on the estuary side. The defences between Brough and Crabley have recently been improved.

Estuary processes
The main channel in this part of the estuary is unstable and migrates across the waterway, causing erosion where it runs close to the shoreline. The main point of attack tends to be on the south bank, near Read’s Island, but erosion can also occur on the north bank.

Natural and historic environment
All of the defences are fronted by land designated as SPA, Ramsar and SSSI and currently being considered for designation as SAC. The Humber Wildfowl Refuge is on Whitton Sand and there are some SNCIs within the unit.

Works in the next 15 years
The existing defences between Brough Haven and the east end of the BAe works have recently been improved to a 200 year standard. The second stage of the scheme, extending the improvement to the east end of the cell, was planned to follow the first stage but was delayed and is now included in the first strategy package. The defences between the end of the earlier works and Welton Bank Clough will be improved to the same 200 year standard and a cross bank will be built from this point to high ground at the back of the flood cell. The rest of the defences in this cell will not be raised now and it is likely to be difficult to justify doing so in the future.

The remaining defences in this unit will continue to be maintained as appropriate but no further capital works are planned for the period.

Weighton Lock was created by reclamation around 1900 and is of medium potential, although Weighton Lock is a Scheduled Ancient Monument.

Standard of protection
The number of properties at risk in each flood cell and the indicative range of protection standard suitable for the land use (based on Defra guidance) is shown in the table above.

<table>
<thead>
<tr>
<th>Flood cell</th>
<th>No of Properties</th>
<th>Indicative Range*</th>
</tr>
</thead>
<tbody>
<tr>
<td>FC 3/1</td>
<td>429</td>
<td>50 to 200</td>
</tr>
<tr>
<td>FC 3/2</td>
<td>660</td>
<td>10 to 100</td>
</tr>
</tbody>
</table>

* On average, the lowest period in years between events likely to cause flooding

Long-term prospects
In principle there are sufficient properties at risk of being flooded in this unit to justify continuing to provide a good standard of protection throughout the 100-year life of the strategy. When the defences between Crabley Farm and Weighton Lock are due to be improved (in 15 to 20 years from now) the option of leaving the crest low in places to provide flood storage (and so help lower extreme flood levels further upstream) will be examined, although preliminary studies suggest that other sites are likely to be more effective for this purpose.
Land use and development

The area extends up to 10 km inland from the defences and is mostly medium or high grade agricultural land, with farms spread throughout and containing several small villages, some of which (Saltmarshe, Yokefleet, Blacktoft, Faxfleet) are close to the defences. The largest village is Gilberdyke, some 6 km from the defences, but the town of Howden lies on the edge of the unit.

Flood cells and flood defences

The unit is treated as a single flood cell (4a/1) as there are no physical boundaries completely separating one part of the unit from another. The defences are a mixture of earth and clay embankments, concrete and masonry retaining walls and steel sheet piling. Many lengths of bank have rock revetments to prevent the river channel from moving and undermining the defences. The defences between Bank House and Saltmarshe have recently been improved.

Estuary processes

The river channel is heavily constrained by the defences and by half-tide training works. Re-aligning the defences to create flood storage is likely to have the effect of lowering water levels in the river during floods.

Natural and historic environment

The river channel and any inter-tidal land in front of the defences are designated as SPA, Ramsar and SSSI and currently being considered for designation as SAC. These designations extend upstream as far as Boothferry Bridge, which marks the boundary of the European site. There are some small SNCIs within the unit.

Parts of the unit have high archaeological potential. It contains a string of linear riverside villages, mostly established during the early medieval period and including some significant medieval moated sites and later halls at Faxfleet, Yokefleet and Saltmarshe. There are also some Roman sites at Faxfleet.

Standard of protection

The number of properties at risk in the flood cell and the indicative range of protection standard suitable for the land use (based on Defra guidance) is shown in the table on the next page.

<table>
<thead>
<tr>
<th>Flood cell</th>
<th>No of Properties</th>
<th>Indicative Range*</th>
</tr>
</thead>
<tbody>
<tr>
<td>FC 4a/1</td>
<td>2751</td>
<td>10 to 100**</td>
</tr>
</tbody>
</table>

* On average, the lowest period in years between events likely to cause flooding
** 50 to 200 years for frontages with villages immediately behind the defences

Works in the next 5 years

A section of riverbank near Saltmarshe has recently shown signs of instability. Site investigations to examine the causes of this failure have been carried out and emergency repairs were carried out. Investigations to determine whether neighbouring sections are likely to be susceptible to similar problems will also be undertaken.

The remaining defences in this unit will continue to be maintained as appropriate but no further capital works are planned for the period.

Works in the next 15 years

The existing defences between Blacktoft and Yokefleet are generally in good condition but provide a low standard of protection that is lower than desirable taking into account the potential consequences of flooding. Works to improve these defences are planned to take place between 10 and 15 years from now. When these works are designed in detail the option of leaving the crest low in places to provide flood storage (and so help lower flood levels elsewhere) will be examined.

Between the end of the newly constructed defences at Saltmarshe and Goole Bridge the river follows a long meander. The defences here are generally in good condition but provide a low standard of protection and improvements are planned to take place between 10 and 15 years from now. Part of the area has been identified as a potential flood storage site, however, as the topography is suitable for this purpose and no properties would be affected. With this arrangement the land could still be used for agriculture but would flood rather more frequently than it does at present. The rest of the defences in this reach will be improved at the same time as the flood storage scheme is built.

Long-term prospects

Although there are a relatively large number of properties at risk of being flooded in this unit, nevertheless the cost of raising all the defences to match the rise in sea levels, and then raising them again in the future, will be very high. This may make it difficult to justify all the works needed to provide a uniformly good standard of protection and suggests that alternative approaches will need to be examined. Managing the defences to provide flood storage in selected areas while preventing flooding in areas where there would be significant damage is one such approach and has the added benefit of lowering flood levels generally.

This approach could, if combined with the building of secondary defences and flood-proofing individual properties, lead to a significant reduction in overall flood risk. There are important flood warning and development control issues to be addressed but, nevertheless, the general principle of managing flood risk rather than just the flood defences is one that will be adopted in the future.
Land use and development
The unit is the relatively narrow strip of land lying between the River Aire and the Aire and Calder Navigation (the Dutch River). It extends up to 10 km inland from its frontage on the River Ouse and is mostly medium or high grade agricultural land. The main town is Goole, sited on the Ouse, where there are important docks and some industry.

Flood cells and flood defences
The unit is at risk of flooding from the River Ouse, the River Aire and the Dutch River. A separate flood defence strategy is being developed for the Aire and, in view of the complexity of the potential flood paths, the unit is treated as a single flood cell (4b/1) and the overall risk is considered within that strategy. The works on the River Ouse frontage will be delivered through the Humber strategy, however, as they lie within the Humber SPA/SAC site.

The River Ouse defences are a mixture of earth and clay embankments, concrete and masonry retaining walls and steel sheet piling. Many lengths of bank have rock revetments to prevent the river channel from moving and undermining the defences. Associated British Ports (ABP) are responsible for some of the defences in the port at Goole.

Estuary processes
The River Ouse channel is heavily constrained by the defences and by half-tide training works. Re-aligning the defences to create flood storage on the left bank of the River Ouse opposite Goole (or anywhere else in the cell) is likely to have the effect of lowering water levels in the river during floods.

Natural and historic environment
The river channel and any inter-tidal land in front of the defences are designated as SPA, Ramsar and SSSI and currently being considered for designation as SAC. These designations extend upstream as far as Boothferry Bridge, which marks the boundary of the European site.

The main archaeological potential of the unit lies outside the area covered by the Humber strategy.

Standard of protection
The number of properties at risk in the flood cell and the indicative range of protection standard suitable for the land use (based on Defra guidance) is shown in the table above.

<table>
<thead>
<tr>
<th>Flood cell</th>
<th>No of Properties</th>
<th>Indicative Range*</th>
</tr>
</thead>
<tbody>
<tr>
<td>FC 4b/1</td>
<td>&gt; 7300</td>
<td>100 to 300</td>
</tr>
</tbody>
</table>

* On average, the lowest period in years between events likely to cause flooding

Works in the next 5 years
Recent surveys have confirmed that the defences along the River Ouse frontage provide a high standard of protection to Goole from tidal flooding and that no improvement works are necessary for the next 15 years (subject to the results of the further investigations mentioned above). The defences will continue to be maintained as appropriate.

Works in the next 15 years
All the defences on this unit’s River Ouse frontage will continue to be maintained and improved as necessary to provide a high standard of protection throughout the 100-year life of the strategy.
Land use and development
The unit lies between the River Trent, the River Ouse and the Aire and Calder Navigation (the Dutch River) and extends inland from the River Ouse for up to 12 km as far as the Stainforth and Keaby Canal. The area is mostly high grade agricultural land, with farms spread throughout and containing several small villages, most of which are sited close to the defences. The largest village is Crowle, close to the Stainforth and Keaby Canal and some six km from the River Trent defences.

Flood cells and flood defences
In the Shoreline Management Plan this area was divided into two units, covering the defences managed by the Agency’s North East and Anglian Regions respectively. The area is at risk of flooding from both rivers, however, and from the Dutch River, so is being treated as a single flood cell (4c&4d/1). Although separate flood defence strategies are being developed for the Dutch River (with the Aire) and the Tidal Trent, the overall flood risk within the cell is considered within the Humber strategy. The works on the Dutch River frontage will be delivered through the Aire strategy.

The Ouse and Trent defences consist of an assortment of earth and clay embankments, concrete walls and steel sheet piling. Many lengths of bank have rock revetments to prevent the river channel from moving and undermining the defences. The defences between Old Goole and Swinefleet and Reedness and Whitgift on the Ouse have recently been improved. The adjacent wharf owner is responsible for short lengths of the defences.

Estuary processes
The river channels are heavily constrained by the defences and by half-tide training works. Realigning the defences to create flood storage in this flood cell is likely to have the effect of lowering water levels in the river during floods.

Natural and historic environment
The river channel and any intertidal land in front of the River Ouse defences are designated as SPA, Ramsar and SSSI and currently being considered for designation as SAC. These designations extend upstream as far as Boothferry Bridge. The Ramsar, SSSI and SAC designations also extend up the River Trent as far as Keaby Bridge but the SPA designation is curtailed just upstream of the village at Alkborough. There is a large SSSI at Thorne Waste and some small SNI areas within the unit. The RSPB has a reserve at Blacktoft Sands.

Parts of the unit have high archaeological potential. There are strings of linear riverside villages, mostly of medieval origin, beside the Ouse, Trent and Old River Don. Earlier settlement was also concentrated beside the rivers and extensive Roman sites at Adlingfleet and along the Old River Don indicate that widespread remains probably lie below later alluvial and warp deposits. An open strip-field pattern survives along the riverside at Swinefleet. Other features include deserted medieval villages and early 19th century structures such as sluices and the canal lock at Keaby.

Standard of protection
The number of properties at risk in the flood cell and the indicative range of protection standard suitable for the land use (based on Defra guidance) is shown in the table above.

Works in the next 5 years
A number of minor slips have occurred in the banks near Whitgift on the Ouse and are currently being investigated. At Boskey Dyke and near Amcotts on the Trent the embankments have a history of seepage and are also being investigated, with remedial works likely to be carried out either later this year or early next year (2006). Further investigations to determine whether other sections of the defences are likely to be susceptible to similar problems will also be undertaken.

Works to improve the defences at Swinefleet are planned to be carried out during the next 5 years, extending the recently completed works so the whole village is protected to a high standard. At Old Goole, improvement works, including the removal of waste material and the construction of a concrete wall, are also planned for this period. The remaining defences in this unit will continue to be maintained as appropriate throughout the period.

Works in the next 15 years
Once the works at Swinefleet have been completed there will be a low section in the defences between this village and neighbouring Reedness. Works to improve the defences along this low section are planned to take place place between 10 and 15 years from now. When these works are designed in detail the option of leaving the crest low in places to provide flood storage (and so help lower flood levels elsewhere) will be examined. No other improvement works are currently planned for this unit during the next 15 years. The defences will continue to be maintained as appropriate throughout the period.

Long-term prospects
Although there are a relatively large number of properties at risk of being flooded in this unit, nevertheless the cost of raising all the defences to match the rise in sea levels, and then raising them again in the future, will be very high. This may make it difficult to justify all the works needed to provide a uniformly good standard of protection and suggests that alternative approaches will need to be examined. Managing the defences to provide flood storage in selected areas while preventing flooding in areas where there would be significant damage is one such approach and has the added benefit of lowering flood levels generally.

This approach could, if combined with the building of secondary defences and flood-proofing individual properties, lead to a significant reduction in overall flood risk. There are important flood warning and development control issues to be addressed but, nevertheless, the general principle of managing flood risk rather than just the flood defences is one that will be adopted in the future.
Unit 4e Keadby Bridge to Whitton

Land use and development
The unit lies between the right bank of the River Trent and the high ground of the Lincolnshire Edge, which limits its width to a maximum of three km. The area is mostly medium or high grade agricultural land, with pockets of industry at Flixborough and Gunness and wharf facilities at a number of sites along the river.

Flood cells and flood defences
The unit is divided into three flood cells (4e/1 to 4e/3). The defences consist of an assortment of earth and clay embankments, concrete walls and steel sheet piling. Many of the embankments have rock revetments and there are half-tide training revetments on the banks at bends and elsewhere.

Estuary processes
The river channels are heavily constrained by the defences and by half-tide training works. Re-aligning the defences to create flood storage is likely to have the effect of lowering water levels in the river during floods.

Natural and historic environment
The river channel and any inter-tidal land in front of the defences are designated as SPA, Ramsar and SSSI and currently being considered for designation as SAC to just upstream of the village at Alkborough, where the SPA designation is curtailed.
Extensive evidence exists from high ground on the Lincolnshire Edge for prehistoric activity in the area. While this is outside the unit, it is possible that associated activity next to the river has been buried beneath subsequent alluvial deposits. The important medieval site at Flixborough also lies outside the unit but again contemporary activity may have continued down towards the river.

Standard of protection
The number of properties at risk in each flood cell and the indicative range of protection standard suitable for the land use (based on Defra guidance) is shown in the table on the next page.

<table>
<thead>
<tr>
<th>Flood cell</th>
<th>No of Properties</th>
<th>Indicative Range*</th>
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</thead>
<tbody>
<tr>
<td>FC 4e/1</td>
<td>2227</td>
<td>10 to 100</td>
</tr>
<tr>
<td>FC 4e/2</td>
<td>&lt; 10</td>
<td>10 to 100</td>
</tr>
<tr>
<td>FC 4e/3</td>
<td>0</td>
<td>1 to 5</td>
</tr>
</tbody>
</table>

* On average, the lowest period in years between events likely to cause flooding

Works in the next 5 years
The managed realignment scheme at Alkborough (flood cell 4e/3) will be built this year, creating 170 ha of new inter-tidal habitat that will compensate for future habitat losses in the rivers and the inner estuary. It will also provide flood storage and will have the effect of lowering flood levels in the Ouse and the Trent, thereby improving the standard of protection along both rivers.

A preliminary assessment of the defences between Neap House and Grove Wharf has been undertaken and confirms that improvement works are not required here during the next five years. Further investigations to identify any incipient instability and to determine the scope of the works planned for subsequent years will be undertaken. The unit’s defences will continue to be maintained as appropriate throughout the period.

Works in the next 15 years
Improvement works are currently planned for the defences between Neap House and Grove Wharf during this period, subject to the outcome of the further investigations mentioned above. An area at Flixborough Grange (flood cell 4e/2) has been identified as a potential flood storage site as the topography is suitable for this purpose. Although this site is not included in the work planned for the next 15 years, further studies will be needed to confirm its suitability. No other improvement works in this unit are planned for the next 15 years. The defences will continue to be maintained as appropriate throughout the period.

Long-term prospects
The cost of raising all the defences in this unit to match the future rise in sea levels, and then raising them again later, will be high. This may make it difficult to justify all the works needed to provide a uniformly good standard of protection and suggests that alternative approaches will need to be examined. Developing a flood storage site at Flixborough Grange to lower flood levels in the river is one such approach and could lead to a significant reduction in overall flood risk.
There are important flood warning and development control issues to be addressed but, nevertheless, the general principle of managing flood risk rather than just the flood defences is one that will be adopted in the future.
Unit 5 Whitton to South Ferriby Cliff

Estuary processes

As this unit is landward of the Humber Bridge, re-aligning the defences could have the effect of lowering water levels upstream. The main channel in this part of the estuary is unstable and migrates across the waterway, causing severe erosion where it runs close to the shoreline, particularly near Read’s Island by Ferriby Sluice.

Natural and historic environment

All of the defences are fronted by land designated as SPA, Ramsar and SSSI and currently being considered for designation as SAC. The RSPB has a reserve at Read’s Island and there are some SNCIs within the unit.

The area from South Ferriby to Whitton has high archaeological potential. Iron Age and Roman sites are known at both places and a recently discovered Roman road linked South Ferriby to the former settlement at Winteringham, where Ermine Street terminates. South Ferriby was an important medieval Humber ferry port and the early 19th century tidal lock and sluice there is a Scheduled Ancient Monument.

Standard of protection

The number of properties at risk in each flood cell and the indicative range of protection standard suitable for the land use (based on Defra guidance) is shown in the table below.

<table>
<thead>
<tr>
<th>Flood cell</th>
<th>No of Properties</th>
<th>Indicative Range*</th>
</tr>
</thead>
<tbody>
<tr>
<td>FC 5/1</td>
<td>&lt; 20</td>
<td>2.5 to 20</td>
</tr>
<tr>
<td>FC 5/2</td>
<td>17**</td>
<td>10 to 100</td>
</tr>
<tr>
<td>FC 5/3</td>
<td>203**</td>
<td>10 to 100</td>
</tr>
</tbody>
</table>

* On average, the lowest period in years between events likely to cause flooding
** Excluding properties where the risk of flooding from the River Ancholme is greater than from the estuary

Land use and development

The shoreline passes from Whitton around the high ground of the Lincolnshire Edge to the long valley of the River Ancholme, where low-lying land behind the defences extends inland for up to 23 km. The area is mostly medium grade agricultural land with scattered farms. The largest town is Brigg, about 14 km from the estuary, which contains some industry. There are a number of smaller industrial areas closer to the defences, including a cement works at Ferriby Sluice.

Flooding cells and flood defences

The unit is divided into three flood cells (5/1 to 5/3). Apart from some walls at Ferriby Sluice, the defences consist mostly of clay embankments, generally with a rock revetment on the estuary side.

Works in the next 5 years

The existing defences opposite Read’s Island are severely threatened by erosion resulting from the very high velocity flows found near the shore when the main channel is in its most southerly position. Repair works have been carried out on a number of occasions over the last 15 years and it is likely that further works will be needed soon. Preliminary studies have been carried out and indicate that on flood defence grounds the most effective solution is likely to involve realigning the defences away from the present shoreline. This will affect the A1077, however, which at this point runs immediately behind the defences, and discussions with North Lincolnshire Council are needed to assess the wider implications and agree what should be done. For this reason the works are not currently planned to be undertaken during the next 5 years, although they may need to be brought forward if the channel shifts further south unexpectedly.

The remaining defences in this unit will continue to be maintained as appropriate but no further capital works are planned for the period.

Works in the next 15 years

The works opposite Read’s Island discussed above are planned to be undertaken soon after the 5-year period has finished. No further improvements to the unit’s defences are planned for the next 15 years, although again this may need to be reviewed if the channel moves unexpectedly and begins to threaten the defences nearby. Improvements to the other defences in the reach between South Ferriby and Winteringham Haven are planned but not in the next 15 years. The defences will continue to be maintained as appropriate throughout the period.

Long-term prospects

The defences between South Ferriby and South Ferriby Cliff (flood cell 5/3) currently provide a reasonable standard of protection to the village and it should be possible to maintain this in the future. The defences between Whitton and Winteringham provide a lower standard, although this is not unreasonable in view of the small number of properties at risk. The standard will continue to deteriorate as sea levels rise and improvement works will eventually be needed if the land is to remain usable. Justifying these works will be difficult, however, and alternatives (such as secondary defences around individual properties) may need to be considered. The opportunity to provide flood storage (and so help lower extreme flood levels further upstream) will need to be taken into account when this is done.
**Unit 6 Barton Cliff to East Halton Skitter**

**Land use and development**
Low-lying land behind the defences extends inland for up to 3 km and further along the East Halton Beck. The area is mostly medium grade agricultural land with scattered farms and includes the northern outskirts of Barton and Barrow upon Humber and Goxhill. There are claypits immediately behind the defences between Chowder Ness and New Holland, some of which have been designated for their environmental value and some are used for recreation. There are several small industrial areas including one at New Holland Dock.

**Flood cells and flood defences**
The unit is divided into three flood cells (6/1 to 6/3). Apart from some short stretches of natural high ground and sea walls, the defences consist of embankments, mostly protected by stone revetments. The defences to Barton Haven have recently been improved.

**Estuary and coastal processes**
The unit is seaward of the Humber Bridge so re-aligning the defences will have little impact on conditions elsewhere.

**Natural and historic environment**
All of the estuary defences are fronted by land designated as SPA, Ramsar and SSSI and currently being considered for designation as SAC. The Barton and Barrow Clay Pits behind the defences, and some bird roosting areas north of East Halton Skitter, are included within these designated areas. There are some small SNCI and Wildlife Trust sites within the unit.

Much of the unit is of high archaeological potential. There is an extensive submerged Neolithic forest at Barton and structures at New Holland and East Halton Skitter, with evidence of many prehistoric and Roman settlements at Goxhill and further south. The havens at Barrow and East Halton Skitter were small medieval ports and Barton was an important medieval town and trading centre, later eclipsed by Hull. There are a number of important early industrial buildings along the shoreline.

**Standard of protection**
The number of properties at risk in each flood cell and the indicative range of protection standard suitable for the land use (based on Defra guidance) is shown in the table on the next page.

**Works in the next 5 years**
The unit’s defences are generally in reasonable condition and currently provide an adequate standard of protection. Accordingly no major improvement works are planned for the next 5 years (or indeed for the next 15). Standard maintenance work, including minor patching to the revetments, will be carried out as necessary. Associated British Ports (ABP) is planning to realign a short length of the defence near Chowder Ness to create compensatory habitat for harbour development at Immingham.

**Works in the next 15 years**
No further improvement works to this unit’s defences are planned for the next 15 years. The defences will continue to be maintained as appropriate throughout the period.

<table>
<thead>
<tr>
<th>Flood cell</th>
<th>No of Properties</th>
<th>Indicative Range*</th>
</tr>
</thead>
<tbody>
<tr>
<td>FC 6/1</td>
<td>Incl</td>
<td>10 to 100</td>
</tr>
<tr>
<td>FC 6/2</td>
<td>~ 1970**</td>
<td>10 to 100</td>
</tr>
<tr>
<td>FC 6/3</td>
<td>Incl</td>
<td>10 to 100</td>
</tr>
</tbody>
</table>

*On average, the lowest period in years between events likely to cause flooding
**No of properties in all three flood cells

**Long-term prospects**
The standard of protection provided by the unit’s defences will deteriorate as sea levels rise. There are likely to be sufficient properties at risk in Barton and Barrow upon Humber and New Holland (flood cells 6/1 and 6/2) to justify improving these defences when this becomes necessary. This may not be the case between New Holland and East Halton Skitter (flood cell 6/3), however, and alternatives (such as secondary defences around villages) may need to be considered. The proposed managed realignment near Goxhill, creating 130 ha of new habitat, is one such approach as the existing defences in front of the area will be replaced by new defences behind it. Opportunities for managed realignment in this area will be reviewed as options for the defences protecting Halton Marshes (in MU7) are considered.
Land use and development
Low-lying land behind the defences extends inland for up to five km. The unit includes parts of the towns of Grimsby and Cleethorpes, both of which contain large residential areas. Grimsby’s industry is largely based on the docks and there is a growing industrial area along the shoreline to North Killingholme with major port facilities, power stations, oil refineries and chemical plants. The whole area has been allocated in development plans for estuary-related industry and its potential for further development has recently been examined in the South Humber Bank Master Plan. The north end of the unit, near East Halton Skitter, is undeveloped and is medium grade agricultural land.

Flood cells and flood defences
The unit is divided into three flood cells (7/1 to 7/3). The defences consist of embankments, mostly with rock or stone revetments and concrete walls, in the Grimsby Docks area. Some lengths are threatened by falling foreshore levels and repairs have been carried out at a number of places over the last 10 years. Associated British Ports (ABP) is responsible for the defences through Grimsby Docks and North East Lincolnshire Council for the defences at Cleethorpes.

Estuary and coastal processes
The unit is seaward of the Humber Bridge so re-aligning the defences will have little impact on conditions elsewhere. The foreshore is eroding at a number of points along this frontage and immediately south of Immingham deep water appears to be migrating towards the shore. Both effects cause the defences to be undermined and so affect their stability.

Natural and historic environment
All of the estuary defences are fronted by land designated as SPA, Ramsar and SSSI and currently being considered for designation as SAC. The North Killingholme Pits, behind the defences, are included in these designations and there are some small SNCI and Wildlife Trust sites within the unit.

Parts of the unit are of high archaeological potential. There is a pattern of late prehistoric and Roman settlement at the northern end and recent work indicates this is likely to extend further south, with further remains surviving beneath later alluvial deposits. Mesolithic or early Neolithic material has been found with Roman pottery near the mouth of the River Freshney at Grimsby. The haven at Killingholme was a small medieval port and Grimsby developed as a major regional centre from the Middle Ages onward.

Standard of protection
The number of properties at risk in each flood cell and the indicative range of protection standard suitable for the land use (based on Defra guidance) is shown in the table below.

<table>
<thead>
<tr>
<th>Flood cell</th>
<th>No of Properties</th>
<th>Indicative Range*</th>
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<tbody>
<tr>
<td>FC 7/1</td>
<td>20**</td>
<td>50 to 200</td>
</tr>
<tr>
<td>FC 7/2</td>
<td>11,460</td>
<td>100 to 300</td>
</tr>
<tr>
<td>FC 7/3</td>
<td>18,852</td>
<td>100 to 300</td>
</tr>
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</table>

* On average, the lowest period in years between events likely to cause flooding
** Including major chemical and other industrial facilities

Works in the next 5 years
Toe protection works are needed to prevent undermining of the defences protecting Halton Marshes (the northern end of flood cell 7/1) and at Stallingborough (just south of Immingham in flood cell 7/2) due to falling foreshore levels. These works are currently planned to be built during the next 5 years, except for the frontage immediately south of East Halton Skitter. There are no properties at risk here so, despite the area’s development potential, it is very difficult to justify spending public money on the repairs. Discussions with North Lincolnshire Council and others are needed to assess the wider implications and agree what should be done, both here and elsewhere in the South Humber Bank development area. These discussions should, among other things, review opportunities for managed realignment and the creation of a buffer zone to limit the extent of new development immediately behind the defences.

In addition to carrying out the toe protection works some local crest raising may be undertaken in one or both flood cells. This will be subject to the results of a detailed review of joint water level and wave height predictions.

The walls and defences through Grimsby Docks provide protection to much of the town. Parts of these defences are in relatively poor condition and on initial inspection the standard they provide appears very variable, although in practice the docks themselves will intercept a large volume of any floodwater so the actual standard is significantly higher. Nevertheless further study is needed to evaluate this issue and discussions with ABP are required concerning the future maintenance and improvement of these defences.

Works in the next 15 years
Further toe protection works to the defences in both flood cells 7/1 and 7/2 are planned once the first round of repairs have been completed. Some crest-raising works may also be carried out, depending on the results of the water level and wave height review mentioned above. On the assumption that the talks with ABP are successful, improvements to the defences in Grimsby Docks are planned for this period as well. The remaining defences will continue to be maintained as appropriate.

Long-term prospects
All the defences to this unit (apart from those protecting agricultural land near East Halton Skitter, discussed separately above) will continue to be maintained and improved as necessary to provide a high standard of protection throughout the 100-year life of the strategy.
Land use and development
In the Shoreline Management Plan this unit stopped at Donna Nook but it has been extended to Saltfleet Haven to ensure consistency between the management of the estuary and coastal defences. Lowliving land behind the defences extends inland for up to 10 km. The area is mostly high grade agricultural land with scattered farms and small to medium sized villages. The main town is the seaside resort of Cleethorpes.

Flood cells and flood defences
The unit is divided into two flood cells (8/1 and 8/2). There are sand dunes fronted by sandflats, mudflats and saltmarsh along most of the shoreline between Cleethorpes and Saltfleet Haven. These provide much of the defence along this frontage, reinforced by kidding and other structures locally and supplemented by retired seawalls and earth embankments. Cleethorpes has a seawall with promenade and further east at Humberston Fitties there are sand dunes maintained by North East Lincolnshire Council.

Estuary and coastal processes
Re-aligning the defences in this unit will have little impact on conditions elsewhere. The foreshore generally appears to be accreting, indicating that it is more affected by coastal processes and the link between the Holderness and Lincolnshire coasts than by internal estuary processes.

Natural and historic environment
All of the defences are fronted by land designated as SPA, Ramsar and SSSI and currently being considered for designation as SAC. There are some small SNCI areas within the unit and a Wildlife Trust site at Donna Nook. The RSPB has a reserve at Tetney.

The shoreline is accreting and is presently obscured by sand, although the remains of a prehistoric forest and other land surfaces have been recorded near Cleethorpes. Salt-making sites from the Bronze Age onwards are known at Tetney and other sites, mostly medieval, lie well inland further south.

<table>
<thead>
<tr>
<th>Flood cell</th>
<th>No of Properties</th>
<th>Indicative Range*</th>
</tr>
</thead>
<tbody>
<tr>
<td>FC 8/1</td>
<td>~ 3000</td>
<td>50 to 200</td>
</tr>
<tr>
<td>FC 8/2</td>
<td>1294**</td>
<td>10 to 100</td>
</tr>
</tbody>
</table>

* On average, the lowest period in years between events likely to cause flooding
** Excluding properties where the risk of flooding from the Louth Canal is greater than from the estuary

Standard of protection
The number of properties at risk in each flood cell and the indicative range of protection standard suitable for the land use (based on Defra guidance) is shown in the table above.

Works in the next 5 years
Between Cleethorpes and Donna Nook the defences are generally in reasonable condition and currently provide an adequate standard of protection. Accordingly no major improvement works are planned for the next 5 years (or indeed for the next 15). A detailed review of joint water levels and wave heights will be undertaken and used to review the standard provided by the defences south of Donna Nook and assess the need for improvement works there.

Managed realignment of a section of the defences at Donna Nook is planned to take place during the next 5 years. The other defences will continue to be maintained as appropriate.

Works in the next 15 years
The need for improvement works will be determined by the results of the review of standards mentioned above. Ongoing maintenance works will continue as appropriate.

Long-term prospects
With an accreting foreshore it is likely that the unit’s defences will continue to be maintained and improved as necessary to provide a reasonable standard of protection throughout the 100-year life of the strategy, although this will be subject to the results of the review mentioned above.

“The area is mostly high grade agricultural land with scattered farms and small to medium sized villages”
Studios undertaken

Defining the problem (1997-2000)

Land use
Identifying the assets lying within the floodplain and so benefiting from the protection provided by the defences.

Flood defences
Consolidating and reviewing data about the defences to determine their condition and the standard of protection they provide.

Historic and current estuary behaviour
Examining the estuary’s geology and historic development as well as the processes taking place there now.

Environmental baseline
Collecting environmental data (natural and historic) about the estuary and floodplain and identifying the constraints on managing the defences.

Developing the proposals (2001-2004)

Future estuary behaviour
Examining the effect of sea level rise on the sediment balance and inter-tidal habitat in the estuary (and on the adjacent coast-line) and assessing the impact of possible management options, including managed realignment.

Coastal Habitat Management Plan (CHaMP)
Drawing up a CHaMP to determine how the integrity of the SPA/SAC can be maintained while continuing to manage the estuary’s defences.

Potential managed realignment sites
Identifying sites where the defences could be re-aligned, costing the works needed and starting to discuss the implications with landowners and tenants.

Environmental baseline
Collecting environmental data (natural and historic) about the estuary and floodplain and identifying the constraints on managing the defences.

Standard of protection
Identifying and costing the works needed over the next 50 years to provide a high or low standard of protection to each of the 12 management units around the estuary shown in the map on page 9.

Strategic Environmental Assessment (SEA)
Undertaking an SEA to assess the impact of the works and determine which option is to be preferred in each unit on environmental grounds.

Economic appraisal
Comparing the costs and benefits of each option to determine which is to be preferred in each unit on economic grounds.

Long-term programme of work
Selecting the preferred option for each unit taking all issues into account and drawing up a prioritised programme of the works needed over the next 50 years (including managed realignment as necessary).

Delivering the strategy (2004-2005)

Works in first 5 years
Reviewing the works in the first 5 years of the programme to identify key issues (including the possibility of realigning the defences), re-assessing their priority and so confirming the works to be included in a package covering the first 5 years.

Approval process
Establishing the approach to be followed when applying for outline approval of a package of flood defence works affected by the Habitats Regulations.

Works in first 5 years
Developing the designs and assessing the impacts (technical, environmental, economic and social) of the works in the first 5 year package sufficiently to allow outline approval to be obtained.

Monitoring and maintenance
Reviewing the monitoring and maintenance works needed to manage the defences in the future (including erosion protection to prevent them being undermined).

Benefits of flood storage
Determining the reduction in risk and saving in cost that will result from the provision of flood storage upstream of the Humber Bridge in the future.

“Shadow” Appropriate Assessment
Assessing the impact of the works included in the package as required by the Habitats Regulations and drawing the individual assessments together to provide a ‘shadow’ assessment of the whole package.

Sustainability Appraisal
Assessing the sustainability of the overall strategy using a methodology developed by the Yorkshire and Humber Regional Assembly.

Strategic Environmental Assessment (SEA)
Undertaking an SEA to assess the impact of the strategy as a whole to complement the earlier study of the individual options.

Supporting reports

The studies carried out as the Strategy was being prepared are outlined on the opposite page and are described in the reports listed below. Details of how to obtain copies of these reports are given inside the back cover.

Defining the problem (1997-2000)

Technical Reports
Joint Probability Analysis of Large Waves and High Water Levels
Geomorphological Studies
Urgent Works Review
Environmental Baseline Study
Historic Environment Baseline Study
Humber Estuary Shoreline Management Plan (HESMP)

Consultation/Information Documents
A Strategy for Flood Defence (April 1999)
Options Consultation Document (November 1999)

Developing the proposals (2001 – 2006)

Technical Reports
HESMP Phase 2 Geomorphology Studies
Coastal Habitats Management Plan (CHaMP)
Engineering Studies Report
Economic Assessment Report
Strategic Environmental Assessment (of the Long Term Programme)

Consultation/Information Documents
Consultation on Managed Realignment: Information for Landowners and Tenants (June 2002)
Update on Managed Realignment (July 2003)
Newsletters ‘TidesNews’ #1 (July 2001) to #5 (February 2004)

Delivering the strategy (2004 – 2005)

Technical Reports
Key Issues Assessments (of works in first 1.5 years)
Detailed Appraisals (of works in first 5 years)
Water Level Modelling Report
Technical Report
“Shadow” Appropriate Assessment
Sustainability Appraisal
Strategic Environmental Assessment (of the Strategy)

Consultation/Information Documents
Newsletter ‘TidesNews’ #6 (March 2005)

Note: A number of studies not commissioned by the Environment Agency have also contributed to the development of the strategy. These include ‘FutureCoast’, ‘The Southern North Sea Sediment Transport Study’, the HECAG Shoreline Management Plan, and others.
Names, organisations and abbreviations

<table>
<thead>
<tr>
<th>Project management</th>
<th>Organisations represented on steering group</th>
<th>Abbreviations</th>
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</table>
Consultations and contact arrangements

This document summarises the Humber Flood Risk Management Strategy and the works to improve the defences that are to be carried out during the next five years. It is supported by the reports listed on page 51, all of which have been completed or are currently being finalised.

If you have any comments or suggestions about the strategy or about any aspects of the works to be carried out during the next five years please respond to the Humber Strategies Manager, Philip Winn, using the contact details below. Copies of any of the reports listed on page 51 can be obtained on CD from the same address once they have been finalised.

Note that planning permission will be sought for each item of work separately so you will have a further opportunity to comment on the details and on the local implications before the work starts. These opportunities will be advertised in the local press and details will be circulated to all those known to have an interest in the area affected.

A key supporting report is the Strategic Environmental Assessment (SEA) of the strategy. Although not a statutory document, the SEA is being issued for consultation at the same time as this report. Copies have been sent to the organisations listed on page 26. If you would like a copy on CD sent to you, or if you have any comments on the SEA please send them by post, by telephone or by e-mail to the address given below.

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Then call us on
08708 506 506 (Mon-Fri 8-6)

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or visit our website
www.environment-agency.gov.uk

incident hotline 0800 80 70 60 (24hrs)
floodline 0845 988 1188