Humber River Basin District
Flood Risk Management Plan

PART A: Background and River Basin District wide information
December 2015
This is a joint plan prepared by the following Risk Management Authorities:
Foreword

The 2013/14 and 2015/16 winter storms and flooding had significant impacts on some communities, businesses, infrastructure, rural areas and the environment. Evidence suggests there could be more extremes in the weather with a changing climate leading to more frequent and more severe flooding. During December 2015, Storms Desmond, Eva and Frank brought record breaking rainfall levels and significant flooding to some parts of the UK. Over 19,000 homes and businesses were flooded, with thousands more affected by loss of power supply and travel disruption. Existing flood defences played an essential part in protecting thousands of homes during December with 12,500 benefitting during Storm Desmond and 10,900 during Storm Eva. Support is in place for affected communities, business and the agricultural sector, along with a programme of inspections and repairs to damaged defences. These December 2015 flood events have emphasised the need to be sure we have the very best possible plans in place for flood management across the whole country.

Risk Management Authorities (RMAs) are committed to producing Flood Risk Management Plans (FRMPs) required by the EU Floods Directive. This FRMP is an important part of meeting that objective and aligns with the Defra Strategy and guiding principles of the National Flood and Coastal Erosion Risk Management Strategy.

The FRMP will provide the evidence to support decision making. The FRMP will also help promote a greater awareness and understanding of the risks of flooding, particularly in those communities at high risk, and encourage and enable householders, businesses and communities to take action to manage the risks. The highest priority is to reduce risk to life.

Measures (actions) in individual FRMPs do not all have secured funding and are not guaranteed to be implemented. Money is allocated to all RMA measures in the same way, based on current Government policy that gives the highest priority to lives and homes.

This FRMP brings together for the first time measures to address all sources of flooding in the Humber. It is based on the most up-to-date information available at the point of publication. Measures in the FRMP are the starting point for RMA decision making and delivery. As part of on-going strategic planning additional measures will be included in RMAs and other partners work programmes between 2015 - 2021, although the FRMP will not be updated. FCRM strategic planning is a continuous process and informs RMA decision making and will be the basis for the 2nd cycle FRMPs.

This document has been produced in consultation with professional partners. The Flood Risk Management Plan (FRMP) sets out the proposed measures to manage flood risk in the Humber River Basin District from 2015 to 2021. This plan should be read in conjunction with the following:

Lead local flood authority (LLFA) information (for example local strategies) listed in Part B of this document

Kingston upon Hull and Haltemprice Catchment within East Riding of Yorkshire FRMP

When used together these plans set a clear framework for the management of flood risk within the Humber river basin district. Together, they will provide a greater awareness and understanding of the risk of flooding and encourage and enable householders, businesses and communities to take action to manage the risks.

In England, RMAs include the Environment Agency, Lead Local Flood Authorities (LLFAs), district councils (where there are no unitary authorities), internal drainage boards, water companies and highway authorities. These RMAs work in partnership with communities to reduce the risk of flooding. The Environment Agency would like
to thank the organisations listed on the previous pages for their contributions and feedback during consultation.

Flood risk in England will continue to change as a result of a growing population and a changing climate. There are many ways to manage flood risk including maintaining and building new flood defences, building flood resilient homes and working more closely with nature to restore flood plains. Flood risk management planning is not new and RMAs have been able to draw on the experience of partners and earlier plans.

Following the December 2015 floods, Defra announced a National Flood Resilience Review, to assess how the country can be better protected from future flooding and increasingly extreme weather events. The review is looking at climate modelling, infrastructure, resilience and future investment strategy. Government is also working to strengthen or establish partnerships in the areas most flood affected to encourage a more integrated approach to managing risk across the whole catchment. These partnerships are considering improvements to flood defences, upstream options to help slow the flow and surface water runoff, and how planning and design of urban areas can help reduce flood risk. They are also aiming to build stronger links between local residents, community groups and flood management planning and decision making. The resulting actions from the Local Flood Partnerships in Cumbria and Yorkshire will complement the measures in the relevant FRMPs and the learning from this approach will be shared across the country. In England, the Government is investing £2.3bn on 1,500 flood defence schemes between 2015-2021. Investment in flood risk management infrastructure not only reduces the risks of flooding but also supports growth by helping to create new jobs, bringing confidence to areas previously affected by floods and creating and restoring habitats.

The FRMP also sets out how these proposed measures can contribute to improving the environment and how they support the objectives of River Basin Management Plans (RBMPs) and specifically the Humber RBMP that the Environment Agency has produced in parallel with this FRMP. Both flood risk management and river basin planning form an important part of a collaborative and integrated approach to catchment planning for water. Building on this essential work, and in the context of the Governments 25-year environment plan, we aim to move towards more integrated planning for the environment over the next cycle. This will be done on a catchment basis and will draw together and integrate objectives for flood risk management, water management, and biodiversity, with the aim of maximising the multiple benefits that can be achieved.

Steve Moore
Director of Operations, North and East
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<tr>
<td>AONB</td>
<td>Area of Outstanding Natural Beauty</td>
</tr>
<tr>
<td>BAP</td>
<td>Biodiversity Action Plan</td>
</tr>
<tr>
<td>Catchment</td>
<td>The watershed of a surface water river system</td>
</tr>
<tr>
<td>CaBA</td>
<td>Catchment based approach: an approach to environmental planning that focuses on local engagement and partnerships</td>
</tr>
<tr>
<td>CFMP</td>
<td>Catchment Flood Management Plan</td>
</tr>
<tr>
<td>Coastal Groups</td>
<td>Voluntary coastal defence groups made up of maritime district authorities and other bodies with coastal defence responsibilities</td>
</tr>
<tr>
<td>Defra</td>
<td>Department for Environment, Food and Rural Affairs</td>
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<tr>
<td>EA</td>
<td>Environment Agency</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>EPR</td>
<td>Environmental Protection Regulations</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>FCRM</td>
<td>Flood and Coastal Risk Management</td>
</tr>
<tr>
<td>FCERM</td>
<td>Flood and Coastal Erosion Risk Management</td>
</tr>
<tr>
<td>Flood Risk Area (FRA)</td>
<td>Areas where the risk of flooding from local flood risks is significant as designated under the Flood Risk Regulations</td>
</tr>
<tr>
<td>Flood Risk Regulations (FRR)</td>
<td>The Flood Risk Regulations came into force December 2009. They set out the requirement for flood risk management authorities to undertake preliminary flood risk assessments, identify flood risk areas and produce flood risk management plans.</td>
</tr>
<tr>
<td>FRMP</td>
<td>Flood Risk Management Plan – plan produced to deliver the requirements of the Regulations</td>
</tr>
<tr>
<td>FWD</td>
<td>Floodline Warnings Direct</td>
</tr>
<tr>
<td>FWMA</td>
<td>Flood and Water Management Act (2010)</td>
</tr>
<tr>
<td>Government</td>
<td>The term government is used within this report to refer to Defra (the Department for Environment, Flood and Rural Affairs) and Welsh Government</td>
</tr>
<tr>
<td>Groundwater flooding</td>
<td>Occurs when water levels in the ground rise above the natural surface. Low-lying areas underlain by permeable strata are particularly susceptible</td>
</tr>
<tr>
<td>Ha</td>
<td>Hectares</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Term</td>
</tr>
<tr>
<td>--------------</td>
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</tr>
<tr>
<td>HRA</td>
<td>Habitats Regulations Assessment: an assessment undertaken in relation to a site designated under the Habitats and Birds Directives</td>
</tr>
<tr>
<td>IDB</td>
<td>Internal Drainage Board</td>
</tr>
<tr>
<td>Km</td>
<td>Kilometres</td>
</tr>
<tr>
<td>LEP</td>
<td>Local Enterprise Partnership</td>
</tr>
<tr>
<td>LLFA</td>
<td>Lead Local Flood Authority</td>
</tr>
<tr>
<td>Local FRM Strategy</td>
<td>Local flood risk management strategy produced by LLFAs under the Flood and Water Management Act (2010)</td>
</tr>
<tr>
<td>Main river</td>
<td>A watercourse shown as such on the main river map, and for which the Environment Agency and Natural Resources Wales has responsibilities and powers</td>
</tr>
<tr>
<td>Medium Term Plan (MTP)</td>
<td>A list of capital projects to fund flood defence works over a 6 year period, drawn from a variety of sources. This is now known as the 6 year investment programme.</td>
</tr>
<tr>
<td>MPS</td>
<td>Marine Policy Statement</td>
</tr>
<tr>
<td>MMO</td>
<td>Marine Management Organisation</td>
</tr>
<tr>
<td>NaFRA</td>
<td>National Flood Risk Assessment: an assessment of flood risk for England and Wales showing the chance of flooding from rivers and the sea (both along the open coast and tidal estuaries)</td>
</tr>
<tr>
<td>National FCERM Strategy</td>
<td>National flood and coastal erosion risk management strategy: these are strategies prepared under the Flood and Water Management Act (2010), by the Environment Agency for England and by Welsh Government for Wales</td>
</tr>
<tr>
<td>NNR</td>
<td>National Nature Reserve</td>
</tr>
<tr>
<td>NPPF</td>
<td>National Planning Policy Framework</td>
</tr>
<tr>
<td>Ordinary watercourses</td>
<td>All watercourses that are not designated Main River, and which are the responsibility of Local Authorities or, where they exist, Internal Drainage Boards</td>
</tr>
<tr>
<td>PFRA</td>
<td>Preliminary Flood Risk Assessment – these were required to be published by December 2011 and were the first stage in delivering the Regulations</td>
</tr>
<tr>
<td>Ramsar</td>
<td>Wetlands of international importance designated under the Ramsar Convention</td>
</tr>
<tr>
<td>Reservoir</td>
<td>A natural or artificial lake where water is collected and stored until needed. Reservoirs can be used for irrigation, recreation, providing water supply for municipal needs, hydroelectric power or controlling water flow</td>
</tr>
<tr>
<td><strong>Risk management authorities (RMAs)</strong></td>
<td>Organisations that have a key role in flood and coastal erosion risk management as defined by the Act. These are the Environment Agency, Natural Resources Wales, lead local flood authorities, district councils where there is no unitary authority, internal drainage boards, water companies, and highways authorities</td>
</tr>
<tr>
<td><strong>RFCCs</strong></td>
<td>Regional Flood and Coastal Committees</td>
</tr>
<tr>
<td><strong>River Basin District (river basin district)</strong></td>
<td>These are the reporting units to the European Commission for the Water Framework Directive and the Floods Directive</td>
</tr>
<tr>
<td><strong>RBMP</strong></td>
<td>River Basin Management Plan – plan required by the European Water Framework Directive</td>
</tr>
<tr>
<td><strong>River flooding</strong></td>
<td>Occurs when water levels in a channel overwhelms the capacity of the channel</td>
</tr>
<tr>
<td><strong>SAC</strong></td>
<td>Special Area of Conservation</td>
</tr>
<tr>
<td><strong>SAM</strong></td>
<td>Scheduled Ancient Monument</td>
</tr>
<tr>
<td><strong>SAMP</strong></td>
<td>System Asset Management Plan</td>
</tr>
<tr>
<td><strong>SEA</strong></td>
<td>Strategic environmental assessment</td>
</tr>
<tr>
<td><strong>Sewer flooding</strong></td>
<td>Flooding due to failure or inadequate capacity of the man-made system which is designed to carry away flows of sewage and drainage water.</td>
</tr>
<tr>
<td><strong>SMP</strong></td>
<td>Shoreline Management Plan</td>
</tr>
<tr>
<td><strong>SPA</strong></td>
<td>Special Protection Area</td>
</tr>
<tr>
<td><strong>SSSI</strong></td>
<td>Site of Special Scientific Interest</td>
</tr>
<tr>
<td><strong>Surface water flooding</strong></td>
<td>Flooding from rainwater (including snow and other precipitation) which has not entered a watercourse, drainage system or public sewer</td>
</tr>
<tr>
<td><strong>uFMiSW</strong></td>
<td>Updated Flood Map for Surface Water - national scale modelling of England and Wales enhanced with compatible locally produced mapping where available. Assessment of a range of flooding scenarios</td>
</tr>
<tr>
<td><strong>UKCP</strong></td>
<td>United Kingdom Climate Projections</td>
</tr>
<tr>
<td><strong>WFD</strong></td>
<td>Water Framework Directive</td>
</tr>
</tbody>
</table>
The format of the flood risk management plan

Flood risk management plans have been divided into four sections to help readers identify and access information relevant to them. The plan is divided into four parts:

<table>
<thead>
<tr>
<th>Name</th>
<th>Audience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summary Document</td>
<td>For those who want a high level overview of the plan</td>
</tr>
<tr>
<td><strong>Part A: Background and river basin district wide information</strong></td>
<td>For those who need some legislative background and river basin district wide, high level information</td>
</tr>
<tr>
<td><strong>Part B: Catchment Summaries</strong></td>
<td>For those who want the detail of the sub-catchments and flooding statistics. This section includes the catchments based on the Water Framework Directive (WFD) management catchments, Flood Risk Areas (identified through the Preliminary Flood Risk Assessment) and other strategic areas across the river basin district</td>
</tr>
<tr>
<td><strong>Part C: Appendices</strong></td>
<td>For those who want to see the programme of work for individual communities</td>
</tr>
</tbody>
</table>

This is Part A, Background and river basin district wide information – this sets the scene for the FRMPs – what they are, what they are for and how they have been developed. Part A goes on to describe the river basin district at that scale.

The other parts of the flood risk management plan are located on gov.uk (https://www.gov.uk/government/publications/humber-river-basin-district-flood-risk-management-plan)

The layout of this document

Section 1: what is flood risk and who manages it?
This explains what flood risk is, who is responsible for managing the risk and what their roles are.

Section 2: what is a flood risk management plan?
What a FRMP is, why it is being developed and describes the kind of information that is included in the FRMP.

Section 3: how the plan has been developed
Describes how the Environment Agency, lead local flood authorities (LLFAs) and other risk management authorities (RMAs) have prepared this FRMP.

Section 4: how to manage risk
Describes some of the terminology used, such as ‘conclusions’, ‘objectives’ and ‘measures’, and how they relate to flood and coastal erosion risk management.

Section 5: getting to know the river basin district
Introduces the Humber river basin district and the ‘sub-areas’ that divide the river basin district further.
Section 6: key flood risk issues in the river basin district
Sets out the flood and coastal erosion risks are set out for the river basin district.

Section 7: the sub-areas
Introduces each of the sub-areas in turn.

Section 8: conclusions, objectives and measures for the Humber river basin district
Sets out the risk conclusions, objectives and measures for the Humber river basin district.

Section 9: implementing the plan, monitoring and reporting
Sets out the proposals for implementing the plan, including co-ordination with the implementation of the RBMPs prepared under the WFD. Section 9 concludes with how the measures will be monitored and reported.

Find out more
Throughout this document you will be directed via hyperlink to more detailed sources of information using ‘find out more’ boxes.
1. What is flood risk and who manages it?

The Flood and Water Management Act (2010) (FWMA) defines flooding as any case where land not normally covered by water becomes covered by water. Flood risk is a combination of two components: the chance (or probability/ likelihood) that a location will flood from any source or type of flooding, and the impact (or consequence) that the flooding would cause if it occurred. Flood risk management is generally concerned with reducing harm which might take the form of property damage or physical injury to people and wildlife. However, flooding can also have beneficial effects too, in particular for wetland wildlife as well as some types of agriculture that are water dependent.

Figure 1: What is flood risk?

Risk captures the severity of, or related consequences produced by, a flood event. The highest impact is loss of life. Impacts can be social, economic and environmental, for example the number of properties flooded and the level of associated economic damages. The consequences of a flood depend on the level of exposure and the vulnerability of those affected.

What is the likelihood of this happening and what does it mean?

Probability (or chance) is a measure of the likelihood that a defined event will occur. The probability of a flood event is typically defined as the relative frequency of occurrence of that flood being equalled or exceeded. Probability can be expressed as a fraction, percentage, a decimal or description, and should always make reference to a time period. For example, the industry refers to a ‘1 in 100 chance of flooding in any given year’ or a ‘1% annual probability of flooding’, which both refer to the same likelihood.

Assessing impacts of flooding prior to an event usually involves estimating the potential impact of flooding on people, property and the environment. The theoretical probability of flooding is illustrated by the Environment Agency Flood Maps which show flood risk for rivers and the sea, surface water and reservoirs. Flood models which are the basis for our flood maps use uniform rainfall scenario (the same amount of rainfall falling across the country), whereas in reality rainfall rates vary greatly from one town to another.

It is not possible to prevent all flooding, but there are a variety of actions which can manage these risks and their impacts on communities. Flood risk managers must identify all potential options to manage flood risk and balance the needs of communities, the economy and the environment. RMAs should work in partnership with each other and communities to manage flood risk, ensuring that communities are part of the decision making process and understand and actively prepare for the risks. By working together RMAs should actively seek opportunities to coordinate risk management, encourage partnership funding and deliver multiple benefits.
Roles and responsibilities
Table 1 and *Please note RMAs have different responsibilities for reservoirs such as regulation, asset management and flood incident response.

Table 2 show the RMAs involved in flood risk management in England and their roles and responsibilities.

The responsibilities for managing flooding in the UK is divided between different risk management authorities (RMAs) as defined in the Flood and Water Management Act. RMAs have powers and duties to manage the different forms for flooding that can occur as shown in table 1 (page 14). The Environment Agency is responsible for taking a strategic overview of the management of all sources of flooding and coastal erosion. Following the December 2015 floods Defra is looking at how this strategic overview role can be strengthened at the catchment scale to promote a more integrated approach to managing the water environment.

Table 1: Summary of responsibilities for risk management authorities

<table>
<thead>
<tr>
<th>Risk source</th>
<th>Environment Agency</th>
<th>Lead Local Flood Authority</th>
<th>District Councils</th>
<th>Water company</th>
<th>Highways Authority</th>
<th>Internal Drainage Board</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main river</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sea</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface water</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface Water (on or coming from the Highway)</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sewer Flooding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Ordinary Watercourse</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Groundwater</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reservoirs</td>
<td>✓*</td>
<td>✓*</td>
<td>✓*</td>
<td>✓*</td>
<td>✓*</td>
<td>✓*</td>
</tr>
<tr>
<td>Coastal Erosion</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strategic overview of all sources of flood risk (and the coast)</td>
<td>✓</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

*Please note RMAs have different responsibilities for reservoirs such as regulation, asset management and flood incident response.

Table 2: Roles and responsibilities of RMAs and others involved in managing flood risk
## Organisation | Role and responsibilities
---|---
Environment Agency | The Environment Agency has a strategic overview of all sources of flooding and coastal erosion (rivers, the sea, groundwater, reservoirs and surface water). Permissive powers to manage flood risk from ‘main rivers’, the sea and reservoirs. Can use enforcement powers to require landowners to take action to minimise flood risk to others.
Lead Local Flood Authority (LLFA) | LLFA. A county council or unitary council. Permissive powers to manage flood risk from surface water, ‘ordinary watercourses’ (non-main rivers) outside of internal drainage districts, and groundwater. Enforcement powers are similar to Environment Agency’s. LLFAs also manage the drainage on the majority of local highways.
Water Company | Manage the sewerage and water supply networks and any flood risk arising from them. Also manage flood risk to any critical infrastructure, such as water treatment plants and pumping stations.
Internal Drainage Board (IDB) | Permissive powers to manage water levels within their drainage districts. Much of IDBs’ work involves the maintenance and improvement of watercourses and related infrastructure such as pumping stations, weirs, sluices, culverts and embankments within their drainage districts.
District Council | By agreement with the upper tier LLFA, the District Council may do some work to manage flood risk. District Councils are the Local Planning Authority.
Highways England | Highways England looks after the motorways and major A roads focussing on the most important national routes, while councils manage the roads serving local communities. Having information about the condition of drainage assets they hold a Drainage Data Management System (also known as HADDMS) to identify flooding issues and places at particular risk, including private property, supporting a risk based programme of drainage renewal works.
Maritime District Council | As District Councils, but also manage coastal erosion. As many coastal defences protect against both erosion and flooding from the sea, these Councils often do both in urban areas.
Navigation Authorities | Manage the canal network throughout the river basin district. Although not a designated ‘Risk Management Authority’, Navigation Authorities manage their network in a way that minimises risk of flooding from it.
Riparian landowner | The owner of land next to a watercourse usually owns the land to the middle of the river (unless property deeds show otherwise). This ‘riparian landowner’ is responsible for maintaining the watercourse to allow free flow.
Communities | Individuals at risk from flooding, or having flooded, are encouraged to form a Flood Action Group or other Community Group as a focus for understanding the issues, considering improvement options and implementing solutions.
Non RMA owners of flood defences | Features and structures that have been designated as a flood defence cannot be altered, removed or replaced without the consent of the responsible authority.
Reservoir owners | In addition to their general duty of care for the public under common law, the owners of reservoirs with an above ground capacity of 25,000 cubic metres or more have a legal duty to have their reservoirs supervised and inspected regularly by experts; in order to prevent dam failures and the dangerous flooding that could result. Reservoir owners could fall into any of the above categories listed in the table.

### Existing flood management schemes and properties protected
Risk management authorities work in partnership with each other and communities to manage flood risk. The flood risk management plan sets out the current and proposed measures to manage flood risk across the Humber river basin district. However, RMAs have been undertaking a range of activities to manage flood risk for
many years. Details of these activities can be found in section 6, Key flood risk issues in the Humber River Basin District.

In some parts of the Humber river basin district flood management schemes are in place to reduce flood risk. The Environment Agency Flood Map for Planning shows all flood defences built in the last five years to protect against river floods with a 1 per cent (1 in 100) chance of happening each year, or floods from the sea with a 0.5 per cent (1 in 200) chance of happening each year. It also shows some, but not all, older defences.

Across the country Government is investing £2.3bn on 1,500 flood defence schemes over 2015 – 2021. Thousands of properties in the river basin district benefit from river flood risk management schemes, including homes and businesses in Grimsby, Lower Tame and Leicestershire. Further schemes are ongoing or planned in the Humber river basin district. The Local Flood Partnerships in Cumbria and Yorkshire, set up in response to the December floods will bring together a wide range of organisations and communities to develop Flood Action Plans. These actions will complement the measures in the FRMP and the learning from this approach will be shared across the country.

During December 2015 existing flood defences played an essential part in protecting thousands of homes with 12,500 benefitting during Storm Desmond and 10,900 during Storm Eva. This also provided vital time for homes and businesses to be evacuated as well as reducing the impacts. Additional temporary defences and pumps were deployed to reduce the risk to homes, businesses and infrastructure. A recovery programme of inspections and repairs to damaged defences was commenced as soon as water levels reduced.

Supporting Communities that Remain at Risk is an Environment Agency project to pre-plan for the use of temporary defences. This project is a great opportunity to have prepared plans and equipment for more communities to maximise the use of the extra time flood forecasting investment has bought us in helping to protect them.

Flood risk information
The Humber FRMP discusses flood risk from rivers and the sea, reservoirs and surface water (where information has been provided by LLFAs). The following section outlines flood risk classifications for the various sources.

Flooding from rivers and the sea
The maps and statistics within this plan relating to flooding from rivers and the sea are taken from the risk of flooding from rivers and the sea map. This map has been developed using the National Flood Risk Assessment (NaFRA). This is an assessment of flood risk for England and Wales produced using local data and expertise. It shows the chance of flooding from rivers and the sea (both along the open coast and tidal estuaries). The risk is presented as a likelihood (or chance) of flooding in any given year and divided into the following categories:

- **High** - greater than or equal to 1 in 30 (3.3%) chance in any given year
- **Medium** - less than 1 in 30 (3.3%) but greater than or equal to 1 in 100 (1%) chance in any given year
- **Low** - less than 1 in 100 (1%) but greater than or equal to 1 in 1000 (0.1%) chance in any given year
- **Very low** - less than 1 in 1000 (0.1%) chance in any given year.
The NaFRA takes flood defences and their condition into account and so describes the actual chance of flooding, rather than the chance if there were no defences present. Flood defences reduce the level of risk but don’t completely remove it. In extreme weather they can be overtopped or fail if they are in poor condition. The NaFRA results can be used in conjunction with receptor data (number and type of properties and infrastructure) to estimate the consequences and economic damage associated with flooding from rivers and the sea.

**Flooding from reservoirs**
Reservoir flood risk maps show the area that could be flooded if a large reservoir were to fail and release the water it holds. A large reservoir is one that holds over 25,000 cubic metres. This is a worst case scenario.

**Flooding from surface water**
The maps and statistics contained in this plan are based on the Updated Flood Map for Surface water (uFMfSW) published in December 2013. The uFMfSW assesses a range of flooding scenarios (annual probability of flooding is shown in brackets):

- High - 1 in 30 (3.3%)
- Medium - 1 in 100 (1%)
- Low - 1 in 1000 (0.1%)

The uFMfSW replaced the ‘Areas Susceptible to Surface Water Flooding’ maps produced in 2010 by the Environment Agency.
2. What is a flood risk management plan?

Flood risk management plans highlight the hazards and risks from rivers, the sea, surface water, groundwater and reservoirs and set out how RMAs will work together with communities to manage flood risk.

What is the flood risk management plan for?
Flood risk management plans (FRMPs) are produced every six years and describe the sources and risks of flooding within a river basin district and catchment. They also include information on how RMAs plan to work together with communities and businesses to manage and reduce flood risk. Over the 6 year planning cycle the FRMP will help promote a greater awareness and understanding of the risks of flooding, particularly in those communities at high risk, and encourage and enable householders, businesses and communities to take action to manage the risks. FRMPs along with River Basin Management Plans (RBMPs) help all those involved in managing water to make decisions that are best for people and the environment.

Why are flood risk management plans being prepared?
This is the first cycle of implementing the Flood Risk Regulations 2009. As a result of this legislation, LLFAs must prepare FRMPs in Flood Risk Areas, where the risk of flooding from local flood risks is significant (as identified in Preliminary Flood Risk Assessments (PFRAs)) for instance from surface water, groundwater and ordinary watercourses. The Environment Agency is required to prepare FRMPs for all of England covering flooding from main rivers, the sea and reservoirs. Further information on what is a flood risk management plan can be found on the GOV.UK website.

Flood risk and coastal erosion management activities require careful planning to ensure that appropriate, sustainable, options are selected and that they are implemented properly. Actions should be planned effectively, for the long-term, and provide a clear picture of what will be done to manage risk and provide multiple benefits. This may include, for example, linking with other plans such as river basin management plans (RBMPs) and supporting biodiversity, habitat creation or improving water quality. The Environment Agency and LLFAs are developing FRMPs by drawing existing information together and building on existing flood and coastal erosion risk management plans such as: Catchment Flood Management Plans (CFMPs), SMPs and Local Flood Risk Management Strategies (LFRMS) (see Figure 2).
Figure 2: Flood risk management plans and their relationship to other planning initiatives (taken from the National Flood and Coastal Risk Management Strategy for England)
What the plan does
The FRMP will help deliver the requirements of the National FCERM Strategy in England by setting out the measures to manage flood risk now and in the future. The FRMP will:

- help develop and promote a better understanding of flood and coastal erosion risk,
- provide information about the economic and environmental benefits to inform decision makers, and
- identify communities with the highest risk of flooding so that investment can be targeted at those in most need.

Measures in FRMPs do not all have secured funding and are not guaranteed to be implemented. Money is allocated to all RMA measures in the same way and is based on current Government policy that gives the highest priority to lives and homes.

What types of flood risk are included in the flood risk management plan?
The FRMP covers the flood risks that the RMAs are responsible for.

The Environment Agency has worked in partnership with other RMAs to pool the information needed to develop the FRMP. Some RMAs have a statutory duty to produce a FRMP as they have areas designated as FRAs Local surface water risk information is only included where lead local flood authorities have a statutory duty to produce a FRMP or where they have volunteered information. Those that are included are detailed in Table 3 and Table 4.

Areas of significant ‘local flood risk’ were identified from historic flood records and analysis of potential future flooding from surface water, groundwater and ordinary watercourse. These FRAs were designated on the basis of there being at least 30,000 people in properties at risk of flooding, or 150 critical services (for example - schools, hospitals, nursing homes, power and water services). This was as shown by locally agreed surface water flood maps produced in 2010 by the Environment Agency and supplemented with data from LLFAs where available.

Table 3: FRAs within the Humber river basin district and those contributing to this FRMP

<table>
<thead>
<tr>
<th>FRA and voluntary information</th>
<th>Authorities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kingston upon Hull and Haltemprice</td>
<td>Hull City Council</td>
</tr>
<tr>
<td>Leicester Principal Urban Area</td>
<td>Leicester City Council, Leicester County Council</td>
</tr>
<tr>
<td>West Midlands</td>
<td>Birmingham City Council, Dudley Metropolitan Borough Council, Sandwell Metropolitan Borough Council, Solihull Metropolitan Borough Council, Staffordshire County Council, Walsall Council, Wolverhampton City Council, Worcestershire County Council</td>
</tr>
<tr>
<td>Voluntary information</td>
<td>North Yorkshire County Council, City of York Council, Kirklees Metropolitan Borough Council, Scarborough Borough Council (Coastal)</td>
</tr>
</tbody>
</table>
East Riding of Yorkshire Council has prepared a separate FRMP from this plan. This FRMP was consulted on during March and April 2015. Published in December 2015, the FRMP which covers the Haltemprice villages can be viewed at www.eastriding.gov.uk/flooding.

Table 4: LLFAs and FRAs in separate FRMPs

<table>
<thead>
<tr>
<th>FRA</th>
<th>LLFA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kingston upon Hull and Haltemprice</td>
<td>East Riding of Yorkshire Council</td>
</tr>
</tbody>
</table>

Find out more:

- National Flood and Coastal Erosion Risk Management Strategy

- Flood Risk Management Plan Guidance

- Flood and Coastal Change

- Interactive flood maps
Figure 3: Sources of flood risk information included in this FRMP
3. How the plan has been developed

The approach to developing flood risk management plans

In 2013 the Government agreed that the preferred approach to developing FRMPs would be for the Environment Agency to work in partnership with other RMAs, in particular LLFAs, to pool information to develop an overall plan for managing all sources of flood risk and coastal erosion. In preparing this FRMP, RMAs have built on relevant information from existing work (see Figure 2 and

Find out more

- Interactive flood maps

- River Basin District Maps

Table 5). Of particular importance are the Local FRM Strategies developed by LLFAs, CFMPs and SMPs. In drawing measures together, RMAs have revisited priorities and ensured that there is a shared understanding of the risks and how best they can be managed.

The Environment Agency is co-ordinating the development of this FRMP with the RBMP so that there is an integrated approach to overall water management for the benefit of people, the environment and the economy.

Find out more

- Interactive flood maps

- River Basin District Maps

Table 5 shows the sources of FRMP information. These plans remain active. The future need for CFMPs as the strategic plan for river and estuary flooding is being reviewed in 2015 and 2016. As with all of the plans listed in

Find out more

- Interactive flood maps

- River Basin District Maps
Table 5, all relevant actions have been brought together by FRMPs. This is the case with CFMP actions. Irrespective of the review, the actions will be being taken forward by the FRMP. The CFMP long term policies have not been carried forward.

### Find out more

- **Interactive flood maps**

- **River Basin District Maps**

### Table 5: Sources of FRMP information

<table>
<thead>
<tr>
<th>Flood risk</th>
<th>Existing plans and FRMP information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flooding from main rivers</td>
<td><strong>Catchment Flood Management Plans (CFMPs):</strong> Aire, Calder, Derwent, Don, Esk, Grimsby and Ancholme, Hull, Louth Coastal, Ouse, Trent</td>
</tr>
<tr>
<td>Flooding from the sea and along estuaries</td>
<td><strong>Shoreline Management Plan 2:</strong> River Tyne to Flamborough Head SMP2 Flamborough Head to Gibraltar Point SMP2</td>
</tr>
<tr>
<td>Flooding from Reservoirs</td>
<td><strong>Reservoir Plans:</strong> Flood Risk Maps – Humber river basin district</td>
</tr>
<tr>
<td>Flooding from surface water, groundwater and ordinary watercourses</td>
<td><strong>Local FRM Strategies:</strong> North Yorkshire County Council City of York Kirklees Metropolitan Borough Council Hull City Council Leicester City Council Lincolnshire County Council North East Lincolnshire Council</td>
</tr>
</tbody>
</table>

### Consultation and engagement

Consultation and engagement on this FRMP helped improve, inform and shape the plan. Through the consultation of others we believe a better final plan has been achieved. National public consultation took place October 2014-January 2015.

The approach to promote the consultation locally was predominately via emails and meetings with stakeholders. Environment Agency staff involved in meetings with stakeholder groups and partners shared information across 22 meetings and 10 workshops to highlight and discuss the consultation.

The Environment Agency also promoted the consultation locally through:

- Periodic Strategic Partnership meetings between July 2014 – January 2015
- Representation at the October Trent and Yorkshire Regional Flood Coastal Committees (RFCCs) meetings
- Further information regarding the consultation process can be found below.

East Riding of Yorkshire Council also has a legal responsibility to consult on their FRMP for the Haltemprice villages and has done so separately. This FRMP was consulted on during March and April 2015. Published in December 2015, the FRMP
Objective setting

Objectives set out what Risk Management Authorities want to achieve to manage the risk of flooding. FRMPs contain objectives for managing flood risk. Objectives are a common set of goals agreed by risk management authorities. They state the main ways in which work is directed to make a difference and reduce flood risk. They cover people, the economy and the environment. The objectives are split into the 3 categories to help demonstrate the balance of objectives across the plans but the categories aren’t assigned a weighting in the FRMP. Objectives are used to plan and prioritise investment programmes to target investment to the most at risk communities. Prioritisation is then done at an England wide level and takes into account the risk but also considers other factors such as cost benefits, the level of investment to date and other aspects such as the potential for external funding opportunities. The measures tables in the appendices show which category of objective relates to each measure.

The FRMP aims to build on existing plans (see

Table 5) as well as bringing together locally gathered information through consultation and experience of recent flood events. With this understanding as Risk Management Authorities are then able to set out what we want to achieve to manage the risk of flooding through the defining of objectives and how we want to achieve it through measures or actions. This informs what we want to achieve by defining objectives to manage the impact of flood and coastal erosion risk to the social, economic and environmental value of the Humber river basin district.

Six year investment programme

In December 2014 the government set out a 6 year plan for investment in flood and coastal erosion risk management (2015/16 to 2020/21). The latest published figures show the current funding profile of each year and the published programme can be found here.
Each year RMAs (local councils, internal drainage boards, highway authorities, and water and sewerage companies) are invited to submit details of proposed FCERM capital works to the Environment Agency. These proposals are combined with Environment Agency proposed schemes to form a programme of work. Investment in FCERM is prioritised according to government policy and in line with the government’s National FCERM Strategy and HM Treasury Green Book on economic appraisal. Government policy gives the highest priority to lives and homes and all FCERM schemes should at least have a benefit cost ratio greater than 1:1. All FCERM schemes are prioritised against a consistent set of criteria applied to all risk management authorities (RMAs). This ensures a fair distribution of government funding based on agreed priorities, principles and needs.

FCERM schemes are normally funded with Flood Defence Grant in Aid from Defra, partnership funding and Local Flood Defence Levy raised by Regional Flood and Coastal Committees. FCERM schemes can also be funded through other private contributions and local funding sources. Where FCERM projects can help to regenerate an area and support economic growth, funding may also be available from other sources. This can include European Structural Investment Fund, Growth Fund through the Local Enterprise Partnership and Community Infrastructure levy through local authorities. In addition to FDGiA for FCERM schemes, internal drainage board activities are predominately funded by the local beneficiaries of the water management work they provide.

Long term investment scenarios
The Environment Agency’s long-term investment scenarios (LTIS) study published in December 2014, presents a new analysis of the costs and risks of FCERM in England. The study sets out the link between national investment in FCERM, and the outcomes in terms of economic risk and numbers of properties at risk. The study found that the annual economic ‘optimum’ investment need over the next 10 years is broadly in line with current expenditure (about £750 million, including public and third party contributions). The study shows that over the next 50 years optimal investment in FCERM is expected to rise by 10-20% (in present day terms). A key finding of the study is that even if average annual investment is sustained at an optimal level there will still be significant numbers of properties at high and medium flood risk in 50 years time meaning new and innovative approaches will be needed. LTIS estimates that, by 2021, the six year programme could reduce overall flood risk by up to 5% on the assumption that planned capital, maintenance and incident management activities are maintained. The National Flood Resilience Review is considering infrastructure and future investment strategy across England to identify any gaps in the approach and to pinpoint where defences and modelling need strengthening. This will allow us to take prompt action.

Flood and coastal risk management and agriculture
Land drainage for agricultural purposes is an important element of operational activity in flood and coastal erosion risk management. Today the prime driver for Government investment in flood and coastal management is one of risk reduction to people and property, and for the protection of the environment. Investment is prioritised according to Government policy, the National Flood and Coastal Erosion Risk Management Strategy and the HM Treasury Green Book on economic appraisal. Government policy gives the highest priority to lives and homes. Agricultural drainage and water level management work continues to be important particularly in low lying areas and this work is predominantly undertaken by farmers and landowners, and where they exist, Internal Drainage Boards. The work of Internal Drainage Boards through managing water levels and maintaining
watercourses and structures can also manage and reduce flood risk to people, property and infrastructure.

**Strategic Environmental Assessment and Habitats Regulations**

A Strategic Environmental Assessment (SEA) was undertaken to consider the significant environmental effects of the FRMP, see section 8. The Environment Agency consulted Natural England, English Heritage and the Marine Management Organisation (MMO) on the scope of the proposed assessment in December 2013, and the environmental report sets out the results of the SEA. The report describes the environmental effects that are significant within the river basin district and identifies measures to mitigate any adverse effects. Opportunities to improve the environment are also considered. The SEA took account of the environmental effects of flood risk management measures in the FRMP. The focus was on the combined effects of the programme of protection measures across a catchment or FRA, rather than individual measures at specific locations.

Using the same assessment approach for both the RBMP and FRMP allows us to compare the environmental effects directly and consider the interaction between the two plans. The likely positive impacts of the FRMP are identified in the SEA, as well as mitigation required to manage the negative effects and opportunities to deliver greater environmental benefits. Indicators are also set out that indicate the effect of the plan on significant environmental receptors, taking advantage of existing monitoring that is already carried out by the Environment Agency and others.

A Habitats Regulations Assessment (HRA) has been carried out on the FRMP to consider whether the plan affects designated sites (Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Ramsar sites). Initial assessment suggests that significant effects are not likely.

**How flood risk management plans have been co-ordinated with river basin management planning (RBMP)**

The South East flood risk management plan has been developed alongside the South East river basin management plan so that opportunities for flood risk improvements can integrate water and biodiversity objectives wherever possible and help provide other benefits to society. These benefits could include greater access to riversides, improved recreation and angling along rivers, more biodiversity and contributing to local council open space strategies. The Environment Agency has led on the development of both plans, and aims to co-ordinate work effectively and support others to do the same. Section 8 of this document provide more detail on how the flood risk management plans relate to other plans and wider policies and objectives.

Humber FRMP objectives have been developed in conjunction with RBMP colleagues. Each river basin district has a Liaison Panel made up of representatives for the key sectors. Members bring their experience, knowledge and their sector views acting as a two-way channel between the panel and their sector.

**Find out more**

4. How to manage risk

Involving communities’ leads to more effective flood and coastal erosion risk management (FCERM). RMAs will continue to work with communities and other stakeholders to manage risk by:

- assessing the sources of flood risk and drawing conclusions about the risks
- setting out what RMAs are trying to achieve and establishing risk management objectives
- determining the best approach to achieving the objectives by identifying the right measures and prioritising them

The conclusions, objectives and proposed measures are set out within this FRMP. During the six year planning cycle set out in the FRRs (2009) RMAs will work with partners and interested parties to:

- seek to secure the necessary funding, including from partners
- implement the measures, with clarity on what each organisation is accountable for
- monitor and review how the plan works

RMAs will monitor, and report annually, on progress in implementing the measures set out in the FRMP. RMAs will continue to work in partnership, ensuring that they can maintain a forward look of prioritised proposals for managing flood risk. The next review of the FRMP under the FRRs will be completed by 2021. The Local Flood Partnerships in Cumbria and Yorkshire, set up in response to the December floods will bring together a wide range of organisations and communities to develop Flood Action Plans. These actions will complement the measures in the FRMP and the learning from this approach will be shared across the country.

National flood and coastal erosion risk management strategy for England

The national FCERM strategy for England (2011) provides the overarching framework for future action by all RMAs to tackle flooding and coastal erosion risk in England. The overall aim of the strategy is to ensure the risk of flooding and coastal erosion is properly managed by using the full range of options in a co-ordinated way. It encourages more effective risk management by enabling people, communities, business, infrastructure operators and the public sector to work together to:

- ensure a clear understanding of the risks of flooding and coastal erosion, nationally and locally, so that investment in risk management can be prioritised more effectively
- set out clear and consistent plans for risk management so that communities and businesses can make informed decisions about the management of the remaining risk
- manage flood and coastal erosion risks in an appropriate way, taking account of the needs of communities and the environment
- ensure that emergency plans and responses to flood incidents are effective and that communities are able to respond effectively to flood forecasts, warnings and advice
- help communities to recover more quickly and effectively after incidents

The strategy recognises that difficult decisions have to be taken on where activities can and can’t be carried out at both national and local levels. As such, six guiding
principles have been identified to help guide these decisions and the processes by which they are taken. These guiding principles are:

- Community focus and partnership working
- A catchment and coastal "cell" based approach
- Sustainability
- Proportionate, risk-based approaches
- Multiple benefits
- Beneficiaries should be encouraged to invest in risk management

This FRMP has been developed to meet the legal requirements of the FRR. In doing so, we have also taken into account the national FCERM strategy for England, in particular its guiding principles.

**Measures for managing risk**

There are different approaches to managing flood and coastal erosion risk – these are known as measures and are described below.

**Preventing:** by avoiding putting people or the environment at risk of flooding, for example, one way of preventing risks arising would be by not building homes in areas that can be flooded

**Preparing:** by taking actions that prepare people for flooding, for example, by improving awareness of flood risk, or by providing warning and forecasting for floods so that people can take precautions to safeguard their valuables

**Protecting:** by protecting people from the risk of flooding. For example, by the maintenance or refurbishment of existing defences, building new defences or incorporating property resilience measures such as using waterproof boards over doors and airbricks to reduce the damage caused by flood water

**Recovery and review:** by learning from when flooding happens and how to recover from it, for example, by improving the availability of recovery services such as providing temporary accommodation, after flooding has occurred

Flood and coastal erosion risk management may require a combination of the measures outlined above. FRMPs bring together measure from existing sources, particularly CFMPs, SMPs, local flood risk management strategies and the 6 year investment programme. The development and completion of these measures is often dependent on partnerships and the provision of funding.

**Flood risk management activities**

As identified by the national FCERM Strategy for England, managing flood risk and coastal erosion involves:

- knowing when and where flooding and coastal erosion are likely to happen;
- taking reasonable steps to reduce the likelihood of them happening;
- forecasting and providing warnings of floods so that people, businesses, infrastructure providers and public services can take effective action to minimise the consequences of floods, and
- adapting to coastal change and acting to reduce the risk to life, damage and disruption caused by flooding.

Ongoing RMA activities relating to flood and coastal risk management can be divided into the following activities.

**Strategic planning**

Strategic planning enables RMAs to prioritise flood risk management activities and ensure that investment aligns with priority areas where the risk is greatest and
ensure that the best value for money is achieved. It is vital that all RMAs continue to work in partnership to agree strategic planning to manage flood and coastal erosion risk across the river basin district, especially areas at risk from more than one sources of flooding.

**Investigations**
Following significant flooding, lead local flood authorities (LLFAs) will carry out and publish a flood investigation report (under Section 19 of the Flood and Water Management Act). This will consider the source(s) of flooding, how the flooding occurred, the flood extent and depth, damage to property and estimate the severity of the flood. It will also identify which RMAs have relevant flood risk management functions, and whether they have exercised, or are proposing to exercise, those functions in response to the flood. The LLFA must publish the results of its investigation, and notify any RMAs.

**Hydraulic modelling and hydrology**
Hydraulic modelling is a process of simulating what happens to river levels during periods of heavy rain. Past flood events are used to support the models' predictions and improve their accuracy. The RMAs use these models to predict where and when flooding is expected to occur and for how long, taking into account storm intensity and duration.

This also informs decisions about how flood risk could be managed. For example, refurbish or improve existing assets, construct new assets, provide planning advice to local councils highlighting risk areas to avoid inappropriate development or provide flood warnings and flood incident management.

**Flood forecasting and warning**
In addition to the hydrology and hydraulic modelling, weather forecasts can be used to predict how river flows and levels are expected to respond to changes in weather. Rainfall and river levels provide data which informs the Environment Agency’s flood warning service and allows the issue of timely and accurate flood warnings. Computer models of weather and tide conditions predict tidal flood forecasts.

Providing an accurate flood forecasting and warning service is critical in managing the consequences of flooding.

**Incident planning and management**
The Environment Agency, local councils, water companies, Emergency Services and other utility companies all plan for incidents of many types, including flooding. These plans inform how the RMAs work together to respond to an incident and inform more strategic Multi-Agency Response Plans. Incident management exercises are used to test and improve the planned procedures. Following flood incidents partners review the plans to further improve procedures and share data. Local Resilience Forums for each of the counties oversee the collective incident planning and response, these are:

- Derbyshire Local Resilience Forum
- Humber Local Resilience Forum
- Leicestershire Local Resilience Forum
- Lincolnshire Local Resilience Forum
- North Yorkshire Local Resilience Forum
- Northumbria Local Resilience Forum
- Nottinghamshire Local Resilience Forum
- South Yorkshire Local Resilience Forum
- Staffordshire Local Resilience Forum
- Warwickshire Local Resilience Forum
- West Midlands Conurbation Local Resilience Forum
- West Yorkshire Local Resilience Forum

**Maintenance**

RMAs carry out regular inspections and maintenance of structures (raised defences, river channel walls, culverts, outfalls and flap valves, pumping stations and flood storage reservoirs) to ensure they are 'fit for purpose'. Clearance of some vegetation, sediment and debris from river channels and culverts is a key maintenance task, as this helps to provide enough capacity to convey flood flows. Similar activities are carried out for drains and sewers. Information from the Environment Agency assets inspections informs System Asset Management Plans (SAMPs) which are updated regularly to inform maintenance programmes, funding requirements and asset condition. Other RMAs also maintain information relating to their assets, for example Asset Registers that are maintained by LLFAs or Asset Management Plans by the water companies.

**Improvement works**

The Environment Agency produces flood maps using models to show where properties are at risk of flooding, or where flooding has happened. These maps help us to identify communities that are at risk of flooding. The Environment Agency, in partnership with other RMAs, works with these communities to look at options to reduce the risk of flooding. The Environment Agency coordinates a 6 year investment programme which prioritises investment to improve or create new defences.

**Development planning and control**

RMAs work together to avoid inappropriate development in the floodplain. The National Planning Policy Framework (NPPF) sets out government policy on new developments, which must be applied by local planning authorities when making land use planning decisions. The Environment Agency is a statutory consultee for planning applications except for minor developments in areas at risk of flooding from rivers and the sea and large developments where flooding from rivers and the sea is very unlikely. Working in partnership as RMAs advise developers on planning consultations in high risk areas. The final decision for development in the floodplain is made by the local planning authorities. Permitting decisions on development are an opportunity for the Local Planning Authority to integrate SuDS.

**Sustainable Drainage Systems**

Sustainable Drainage Systems (SuDS) are a way to manage surface water by reducing or delaying rainwater runoff. They aim to mimic the way rainfall drains naturally rather than conventional piped methods. This helps to manage flooding and reduce pollution and damage to the environment. Common types of SuDS are ponds which change in level with rainfall, swales (wide grass ditches), soakaways and permeable pavements (block paving, sometimes with gravel beneath). The approach to be adopted requires infiltration (allowing water to soak in to the ground) to be considered first, then attenuation (storing water at the top of the catchment) and discharge into a watercourse and only if these are impractical should attenuation with discharge to a sewer be considered. Retro-fitting of SuDS to existing buildings and land is also a way of reducing peak flows in drains/sewers and watercourses and so helping to reduce flooding and pollution. The Department for Food and Rural Affairs
(Defra), along with the Department for Communities and Local Government (DCLG), are reviewing SuDS, including how they will be maintained.

**Enforcement**

RMAs may take enforcement action against a riparian owner (owner of land adjacent to or over a watercourse) to repair their structure/s before a possible collapse which could lead to flooding. Enforcement action is also sometimes necessary to keep access alongside watercourses clear, so that the RMAs can do maintenance and other work.

**Working with communities**

The risk management authorities work in partnership with communities to understand the community perspective of flooding and coastal erosion. The aim is to help communities understand and actively prepare for the risks, and encourage them to have direct involvement in decision-making. Flood Action Groups or other community groups become a clear focus for the community to bring together all the relevant information its residents and businesses may have. Working together to share knowledge, all relevant RMAs can work with communities on managing local risk. This becomes an opportunity for the RMAs to explain what steps they propose to take, talk about the likelihood of funding for any construction works, explore any other funding sources and advise residents and businesses what they can do to help themselves. It also gives the community the opportunity to shape the proposals.

**Partnership Working**

Managing flood and coastal risks, and particularly local flood risks, requires many organisations to work together in partnership. The main RMAs in the Humber river basin district which work in this way are the Environment Agency, 36 Lead Local Flood Authorities (for further information please see Figure 3), 27 Internal Drainage Boards, District Councils in North Yorkshire and Leicestershire, water and sewerage companies (Yorkshire Water Services, Severn Trent Water, United Utilities) and Highways England. Government is also working to strengthen or establish partnerships in the areas most affected by the December 2015 floods to encourage a more integrated approach to managing risk across the whole catchment. The Local Floods Partnerships across Cumbria and Yorkshire, established after the December 2015 flooding, are a good example of this way of working.

Maritime district councils also work with the Environment Agency and others to pursue solutions to coastal erosion and flooding. Maritime district councils within the Humber river basin district are Scarborough Borough Council, East Riding of Yorkshire Council, East Lindsey District Council, North East Lincolnshire Council and North Lincolnshire Council.

Partnership working allows organisations to pool expertise and resources. This means they can be as efficient and effective as possible. It encourages the sharing of knowledge, data and expertise and provides opportunities to manage cross boundary issues ensure consistent approaches and develop and test innovative approaches to delivery.

To enable effective partnership working to take place between the RMAs, eight strategic partnership groups have been set up within the Humber river basin district. These are:

**North Yorkshire**: City of York Council, North Yorkshire County Council, Environment Agency, Scarborough Borough Council, York Consort IDB, Ouse & Humber IDB and Yorkshire Water Services


Derbyshire: Derbyshire County Council, All Borough and District Councils in Derbyshire (in a Risk Management Authority guise), Derby City Council, Environment Agency and Severn Trent Water.

Leicestershire: Leicestershire County Council, Leicester City Council, Rutland County Council, Severn Trent Water, All Borough and District Councils in Leicestershire (in a Risk Management Authority guise), and Environment Agency.

Nottinghamshire and Nottingham City: Nottinghamshire County Council, Nottingham City Council, Severn Trent Water, All Borough and District Councils (Risk Management Authorities), Trent Valley Internal Drainage Board and Environment Agency.

Lincolnshire: Environment Agency, Internal Drainage Boards operating in Lincolnshire, District Councils in Lincolnshire, Water and Sewerage Companies operating in Lincolnshire, Natural England, Regional Flood & Coastal Committee (Anglian Region, Northern Area), Lincolnshire Resilience Forum (authorities responsible for planning for and responding to emergencies of all kinds).

In addition to the above flood risk partnerships involving RMAs, flood risk partnerships are informally formed through the Catchment Based Approach, encouraging the achievement of wider environmental outcomes. In the context of developing an integrated approach we will be looking to align the work of these partnerships with the other activity set out in this plan over the next six years.

Regional Flood and Coastal Committees

RFCCs were established in 2011 following the Flood and Water Management Act 2010, replacing the former Regional Flood Defence Committees. There are three RFCCs within the Humber FRMP area. These are Yorkshire, Anglian (Northern) and Trent RFCCs. Committee members are responsible for using their skills and experience to provide strategic advice, as well as contributing to the delivery of local flood risk plans and strategies by actively engaging with local communities, particularly to gain external views and financial contributions.

The RFCCs play a key role in local funding and approving programmes of work that reduce flood risk to communities. The RFCCs support the Environment Agency and other RMAs in working with these communities and other partners to identify and secure funding.

The Environment Agency annually submits the Medium Term Plan (MTP) to the RFCCs which contains the funding bids for the Environment Agency and other RMAs for the next 6 years.

Catchment based approach

Catchment partnerships are groups of organisation with an interest in improving the environment in the local area and are led by a catchment host organisation. The
partnerships work on a wide range of issues, including the water environment but also address other concerns that are not directly related to river basin management planning.

Government is also working to strengthen or establish partnerships in the areas most affected by the December 2015 floods to encourage a more integrated approach to managing risk across the whole catchment, and will look to build on the work of successful catchment partnerships.

The National Resilience Review will align closely with Defra's work on integrated catchment-level management of the water cycle in the Government's 25 year Environment Plan. Government's aspirations for the next cycle of planning (now to 2021) is for more integrated catchment planning for water, where Flood and Coastal Risk Management, River Basin Management, nature conservation and land management are considered together.

**Table 6: Catchment Partnerships within the Humber river basin district**

<table>
<thead>
<tr>
<th>Catchment</th>
<th>Partnership group host</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aire and Calder</td>
<td>Aire Rivers Trust</td>
</tr>
<tr>
<td>Derbyshire Derwent</td>
<td>Derbyshire Wildlife Trust</td>
</tr>
<tr>
<td>Derwent (Humber)</td>
<td>East Yorkshire Rivers Trust and Yorkshire Wildlife Trust</td>
</tr>
<tr>
<td>Don and Rother</td>
<td>Don Catchment Rivers Trust and Environment Agency</td>
</tr>
<tr>
<td>Dove</td>
<td>Trent Rivers Trust</td>
</tr>
<tr>
<td>Esk and Coast</td>
<td>Yorkshire Esk Rivers Trust and Yorkshire Moors National Parks Authority</td>
</tr>
<tr>
<td>Hull and East Riding</td>
<td>East Yorkshire Rivers Trust and Yorkshire Wildlife Trust</td>
</tr>
<tr>
<td>Idle and Torne</td>
<td>Nottinghamshire Wildlife Trust and Yorkshire Wildlife Trust</td>
</tr>
<tr>
<td>Louth and Ancholme</td>
<td>Lincolnshire Chalk Streams Project</td>
</tr>
<tr>
<td>Lower Trent</td>
<td>Trent Rivers Trust</td>
</tr>
<tr>
<td>Soar</td>
<td>Trent Rivers Trust</td>
</tr>
<tr>
<td>Staffordshire Trent</td>
<td>Staffordshire Wildlife trust</td>
</tr>
<tr>
<td>Swale and Upper Ouse</td>
<td>Yorkshire Dales Rivers Trust</td>
</tr>
<tr>
<td>Tame and Mease</td>
<td>Severn Trent Water</td>
</tr>
<tr>
<td>Wharfe and Lower Ouse</td>
<td>Yorkshire Dales Rivers Trust</td>
</tr>
</tbody>
</table>

**Internal Drainage Boards**

Internal Drainage Boards (IDBs) are local public authorities established in areas of special drainage need in England. IDBs play an important role in managing water levels to improve drainage for agricultural land, protect wetland habitats and to reduce flood risk to people, property and infrastructure in low lying areas known as internal drainage districts. Within the Humber river basin district there are a large number of IDBs.

**Find out more**

- [Internal Drainage Boards](http://www.ada.org.uk/idbs.html)
The Flood and Water Management Act (2010) made it easier for risk management authorities to undertake work on each other’s behalf. Public sector cooperation agreements have been developed to make this happen and are being used to deliver maintenance by a partnership approach. They will help deliver value for money in operational maintenance activities and will ensure a consistent approach across the country.
5. Getting to know the Humber River Basin District

Introduction
The Humber river basin district is one of 11 across England and Wales and covers 15 management catchments. It covers approximately 26,000km² from the North York Moors to Birmingham, the Pennines to the North Sea and Stoke-on-Trent to Rutland and is one of the most diverse in England. It ranges from the upland areas of the Peak District, South Pennines and the North York Moors with their internationally-important peat lands, across the Derbyshire and Yorkshire Dales and the fertile river valleys of the Trent and Ouse, to the free-draining chalk of the Yorkshire and Lincolnshire Wolds.

Managing the water environment at a catchment scale promotes a holistic approach to the work RMAs do and to engagement with many others. The 15 catchments in the Humber river basin district, as shown in Figure 4, are:

- Aire and Calder
- Derbyshire Derwent
- Derwent (Humber)
- Don and Rother
- Dove
- Esk and Coast
- Hull and East Riding
- Idle and Torne
- Louth, Grimsby and Ancholme
- Lower Trent and Erewash
- Soar
- Staffordshire Trent Valley
- Swale, Ure, Nidd and Upper Ouse
- Tame, Anker and Mease
- Wharfe and Lower Ouse

Water
Groundwater and surface water bodies are subject to high levels of abstraction. The Sherwood Sandstone and the various limestone aquifers in the district are used heavily for drinking water. There are a number of water transfer schemes that move water from reservoirs and rivers to other catchments in the district. Some of the key uses for the water are fisheries, farming, public water supply and industrial/commercial activities.

There are groundwater quality risks from urban and rural inputs through localised use of nitrates and pesticides in agriculture and horticulture. Some areas of the Coal Measures formation groundwater have been impacted by the mining heritage of the district. The Environment Agency is working closely with The Coal Authority on mine water treatment schemes to improve the water environment.
Canals and surface water transfers are one of the main ways society has modified the water environment to meet its needs. Surface water transfers move water from where it occurs naturally to where it is needed, while canals are a major part of the network of inland waterways. They were the focus of the industrial revolution, providing links between towns and cities - for example, the Grand Union Canal linking Birmingham to London and the Leeds Liverpool Canal. Despite a period of
decline following the development of the railways, the canal system is again in good shape with an important role for recreational boating, angling, cycling and walking. Canals and rivers are also still used to transport goods. Birmingham is said to have more canals than Venice. There are 73 canals and 10 surface water transfers in the Humber river basin district.

The Trent, Witham, Ancholme River Transfer Scheme plays a vital role in supplying water to people and industry and conserving the environment. Water is pumped along an 800 metre pipeline from the River Trent at Torksey (Humber river basin district) into the Foss Dyke Canal (Witham catchment in the Anglian river basin district). Water then transfers down the River Witham, to a pumping station south of Lincoln at Short Ferry, where water is pumped via a 17km underground pipeline until it reaches the River Ancholme at Toft Newton (Humber river basin district).

Flood risk management systems and drainage
In the past we have built embankments and walls to hold back and redirect floodwater in response to the flood events. These defences will become less effective in the future as the threat of flooding from the sea and rivers is likely to increase due to climate change. The cost of maintaining these ‘hard defences’ may become uneconomical in the future. These ‘hard defences’ can also restrict the natural tendency of large volumes of water to inundate the floodplain, which can increase the risk to people, property and the environment further downstream. We now recognise that this is not sustainable in the long term. The Environment Agency has changed its flood risk management approach to a system that works with nature, wherever possible, to reduce the probability of floods occurring and minimise the impact of flooding on people, property and the environment. This is done through:

- flood risk mapping and management of data associated with monitoring flood risk
- working with local planning authorities to ensure that new development is not at flood risk and does not increase flood risk elsewhere
- management of the operation and maintenance of the river network in the catchment, and the structures in place to control flood flows
- forecasting flood events and managing flood incidents to minimise the risk during flood events
- where we can justify constructing new or improved defences, these will work with natural processes to achieve a more sustainable solution that will provide a better more robust standard of protection in the future

Climate and climate change adaptation
There is clear scientific evidence that global climate change is happening now. Over the past century we have seen sea levels rise around England and more of the winter rain has fallen in intense wet spells. Climate change can affect flood risk in several ways and the impacts will vary depending on local conditions and vulnerability. Risk management authorities should consider climate change within the development of all plans.

We already plan for climate change. We build climate change predictions in to the design of flood defence schemes to make sure that they are fit for the future. We will revisit this modelling after the record breaking wet weather experienced in December 2015. Wetter winters and more intense rainfall may increase river flooding and cause more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers, so RMAs need to be prepared for the extreme events. Rising sea or river levels may also increase local flood risk inland or away
from major rivers because of interactions with drains, sewers and smaller watercourses. Even small rises in sea level could add to very high tides so as to affect places a long way inland.

Sea level rise is affected by 2 factors. The thermal expansion of sea water as temperature rises and the amount of water in the oceans increases as ice sheet and glaciers melt as a result of climate change. This is in combination with Isostatic rebound, the vertical movement or settling of land. The ice cap that covered the north and west of the UK melted, and retreated northwards, following the end of the last Ice Age around 12,000 years ago. The general trend is the northern and western parts of England and Scotland is lifting and south east of England is sinking.

Lower emissions could reduce the amount of climate change further into the future, but changes are still projected at least as far ahead as the 2080s. UK Government’s Flood Foresight (2014) re-endorses the findings of the 2008 foresight work, stating that in general terms climate change is likely to increase river flood risks by 2080 by between 2 and 4 times, and coastal flood risk by 4 to 10 times. Increases in the frequency of flooding would affect people’s homes and wellbeing, especially for vulnerable groups.

It is not possible to predict exactly how much change will happen or when. But in planning, a range of scenarios should be used for long term decisions to understand the potential range of impacts. The National Planning Policy Framework (NPPF) and Planning Practice Guidance state that local planning authorities and developers should ensure development is appropriately flood resilient and resistant, safe for its users for the development’s lifetime and will not increase flood risk overall. The changing climate is expected to increase frequency, extent and impact of flooding and the need to adapt to it. This will be recognised by local planning authorities, lead local flood authorities and the Environment Agency in exercising their development control roles as statutory consultees. The nature of the proposal, the site and the development’s lifetime will determine what level of resilience needs to be incorporated at the time of construction and what action(s) can be deferred to be incorporated at a later date should future adaptation be required.

The National Planning Policy Framework (NPPF) requires that new development is resilient to flooding for its lifetime, taking climate change into account. ‘Flood risk assessments: climate change allowances’ are the best available evidence on the likely impact of climate change on flood risk. By using this guidance for flood risk assessments and to inform the location of development and the design of associated flood risk management measures, it will help local authorities and developers comply with the NPPF.

Some areas of the Humber river basin district are very low lying, particularly around the Humber estuary where both the north and south banks are very vulnerable to increasing sea levels and higher tidal surges as a result of a changing climate. The easterly part of the river basin district will be more vulnerable to drought, due to drier summers.

The FRMPs contain high level measures/ actions detailing how RMAs will:

- Incorporate climate change allowances into flood risk management works. Impacts from a changing climate will be considered in plans for location-specific works to reduce flood risk from all sources
- Identify where working with natural processes and natural flood management can help to reduce flood and coastal erosion risk and help towards communities becoming more resilient both adapt and become more resilient to the impacts of climate change.
Measures in the FRMP will complement the outputs of the National Flood Resilience Review. The National Resilience Review will assess how the country can be better protected from future flooding and increasingly extreme weather events. The review is looking at climate modelling, infrastructure, resilience and future investment strategy. Accounting for climate change reduces the risk of flooding and provides better levels of protection but we can never eradicate the risk of flooding entirely.

Coastal erosion risk management

The Environment Agency has the coastal Strategic Overview in England. The coastal overview joins up coastal management activities to ensure flooding and erosion risk is managed effectively. The overview encourages authorities to work together in partnership to achieve effective management of coastal flooding and erosion risks.

Work to tackle coastal erosion is the responsibility of district or unitary councils. Local authorities have operational powers relating to managing coastal erosion under the Coast Protection Act 1949 and the Flood and Water Management Act 2010. Local Authorities lead on coastal risk management activities and undertake works on sea flooding and coastal erosion where they are best placed to do so. This is undertaken in collaboration with the Environment Agency.

SMPs are non-statutory, high level planning documents. They are large scale assessments of the risk associated with coastal processes, and a policy framework to reduce these risks to people and the developed, historic and natural environment in a sustainable manner. They set the strategic direction for how the coast is wanted to be managed over the next 100 years. SMPs identify the most sustainable approaches to managing coastal erosion and flooding risks in the short, medium, and long term.

During the development of SMPs, a range of partners and the public were extensively consulted and involved in the decision making processes.

This FRMP also draws some coastal erosion information from the Shoreline Management Plan 2 (SMP2); however, the full SMP has not been included in this FRMP. The SMP measures included in this FRMP are those that are most relevant for sea flooding and flood risk issues. You can access further information and the full SMPs here: https://www.gov.uk/government/publications/shoreline-management-plans-smps/shoreline-management-plans-smps.

SMPs remain the primary high level strategic planning documents on the coast, as they also contain information on coastal erosion risk management, and their content can be updated or changed using an established auditable process. These changes will be reflected in the FRMPs as they are updated on a six-yearly cycle. These changes may be prompted by changes in the evidence base guiding management decisions in SMPs, including evidence emerging from experience of the ongoing implementation of RBMPs. In this way, the Programme of Measures in RBMPs, the action plan and information in the FRMP, and the ‘living’ SMP documents should successfully inform and read-across to each other.

The Marine and Coastal Access Act 2009 established the MMO to produce marine plans, administer marine licensing and manage marine fisheries in English waters. It introduced marine planning in the UK through production of a marine policy statement and more detailed marine plans setting spatial policy at a more local level. Eleven marine plans covering English waters are anticipated by 2021.

Marine plans will inform and guide marine users and regulators across England, managing the sustainable development of marine industries such as wind farms and fishing, alongside the need to conserve and protect marine species and habitats. At its landward extent, a marine plan will apply up to mean high water, including
estuaries and the tidal extent of rivers. All public bodies making authorisation or enforcement decisions capable of affecting the marine area must do so in accordance with the Marine Policy Statement (MPS) or marine plans (where they are in place) or state reasons for not doing so. Marine licensing, administered by the MMO is the main environmental and development control system below high water.

Further information can be found on the MMO web pages on: https://www.gov.uk/government/collections/marine-planning-in-england

Coastal squeeze
Flood risk and coastal erosion management measures, such as coastal flood defences, can have an impact on wetland and coastal environments and their conservation interest. As sea levels rise, intertidal habitat in front of a flood defence can get squeezed and erode. It is therefore important that a long term plan and measures are in place to compensate for habitat losses. Measures can include habitat creation that offsets or replaces habitat losses. Risk management and coastal authorities are encouraged to develop a strategic approach to the planning and delivery of any habitat creation measures that they anticipate will be required before seeking consent for plans or projects.

Society and health
Around 11.7 million people live and work within the Humber river basin district. The population is split between the large urban conurbations of the great cities of the Midlands and the north east, and small communities within very rural areas. Many of the towns and cities are proposing significant housing and economic growth, along with the creation of jobs and services. For example, the city of Kingston upon Hull and other areas around the Humber Estuary are benefitting from substantial investment within the renewable energy generation sector. Currently these areas have been classed as ‘most deprived’ within the government produced Indices of Deprivation 2010. Other areas of deprivation are associated with the urban areas of Leeds, Doncaster, Sheffield, Stoke-on-Trent, Wolverhampton and Birmingham. In contrast, there are many areas within the river basin district which are considered to be very affluent. These tend to be spread through the more rural areas and include communities in North Yorkshire, Leicestershire and Staffordshire. Along the coast of the river basin district, the population tends to be older with more associated ill health and disability because many people choose to retire to these areas.

Land use
The topography of the Humber river basin varies considerably. There are two distinct areas of high ground, see Figure 5. These are the North York Moors and Cleveland Hills to the north east and the Pennines and Peak District which run to the west across six management catchments.

The headwaters of the River Esk in the north of the river basin are located in Westerdale in the Cleveland Hills at an altitude of between 300m and 400m Above Ordnance Datum (AOD) whilst the River Derwent reaches between 300m and 350m above sea level.

The River Derwent (Derbyshire) rises in an upland moorland area of the Pennines with elevations of more than 630mAOD whilst the Upper Calder catchment peaks at 583m at Black Hill near Holme. These areas are characterised by high gradients, steep valleys and narrow floodplains and as a result indicate a faster, ‘flashy’ system with water levels and flows responding to rainfall in a shorter time.

In contrast, to the east of the river basin many of the management catchments are characterised by large areas of low lying land, parts of which are below sea level.
The river basin district is predominantly rural with more than 60% of its land used for agriculture. Farming types include pastoral (livestock) farming on the upland areas of the catchment, with mixed and arable farming in the lowlands. This has led to physical changes to the water environment and some pollution from agricultural runoff. However a combination of incentive, advisory and regulatory measures have been in place for a number of years to help farmers and other land managers protect the environment.

Tree cover is approximately 3.4% of the river basin district, with remnants of the once-great Sherwood Forest in the Idle and Torne Management Catchment and Dalby Forest within the North Yorkshire Moors National Park and Derwent Management Catchment. The Yorkshire and Humber region contains more than 23,600ha of ancient woodlands, including Batty’s Wood (West Yorkshire), Grass Wood (Wharfedale) and Martinshaw Wood (Leicestershire).

Large-scale deforestation of the moorland areas over many centuries has increased rainfall runoff and fluvial flows. This has placed established communities at increased risk of flooding. The National Forest aims to reforest 200 square miles in the centre of the river basin district, between Derby, Loughborough and Tamworth. There are large urban areas including Birmingham and the Black Country, Derby, Nottingham, Leicester, Sheffield, Leeds, Bradford, York and Kingston upon Hull.
There is evidence that woodland measures can reduce flood flows, particularly but not only within smaller catchments. Trees help reduce flood risk in a number of ways:

- greater water use by trees compared to other vegetation types reduces run-off and also creates greater capacity for woodland soils to absorb rainfall during flood events;
• higher infiltration rates of forest soils resulting from the extensive rooting systems of trees reduces run-off to watercourses and aids interception of overland flow from adjacent land;
• floodplain and riparian woodland can slow down flood flows, increase temporary storage and thereby delay the transfer of flood water downstream;
• soils under woodland are generally protected from erosion risk, reducing delivery of sediment to watercourses.

Therefore, ‘woodland measures’ for flood risk reduction include both targeted woodland creation – in the right place and to the right design – and woodland management such as the installation of features such as large woody debris dams to reconnect watercourses with already wooded riparian zones and floodplains.

The 2011 ‘Woodland for Water’ report detailed the evidence behind these conclusions. As a result opportunity mapping to be used to identify where in the country to target woodland measures to help reduce flood risk. Priority locations fall into three categories:

• Floodplains – where hydraulic roughness from woodland cover slows the flow and encourages the deposition of sediment;
• Riparian zones – to intercept overland flow, protect river banks from erosion, and help slow the flow of water;
• Wider catchment planting – to protect sensitive soils from erosion, increase infiltration rates, and intercept sediment in run-off from adjacent land.

While opportunity maps can identify priority catchments where woodland creation and management can help reduce flood risk, it is important that woodland is located in the right part of the landscape and then designed and managed appropriately in order to maximise their contribution to reducing flood risk.

Economic activity

The economy of the district contributes about 20% to Gross Domestic Product. The combined Gross Value Added - a measure of the value of goods and services produced in the area for counties within the Humber is about £211 billion per year. Key industries include farming and manufacturing. The region was at the heart of the industrial revolution, with the remnants of these heavy engineering industries still operating albeit at a reduced level. Manufacturing is still a large part of the economy in the region but lighter engineering companies and high technology industries are now present. Agriculture, as indicated by the land coverage, is still a big contributor to the economy and a number of financial institutions are now based within the Midlands. A proportion of the RIVER BASIN DISTRICT is the focus of urban renewal programmes. Historically, mining and quarrying for coal and other minerals was a significant industry across the region. Today, mineral extraction is less widespread although there are important exceptions including a few surviving deep coal mines. Over to the east of the river basin, the main economic sectors include food and drink, ports and logistics, renewable energy, chemicals and process industries and digital media.

The scale of development and the future pressure for development is important in the long term planning for flood risk and coastal erosion risk management. There is considerable pressure for development and regeneration within the river basin district notably within the Humber estuary area, West Midlands, and South and West Yorkshire. This pressure for economic growth is summarised by the Local Enterprise Partnerships (LEP) which have developed Strategic Economic Plans to support economic activity. For example, the Humber LEP predicts that investment linked to renewables and regeneration could result in up to £7bn of further investment across the Humber including the key development sites of Greenport Hull, Paull and Brough.
To support this growth, one key objective of the Strategic Economic Plan is to “stimulate economic development through further investment in flood and coastal risk management. Promote and embed sustainable development activities across the LEP area to sustain the natural environment”.

Recreation and tourism
The Humber river basin district is fortunate to contain three National Parks. The North Yorkshire Moors, Yorkshire Dales and Peak District National Parks attract more than 30 million visitors a year. There are also four Areas of Outstanding Natural Beauty (AONB), plus many historic and heritage attractions such as the National Railway Museum and a large network of canals and navigable waterways. The seaside towns of Bridlington, Scarborough, Whitby and Cleethorpes all attract large numbers of visitors.

Infrastructure
Significant infrastructure in the Humber river basin district includes the Port of Grimsby and Immingham which in 2008 was the largest port by tonnage in the UK. Much of the coal for the Trent Valley power stations arrives via this port. On the opposite bank of the Humber, the Port of Hull handles one million passengers per year and is the main softwood timber importation port for the UK. Leeds Bradford International Airport, Humberside Airport, Robin Hood Airport, Nottingham City Airport, East Midlands Airport and Birmingham International Airport are all located within the river basin district. Major motorways which connect the south with the north of the UK run through the river basin. The M1, A1(M), M5 and M6 and associated connecting motorways are crucial to the economy of the area. Both the East and West Coast Mainlines pass through the area, along with the Midland Mainline. High Speed 2 (HS2) is a rail link planned for construction in 2017, with completion estimated in 2026 and will cross the river basin district to connect London to Birmingham.

Landscape
The Humber river basin district is one of the most diverse regions in England. It ranges from the upland areas of the Peak District, South Pennines, and the North York Moors with their internationally important peat lands, across the Derbyshire and Yorkshire Dales and the fertile river valleys of the Trent and Ouse, to the free-draining chalk of the Yorkshire and Lincolnshire Wolds. There are three ‘heritage coasts’ in the river basin district – North Yorkshire and Cleveland, Flamborough Headland and Spurn. These areas attract large numbers of tourists each year, providing an important contribution to the economy. 13% of the Humber river basin district is designated as an Area of Outstanding Natural Beauty (AONB) and comprises the Lincolnshire Wolds, Cannock Chase, Nidderdale and Howardian Hills.

Biodiversity
Owing to the size of the area and range of different landscapes it contains, the Humber river basin district has a very rich and diverse range of habitats. There are 31 SAC sites, nine SPA and four RAMSAR sites. These include the Humber Estuary, Lower Derwent Valley, Derbyshire, Malham Tarn and Midland Meres and Mosses. There are more than 2,750 Sites of Special Scientific Interest (SSSIs) and 23 National Nature Reserves (NNR).

The majority of the SSSIs within the river basin district are in favourable condition, with abstraction, general water shortage, flooding and coastal erosion considered key threats.
Historically, all rivers within the district contained salmon and sea trout. Following decades of pollution, water quality has improved greatly and all river systems within the Humber river basin district now contain stocks of migratory salmonids to a greater or lesser extent. Man-made physical barriers to fish movement prevent these fish, along with freshwater fish, eels and lampreys, from reaching their true natural potential in rivers such as the Ouse and Trent and their tributaries.

Water bodies and wetland areas within the river basin district support a number of protected species, such as otters and water voles, and priority species listed in the UK Biodiversity Action Plan (BAP). These include freshwater white-clawed crayfish and bittern. There are 30 designated BAP chalk streams and five designated BAP intertidal tidal mudflats within the river basin district. Invasive species, such as the mink, are present in more than half of the water bodies across the river basin district, with numbers much higher in the southern half of the river basin district.

Cultural heritage
Cultural heritage has a high profile in the river basin district with approximately 4,000 Scheduled Ancient Monuments (SAM) and numerous registered parks and gardens, listed buildings and heritage sites. There are three World Heritage Sites; Derwent Valley Mills, Saltaire and Studley Royal Park (including the ruins of Fountains Abbey). The majority of listed buildings are within built-up areas. Listed buildings may be vulnerable to both river and tidal flooding where these have been built in low-lying areas and close to canals, rivers or the sea. Many structures such as mills, bridges, weirs and sluices are directly associated with the water environment have listed status or are of local historic importance.

This river basin district is rich in archaeology and there are 10 historic battlefields. This basin also includes a large part of an area known to as the cradle of the Industrial Revolution. Textile mills and iron founding industries were located throughout the Humber river basin district due to the close proximity of coal from the Midland and northern coal mines and water from the watercourses of the area. Many canals were also constructed during this period to allow the free movement of goods produced in the area.

Geology
The bedrock geology of the Humber river basin district is characterised by chalk to the most eastern edge of the area, through mudstone, clays, limestone (in Lincolnshire), sandstones as you move through Nottinghamshire, with dolomitised limestone and middle coal measures formation to the west of the district. The surface or drift geology features clays, till, alluvium, sands, gravels with some peat in the north west of the area. There are six major aquifers in the river basin district including the Sherwood Sandstone, the Corallian Limestone, Lincolnshire Limestone, Lincolnshire Chalk, Carboniferous Limestone and Magnesian Limestone.

Quarrying and minerals extraction are important industries for the river basin district. Sand and gravel extraction is particularly common on the lower parts of the Trent and carboniferous limestone is quarried in the Dove catchment.

Soil
The soils of the river basin district range from shallow well drained calcareous silty soils over chalk and limestone to seasonally wet and deep clays and loams within the river valley bottoms. In the middle of the district, soils are sandy and coarse due to the presence of the underlying sandstone geology. Within the highland areas to the northwest there are very acid, raw peat soils.
Soil drainage capacity is a critical factor in flooding and catchment responses. Well managed, uncompacted soils rich in organic matter will be able to absorb rainfall. However, drainage infrastructure can also be critical because once soils become waterlogged, and if water cannot drain away, there is an increased risk of surface water runoff and sediment transfer. Farmers are now much more aware of the need to manage soils sustainably to reduce soil compaction and erosion and the farming industry has engaged in a number of initiatives to provide help and support to farmers to enable them to manage their soils. Technology is also providing assistance and new techniques which can help manage soil, increase infiltration and reduce the risk of soil erosion. Catchment Sensitive Farming pilot programmes have proved to be an effective method of improving environmental management and soil conservation on farms in the Humber river basin district.
6. Key flood risk issues in the Humber River Basin District

Around 1 million people are identified as being in areas at risk of flooding from rivers and the sea in the Humber river basin district. Of these, just over 58,000 are classed as at high risk. Approximately 1 million people are at risk of surface water flooding. As well as this, the Holderness coast is the fastest eroding coastline in Europe with 26 communities listed in the Domesday survey being lost to the sea since 1086.

Flooding and coastal erosion can have devastating impacts. The widespread flooding across England in summer 2007 included significant areas of the Humber river basin district. It resulted in loss of life and major impacts on the health and well-being of people living and working in the areas affected. Flooding can also cause major disruption to energy, water, communications and transport infrastructure. It can interfere with public services such as schools and hospitals and have significant indirect effects through disruption to travel or loss of income. Coastal erosion and landslides on the coast affect smaller areas of land than floods but cause permanent loss of property and infrastructure. Such losses can have significant impacts on the local economy outside of the directly affected area. Flooding and coastal erosion can also have significant impacts on the environment and on cultural heritage. It can cause pollution or damage to historic buildings and changes to habitats. However, for some habitats and heritage assets, managed flooding and/or deposits of material eroded from elsewhere are essential for their existence and health.

The following sub-sections illustrate the broad scale of flood and coastal erosion risks across the Humber river basin district. You can see this information in more detail by following the links provided below.

Flood History

The Humber river basin district is one of the most diverse regions in England and this is reflected in the different approaches to flood risk management. In the West Pennines, there are catchments where the rivers respond rapidly to rainfall as well as areas in East Yorkshire and Lincolnshire where pumps are used to manage water levels. Tidal flooding is a risk around the Humber Estuary and rivers Ouse and Trent. Watercourses range from heavily modified to pristine natural chalk rivers. The landscape includes steep-sided valleys and rural communities along with large and historical industrial urban areas.

There has been a long history of flooding within the Humber river basin district. In recent years surface water flooding has had a significant impact on communities. In 2007 more than 14,000 properties were affected by a combination of river and surface water flooding. Table 7 summarises large flooding incidents within the river basin district.
In December 2015, communities throughout Yorkshire experienced significant impacts of prolonged rainfall. Figures published by the Met Office indicate that storm Desmond, the fourth named storm of the season, saw 136mm of rain fall in Bainbridge in North Yorkshire within a 48 hour period. This, falling on already saturated ground, and followed closely by storms Eva (24 December) and Frank (29-30 December) led to high river levels and widespread river flooding. Initial rainfall data indicates that for many sites within the Aire and Calder catchment for example shows that the total rainfall for December was in excess of 200% of the expected average December rainfall\(^1\).

Across the country over 19,000 homes were flooded, with thousands more affected by loss of power supply and travel disruption. Existing flood defences played an essential part in protecting thousands of homes during December with 12,500 benefitting during Storm Desmond and 10,900 during Storm Eva.

Early data analysis carried out by the Environment Agency suggests that the peak river level on the River Ouse at Viking recorder in York reached 5.19m making this the second highest recorded level for the River Ouse, exceeding 2012 by more than 100mm. Multiple locations suffered impacts throughout the Aire and Calder catchment, including the Upper Calder Valley, Bradford, Kirklees, Leeds, Wakefield and some areas along the lower Aire reaches.

The Aire and Calder, SUNO, Wharfe and Lower Ouse and Derwent management catchments were all affected, impacting residential and commercial properties, community buildings, infrastructure such as roads, substations and operational assets such as defences. Many bridges were damaged or washed away due to the high velocity of flood flows in the rivers. Severe flood warnings were issued by the Environment Agency for areas along the rivers Aire, Calder and Ouse which contributed to reducing the risk to life from the flooding.

The impact of this flood event is currently being reviewed by all RMAs. These reviews will further define and review the hydrological conditions, emergency response and long term needs for managing river and surface water flooding throughout the affected management catchments. The published recommendations will be taken into account by all responsible parties in the long term management of the catchment where appropriate.

### Table 7: History of flooding in the Humber river basin district

<table>
<thead>
<tr>
<th>Date</th>
<th>Source of flooding</th>
<th>Impacts on the Humber river basin district</th>
</tr>
</thead>
<tbody>
<tr>
<td>1920</td>
<td>Fluvial</td>
<td>River Lud, Louth - 23 fatalities and many properties flooded</td>
</tr>
<tr>
<td>1947</td>
<td>Fluvial</td>
<td>River Trent - Approximately 9,000 properties and 50,000 acres of farmland flooded</td>
</tr>
<tr>
<td>1953</td>
<td>Tidal surge</td>
<td>43 fatalities Lincolnshire Coast, 300+ fatalities and 24,000 properties flooded in Yorkshire</td>
</tr>
<tr>
<td>1977</td>
<td>Fluvial</td>
<td>River Trent, flooding in Sutton-on-Trent</td>
</tr>
<tr>
<td>1978</td>
<td>Tidal surge, fluvial</td>
<td>Approximately 1,500 properties flooded in Cleethorpes, hundreds of properties flooded in York from the River Ouse</td>
</tr>
<tr>
<td>1981</td>
<td>Fluvial</td>
<td>Hundreds of properties flooded in the Grimsby,</td>
</tr>
</tbody>
</table>

\(^1\) It should be noted that this hydrology data has not yet been validated and records may be revised following further analysis and data collection carried out as part of the winter 2015/16 flood review.
<table>
<thead>
<tr>
<th>Year</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>Fluvial</td>
<td>Ancholme and Louth Catchment, widespread flooding within the Yorkshire area and the Trent valley</td>
</tr>
<tr>
<td></td>
<td></td>
<td>River Dove and Derwent in Derbyshire, River Soar and Wreake in Leicestershire</td>
</tr>
<tr>
<td>2000</td>
<td>Fluvial, surface water and tidal</td>
<td>In the months of June, July, October and November there was widespread flooding to hundreds of properties. Locations included Skipton, Todmorden, Scarborough, and York. Flooding was also seen in the Lower Dove valley Derbyshire, and the Trent Valley and its tributaries in Nottinghamshire</td>
</tr>
<tr>
<td>2007</td>
<td>Fluvial and surface water</td>
<td>Approximately 7,888 properties were affected by flooding in Hull and 6,250 properties flooded in the East Riding of Yorkshire. There was widespread flooding throughout the Humber river basin district</td>
</tr>
<tr>
<td>2008</td>
<td>Fluvial, tidal and surface water</td>
<td>Widespread flooding in January and September with properties flooded in the following locations: Huddersfield, Shipley, York, Selby, East Riding of Yorkshire and Hull</td>
</tr>
<tr>
<td>2012</td>
<td>Tidal and fluvial</td>
<td>Flooding during spring, summer, autumn and winter 2012 affected properties across the Humber River Basin District. Surface water flooding occurred experienced across Birmingham and the Black Country and Southern Staffordshire in June</td>
</tr>
<tr>
<td>2013</td>
<td>Tidal surge</td>
<td>The largest tidal surge ever recorded in some areas affected 1,100 properties and flooded more than 7,000 hectares of agricultural land on both the north and south Humber Banks and tidal River Trent.</td>
</tr>
<tr>
<td>2015</td>
<td>Fluvial and surface water</td>
<td>Prolonged rainfall as a result of a succession of winter storms: namely Desmond, Eva and Frank. Management catchments affected include the SUNO Wharfe and Lower Ouse, Derwent (Humber) and the Aire and Calder. A number of sites recorded their highest ever river levels.</td>
</tr>
</tbody>
</table>

**Flood risk from rivers and the sea**

Around 1 million people are identified as living or working in areas at risk of flooding from rivers and the sea. Just over 58,000 of these are at high risk. This equates to 0.5% of the population. The greatest level of risk is associated with the Hull and East Riding catchment where nearly 325,000 people are at risk of flooding. However 80% of these are classified as low risk. The highest number of people at high risk of flooding from rivers and the sea live or work within the Aire and Calder management catchment followed by the Soar. The lowest risk of flooding from rivers and the sea is within the Esk and Coast management catchment where fewer than 1,200 (4%) of people are at risk. Further details regarding the distribution of risk can be seen in the following publication: [Humber river basin district: rivers and the sea](#)

Kingston upon Hull has the greatest number of people at risk of flooding from rivers and the sea with more than 5,000 people identified at risk. As would be expected, the cities of Leeds, York, Selby, Goole, Leicester and the West Midlands area have a large number of people at risk of flooding (between 1000-5000). However there are also a significant number of smaller communities at risk throughout the river basin district. The consequence of flooding in these communities is heightened due to a combination of the percentage of properties at risk, infrastructure present and the rapid onset of flooding.
Table 8: Summary of flood risk from rivers and the sea to people, economic activity and the natural and historic environment across the Humber river basin district

<table>
<thead>
<tr>
<th>Risk to people:</th>
<th>Total in river basin district</th>
<th>High risk</th>
<th>Moderate risk</th>
<th>Low risk</th>
<th>Very low risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>N° of people:</td>
<td>11,707,050</td>
<td>58,200</td>
<td>299,000</td>
<td>630,600</td>
<td>67,650</td>
</tr>
<tr>
<td>N° of services:</td>
<td>19,390</td>
<td>610</td>
<td>890</td>
<td>1,280</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk to economic activity:</th>
<th>Total in river basin district</th>
<th>High risk</th>
<th>Moderate risk</th>
<th>Low risk</th>
<th>Very low risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>N° of non-residential properties:</td>
<td>1,130,470</td>
<td>16,450</td>
<td>48,950</td>
<td>74,650</td>
<td>6,350</td>
</tr>
<tr>
<td>N° of airports:</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Roads (km):</td>
<td>6,780</td>
<td>110</td>
<td>260</td>
<td>400</td>
<td>20</td>
</tr>
<tr>
<td>Railway (km):</td>
<td>2,810</td>
<td>110</td>
<td>220</td>
<td>320</td>
<td>20</td>
</tr>
<tr>
<td>Agricultural land (ha):</td>
<td>1,541,350</td>
<td>70,750</td>
<td>103,000</td>
<td>81,700</td>
<td>2,800</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk to the natural and historic environment:</th>
<th>Total in river basin district</th>
<th>High risk</th>
<th>Moderate risk</th>
<th>Low risk</th>
<th>Very low risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>N° of EU designated bathing waters within 50m:</td>
<td>9</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>N° of EPR installations within 50m:</td>
<td>857</td>
<td>86</td>
<td>104</td>
<td>97</td>
<td>6</td>
</tr>
<tr>
<td>SAC (ha):</td>
<td>188,050</td>
<td>5,650</td>
<td>2,650</td>
<td>1,200</td>
<td>&lt;50</td>
</tr>
<tr>
<td>SPA (ha):</td>
<td>174,100</td>
<td>4,850</td>
<td>2,100</td>
<td>1,050</td>
<td>&lt;50</td>
</tr>
<tr>
<td>RAMSAR site (ha):</td>
<td>36,700</td>
<td>4,350</td>
<td>600</td>
<td>200</td>
<td>&lt;50</td>
</tr>
<tr>
<td>World Heritage Site (ha):</td>
<td>6,950</td>
<td>650</td>
<td>250</td>
<td>300</td>
<td>0</td>
</tr>
<tr>
<td>SSSI (ha):</td>
<td>212,450</td>
<td>9,500</td>
<td>3,600</td>
<td>1,900</td>
<td>&lt;50</td>
</tr>
<tr>
<td>Parks and Gardens (ha):</td>
<td>28,200</td>
<td>1,150</td>
<td>400</td>
<td>450</td>
<td>&lt;50</td>
</tr>
<tr>
<td>SAM (ha):</td>
<td>8,900</td>
<td>300</td>
<td>300</td>
<td>350</td>
<td>&lt;50</td>
</tr>
<tr>
<td>N° of Listed Buildings:</td>
<td>52,670</td>
<td>1,780</td>
<td>1,830</td>
<td>2,790</td>
<td>110</td>
</tr>
<tr>
<td>N° of Licensed water abstractions:</td>
<td>6,390</td>
<td>1,780</td>
<td>780</td>
<td>450</td>
<td>40</td>
</tr>
</tbody>
</table>
The June 2007 floods highlighted the impact of flooding on communities. Within Yorkshire, 467 schools were flooded or otherwise affected. In total 91 of Hull’s 99
schools were affected with 65 primary schools, 13 secondary schools, 10 special units and three nurseries temporarily closed. The closure of schools also forced some parents to take time off work with resultant loss of earnings and of the value of output associated with work days. This was estimated at average wage rates, net of national insurance, at £2.4 million in Hull alone².

Around 13% of non-residential properties within the Humber river basin district are at risk of flooding from rivers and the sea. Although most (just under 75,000) are at low risk, more than 16,000 are at high risk. The impact on business from flooding is high and can result in damage to premises, equipment and fittings, and loss of stock. For example, Meadowhall Shopping Centre in Sheffield was overwhelmed and was shut for a week. The result was millions of pounds in lost trade. The effect of flooding on the transport network also has an indirect impact on commercial properties. Almost 6,800 km of road and 2,800 km of rail are at risk of flooding from rivers and the sea within the river basin district.

A significant area – around 258,000ha - of agricultural land is also at risk of flooding within the river basin district. This high level of risk is associated with the tidal floodplain surrounding the Humber Estuary and lower reaches of the catchment where there are a significant number of low-lying communities. It is estimated the summer 2007 floods caused losses to agriculture of around £50 million. Around 50% of these losses were borne by farms in Yorkshire. Flooding leads to financial losses to agriculture through: reduced yield in the year of the flood; additional inputs (fertiliser and sprays); additional harvesting costs and the value of replacement crops. The economic impact of flooding to agriculture depends on the type of farming, with horticulture and arable being the most heavily impacted.

There are a large number of water-related environmental designations within the Humber river basin district. As well as this, the development of industrial communities along the coast, estuary and rivers mean a significant proportion of historic designations are also at risk of flooding from rivers and the sea. For example, 12% of listed buildings, 11% of SAM, 7% of SSSIs and 5% of SAC are at risk.

More than 290 Environmental Protection Regulations (EPR) installations are at risk of flooding from rivers and the sea. A total of 86 of these are at high risk including those dealing with water discharges and groundwater, radioactive substances, waste, mining waste and installations which if flooded can have significant implications on the environment. All 9 EU-designated bathing waters within the Humber river basin district are vulnerable to the effects of flooding which can cause bathing water standards to fall. This is because heavy rainfall can wash pollution from cities and rural areas into rivers and streams which eventually flow into the sea.

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Figure 7: Flood risk from rivers and the sea – Risk to economic activity
Figure 8: Flood risk from rivers and the sea – Risk to the Natural and Historic Environment
Flood risk from reservoirs

The Environment Agency regulates large raised reservoirs with regard to flood risk and provides guidance to reservoir managers. Enforcement action may be taken where improvements are needed. The ‘flood risk map for reservoirs’ for the Humber river basin district can be found on GOV.UK contains a summary of risk per management catchment. It can be viewed at Humber river basin district: reservoirs

Table 9: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Humber river basin district

<table>
<thead>
<tr>
<th>Risk to people:</th>
<th>Total in river basin district</th>
<th>Maximum extent of flooding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nº of people:</td>
<td>11,707,050</td>
<td>441,150</td>
</tr>
<tr>
<td>Nº of services:</td>
<td>19,390</td>
<td>1,430</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk to economic activity:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nº of non-residential properties:</td>
<td>1,130,470</td>
<td>68,270</td>
</tr>
<tr>
<td>Nº of airports:</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Roads (km):</td>
<td>6,780</td>
<td>410</td>
</tr>
<tr>
<td>Railway (km):</td>
<td>2,810</td>
<td>260</td>
</tr>
<tr>
<td>Agricultural land (ha):</td>
<td>1,541,350</td>
<td>75,750</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk to the natural and historic environment:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nº of EU designated bathing waters within 50m:</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Nº of EPR installations within 50m:</td>
<td>857</td>
<td>112</td>
</tr>
<tr>
<td>SAC (ha):</td>
<td>188,050</td>
<td>1,050</td>
</tr>
<tr>
<td>SPA (ha):</td>
<td>174,100</td>
<td>850</td>
</tr>
<tr>
<td>RamsAR site (ha):</td>
<td>36,700</td>
<td>500</td>
</tr>
<tr>
<td>World Heritage Site (ha):</td>
<td>6,950</td>
<td>1,100</td>
</tr>
<tr>
<td>SSSI (ha):</td>
<td>212,450</td>
<td>3,050</td>
</tr>
<tr>
<td>Parks and Gardens (ha):</td>
<td>28,200</td>
<td>1,700</td>
</tr>
<tr>
<td>SAM (ha):</td>
<td>8,900</td>
<td>250</td>
</tr>
<tr>
<td>Nº of Listed Buildings:</td>
<td>52,670</td>
<td>3,830</td>
</tr>
<tr>
<td>Nº of Licensed water abstractions:</td>
<td>6,390</td>
<td>1,410</td>
</tr>
</tbody>
</table>

Around 4% of the population is at risk of flooding from reservoirs together with more than 1,400 services. As illustrated in Figure 9, the greatest risk to communities is seen within the Aire and Calder management catchment where more than 110,000 people are at risk. This includes seven communities which have more than 5,000 people located within the maximum extent of flooding. People in the Esk and Coast and Louth Grimsby and Ancholme catchments have the lowest risk of flooding from reservoirs – approximately 140 and 2,500 respectively.

Almost 69,000 non-residential properties lie within the maximum reservoir flood extent. This equates to 6% of the river basin district. Around 670km of the road and rail network is at risk of flooding from
reservoirs. This would impact significantly on the river basin, as seen in 2007 when the M1 was affected. Around 76,000ha (5%) of agricultural land is within the maximum reservoir flood extent. A number of areas with environmental and cultural designations are at risk of reservoir flooding. This includes 16% of world heritage sites, 1,000ha of SAC, almost 4,000 listed buildings and more than 3,000ha of SSSI. Although the consequence of reservoir failure is high, the risk of it happening is low as a result of the legal requirements associated with their management.
Figure 9: Reservoir flood risk – Risk to people
Figure 10: Reservoir flood risk - Risk to Economic activity
Figure 11: Reservoir flood risk – Risk to the Natural and Historic Environment
Flood risk from surface water

Surface water flooding can occur in two ways. Usually it is caused when intense rainfall, often of short duration, is unable to permeate the ground or enter drainage systems quickly enough. This means water builds-up to such an extent that it ponds on or flows across the land surface. This can cause considerable problems in urban areas. Surface water flooding can also originate in rural areas where high-intensity rainfall can run off fields without entering land drainage systems. Surface water can be hazardous as a result of its depth, velocity of flow and sometimes its sudden and unpredictable occurrence. It is difficult to warn people about and prepare for surface water flooding as it is dependent on many factors. This includes how empty the sewers are, how localised the rainfall is and how saturated the ground is beforehand.

The most significant surface water flooding incident within the Humber river basin district happened in June 2007 when Hull experienced high volumes of rainfall. More than 70mm of rain fell on the 15 June with further rain over the next few days leading up to the 25 June when more than 105mm of rainfall was recorded. The ground was heavily saturated following the prolonged rainfall and this resulted in severe flooding which caused city-wide disruption and damage to more than 1,300 businesses, more than 8,600 properties and the loss of life.

The flood risk regulations require the identification of areas where the risk of local sources of flooding is particularly high. This process, delivered through the preliminary flood risk assessment, identified three flood risk areas (FRAs) within the Humber river basin district. These are Kingston upon Hull and Haltemprice, the West Midlands and the Leicester Principal Urban Area. Within these areas, more than 30,000 people have been identified as being at risk from surface water flooding. A summary of risk per FRA can be viewed at Humber river basin district: surface water

Outside of the three FRAs, there is a high risk of surface water flooding, as experienced in communities such as Leeds, Sheffield, Stafford and Louth. The management of this risk is coordinated by LLFAs under the framework set by local flood risk management strategies (LFRMS).

A number of LLFAs have volunteered to include information from their LFRMS within this FRMP. These are City of York Council, North Yorkshire County Council, Kirklees Council and Leicester City Council. Further information about surface water flooding in these areas can be found within the relevant catchment summaries in Part B for the Humber FRMP. Outside of these locations, LFRMS are available on the relevant LLFAs websites.

Prior to April 2015 the Environment Agency was also a statutory consultee for large developments, greater than 1ha in size in flood zone 1 (i.e. in areas at low risk of flooding from rivers and the sea). However, since 15 April 2015 this duty has now passed onto the Lead Local Flood Authorities who now provide local planning authorities with comments on surface water management for new development. This includes review of sustainable drainage systems (SuDS) associated with new development.
Table 10: Summary of flood risk from surface water to people, economic activity and the natural and historic environment across the Humber river basin district

<table>
<thead>
<tr>
<th>Risk to people:</th>
<th>Total in river basin district</th>
<th>High risk</th>
<th>Moderate risk</th>
<th>Low risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of people:</td>
<td>11,707,050</td>
<td>77,750</td>
<td>158,100</td>
<td>814,300</td>
</tr>
<tr>
<td>No of services:</td>
<td>19,390</td>
<td>340</td>
<td>360</td>
<td>1,610</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk to economic activity:</th>
<th>Total in river basin district</th>
<th>High risk</th>
<th>Moderate risk</th>
<th>Low risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of non-residential properties:</td>
<td>1,130,450</td>
<td>14,050</td>
<td>18,750</td>
<td>84,500</td>
</tr>
<tr>
<td>No of airports:</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Roads (km):</td>
<td>6,780</td>
<td>310</td>
<td>380</td>
<td>1,050</td>
</tr>
<tr>
<td>Railway (km):</td>
<td>2810</td>
<td>140</td>
<td>130</td>
<td>310</td>
</tr>
<tr>
<td>Agricultural land (ha):</td>
<td>1,541,350</td>
<td>27,550</td>
<td>20,900</td>
<td>89,450</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk to the natural and historic environment:</th>
<th>Total in river basin district</th>
<th>High risk</th>
<th>Moderate risk</th>
<th>Low risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>N° of EU designated bathing waters within 50m:</td>
<td>9</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>N° of EPR installations within 50m:</td>
<td>857</td>
<td>265</td>
<td>155</td>
<td>233</td>
</tr>
<tr>
<td>SAC (ha):</td>
<td>188,050</td>
<td>1,550</td>
<td>1,050</td>
<td>8,900</td>
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<td>SPA (ha):</td>
<td>174,100</td>
<td>1,300</td>
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<td>RAMSAR site (ha):</td>
<td>36,700</td>
<td>&lt;50</td>
<td>&lt;50</td>
<td>250</td>
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<td>World Heritage Site (ha):</td>
<td>6,950</td>
<td>200</td>
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<tr>
<td>SSSI (ha):</td>
<td>212,450</td>
<td>2,400</td>
<td>1,600</td>
<td>10,750</td>
</tr>
<tr>
<td>Parks and Gardens (ha):</td>
<td>28,250</td>
<td>650</td>
<td>350</td>
<td>1,300</td>
</tr>
<tr>
<td>SAM (ha):</td>
<td>8,900</td>
<td>150</td>
<td>100</td>
<td>450</td>
</tr>
<tr>
<td>N° of Listed Buildings:</td>
<td>52,670</td>
<td>1,120</td>
<td>500</td>
<td>1,870</td>
</tr>
<tr>
<td>N° of Licensed water abstractions:</td>
<td>6,390</td>
<td>1,070</td>
<td>410</td>
<td>880</td>
</tr>
</tbody>
</table>
Figure 12: Surface water flood risk – Risk to people in the Humber river basin district FRAs
Figure 13: Surface water flood risk - Risk to economic activity in the Humber river basin district FRAs
Figure 14: Surface water flood risk – Risk to the Natural and Historic Environment in the Humber river basin district FRAs
Flood risk from groundwater

Groundwater flooding occurs as a result of water rising up from the underlying rocks or from water flowing from springs. This tends to occur after much longer periods of sustained high rainfall. Generally groundwater flooding occurs during the winter and spring when groundwater levels reach their peak and start to come above ground in low lying areas. Groundwater flooding takes longer to dissipate because groundwater moves much more slowly than surface water and will take time to flow away underground.

Although the risk of groundwater flooding in the Humber river basin is low, there have been a number of incidents over recent years. Locations where notable incidents have occurred include the Hull and East Riding catchment where springs from major aquifers on the edge of the Wolds rise to the surface; the coastal areas from Barton-upon-Humber to Humberston and parts of the City of Nottingham where the gradual decline of water intensive industry has seen the water table rise with particular issues around the Old Basford area of the city. As well as this, Malton and Norton in the Derwent Humber management catchment have experiences prolonged groundwater flooding, most notably in 2012 and 2015.

Flood risk from canals

When there is too much water in the canal, the Canals and River Trust try to remove the excess water as soon as possible. Water is removed in a number of ways:

- ensuring weirs which send water out of the canal are not blocked
- reducing the amount of water entering the canal in the flooded area
- removing water out of the canal as quickly as possible via sluices
- moving water via locks to downstream unaffected areas

There have been a small number of recorded flooding incidents from canals within the river basin. In 1986 there was a structure breach within Leicester, a failure of the Freemans Meadow weir, lock and sluice system however, there is no information relating to whether flooding occurred to the surrounding area, or the consequences of this flooding.

The Leeds & Liverpool Canal flows through the Aire and Calder management catchment, and in many places, is in close proximity to the River Aire. Flooding has been recorded when the River Aire overtops into the canal, causing increased flood risk to communities located close to the canal network. Areas where this risk has been identified include Skipton, Shipley, Leeds and Ferrybridge. As well as this, Selby, in the Swale, Ure and Nidd management catchment has been known to flood from the River Aire via the Selby Canal.

Flood risk from sewers

Sewers and drains are designed to take away sewage from properties, as well as the surface water which runs off roofs, driveways, roads, footpaths and paved areas. The most likely causes of sewer flooding are:

- Blockages or defects within the sewerage network
- Overloaded sewers
- Flooding from rivers, highway drains and other watercourses.

According to Severn Trent Water, around 75% of all sewer flooding is the result of blockages caused by the wrong things being flushed into sewers – such as cooking fats and oils, which often become solid in sewers, as well as sanitary products and nappies.
Flooding could also be caused when a sewer becomes damaged or collapses. Water Companies monitor and repair or replace damaged sewers, or those we think are likely to become damaged in the future, to reduce the risk of these defects causing flooding.

To meet requirements set by the Office of Water Trading (OFWAT), water companies must record all instances of sewer flooding where flooding has resulted from rainfall events in a level of service ‘DG5 register’. In such circumstances internal flooding is defined as ‘flooding that enters a building or passes below a suspended floor’. External flooding is defined as ‘flooding which is not classed as internal’ for example flooding of gardens and other open spaces. Properties at risk are ‘properties that have suffered or are likely to suffer internal flooding from public foul, combined or surface water sewers due to the sewerage system being overloaded’. Water and Sewerage Companies in the UK set a minimum design standard for new sewers to ensure there is no flooding during rainfall events of 3.3% annual probability (1in30 event) of occurrence or higher.

There have been numerous occasions of sewer flooding across all management catchments of the river basin. Some locations are particularly susceptible to this form of flooding due to the interaction between rivers, highway drains and other watercourses, for example, the vast majority of Hull City drains into a combined sewerage system where rainwater mixes with domestic and commercial sewage. As a result West Hull can be affected by sewer flooding. This occurs when rain falling on the areas outside of the city flows into the sewers and they rapidly fill. By the time the sewers have reached the city they are already full and therefore there is little capacity left for runoff from the roads and properties within the city.

Other communities that have been affected in the part include Mansfield, Workshop and Retford in the Idle and Torne management catchment, Malton and Norton in the Derwent (Humber) management catchment as well as southwell and Lowdham in the Lower Trent and Erewash management catchment.

Find out more

- Interactive flood maps for flooding from rivers, the sea, reservoirs and surface water
- River basin management plans
- Current Ecological and Chemical Status of Water Bodies
  http://maps.environment-agency.gov.uk/wiwy/wiwyController?x=357683&y=355134&scale=1&layerGroups=default&ep=map&textonly=off&lang=_e&topic=wfd_rivers&x=466704&y=403302&lg=1,7,8,9,5,6,&scale=3
- The Environment Agency maintenance programme for rivers and sea
- Canal River Trust
- Severn Trent Water sewer flooding
  https://www.stwater.co.uk/my-supplies/waste-water-and-sewers/during-flooding/sewer-flooding/
- Yorkshire Water flood risk
  https://www.yorkshirewater.com/household/help-advice/in-an-emergency#ls2
7. Sub-areas in the Humber River Basin District

Introduction
There are a number of sub-areas within the Humber river basin district, as shown in Figure 15 and outlined below. These sub-areas and issues in them are described in Catchment Summaries in Part B. These sub areas are:

- Flood Risk Areas (identified in the Preliminary Flood Risk Assessment): areas that require flood risk management plans for local sources of flooding.
- Catchments (which are set out according to WFD management catchments)
- Strategic areas (geographical area where it is important to consider flood risk management across more than one of the above).

Flood risk areas
These are identified through preliminary flood risk assessments as areas of potentially significant local flood risk (for instance surface runoff, groundwater and ordinary watercourses), for which FRMPs need to be prepared. The FRAs in the Humber river basin district are:

Kingston upon Hull and Haltemprice Flood Risk Area – This flood risk area falls within the Hull and East Riding catchment. It covers the majority Kingston upon Hull as well as Haltemprice villages to the west and north-east of the city. Hull City Council has contributed to this FRMP whilst East Riding Yorkshire Council has produced a separate FRMP for the Haltemprice villages.

The West Midlands Flood Risk Area - This covers parts of Birmingham, the Black Country, Solihull, Staffordshire and Worcestershire. It includes parts of the River Tame catchment. The flood risk area also crosses into the Severn River Basin District but it is being reported under the Humber river basin district in which it predominantly sits.

The Leicester Principle Urban Area FRA – This FRA includes the urban watercourses and the majority of their catchments that feed into the River Soar in Leicester. Leicester City Council (LLFA) lead on the FRMP for this Area, as they have the largest area contributing to the Urban Area, with Leicestershire County Council the other LLFA providing support. Both LLFAs have contributed to this FRMP.
Figure 15: Humber river basin district showing catchments and flood risk areas
Management catchments
These are areas, which are set out according to WFD Management Catchments, where the Environment Agency focuses engagement to enable a catchment-based approach to water management. There are 15 management catchments in the Humber river basin district. These are:

- Aire and Calder
- Derwent Derbyshire
- Derwent Humber
- Don and Rother
- Dove
- Esk and Coast
- Hull and East Riding
- Idle and Torne
- Louth, Grimsby and Anholme
- Lower Trent and Erewash
- Soar
- Swale, Ure, Nidd and Upper Ouse
- Tame, Anker and Mease
- Trent Valley Staffordshire
- Wharfe and Lower Ouse

Strategic areas
These are areas where it is important to consider flood risk management across more than one sub-area, so that interested parties can work in a co-ordinated way to set out conclusions, objectives and measures to manage risk. The Humber Estuary has been identified as a strategic area because it covers the estuary frontage of 7 different management catchments as well as a significant portion of the Kingston upon Hull and Haltemprice FRA.
8. Conclusions, objectives and measures to manage risk for the Humber River Basin District

This plan sets out the type of measures proposed to manage flood risk. In developing the proposed measures the RMAs contributing have:

- drawn conclusions from hazard and risk maps and other sources of information. This helps us all to understand the risks or opportunities the RMAs are aiming to manage
- developed risk management objectives (related to people and society, the economy and the environment) that set out the outcomes the RMAs are trying to achieve
- identified the likely approach to managing risk using the following categories: preventing, preparing, protecting and recovering and review

These conclusions, objectives and measures are set out for the Humber river basin district. To provide an overview of measures in the river basin district, this section also summarises the proposed measures for the sub-areas as set out further in Part B.

Conclusions

The Humber river basin district is one of the most diverse regions in England. In the West Pennines, there are catchments where the rivers respond rapidly to rainfall as well as areas in East Yorkshire and Lincolnshire where pumps are used to manage water levels. Tidal flooding is a risk around the Humber Estuary and rivers Ouse and Trent. Watercourses range from heavily modified to pristine natural chalk rivers. The landscape includes steep-sided valleys and rural communities along with large and historical industrial urban areas. There has been a long history of flooding within the Humber river basin district. In recent years surface water flooding has had a significant impact on communities.

The December floods have emphasised the need to be sure we have in place and implement the very best possible plans for flood management across the whole country. In response to these floods the Government has put in place a National Flood Resilience Review and Local Flood Partnerships in Cumbria and Yorkshire. It is working to strengthen or establish partnerships in the areas most affected by the December 2015 floods to encourage a more integrated approach to managing risk across the whole catchment.

The outcomes of these initiatives will strengthen partnership working and complement the flood risk measures within the Flood Risk Management Plan to further reduce flood risk and increase resilience.

Flood risk from rivers and the sea

Of the almost 12 million people who live within the river basin district, on average 9% are at risk from flooding from rivers or the sea. However in some of the district’s management catchments, for example the Hull and East Riding catchment and the Louth, Grimsby and Ancholme catchment, this risk is much greater. In these catchments it affects between 57% and 32% of the respective populations. This is as a result of the low-lying nature of much of the land and associated towns and villages and their proximity to the coast/Humber Estuary.
Other catchments in the river basin district carry a much lower risk. One of these is the Aire and Calder catchment where only 4% of people are at risk. This is because, despite having a large population in the cities of Leeds, Bradford and other large towns, most settlements are constructed on higher ground and the low areas are sparsely populated. This catchment also benefits from storage reservoirs (both for water supply and flood protection), which reduce flood risk to more than 110,000 people. Although the proportion of risk is low within this catchment, the impact of flooding is significant, as witnessed in winter 2015/16. Steep upland watercourses result in flashy catchments and an increased risk to life.

Key industries for the river basin district include agriculture and manufacturing. Around 16% of all agricultural land in the river basin district is at risk of flooding from rivers and the sea. In addition, 34% of sites which come under the environmental permitting regulations, including heavy manufacturing industry, intensive agriculture, waste and landfill sites and aggregate industries, are at risk of flooding from rivers and the sea.

As an average across the river basin district, 12% of primary roads and 24% of railways are at risk of river or tidal flooding. Risks to this type of key transport infrastructure are however much higher in some areas, for example in the Hull and East Riding Catchment 89% of railways are at risk.

**Reservoir flood risk**

There are 485 large raised reservoirs that each holds at least 25,000 cubic metres (m$^3$) of water above natural ground level. The hazard maps show the maximum area that might flood if a reservoir was to fail. While the chance of a reservoir failing and causing flooding is very low, the extent of flooding from a failure could be extensive and many miles from its source. This is because the local geography, such as valleys, can channel flood water long distances.

There are approximately 440,000 people, 1,400 services (including hospitals and schools), 400 km of primary roads, 260 km of railways and over 8,000ha of European designated wildlife sites at risk of flooding in the Humber river basin district. These figures are the totals at risk and are not an indication of the risk from the failure of any individual reservoir.

The Environment Agency regulates all reservoirs with a capacity of 25,000m$^3$ or more under the Reservoirs Act 1975. The Environment Agency is currently re-classifying high-risk reservoirs. In future, the Environment Agency will continue to maintain a register of all reservoirs with a capacity of more than 25,000m$^3$ but we will only fully regulate those designated as ‘high-risk’.

**Surface water flood risk**

There are some locations where surface water flooding is a particular problem, such as the FRAs of Kingston-upon-Hull and Haltemprice where 14% of the population is at risk. 14% of the population is at risk in the Leicester Principal Urban Area and in the West Midlands 10% of the population is at risk from this form of flooding.

Although these 3 areas are the only designated FRAs in the river basin district, this type of flooding is an issue in most urban areas in the river basin district. 9% of the population, 12% of services (including schools and hospitals) and 26% of roads within the river basin district are at risk from surface water flooding.

**Other sources of flooding**

There are other sources of flooding that affect the river basin district, such as groundwater flooding and sewer flooding. The Environment Agency does not have national scale modelling and mapping for these sources of flooding, and so it is not possible to draw conclusions about the risks in this FRMP at this stage. Water
companies have developed a five year Asset Management Plan from 2015 to 2020 to target known flood risk issues. Ground water flood risk is the responsibility of LLFAs and, where relevant, will be taken into account in their Local FRM Strategy.

**Partnership working**

There are 8 strategic flood risk partnership groups in the Humber river basin district. These bring together LLFAs, District Councils, Environment Agency, IDBs and water companies. Their work together provides mutual benefit and produces better outcomes for people and property at risk of flooding.

**Coastal erosion**

Many coastal areas of the Humber river basin district suffer from erosion and landslip. In the Derwent catchment, drainage and water tables are critical, so that periods of heavy rain can destabilise slopes. In the Esk and Coast management catchment, waves from the north east scour the defended frontage and lead to direct impacts on the slumping coastal slopes. Beach levels have dropped substantially over the last decade although they are currently relatively constant. In the Robin Hood’s Bay area, slow retreat on the frontage has been identified and there is the potential for landslides which are affected by drainage or lack of drainage to the coastal slope. The Holderness cliffs are eroding as a result of waves reaching the base of the cliffs. This removes material and causes the cliff face to over-steepen. Rain can also saturate the cliff, making it slide and collapse more easily. The peninsular of Spurn Head is an important feature at the mouth of the Humber Estuary and has breached a number of times during tidal surges.

**Objectives to manage risk for the Humber river basin district**

A number of LLFAs have volunteered to include flooding information from their LFRMS within the Humber FRMP. Within these strategies the LLFA set out their own objectives for managing flood risk within their administrative areas. Figure 16 shows the objectives of these councils. Objectives relating to the management of coastal issues can be found in the relevant coastal strategies which can be viewed here.

The Environment Agency has identified social, economic and environmental objectives for the management of river, sea and reservoir flooding for the Humber river basin district. These objectives have been developed from existing plans and strategies and public consultation and are listed below.

**Social objectives**

**SOC 1: Understanding Flood Risk and Working in Partnership**

Work in partnership with RMAs and communities, as appropriate, to understand the risk of flooding from all sources of flooding, including interrelated flood risks, both now and in light of climate change implications.

Partnership working will develop long term plans to manage the risks with direct involvement from the community in the decision making process.

**SOC 2: Community Preparedness and Resilience**

Work in partnership with communities to build awareness of flood risk and engage with them to reduce the consequences of flooding by enabling them to take effective action before, during and after a flood. Where necessary, support communities and individuals to make their property more resilient.

**SOC 3: Reduce Community Disruption**

Minimise the impact of flooding to community services and critical infrastructure such as education and health facilities, emergency services, significant transport network
and domestic infrastructure (gas, electric and water installations) taking into account the potential implications of climate change scenarios.

**SOC 4: Flood Risk and Development**

Work in partnership to understand the pressure for economic growth and economic sustainability throughout the river basin whilst avoiding inappropriate development in areas of flood and coastal erosion risk. Where possible seek opportunities to reduce existing and future risks through collaborative working on new and future development plans, for example the publication of development plans and policies and the opportunities arising through government initiatives such as Local Growth Deals and LEP.

**SOC 5: Reduce risk to people**

Reduce flood risk and avoid loss of life to people and existing residential properties.

**Economic objectives**

**ECON 1: Reduce economic damage**

Reduce the economic damage of flooding to non-residential properties.

**ECON 2: Maintenance of main river and existing assets**

Prioritise investment of public money in asset maintenance where the risk of flooding, risk to life to people and economic damage are greatest. Future investment in maintenance will continue to be prioritised to ensure that the greatest possible overall outcome is achieved with the available funding.

Partnership working with relevant landowners and affected parties, including other RMAs, will provide the opportunity to comment and highlight any factors which should be considered to reach a broad consensus on the preferred way forward. This will be carried out in line with the Asset Maintenance Protocol.

**ECON 3: Transport Services**

Minimise the risk of flooding to key transport links within the river basin such as railway lines, motorways, primary roads and trunk roads.

**ECON 4: Flood risk to agricultural land**

Consider the value of agricultural land and the damages that can occur as a result of flooding within the economic appraisal of maintenance and investment options for flood risk management.

**ECON 5: Tourism**

Ensure that flood risk management activities do not adversely affect the tourism industry, and where possible enhance the attractiveness of the river and coastal environment to visitors.

**Environmental objectives**

**ENVI 1: Water Framework Directive**

Working with the newly formed Catchment based approach (CaBA) partnerships, contribute to achieving WFD objectives across the river basin district, by working with natural processes wherever possible, to manage flood risk through protecting and restoring the natural function of the catchment, rivers and floodplains.

**ENVI 2: Designated Nature Conservation Sites**

Minimise the negative impacts of flooding to designated nature conservation sites (SSSI, SPA, SAC and Ramsar sites) throughout the Humber river basin district, wherever possible contributing to the enhancement of such sites.
ENVI 3: Designated Heritage sites
Minimise the negative impacts of flooding to heritage assets and landscape value (SAM, listed buildings and historic parks and gardens), wherever possible enhancing such assets.

Reservoir objectives
RES 1: Reservoir flood risk
Avoid loss of life and reduce the risk of flooding from reservoirs to people, property, infrastructure and the environment.

The objectives associated with the three FRAs within the Humber FRMP can be viewed in Part B: Sub areas.
Figure 16: Local FRM Strategy objectives relevant to the Humber river basin district

Measures across Humber river basin district
Over 1,000 measures have been identified to manage flood risk and coastal erosion across the Humber river basin district. This includes a number of measures that have been taken from existing plans and strategies that have been provided on a voluntary basis by our partners including:

- LLFA outside of a statutory FRA* x 68
- River Tyne to Flamborough Head SMP x 12/8
- Approved coastal strategies x 51
  * City of York Council, North Yorkshire Council, Kirklees Council

Many measures are specific to a catchment or smaller areas such as communities. However, there are some important measures which apply across the entire Humber river basin district. Below is a summary of these 21 river basin wide measures. More detailed catchment measures are available in the catchment summaries in Part B, and the full table of measures is included in Part C. Measures in FRMPs do not all have secured funding and are not guaranteed to be implemented. Money is allocated to all RMA measures in the same way and is based on current Government policy that gives the highest priority to lives and homes. Measures included are over and above RMA ‘flood risk management activities’ undertaken routinely, as explained in Section 4 – How to Manage Risk. The measures cover discrete pieces of work such as projects and campaigns.

Preventing risk: 9 measures

- Work closely with English Heritage, and other relevant organisations, to understand the implications of flooding on the historic environment
- Continue to work with all relevant parties to provide guidance and advice on planning applications to prevent the inappropriate location of new or additional receptors in flood prone areas
- Maintain a prioritised programme of mapping and modelling to ensure our flood risk information remains up to date and fit for purpose
- Review SAMPs regularly with regard to maintenance, funding requirements and asset condition related works across each catchment
- Continue to work with Internal Drainage Boards through regular liaison meetings and the RFCC
- Working with partners, undertake data collection and assessment to further improve our understanding of flood risk to local communities from all sources of flooding
- Undertake a prioritised programme of works to refurbish existing FRM assets in order to sustain the standard of service
- Impacts from a changing climate will be considered in plans for location-specific works to reduce flood risk from all sources
- Produce working with natural processes opportunity maps to show where these measures could help

Preparing for risk: 5 measures

- Ensure that all Environment Agency ‘high risk’ reservoirs have on-site reservoir plans in place
• Undertake a prioritised programme of hydrometry and telemetry improvements, which may include creating new assets, or increasing the life or performance of existing assets

• Provide advice and information to Local Resilience Fora to enable them to reduce the impact of flooding

• Provide advice and information to local communities at to enable them to reduce the impact of flooding

• Undertake work to improve our flood forecasting and flood incident management services.

Protecting from risk: 6 measures

• Ensure that all ‘high-risk’ reservoirs are regulated in accordance with the Reservoirs Act 1975

• Work in partnership to identify opportunities throughout the river basin district, initially through the identification of priority catchments and sub-catchments, for land management opportunities that will deliver a reduction in local flood risk and deliver the objectives of the WFD

• In having regard to the asset maintenance protocol 2014 and local flood risk management strategy, work with our partners and landowners to determine the affordability of flood defence assets throughout the river basin district and determine a cost effective solution to providing flood risk management and land drainage benefits

• Work with the newly formed Catchment Hosts to develop an integrated programme for delivering the outputs of both the Humber FRMP and RBMP, capitalising on projects that deliver multiple benefits thus providing financial and resource efficiencies

• Work with water companies to develop integrated programmes for delivering flood risk reduction. In doing so, the potential for delivering multi-agency schemes will be identified thus providing value for money and where possible environmental betterment

• Undertake a prioritised programme of assessment and if necessary, works to ensure Environment Agency flood risk management structures are compliant with the Eel Regulations 2009

Recovery and review: 1 measure

• Continue to improve and develop our services based on lessons identified following flood event and feedback from communities and partners

Underpinning all of the measures above is the principle that we, as RMAs, will work in a way which conserves the environment and enhances it where possible.

It should be noted that the impact of the winter 2015/16 flood event is currently being reviewed by all RMAs within the affected management catchments. These reviews will further define and review the hydrological conditions, emergency response and long term needs for managing river flooding throughout the management catchment. The published recommendations from these reviews will be taken into account by all responsible parties in the long term management of the catchment where appropriate.
Flood risk management plan contributing to broader benefits

**Links with the Humber River Basin Management Plan**

The strategic aims, objectives and principles of the National Strategy for Flood and Coastal Erosion Risk Management are outlined in Section 4. The overall aim of the strategy is ‘to ensure the risk of flooding and coastal erosion is properly managed by using the full range of options in a co-ordinated way’. The strategy promotes the development of broader benefits to communities related to flood risk management through a range of guiding principles i.e.

- Community focus and partnership working
- A catchment and coastal cell based approach
- Sustainability
- Proportionate, risk based approaches
- Multiple benefits
- Beneficiaries should be encouraged to invest in risk management

The specific guiding principles for ‘Sustainability’ and ‘Multiple benefits’ more specifically cover how:

- RMAs should manage risks in ways that take account of all impacts
- Flood risk management solutions should be adaptable to climate change
- Flood risk management solutions should enhance the environment
- The ability of communities to shape risk management actions to take account of local priorities
- Flood and Coastal Risk Management (FCRM) can bring significant economic, environmental and social benefits (‘It can enhance and protect the built, rural and natural environments, cultural heritage and biodiversity’)
- FCRM should avoid damaging the environment, including the historic environment
- FCRM should wherever possible work with natural processes
- FCRM should always seek to provide environmental benefit as required by the Habitats, Birds and Water Framework Directives

In taking forward the National Strategy for Flood and Coastal Erosion Risk Management, FRMPs have set out a range of social, economic and environmental objectives that include wider benefits alongside the delivery of flood risk management outcomes – see the following sections. These have been informed by considering how the FRMP relates to other plans and wider policies and objectives. In particular, how the FRMP links to the River Basin Management Plans to contribute to a more integrated approach to water management planning, and also to the priorities of Natura 2000 sites that are the subject of recent Site Improvement Plans. The following sections provide more details of this.

**Links with the Humber River Basin Management Plan**

The main aims of the EU Water Framework Directive (WFD) are to return rivers and the water environment to a state, as free from human influence as possible. Aspects of this include reversing some of the ways in which water bodies have been physically modified in the past, improving water quality and bio-diversity and improving the quality of bathing waters. To achieve this, work by water companies, farmers and business is regulated by the Environment Agency and complemented by a programme of works by the Environment Agency and others to remove some structures from rivers.

The Humber FRMP promotes a range of benefits that will contribute to the RBMP through re-naturalisation, water quality improvements, bathing water improvements and natural flood management.
• **Re-naturalisation:** Redundant structures such as weirs, culverts, embankments and channel retaining walls are removed to make fish and eel passage easier and provide a more natural water environment with benefits for biodiversity. Modifications to pumping stations and debris screens also benefit fish and eels. The Environment Agency’s ‘integrated environment programme’ is targeting these with ‘mitigation measures’ for ‘physical modifications’ where these are the reason why a waterbody has been classified less than good. Other opportunities are also explored as part of proposals to reduce flood risk in a given location, or when considering development proposals.

• **Water quality:** Water quality in some rivers is lower than that sought by the Directive. This and sediment run-off affects invertebrates and fish. Where sediments discolour water in reservoir catchments this needs increased treatment for water supply. Reducing rates of surface water and sediment run-off from land can improve water quality and biodiversity and free up capacity in sewers and drains, which in turn reduces flood risk and potential pollution of rivers. Natural flood management and sustainable drainage measures can achieve these benefits and provide welcome habitat in a more urban environment. Other forms of below-ground run-off attenuation provide less benefit to water quality and biodiversity.

• **Bathing waters:** Bathing water quality is monitored by the Environment Agency throughout the summer months in accordance with the EU Bathing Waters Directive. The quality of water in rivers ultimately affects the quality of bathing waters along the coast. In the North West this is particularly important to resorts such as Blackpool which currently sometimes fails the bathing water standard. Discharges from the sewer network, or by industry, agriculture and diffuse sources, such as roads, are all contributory factors. Many of the improvements sought in water quality will be achieved by the work of others such as United Utilities, farming and industry. Measures, as described for improving water quality above, have potential to benefit bathing waters and demonstrate strong links with flood risk management.

• **Natural flood management:** Natural flood management and ‘slowing the flow’ techniques such as restoration of peat moorland, woodland creation, wetlands and ponds encourage greater infiltration of water into the ground and/or hold water back. This reduces peak flows in minor watercourses and across the surface of undeveloped land. The Environment Agency will work with many other organisations and within partnerships to consider the application of these methods and to develop programmes of them alongside more traditional solutions, such as building raised flood defences. Programmes will include the 6 year Medium Term Plan of Environment Agency and Lead Local Flood Authority projects. This more natural approach can reduce sediment volumes entering rivers, filter out contaminants and enhance habitats. Similar techniques may be applied in or on the fringe of urban areas where they may be referred to as green infrastructure, or sustainable drainage systems. Natural flood management to counter fluvial flood risk will involve installing measures upstream of communities at risk. Measures to satisfy Water Framework Directive objectives will be located upstream or along stretches of water with poor water quality or habitats. Locations where these coincide may require input from more stakeholders to work in collaboration, perhaps using funding from multiple sources. These are likely to provide greater benefit for a given investment and so have a high priority. For example, the Environment Agency will look to reduce flood risk and enhance habitats, United Utilities’ focus is on improving the water quality of rivers and the sea and reducing treatment costs of potable water supplies, while Rivers Trusts and many others have drivers to improve the environment and habitats.
The following table summarises the WFD outcomes expected to be delivered through flood risk management programmes by the end of the cycle 2 of the RBMP by 2021:

Table 11: River Basin Management Plan outcomes related to flood risk management programmes by 2021

<table>
<thead>
<tr>
<th>Type of FCERM programme actions</th>
<th>Nº of actions</th>
<th>Hectares of water dependent habitat created or improved to help meet the objectives of WFD</th>
<th>Hectares of intertidal habitat created to help meet the objectives of WFD for protected areas</th>
<th>Kilometres of rivers protected under EU Habitats/Birds Directive improved to help meet the objectives of WFD</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCERM actions with predicted and targeted WFD outcomes in specific water bodies.</td>
<td>2</td>
<td>30</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>FCERM actions in Site Improvement Plans of water dependent sites designated under the EU Habitats and Birds Directives that will deliver a WFD outcome.</td>
<td>2</td>
<td>20</td>
<td>0</td>
<td>34</td>
</tr>
<tr>
<td>FCERM actions addressing remedies and threats to water dependent sites designated under the Wildlife and Countryside Act 1981 (SSSIs) that will deliver a WFD outcome.</td>
<td>4</td>
<td>273</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>FCERM actions addressing requirements for consent of flood works such as planning, Environmental Impact Assessment (EIA), HRA etc.</td>
<td>15</td>
<td>101</td>
<td>125</td>
<td>0</td>
</tr>
<tr>
<td>FCERM actions (over and beyond other measures) to ensure compliance with the RBMP.</td>
<td>2</td>
<td>15</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>FCERM actions that deliver WFD outcomes from works that contribute to the Eel Regulations.</td>
<td>3</td>
<td>Nº of eel barrier easements or removal = 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>28</td>
<td>439</td>
<td>125</td>
<td>46</td>
</tr>
</tbody>
</table>

Humber opportunities for linked work

Guided by the Water Framework Directive the Environment Agency is looking at where previous ‘physical modifications’ to waterbodies can be reversed, such as opening up culverts and removing weirs, river channel walls and flood defences that are no longer required. Across the river basin district, there are several projects that have been successful in delivering both flood risk benefits and improvements to the wider environment. Examples are given in Part B – Catchment Summaries.

- **Skipton Flood Alleviation Scheme** is expected to deliver approximately 2ha of priority habitat as part of the overall scheme. The Environment Agency is working with the Yorkshire Wildlife Trust and other partners to identify suitable
locations along the River Aire to introduce a combination of wet and deciduous woodland and hedgerow planting.

- **Leicester Flood Risk Management Strategy - conveyance works** Part of the Leicester Flood Risk Management Strategy is looking at improving the movement of flood flows through the River Soar corridor. This work involves reconnecting the river to its floodplain and the removal of silt that has accumulated in structures in the floodplain over the years, to improve the movement of out of bank flows. As part of these works it is expected that the Environment Agency will deliver approximately a hectare of priority habitat in the form of a wetland as part of the overall scheme.

The measures can also help deliver broader benefits, in particular to biodiversity, water and ecological quality. In parallel to flood risk management planning, the Environment Agency works with others to improve the quality of the water environment through river basin management planning. The Environment Agency aims to co-ordinate effectively between the FRMP and River Basin Management Planning so that all organisations can do more for the environment.

**Other Plans and Partnerships**
Table 12 sets out the key themes from a review of the main other plans and strategies that the Humber FRMP would be expected to influence. The purpose of the review is to take account of the objectives of these key documents in the assessment with a view to aligning and ensuring compliance of the plan with other policies and legislation. The plan review can also help to identify where other planning processes and organisations may be able to work with the flood risk management planning process. It is taken from the Environmental Report for the Humber FRMP.
Table 12: Key influences from the plans review (from SEA Report)

<table>
<thead>
<tr>
<th>Category of plan/strategy</th>
<th>Common themes relevant to the FRMP</th>
<th>Key plans</th>
</tr>
</thead>
</table>
| Water and flood risk management | • Protection, improvement, sustainable management and use of the water environment in terms of quantity and quality – for the benefit of the human and natural environment.  
• Flood risk management measures could place pressure on water bodies and any measure to be implemented would have to be Water Framework Directive compliant.  
• An update to the Humber river basin management plan is being prepared in parallel to the FRMP. The strategic environmental assessment for the FRMP will include a check on the alignment with the RBMP. | • The national FCERM strategy for England  
• Water white paper: Water for life  
• Water Companies Water Resources Management Plans  
• Water Resources Strategy: Regional Action Plans  
• Catchment Abstraction Management Plans  
• Humber RBMP  
• Catchment FRMPs  
• Coastal and Flood Risk Management Strategies  
• SMP  
• Surface water management plans |
| Biodiversity | • Protection and enhancement of important habitats and species, both from a statutory basis (International and National conservation designations and protected species) and through policy.  
• Promotion of coherent ecological networks.  
• Promotion of working with natural processes and sustainable development/management.  
• Tackling the issue of non native invasive species.  
• Flood risk management measures could place pressure on habitats and species, and work against natural processes. | • Natural environment white paper: The natural choice: Securing the value of nature  
• Biodiversity 2020: A strategy for England’s wildlife and ecosystem services  
• Coastal squeeze: Implications for flood management. The requirements of The European Birds and Habitats Directives. Defra policy guidance.  
• The invasive and non-native species framework strategy for Great Britain  
• Local BAP  
• Eel Management Plan: Humber river basin district. |
| Landscape | • Protection of existing sensitive landscapes (such as National Parks and AONBs).  
• Promotion of actions to improve water quality and water quantity, protect and enhance habitats, and restore the wider landscape character.  
• Flood risk management measures could place pressure on sensitive landscapes, and lead to changes in water quality, quantity and change in habitat type. | • All Landscapes Matter.  
• National Character Area Profiles.  
• AONB Management Plans (Nidderdale, Howardian Hills, Cannock Chase and Lincolnshire Wolds).  
• National Park Management Plans (North York Moors, Yorkshire Dales and Peak District). |
<table>
<thead>
<tr>
<th>Category of plan/strategy</th>
<th>Common themes relevant to the FRMP</th>
<th>Key plans</th>
</tr>
</thead>
</table>
| **Climate**               | Long term aims for reduction of carbon dioxide emissions including binding targets, and wide-reaching policies across all sectors to deliver reductions.  
   • Requirements to adapt to climate change and associated threats, the need for increased resilience to climate change.  
   • Likely increase in flooding and coastal erosion due to climate change. | • Climate Change Act.  
   • Climate Change - The National Adaptation Programme.  
   • Managing the environment in a changing climate.  
   • The national FCERM strategy for England |
| **Marine and Coastal**    | Sustainable economic growth in the UK marine area that balances benefits to society with the needs of local communities and protecting nature conservation.  
   • New plan-led system for marine activities, management of the marine area, its resources, and the activities and interactions, including coastal flood risk management.  
   • Marine / coastal flood risk management measures can enable growth.  
   • Marine / coastal flood risk management measures would need to be in alignment with Marine Plan planning policies. | • UK MPS.  
   • Marine Plan for East / North East Inshore and Offshore. |
| **Cultural heritage**     | Sustainable development in relation to historic assets through conservation and enhancement.  
   • The historic environment could be affected by flood risk management measures, for example through the construction of new flood risk management schemes, implementation of fish/eel passage on flood risk management assets etc and as such any such measures would need to be appropriately assessed. | • The Government’s Statement on the Historic Environment for England 2010.  
   • Heritage at Risk 2012: East / West Midlands, Yorkshire and the Humber.  
   • LLFA Core Strategies. |
| **Resource management**   | Promotion of sustainable waste and resource management and the protection and enhancement of the environment. | • LLFA Minerals and Waste Plans. |
| **Planning**              | Promotion of sustainable growth.  
   • Flood risk management measures can enable growth.  
   • Flood risk management measures would need to be in alignment with planning policies. | • National Planning Policy Framework.  
   • LLFA Core Strategies.  
   • Regional Transport Plans. |
| **Forestry**              | Protection, management and enhancement of woods and forests to provide economic, social and environmental benefits, for example managing flood risk in a sustainable way, and helping to reduce water pollution.  
   • Benefits of woodland creation for water in improving condition of the water environment, riparian and aquatic habitats, meeting objectives of WFD, reducing diffuse pollution and the ability to ‘slow the flow’ and help to reduce downstream flood risk. | • Government Forestry and Woodlands Policy.  
   • Midlands Woodland for Water Project - Phase 1: Opportunity Mapping. |
The FRMP aims to contribute to the specific plans of designated conservation sites and these are set out as proposed actions in specific plans and related to FCERM and the relevant RMAs. These include actions in the Humber river basin district Site Improvement Plans for the following European designated sites:

<table>
<thead>
<tr>
<th>Humber river basin district Natura 2000 sites with Site Improvement Plans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arnecliff and Park Hole Woods</td>
</tr>
<tr>
<td>Beast Cliff-Whitby (Robin Hood’s Bay)</td>
</tr>
<tr>
<td>Bees Nest and Green Clay Pits</td>
</tr>
<tr>
<td>Cannock Chase</td>
</tr>
<tr>
<td>Cannock Extension Canal</td>
</tr>
<tr>
<td>Craven Limestone Complex</td>
</tr>
<tr>
<td>Denby Grange Colliery Ponds</td>
</tr>
<tr>
<td>Ellers Wood and Sand Dale</td>
</tr>
<tr>
<td>Ensor’s Pool</td>
</tr>
<tr>
<td>Fen Bog</td>
</tr>
<tr>
<td>Flamborough and Filey Coast</td>
</tr>
<tr>
<td>Hornsea Mere</td>
</tr>
<tr>
<td>Humber Estuary</td>
</tr>
<tr>
<td>Kirk Deighton</td>
</tr>
</tbody>
</table>
9. Implementing the plan, monitoring and reporting

Flood risk management plans (FRMPs) are produced every 6 years and describe the sources, risks and measures to manage flooding within a river basin and catchment. Implementing the measures in the FRMP will be carried out by risk management authorities (RMAs) working with partners and communities. RMAs are invited to submit details of proposed flood and coastal erosion risk management work to the Environment Agency who administer funds on behalf of the Department for Environment, Food and Rural Affairs (Defra). These proposals are combined with Environment Agency proposed schemes and local (RFCC) funded projects to form a programme of work. Funding is allocated in line with government policy and priorities.

Not all of the measures identified will be implemented over the 6 year lifetime of this plan. Some measures require further work such as technical feasibility assessment, consultation with land and property owners, as well as assessing impacts on other river functions. Some measures may be disproportionately costly or unable to raise the necessary partnership funding to enable them to go ahead at this time. All of these issues are considered by the RFCCs, which are set up by Defra to scrutinise and approve the flood risk plans proposed by the Environment Agency and lead local flood authorities. There may be additional measures implemented alongside those in this plan on a national and local basis as a result of the National Flood Resilience Review and the work by the Local Flood Partnerships in Cumbria and Yorkshire.

The catchment based approach
The catchment based approach encourages local engagement and participation in decision-making. As the plan is finalised and implemented, the Environment Agency will seek to engage further with relevant catchment partnerships in order to deliver flood risk management outcomes and broader benefits.

Monitoring delivery of measures
During the planning and implementation cycle RMAs will monitor progress in delivering the measures set out in the FRMP. Progress will be reported annually to the relevant Regional Flood and Coastal Committees and the FRMP will be reviewed every 6 years, as required by the Flood Risk Regulations.

It should be noted that the impact of the winter 2015/16 flood event is currently being reviewed by all RMAs within the affected management catchments. These reviews will further define and review the hydrological conditions, emergency response and long term needs for managing river flooding throughout the management catchment. The published recommendations from these reviews will be taken into account by all responsible parties in the long term management of the catchment where appropriate.
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