

# Louth Coastal Catchment Flood Management Plan

Summary Report December 2009



managing  
flood risk

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December 2009

# Introduction

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**I am pleased to introduce our summary of the Louth Coastal Catchment Flood Management Plan (CFMP). This CFMP gives an overview of the flood risk in the Louth Coastal catchment and sets out our preferred plan for sustainable flood risk management over the next 50 to 100 years.**

The Louth Coastal CFMP is one of 77 CFMPs for England and Wales. Through the CFMPs, we have assessed inland flood risk across all of England and Wales for the first time. The CFMP considers all types of inland flooding, from rivers, ground water, surface water and tidal flooding, but not flooding directly from the sea (coastal flooding). This is covered by Shoreline Management Plans (SMPs). Our coverage of surface and groundwater flooding is however limited due to a lack of available information.

The role of CFMPs is to establish flood risk management policies which will deliver sustainable flood risk management for the long term. This is essential if we are to make the right investment decisions for the future and to help prepare ourselves effectively for the impact of climate change. We will use CFMPs to help us target our limited resources where the risks are greatest.

This CFMP identifies flood risk management policies to assist all key decision makers in the catchment. It was produced through a wide consultation and appraisal process, however it is only the first step towards an integrated approach to flood risk management. As we all work together to achieve our objectives, we must monitor and listen to each others progress, discuss what has been achieved and consider where we may need to review parts of the CFMP.

There are different sources of flood risk in the catchment. River flooding can affect Louth, Mablethorpe and Chapel St Leonards. Tide locking, which is where rivers cannot flow freely at high tide, can affect Willoughby High Drain at Chapel St Leonards Pumping Station and

Trusthorpe Pumping Station in Mablethorpe. Breaching/failure of embankments that carry the main upland rivers across the low lying area of the catchment could cause significant flood risk. Surface water drainage and sewer flooding can affect Louth and the coastal towns. Parts of the Lincolnshire Wolds may be susceptible to groundwater flooding.

We cannot reduce flood risk on our own. We will therefore work closely with all our partners to improve the co-ordination of flood risk activities. For example, in parts of the catchment Internal Drainage Boards (IDBs) have an important role in managing flood risk. We will work in partnership with the IDBs to agree the most effective way to manage flood risk in the future. We also work with many other organisations, groups and individuals with an interest in how flood risk is managed. This includes local authorities, water companies, conservation bodies such as Natural England and the public.

This is a summary of the main CFMP document. If you would like to see the full document an electronic version can be obtained by emailing [enquiries@environment-agency.gov.uk](mailto:enquiries@environment-agency.gov.uk) or telephoning 08708 506 506. Alternatively, paper copies can be viewed at any of our offices in Anglian Region.

A handwritten signature in black ink that reads "Paul Woodcock". The signature is written in a cursive style with a horizontal line underneath the name.

**Paul Woodcock**  
**Regional Director Anglian Region**

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↑ River Steeping, Crow Bridge

# The purpose of a CFMP in managing flood risk

CFMPs help us to understand the scale and extent of flooding now and in the future, and set policies for managing flood risk within the catchment. CFMPs should be used to inform planning and decision making by key stakeholders such as:

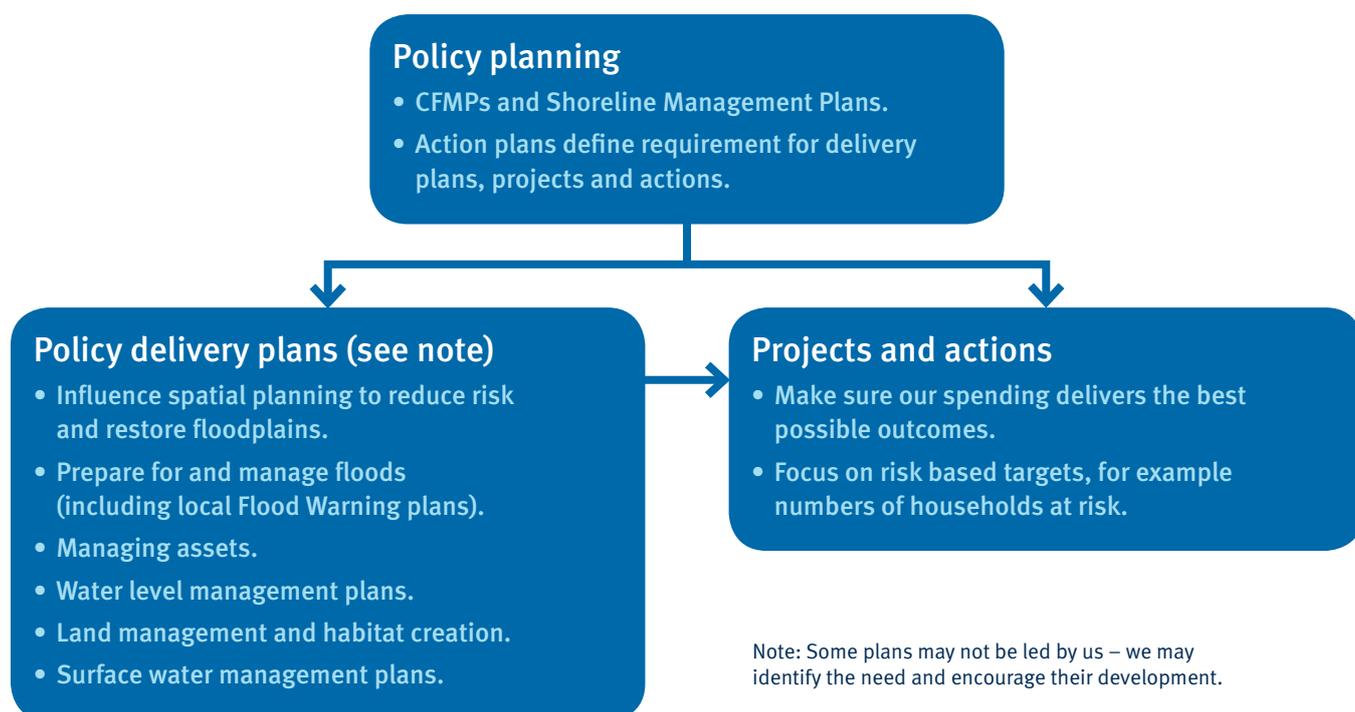
- the Environment Agency, who will use the plan to guide decisions on investment in further plans, projects or actions;
- regional planning bodies and local authorities who can use the plan to inform spatial planning activities and emergency planning;

- Internal Drainage Boards (IDBs), water companies and other utilities to help plan their activities in the wider context of the catchment;
- transportation planners;
- land owners, farmers and land managers that manage and operate land for agriculture, conservation and amenity purposes;
- the public and businesses to enhance their understanding of flood risk and how it will be managed.

CFMPs aim to promote more sustainable approaches to managing flood risk. The policies identified in the CFMP will be delivered through a combination of different approaches. Together with our partners, we will implement these approaches through a range of delivery plans, projects and actions.

The relationship between the CFMP, delivery plans, strategies, projects and actions is shown in Figure 1.

Figure 1 The relationship between CFMPs, delivery plans, projects and actions



# Catchment overview

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The Louth Coastal CFMP area is located within eastern Lincolnshire. It extends along the east coast from Tetney, near Grimsby in the north, to Wainfleet in the south. The ridge of hills in the Lincolnshire Wolds form the western boundary of the CFMP area. Map 1 shows the location and extent of the Louth Coastal CFMP. It includes the catchments of the River Lud/Louth Canal, Waithe Beck, Greyfleet Drain, Great and Long Eau, Woldgrift Drain, Willoughby High Drain, the River Lymn and River Steeping. The downstream limit of the CFMP area is located at the HECAG (Humber Estuary Coastal Authorities Group) Shoreline Management Plan (SMP) boundary, which covers the coastline between Flamborough Head and Gibraltar Point. The SMP deals with coastal flood management issues along this coastline.

The CFMP covers an area of around 1,000 km<sup>2</sup>, and has a population of around 100,000 people. It is predominantly rural, with over 90% of the CFMP area being used for both arable or pastoral agricultural production. The main urban areas are the coastal holiday resorts of Skegness, Ingoldmells and Mablethorpe and the market town of Louth.

The landscape of the CFMP area varies significantly from west to east. In the west is the higher ground of the Lincolnshire Wolds, with rolling topography. To the east of the Wolds the land is low-lying where the rivers are embanked. The low-lying areas are drained mainly by pumping and water is discharged into the embanked rivers or directly to the sea. However, there are some watercourses which drain into the sea via outfalls using gravity. Water levels in the lowland areas include those managed by Lindsey Marsh Drainage Board (LMDB).

The underlying geology of the area is chalk. In the hilly areas to the west of the catchment runoff may infiltrate the rock delaying the response of rivers to rainfall and reducing peak flood flows. There is also a risk from groundwater flooding in these areas. In the east the underlying chalk is covered by thick till deposits which reduces the infiltration of rainfall into the soil. This combined with the low gradients means that water moves slowly to the river channels.

In the CFMP area there are a number of sites designated for their environmental importance including Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Ramsar sites located along the Lincolnshire coast. Important environmental sites in the catchment include the Humber Estuary (Ramsar, SAC, SPA, SSSI), Gibraltar Point (Ramsar, SAC, SPA, SSSI, NNR), Saltfleetby to Theddlethorpe Dunes (SAC, SSSI, NNR) and The Wash (Ramsar, SSSI, SPA). The Lincolnshire Wolds is designated as an Area of Outstanding Natural Beauty (AONB). There are also 26 Sites of Special Scientific Interest (SSSI) in the CFMP area. Scheduled Monuments (SMs) and listed buildings, designated for their heritage value, are distributed across the CFMP area.

Map 1 Location and extent of the Louth Coastal CFMP area



↑ Louth Canal

# Current and future flood risk

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## Overview of the current flood risk

Flood risk has two components: the chance (probability) of a particular flood and the impact (or consequence) that the flood would have if it happened. The probability of a flood relates to the likelihood of a flood of that size occurring within a one year period, it is expressed as a percentage. For example, a 1% annual probability flood has a 1% chance or 0.01 probability of occurring in any one year, and a 0.5% annual probability flood has a 0.5% chance or 0.005 probability of occurring in any one year. The flood risks quoted in this report are those that take account of flood defences already in place.

The catchment has a history of flood risk, the most significant events in recent years occurred in June/July 2007 and resulted in river flooding and surface water flooding across the Louth Coastal CFMP area.

Currently the main sources of flood risk for people, property, infrastructure and the land are:

- river flooding from the main watercourses and the drainage channels managed by LMDB in the CFMP area, particularly within Louth, Mablethorpe and Chapel St Leonards;
- the impacts of rivers not being able to flow freely to the sea at high tide (called tide locking), such as at Tetney Haven (Louth Canal), Saltfleet Haven (Great

Eau), Trusthorpe (Woldgrift Drain) and Gibraltar Point (River Steeping);

- breaching/failure of embankments that carry the main upland rivers across the low-lying parts of the CFMP area, for example the Willoughby High Drain, Woldgrift Drain and the Louth Canal. This type of flooding is difficult to predict but could cause the rapid flooding of the areas immediately behind the embankments and the potential for loss of life;
- surface water drainage and sewer flooding is thought to be a risk in Louth and the coastal towns. This is due to a combination of the surface water drainage system being overwhelmed and heavy rainfall ponding in the low-lying parts of the CFMP area;
- groundwater flooding is a risk for parts of the Lincolnshire Wolds when there are high groundwater levels within the underlying chalk rock. The villages along the springline (an area where groundwater emerges in springs) to the east of the Wolds are also likely to be at risk of this type of flooding, for example at Manby, Grimoldby, North Cockerington and Alvingham;
- failure or the overwhelming of pumping stations, such as those at Saltfleet, Trusthorpe, Anderby and Chapel St Leonards, which increases the risk in low-lying parts of the CFMP area.

## What is at risk?

Using river models we estimate that at present there are around 2,750 people, 1,250 properties and 440 caravans at risk in the CFMP area from a 1% annual probability river flood, including flooding from LMDB drains. These figures take account of current flood defences. This means that 3% of the total population living within the CFMP area are currently at risk of flooding. There is 299 km<sup>2</sup> of grade one and two agricultural land in the CFMP area and approximately 4.7% of this is at risk of flooding from a 1% annual probability river flood. Table 2 shows the critical infrastructure at risk in the CFMP area.

It is difficult to assess the current impact of flooding to environmental and historical features, but the internationally important sites of Gibraltar Point, Humber Estuary, The Wash and Saltfleetby to Theddlethorpe Dunes are at risk from flooding. Flooding has a negative impact on these sites. Five other SSSIs, one Scheduled Monument and 18 listed buildings are also at some flood risk.

## Where is the risk?

Around half of the people and property at risk from the 1% annual probability river flood (including flooding from LMDB drains) in the CFMP area are located in Mablethorpe, Skegness and Chapel St Leonards. However, the expected flood depths in these towns are generally very low. A further 10% of people and property at risk are in Louth where flood depths and velocities are much greater.

The distribution of property at risk from river flooding, including flooding from LMDB drains is illustrated in Map 2. Table 1 summarises where there is flood risk to more than 25 properties.

We recognise that there is also a potential risk from surface water and groundwater flooding. However, further studies following on from the CFMP are needed by us and our partners to quantify this potential risk.

**Table 1** Locations of towns and villages with 25 or more properties at risk in a 1% annual probability river flood

| Number of properties at risk | Locations  |
|------------------------------|--|
| 100 to 500                   | Mablethorpe, Chapel St Leonards, Skegness, Louth |

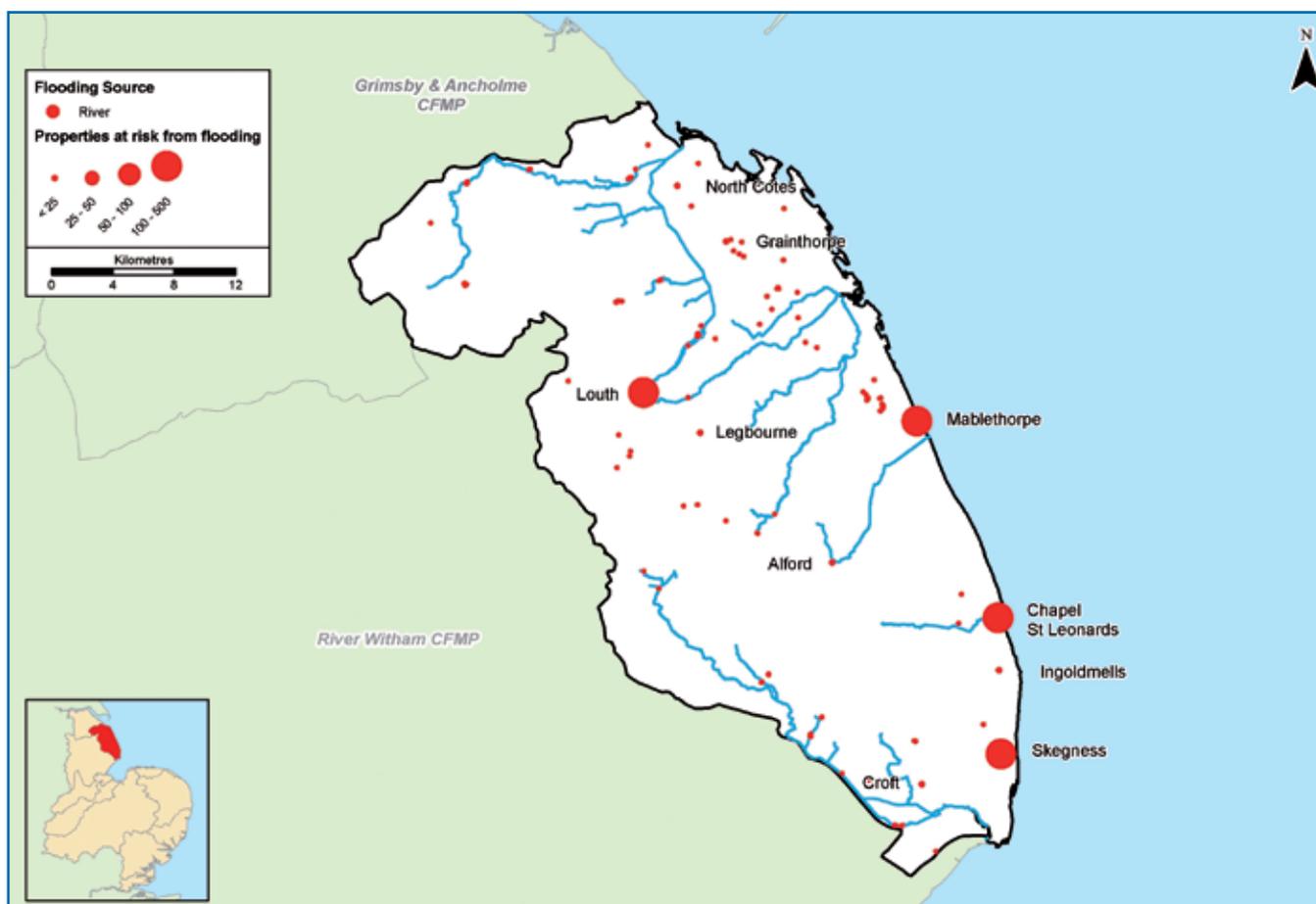
**Table 2** Critical infrastructure at risk

|                                 | Risk from a 1% annual probability river flood   |
|---------------------------------|---|
| Critical Infrastructure at risk | Six electricity sub-stations<br>Three Wastewater Treatment Works (WwTW)<br>One power and gas terminal<br>A short stretch of the Boston to Skegness railway line |



↑ River Steeping, Gibraltar Point

**Map 2 Flood risks to property from the 1% annual probability river flood, taking into account current flood defences**



## How we currently manage the risk in the catchment

The CFMP area has a history of flood risk, generally due to high rainfall that can lead to watercourses and drains being overwhelmed, flood defences overtopped or raised embankments breached. Over the last 50 years numerous engineering schemes have been implemented to reduce flood risk in the CFMP area, including:

- the widening, straightening and embanking of rivers. Embankments along the River Steeping and Wainfleet relief channel provide protection up to the 2% annual probability
- the construction of a relief channel. The Wainfleet Relief Channel provides protection up to the 2% annual probability river flood;
- tidal sluices, pumping stations and tidal gates. Tidal defences on the main rivers in this CFMP area provide protection up to the 0.5% annual probability tidal flood.

These measures have all reduced flood risk and around half of the total population currently living within the CFMP area benefit from flood risk management schemes.

In addition to these engineering schemes, other flood risk management activities are carried out in the CFMP area. These include activities which help to reduce the probability of flooding and those that address the consequences of flooding.

Activities that reduce the probability of flooding include:

- maintaining and improving existing flood defences and structures;
- maintaining river channels;
- maintenance of drainage networks by LMDB and landowners;
- maintenance of road drainage and sewer systems.

Activities that reduce the consequences of flooding include:

- working with local authorities to influence the location, layout and design of new and redeveloped property and ensuring that only appropriate development is allowed on the floodplain through the application of Planning Policy Statement 25 (PPS25);
- understanding where flooding is likely by using flood risk mapping;
- providing flood forecasting and warning services;

- promoting awareness of flooding so that organisations, communities and individuals are aware of the risk and are prepared in case they need to take action in time of flood;
- promoting resilience and resistance measures for those properties already in the floodplain.

Combinations of engineering and other flood risk management activities are used to reduce the probability or consequences of flooding. Investigations are ongoing to identify which activities are likely to be most effective and appropriate in different parts of the CFMP area in the future.



↑ Woldgrift Drain

## The impact of climate change and future flood risk

In the future, flooding can be influenced by climate change, changes in land use (for example urban development) and rural land management. Using river models we tested the sensitivity of the rivers in the CFMP area to these drivers.

For urbanisation, we tested an increase of 48% to the urban area the years 2000 and 2100. This did not have a significant impact on river flooding. Therefore, urbanisation was not taken forward into the final future scenario.

For rural land management, we adjusted the river models to represent the effect of reducing intensive farming practices. At a catchment scale this had a limited impact on river flooding. Therefore, changes in rural land management were not taken forward into the final future scenario.

For climate change we tested the following changes up to 2100:

- 20% increase in peak flow in all watercourses. This will increase the probability of large-scale flooding;
- a total sea level rise of 900 mm. This will increase the probability of tidal flooding and increase the length of time watercourses will not be able to flow freely to the sea at high tide (tide-locked).

Climate change was shown to have a significant impact on flooding.

In the Louth Coastal CFMP area, climate change was shown to have the greatest impact on flood risk. Therefore, the scenario used to model future flood risk was based only on climate change as described.

Using river models we estimate that by 2100, 5,800 people and 2,800 properties will be at risk from the 1% annual probability river flood, including flooding from LMDB drains. These figures take account of current flood defences. In the future there are significant increases in flooding in Mablethorpe, Chapel St Leonards and Skegness.

**Figure 2** Current and future (2100) flood risk to property from a 1% annual probability river flood, taking into account current flood defences

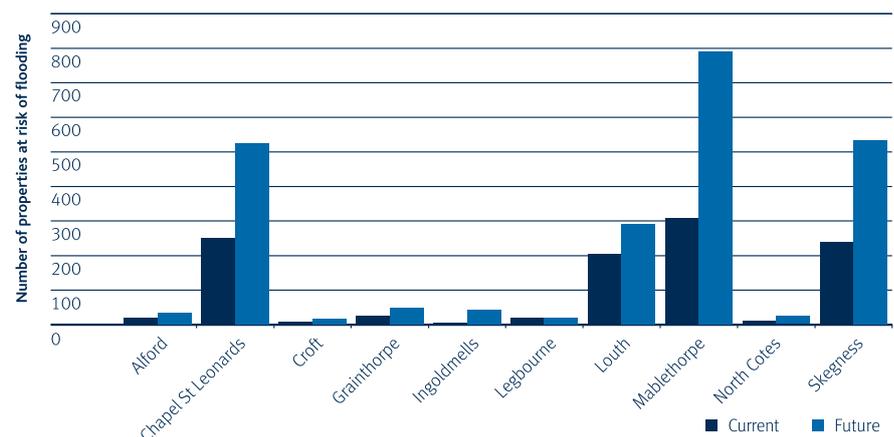


Figure 2 shows the difference between current and future flood risks from a 1% annual probability river flood (including flooding from LMDB drains) at key locations in the CFMP area. Following on from the CFMP, organisations need to work together to investigate flood risk from other sources (for example, surface water and ground water flooding) in more detail.

Flood risk to infrastructure also increases. During a 1% annual probability river flood there is risk to ten electricity sub-stations, three Wastewater Treatment Works, one power and gas terminal and an increase in the length of railway line at risk. In general, it is unlikely that the impact of flooding on environmental sites will change significantly in the future.



↑ Tributary of Long Eau, Legbourne

# Future direction for flood risk management

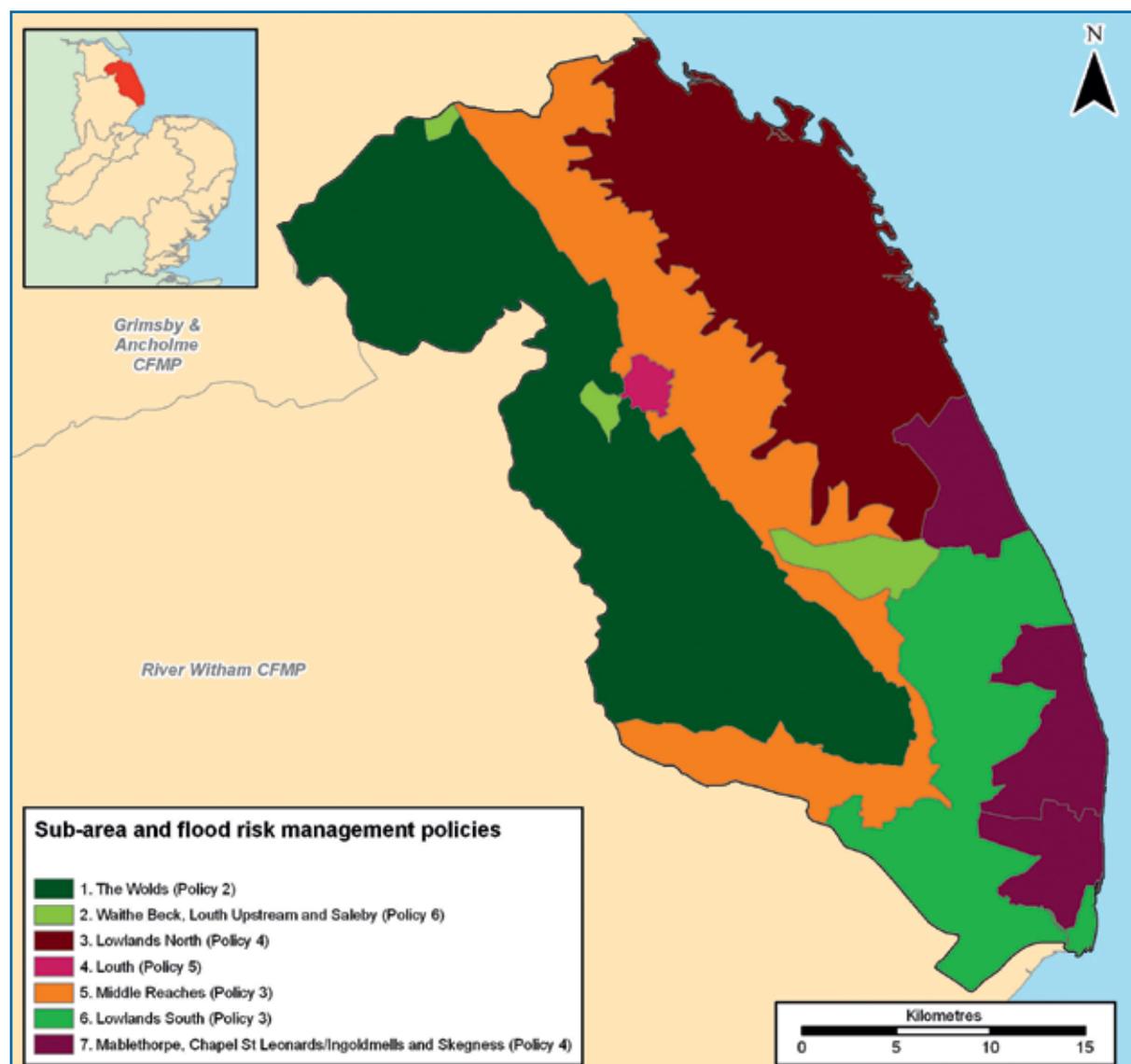
## Approaches in each sub-area

We have divided the Louth Coastal CFMP into seven distinct sub-areas which have similar physical characteristics, sources of flooding and level of risk. We have identified

the most appropriate approach to managing flood risk for each of the sub-areas and allocated one of six generic flood risk management policies, shown in Table 3.

To select the most appropriate policy, the plan has considered how social, economic and environmental objectives are affected by flood risk management activities under each policy option.

Map 3 Sub-areas and flood risk management policies



**Table 3 Flood risk management policy options**

**→ Policy 1**

**Areas of little or no flood risk where we will continue to monitor and advise**

This policy will tend to be applied in those areas where there are very few properties at risk of flooding. It reflects a commitment to work with the natural flood processes as far as possible.

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**→ Policy 2**

**Areas of low to moderate flood risk where we can generally reduce existing flood risk management actions**

This policy will tend to be applied where the overall level of risk to people and property is low to moderate. It may no longer be value for money to focus on continuing current levels of maintenance of existing defences if we can use resources to reduce risk where there are more people at higher risk. We would therefore review the flood risk management actions being taken so that they are proportionate to the level of risk.

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**→ Policy 3**

**Areas of low to moderate flood risk where we are generally managing existing flood risk effectively**

This policy will tend to be applied where the risks are currently appropriately managed and where the risk of flooding is not expected to increase significantly in the future. However, we keep our approach under review, looking for improvements and responding to new challenges or information as they emerge. We may review our approach to managing flood defences and other flood risk management actions, to ensure that we are managing efficiently and taking the best approach to managing flood risk in the longer term.

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**→ Policy 4**

**Areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change**

This policy will tend to be applied where the risks are currently deemed to be appropriately-managed, but where the risk of flooding is expected to significantly rise in the future. In this case we would need to do more in the future to contain what would otherwise be increasing risk. Taking further action to reduce risk will require further appraisal to assess whether there are socially and environmentally sustainable, technically viable and economically justified options.

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**→ Policy 5**

**Areas of moderate to high flood risk where we can generally take further action to reduce flood risk**

This policy will tend to be applied to those areas where the case for further action to reduce flood risk is most compelling, for example where there are many people at high risk, or where changes in the environment have already increased risk. Taking further action to reduce risk will require additional appraisal to assess whether there are socially and environmentally sustainable, technically viable and economically justified options.

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**→ Policy 6**

**Areas of low to moderate flood risk where we will take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits**

This policy will tend to be applied where there may be opportunities in some locations to reduce flood risk locally or more widely in a catchment by storing water or managing run-off. The policy has been applied to an area (where the potential to apply the policy exists), but would only be implemented in specific locations within the area, after more detailed appraisal and consultation.

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# The Wolds

## Our key partners are:

East Lindsey District Council

North East Lincolnshire Council

West Lindsey District Council

## The issues in this sub-area

There are very few people and property at risk, located in isolated areas scattered throughout the rural region. Currently 36 properties are at risk from the 1% annual probability river flood. Properties at risk are mainly located in Binbrooke and Hatcliffe. Within The Wolds sub-area, river flooding is infrequent and the consequence of flooding is low. There is no agricultural land at risk, but there is a Wastewater Treatment Works at risk in the 1% annual probability river flood. Table 4 details flood risk to people and property in this sub-area.

**Table 4 Risk to people and property within the Wolds sub-area during a 1% annual probability river flood, taking into account current flood defences**

|                              | Current | Future<br>(2100) |
|------------------------------|---------|------------------|
| Number of people at risk     | 84      | 86               |
| Number of properties at risk | 36      | 37               |

## The vision and preferred policy

**Policy option 2:** Areas of low to moderate flood risk where we can generally reduce existing flood risk management actions.

In these rural reaches the current activity to manage flooding is out of proportion with the level of flood risk, or is not effective. In general, overall flood risk management activities will be reduced within the sub-area, however where flood risk is more concentrated (for example in towns and villages) existing actions to manage flooding may be continued.

The preferred approach is to reduce bank and channel maintenance in some locations. This will enable limited resources to be targeted to other areas of the catchment where the risks are greater, to ensure value for money. The preferred approach will also help improve the flow between the river and its floodplain and so improve wetland and aquatic habitats.

Flood warning is an important way of managing the consequences of flooding throughout the catchment. Therefore, the local flood warning infrastructure (such as river flow gauging stations) need to be maintained.

## The key messages

- Where feasible, flood risk management activities will be reduced as the current activity to manage flooding is out of proportion with the level of flood risk.
- Reducing bank and channel maintenance will help naturalise rivers and improve the flow between the river and its floodplain.
- Maintain flood warning infrastructure (such as river flow gauging stations) to ensure that an effective flood warning service can be provided throughout the catchment.

## Proposed actions to implement the preferred policy

- Investigate options to cease or reduce current bank and channel maintenance and flood defence maintenance. In addition, changes in land use, development of sustainable farming practices and environmental enhancement should be investigated to mitigate an increase in flooding in the future.
- Continue with the flood warning service including the maintenance of flood warning infrastructure (such as river flow gauging stations) and public awareness plans.
- Carry out an investigation into the extent and impact of groundwater flooding and identify possible mitigation measures to reduce the risk.
- Work with partners to investigate the impact of flooding to critical infrastructure at risk.



↑ The Lincolnshire Wolds

# Saleby, Louth Upstream and Waithe Beck

## Our key partners are:

North East Lincolnshire Council

Lindsey Marsh Drainage Board

## The issues in this sub-area

There is low risk to people and property, which are scattered in isolated settlements throughout this sub-area. Currently two properties are at risk from the 1% annual probability river flood, these are located in Saleby. There is approximately nine ha of grade two agricultural land at risk of flooding within Saleby. There may also be some risk from groundwater flooding in Saleby.

The floodplain in this sub-area can provide an area to store water during flood events. The storage of floodwaters can reduce the impact of flooding to people and property in urbanised areas downstream. For example, storage of water in Louth Upstream may reduce the risk to people in the town of Louth, and storage of water in Saleby may reduce the risk of future flooding to people in Mablethorpe. Currently there is low risk to people and property in this sub-area and the storage of floodwaters will not increase this risk. There is no critical infrastructure at risk. Table 5 details flood risk to people and property in Saleby.

**Table 5 Risk to people and property within Saleby during a 1% annual probability river flood, taking into account current flood defences**

|                              | Current | Future (2100) |
|------------------------------|---------|---------------|
| Number of people at risk     | 2       | 2             |
| Number of properties at risk | 2       | 2             |

## The vision and preferred policy

**Policy option 6:** Areas of low to moderate flood risk where we will take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits.

In these largely rural areas the aim is to manage flood risk by maximising the potential of the floodplain to retain water to benefit locations elsewhere in the catchment. Storing water on these floodplains can reduce flood risk to settlements downstream.

This approach may involve:

- restoring river channels, water meadows and the natural floodplain;
- reducing runoff from agricultural land;
- structural measures to control water levels and retain more water on the floodplains;
- engineered schemes to store floodwater.

Locally, the floodplain storage areas may provide long-term benefits for the river environment and wetland habitats.

Within these sub-areas reducing bank and channel maintenance will increase the ability of the floodplain to store water by improving the flow between the river and its floodplain. However, where flood risk may be more concentrated, such as in towns and villages, existing actions to manage flooding may be continued.

To be able to use the floodplain for flood risk management, planners must prevent development that affects the ability of the floodplain to retain water.

## The key messages

- Storing water on the floodplain in these areas can reduce flood risk to settlements downstream.
- Development that affects the ability of the floodplain to retain water should be prevented.
- Maintenance work on rivers should aim to increase the capacity of the floodplain to retain water.
- Storing water on the floodplain could provide long-term benefits for the river environment and wetland habitats.

## Proposed actions to implement the preferred policy

### General action across the area:

- Produce flood storage studies for these sub-areas to investigate the most appropriate storage options and locations for floodplain storage. The studies should also consider opportunities to enhance the environment by improving the natural state of the river and its habitat.

### Actions specific to Saleby:

- Continue with the flood warning service including the maintenance of flood warning infrastructure (such as river flow gauging stations) and flood awareness plans.
- In the short term continue with the current flood risk management activities in parts of the sub-area that will not be used for flood storage. Current flood risk management activities will be reviewed following the storage study.
- Encourage planners to prevent development within the floodplain. The floodplain should be maintained as an asset to make space for water.
- Carry out an investigation into the extent and impact of groundwater flooding and identify possible mitigation measures to reduce the risk.

### Actions specific to Louth Upstream:

- Encourage planners to prevent development within the floodplain. The floodplain should be maintained as an asset to make space for water.
- Improve the flood warning service to provide increased warning times to Louth.

### Actions specific to Waithe Beck:

- Encourage planners to prevent development within the floodplain. The floodplain should be maintained as an asset to make space for water.

# Lowlands North

## Our key partners are:

East Lindsey District Council

North East Lincolnshire Council

Lindsey Marsh Drainage Board

## The issues in this sub-area

This lowland area is predominantly rural, where historically much of the land has been drained for agriculture. Embanked watercourses carry water from upstream across the area to outfall along the coast. The probability of flooding has been significantly reduced through various engineering works including those for land drainage purposes. There is a perception of little or no risk despite some areas having significant residual risk from the breaching or failure of flood defences. This means that the consequences of flooding have the potential to be high. The Humber Estuary Coastal Authorities Group (HECAG) SMP considers the risk of tidal flooding to this sub-area.

There are currently 108 properties within this sub-area at risk from the 1% annual probability river flood, including flooding from LMDB drains. The properties at risk are mainly located in Grainthorpe (58) and North Cotes (22). There is approximately 251 ha of grade one and 379 ha of grade two agricultural land at risk of flooding within this sub-area. There is also a Wastewater Treatment Works and an oil terminal at risk in the 1% annual probability river flood. Table 6 details flood risk to people and property in this sub-area.

There is an appropriate standard of protection offered by the defences along these heavily managed watercourses. In the long term these defences will become less effective because of increased flooding caused by climate change.

**Table 6 Risk to people and property within the Lowlands North sub-area during a 1% annual probability river flood including flooding from LMDB drains, taking into account current flood defences**

|                              | Current | Future (2100) |
|------------------------------|---------|---------------|
| Number of people at risk     | 245     | 523           |
| Number of properties at risk | 108     | 233           |

## The vision and preferred policy

**Policy option 4:** Areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change.

Historically this area has been heavily managed by a number of organisations to reduce the probability of river and tidal flooding. Flood risk is expected to increase in the future to people, property, agriculture and the environment. It is therefore important to maintain the current level of flood risk into the future. The preferred approach is to store water upstream of this sub-area, along Waithe Beck, combined with an improvement of current maintenance activities carried out by LMDB.

For this approach to be sustainable it must be recognised that flood defences cannot completely remove the flood risk. The risk to people and property behind the defences, which could fail or be overwhelmed, should be managed with a flood awareness plan.

Within this low-lying area there are important designated environmental sites where flood risk needs to be managed. This lowland area is a unique man-made landscape where organisations must work together to manage flood risk to people, property and the environment.

## The key messages

- LMDB to investigate improving current maintenance activities to manage future flood risk.
  - Where possible, future flood risk should be managed by storing water on the floodplain upstream of this sub-area.
  - Flood awareness plans will be used to manage flood risk from the flood defences failing or being overwhelmed.
  - Organisations must work together to achieve a long term integrated flood risk management approach in this lowland area.
- Work with partners to ensure that environmental opportunities are incorporated into flood risk management activities.
  - LMDB to investigate the feasibility of improving current maintenance activities to manage future flood risk.
  - Develop a flood storage study to investigate the feasibility of creating storage areas, natural or engineered, along the river corridor upstream of this area to manage future flood risk.
  - Carry out an investigation into the extent and impact of groundwater flooding and identify possible mitigation measures to reduce the risk.
  - Work with partners to develop an emergency response plan for the critical infrastructure at risk from flooding.

## Proposed actions to implement the preferred policy

- Work with partners in the short term to maintain any structures that are effective at reducing flood risk and continue current maintenance activities. Investigate and consider options to manage the risk of breaching.
- Reduce the consequences of flooding by improving public awareness of flooding and encouraging people to sign up to, and respond to, flood warnings. Flood awareness plans will inform people about the risk of defences breaching and the actions they can take to protect themselves and their property.



↑ Louth Canal, Tetney Lock

# Louth

## Our key partners are:

East Lindsey District Council

## The issues in this sub-area

We currently manage the risk of river flooding by clearing obstructions to maintain the channel capacity, encouraging landowners to maintain appropriate floodwalls and operating a tilting gate located downstream of the town. The tilting gate controls water levels through the town. The gate is opened when water levels are high.

Currently 199 properties are at risk from the 1% annual probability river flood. There is no agricultural land at risk, but there are two electricity sub-stations at risk during the 1% annual probability river flood. The town is at risk from flash flooding where flood waters can be deep. This means that the impacts of flooding can be severe. Table 7 details flood risk to people and property in the Louth sub-area. High concentrations of impermeable surfaces increase the risk of surface water within the town. There is also risk from groundwater flooding.

The benefits of the current approach to manage flood risk will reduce in the future as storms are expected to become more frequent and intense.

**Table 7 Risk to people and property within the Louth sub-area during a 1% annual probability river flood, taking into account current flood defences**

|                              | Current | Future (2100) |
|------------------------------|---------|---------------|
| Number of people at risk     | 415     | 586           |
| Number of properties at risk | 199     | 288           |

## The vision and preferred policy

**Policy option 5:** Areas of moderate to high flood risk where we can generally take further action to reduce flood risk.

Historically, defences have been constructed to reduce the probability of flooding. However, flood defences can fail or be overwhelmed and may become less effective in the future. Different approaches are required for different sources of flooding, as river defences do not reduce the risk from urban drainage issues and surface water flooding. For Louth the preferred approach is to manage the probability of river flooding by storing water on the floodplain upstream. Within the town the urban environment needs to be adapted to make it more resilient to flooding, for example as commercial sites are redeveloped, the location and layout of buildings could be designed to help reduce flood risk. The risk of flooding cannot be reduced entirely, therefore flood awareness must continue to be promoted.

## The key messages

- Where possible, flood risk should be managed by storing water on the floodplain upstream of the town.
- Any redevelopment of floodplain areas is an opportunity to increase their flood resilience.
- Organisations must work together to provide an integrated approach to urban drainage issues and surface water flooding.
- Flood awareness plans will be used to manage the consequences of flooding.

## Proposed actions to implement the preferred policy

- Develop a flood storage study to investigate the feasibility of creating storage areas, natural or engineered, along the river corridor upstream of this area, to benefit areas at risk within the town.
- Continue current maintenance activities through the town.
- Flood forecasting and warning study to improve the current flood warning service.
- Reduce the consequences of flooding by: improving public awareness of flooding; encouraging people to sign up to, and respond to, flood warnings; and by improving local emergency planning for critical infrastructure at risk.
- Encourage planners to develop policies for new development and regeneration (including commercial sites) to incorporate resilience measures so that the location, layout and design of development can help to reduce flood risk. Planners should prevent inappropriate development in the floodplain using measures set out in Planning Policy Statement 25 (PPS25), and ensure that any new development does not increase the risk to existing development. Any new development or regeneration should provide opportunities to improve the river environment and make space for water.
- Work with partners to develop a Surface Water Management Plan for Louth.



↑ River Lud, Louth

# Middle Reaches

## Our key partners are:

East Lindsey District Council

North East Lincolnshire Council

Lindsey Marsh Drainage Board

## The issues in this sub-area

This area contains settlements located in and around river floodplains, which are at risk from river flooding, for example Alford and Legbourne. Currently there are 55 properties at risk from the 1% annual probability river flood. The properties at risk are distributed throughout this sub-area, with small clusters in Alford (17) and Legbourne (20). There is approximately 86 ha of grade two agricultural land at risk of flooding within this sub-area. There is also a Wastewater Treatment Works at risk in the 1% annual probability river flood. Surface water and groundwater are also potentially significant sources of flooding to villages in this sub-area, as shown by the flooding in June 2007. Table 8 details flood risk to people and property in this sub-area.

**Table 8 Risk to people and property within the Middle Reaches sub-area during a 1% annual probability river flood, taking into account current flood defences**

|                              | Current | Future (2100) |
|------------------------------|---------|---------------|
| Number of people at risk     | 127     | 166           |
| Number of properties at risk | 55      | 75            |

## The vision and preferred policy

**Policy option 3:** Areas of low to moderate flood risk where we are generally managing existing flood risk effectively.

The settlements in this sub-area have been built in the floodplain and as a result have a history of flooding. Although flood risk is not expected to increase significantly in the future, as there is a concentration of people and property within the floodplain, it is still feasible and effective to continue with the current level of flood risk management. In the short term this will be achieved by continuing with existing flood risk management activities. However, in the long term, alternative, more appropriate ways to manage flood risk at the current level should be applied. In particular, studies should be carried out to investigate the extent and impact of surface water and groundwater flooding and identify actions to manage flooding from these sources. Another alternative measure may include reducing flood risk maintenance in parts of the sub-area that may benefit in the future from upstream flood storage.

## The key messages

- The current level of flood risk management should be continued.
- Investigate alternative, more appropriate ways to manage flood risk at the current level in particular surface water and groundwater flooding.

## Proposed actions to implement the preferred policy

- In the short term, work with partners to continue with the current flood risk management activities.
- In the longer term, consider alternative, more appropriate ways to manage flood risk at the current level by taking into account potential benefits from future upstream storage areas.
- Carry out an investigation into the extent and impact of groundwater flooding and identify possible mitigation measures to reduce the risk.
- Work with partners to develop Surface Water Management Plans for the settlements in this sub-area. These plans should investigate the extent and impact of surface water flooding, focusing on key villages that were flooded in June 2007.
- Work with partners to investigate the impact of flooding to critical infrastructure at risk.
- Continue with the flood warning service including the maintenance of flood warning infrastructure (such as river flow gauging stations).



↑ Tributary of the Long Eau, Little Cawthorpe

# Lowlands South

## Our key partners are:

East Lindsey District Council

North East Lincolnshire Council

Lindsey Marsh Drainage Board

## The issues in this sub-area

This lowland area is predominantly rural, where historically much of the land has been drained for agriculture. Embanked watercourses carry water from upstream across these areas to outfall along the coast. Currently there are 40 properties at risk from the 1% annual probability river flood. There is approximately 259 ha of grade one and 199 ha of grade two agricultural land at risk of flooding within this sub-area. There are also some sections of railway line, an electricity sub-station and a Waste Water Treatment Works at risk in the 1% annual probability river flood. The probability of flooding has been significantly reduced in this area through various engineering works including those for land drainage purposes. There is a perception of little or no risk despite some areas having significant residual risk from the breaching or failure of flood defences. This means that the consequences of flooding have the potential to be high. The Humber Estuary Coastal Authorities Group (HECAG) SMP considers the risk of tidal flooding to this sub-area.

**Table 9 Risk to people and property within the Lowlands South sub-area during a 1% annual probability river flood, including flooding from LMDB drains, taking into account current flood defences**

|                              | Current | Future (2100) |
|------------------------------|---------|---------------|
| Number of people at risk     | 89      | 139           |
| Number of properties at risk | 40      | 61            |

## The vision and preferred policy

**Policy option 3:** Areas of low to moderate flood risk where we are generally managing existing flood risk effectively.

The settlements in this sub-area have been built in the floodplain and as a result have a history of flooding. In the past flood defences have been constructed and maintenance work carried out to reduce flood risk. Although flood risk is not expected to increase significantly in the future, as there is a concentration of people and property within the floodplain, it is still feasible and effective to continue with the current level of flood risk management. This will be achieved by continuing with existing flood risk management activities.

## The key messages

- The current level of flood risk management should be continued.
- Continue current flood risk management activities.

## Proposed actions to implement the preferred policy

- Continue with the current flood risk management activities.
- Continue with the flood warning service including the maintenance of flood warning infrastructure (such as river flow gauging stations) and public awareness plans.
- Work with partners to develop an emergency response plan for critical infrastructure and transport links at risk of flooding.
- Options to manage the risk of the River Steeping overtopping and causing flood risk issues in the neighbouring River Witham CFMP area should be investigated as part of the Fens Flood Risk Management Strategy. This strategy will investigate how flood risk varies across the Fens area and the best approach to manage this risk. As part of this strategy we must work with LMDB to gain a better understanding of the level of risk and the benefits associated with their lowland systems.
- Work with partners to ensure that environmental opportunities are incorporated into flood risk management activities.



↑ River Steeping

# Mablethorpe, Chapel St Leonards/ Ingoldmells and Skegness

## Our key partners are:

East Lindsey District Council

Lindsey Marsh Drainage Board

## The issues in this sub-area

In this sub-area, there are currently 794 properties at risk from the 1% annual probability river flood, including flooding from IDB drains. The majority (299) of the property at risk are located in Mablethorpe. There are 400 caravans at risk which could potentially have an impact on the tourism industry.

There is approximately three ha of grade two agricultural land at risk of flooding in Chapel St Leonards/ Ingoldmells, and 152 ha of grade one and 56 ha of grade two agricultural land at risk of flooding within Skegness. There is also a Wastewater Treatment Works and three electricity sub-stations at risk. The Humber Estuary Coastal Authorities Group (HECAG) SMP considers the risk of tidal flooding to this sub-area. There are a significant number of properties and caravans at risk, however the expected depth of flooding is generally low. Tables 10, 11 and 12 detail flood risk to people, property and caravans in this sub-area.

**Table 10 Risk to people, property and caravans within Mablethorpe during a 1% annual probability river flood, including flooding from LMDB drains, taking into account current flood defences**

|                              | Current | Future (2100) |
|------------------------------|---------|---------------|
| Number of people at risk     | 713     | 1,824         |
| Number of properties at risk | 299     | 783           |
| Number of caravans at risk   | 158     | 541           |

**Table 11 Risk to people, property and caravans within Chapel St Leonards/Ingoldmells during a 1% annual probability river flood, including flooding from LMDB drains, taking into account current flood defences**

|                              | Current | Future (2100) |
|------------------------------|---------|---------------|
| Number of people at risk     | 533     | 1,426         |
| Number of properties at risk | 256     | 575           |
| Number of caravans at risk   | 214     | 786           |

**Table 12 Risk to people, property and caravans within Skegness during a 1% annual probability river flood, including flooding from LMDB drains, taking into account current flood defences**

|                              | Current | Future (2100) |
|------------------------------|---------|---------------|
| Number of people at risk     | 550     | 1,214         |
| Number of properties at risk | 239     | 532           |
| Number of caravans at risk   | 28      | 119           |

Currently flood risk is managed in this sub-area by maintenance of the watercourses, raised embankments and pumping stations, such as those at Anderby, Chapel St Leonards and Burgh Sluice. There is a lot of development behind these embankments, therefore if the embankments were to fail the consequences would be significant. The existing embankments will become increasingly ineffective against storms which are expected to become more frequent and intense in the future.

## The vision and preferred policy

**Policy option 4:** Areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change.

Historically, flooding has been managed within these coastal settlements by a number of organisations. Flood defences have been constructed to reduce the probability of river and tidal flooding in Mablethorpe and Chapel St Leonards/Ingoldmells. In the future the protection given by these defences may decline. Flood risk is expected to increase in the future to people and property. It is therefore important to maintain the current level of flood risk into the future. For these coastal settlements the most effective way to manage future flood risk will be for LMDB to improve current maintenance activities. In Mablethorpe this should be combined with storage of flood water upstream of the town, within Saleby. Within Mablethorpe and Skegness investigations into the impacts of surface water flooding may identify the need for further management.

The risk of flooding cannot be completely removed, therefore flood awareness plans must continue to be promoted. The flood awareness plans should focus on informing the tourist population on how to prepare for and respond to flooding.

## The key messages

- LMDB to investigate improving current maintenance activities to manage future flood risk.
- Flood awareness plans will be used to manage the consequences of flooding.

## Proposed actions to implement the preferred policy

### General actions across the area:

- LMDB to investigate the feasibility of improving current maintenance activities to manage future flood risk.
- Continue with the flood warning service including the maintenance of flood warning infrastructure (such as river flow gauging stations).

### Actions specific to Mablethorpe:

- Develop a flood storage study to investigate the feasibility of creating storage areas, natural or engineered, along the river corridor upstream of the town to manage future flood risk.
- Continue with the current maintenance activities on the rivers managed by the Environment Agency.
- Continue with the current flood awareness plan to encourage people to sign up to, and respond to flood warnings. The flood awareness plan will inform people about the risk of defences breaching and the actions they can take to protect themselves and their property.
- Work with partners to develop an emergency response plan to manage flood risk from the defences failing or being overwhelmed.
- Work with partners to develop a Surface Water Management Plan for Mablethorpe.

### Actions specific to Chapel St Leonards/Ingoldmells:

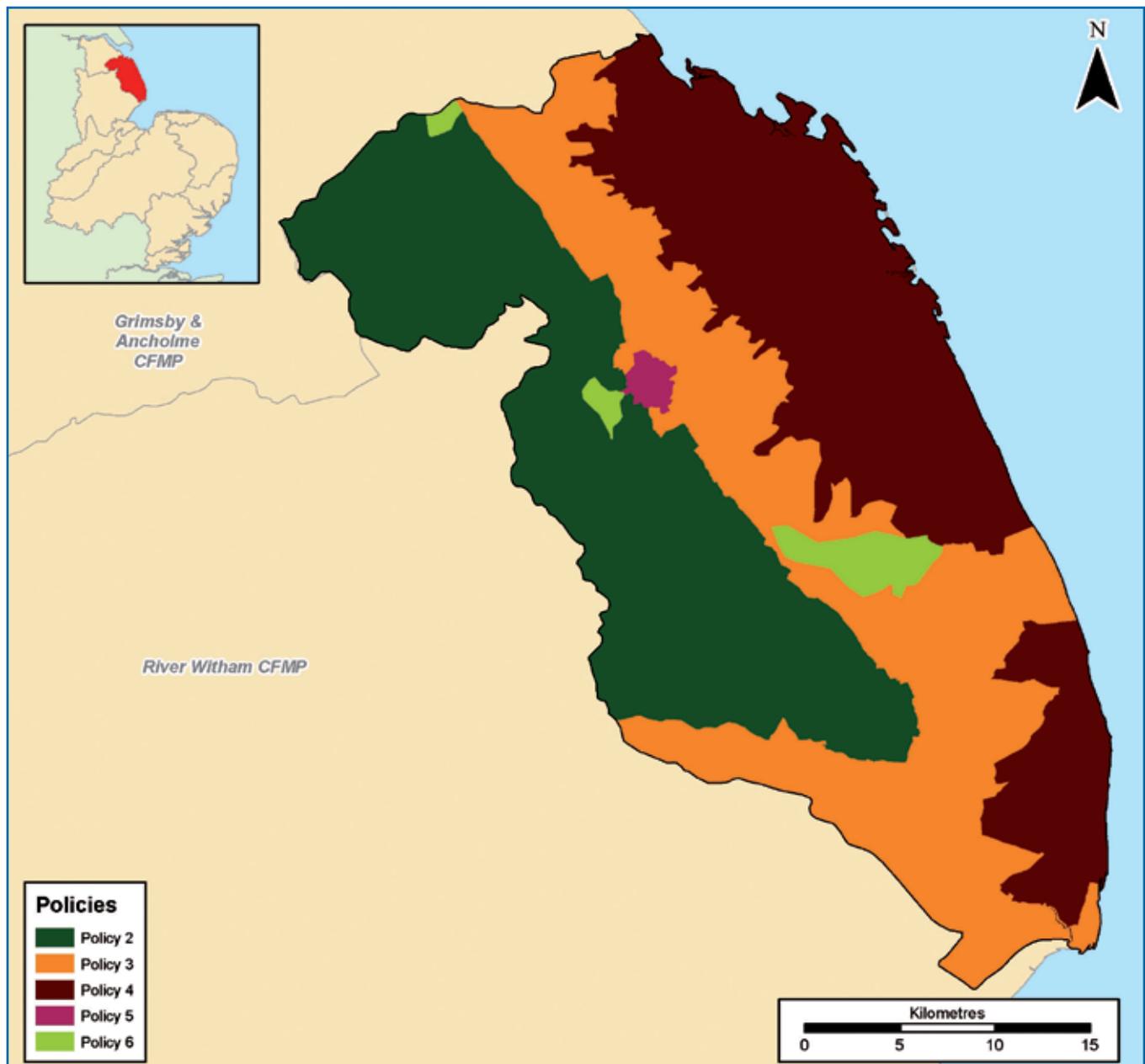
- Continue with the current maintenance activities on the rivers managed by the Environment Agency.
- Continue with the current flood awareness plan to encourage people to sign up to, and respond to flood warnings as well as using self help methods to protect their property. The flood awareness plan should be focused on informing the tourist population on how to prepare for and respond to flooding.
- Work with partners to develop an emergency response plan to manage flood risk from the defences failing or being overwhelmed.

### Actions specific to Skegness:

- Continue with the current flood awareness plan to encourage people to sign up to, and respond to flood warnings as well as using self help methods to protect their property. The flood awareness plan should be focused on informing the tourist population on how to prepare for and respond to flooding.
- Work with partners to develop an emergency response plan for the critical infrastructure at risk of flooding.
- Work with partners to develop a Surface Water Management Plan for Skegness.

# Map of CFMP policies

Map 4 The flood risk management policies for the Louth Coastal CFMP area





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