

# Aire Catchment Flood Management Plan

Summary Report December 2010

# managing flood risk



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December 2010

# Introduction

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

The Aire 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), which is covered by Shoreline Management Plans (SMPs). Our coverage of surface and ground water 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 is a long history of flooding within the Aire CFMP area. Flooding has been reported from rivers, canals,

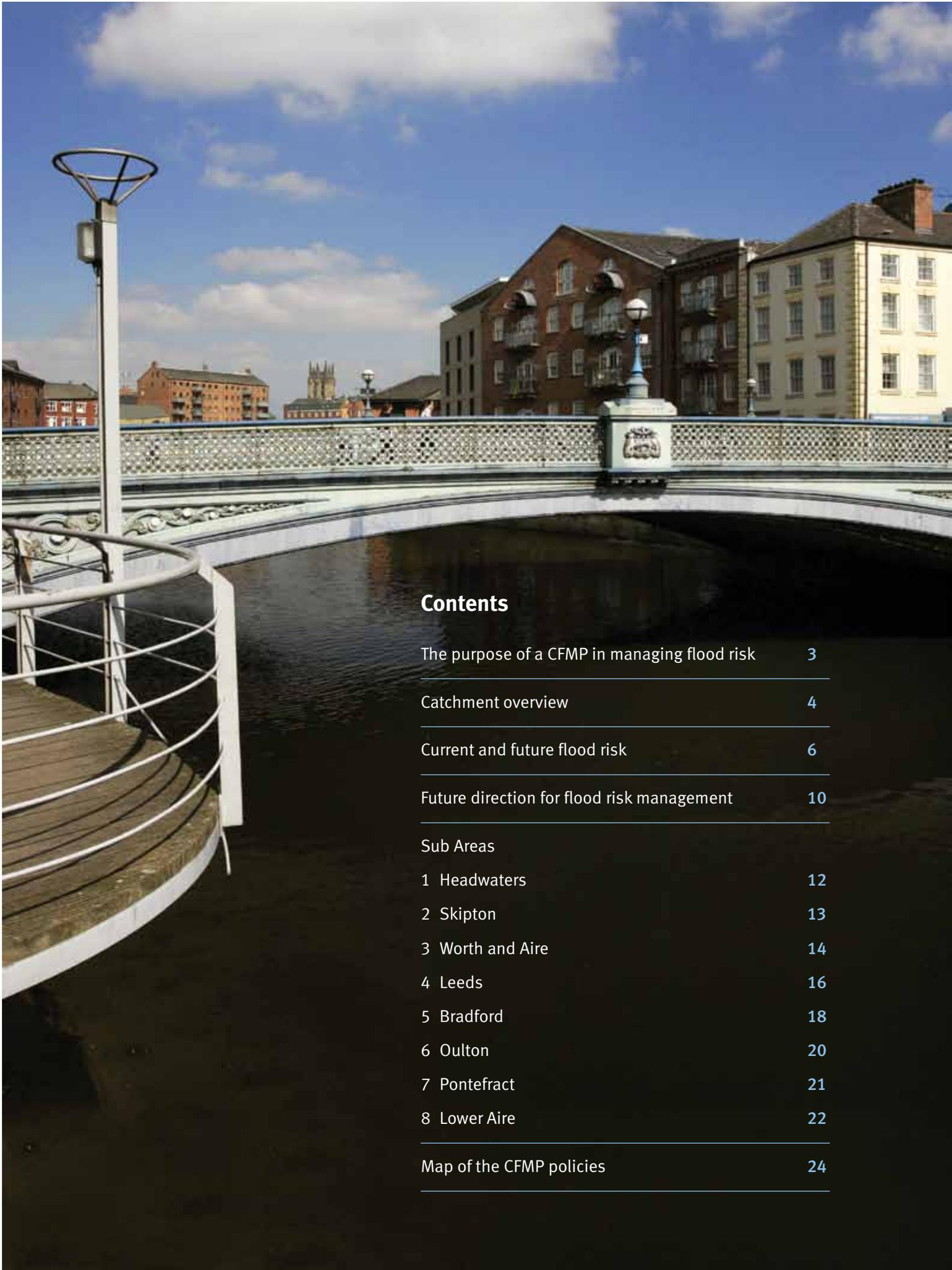
groundwater, surface water and sewers. Just under 13,400 properties have a one per cent chance of flooding each year if there were no defences in place. Flooding from other sources such as groundwater, canals and surface water are not as closely monitored, mitigated or recorded, and so the risk posed from these sources is not fully evaluated.

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 and agree the most effective way to manage flood risk in the future. We have worked with others including Planning and Local Authorities, Yorkshire Water, British Waterways, Internal Drainage Boards (IDBs) and Natural England to develop this CFMP.

This is a summary of the main CFMP document, if you need to see the full document an electronic version can be obtained by emailing [necfmps@environment-agency.gov.uk](mailto:necfmps@environment-agency.gov.uk) or alternatively paper copies can be viewed at our Yorkshire offices.



**David Dangerfield**  
Yorkshire and North East Regional Director



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# The purpose of a CFMP in managing flood risk

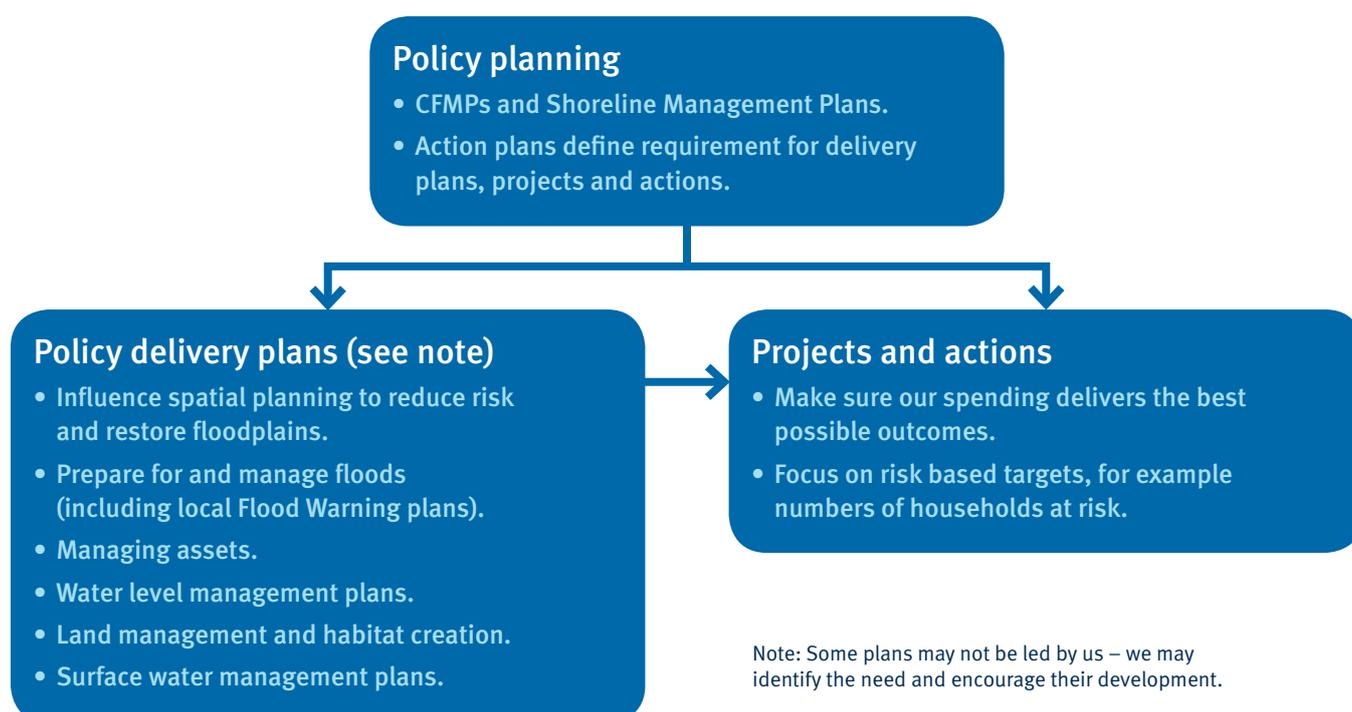
CFMPs help us to understand the scale and extent of flooding now and in the future, and set policies for managing flood risk within the catchment. CFMPs should be used to inform planning and decision making by key stakeholders such as:

- 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;

- IDBs, water companies and other utilities to help plan their activities in the wider context of the catchment;
- transportation planners;
- landowners, 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. The following actions and their implementation will be subject to further appraisal and funding, and prioritised by their supporting evidence. The CFMP is a living document and actions will be updated as necessary to reflect changing responsibilities and delivery mechanisms.

Figure 1 shows the relationship between CFMPs, delivery plans, projects and actions



# Catchment overview

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The Aire CFMP is bordered by four other Yorkshire and North East Region CFMP areas, the Ouse, Calder, Don and Hull and Coastal Streams CFMPs. The Aire CFMP is also bordered by the Ribble CFMP which is managed by our North West region.

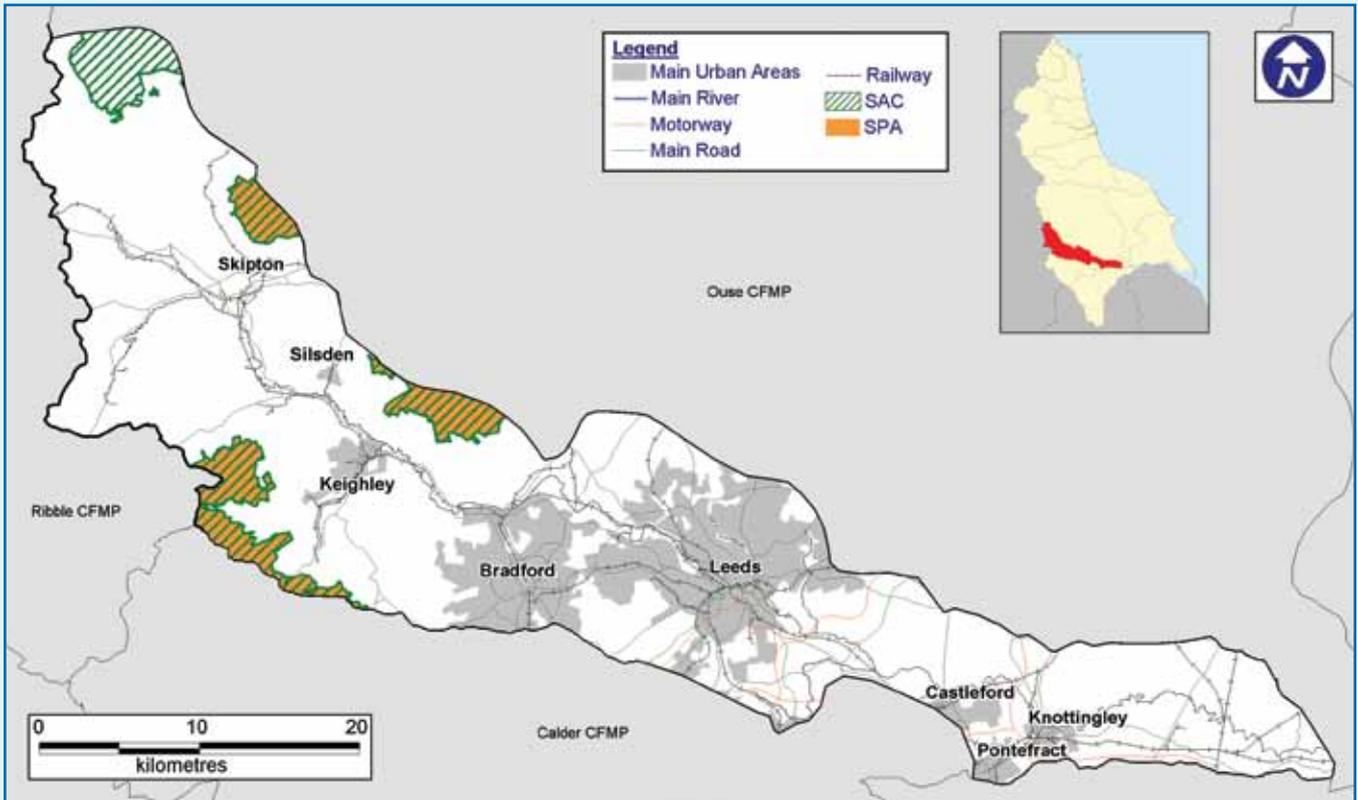
The Aire CFMP area covers approximately 1,114 kilometre squared and includes four sub-catchments; the Upper Aire, Mid Aire, Lower Aire and the Worth. The River Aire flows for 148 kilometres from its source in the Yorkshire Dales near Malham to its confluence with the River Ouse near Goole. The lower 26 kilometres between Chapel Haddlesey and the Ouse confluence, is tidal. The headwaters of the CFMP area are characterised by swift-flowing upland streams, which flow through former mill towns nestling in narrow valley bottoms. Below Leeds, the River Aire follows an increasingly gentle meandering course through a broad floodplain where it joins the River Ouse. Within this low-lying section of the River Aire the importance of agricultural land is highlighted, as the 'grade' of this asset rises to between grade one and three: excellent to moderate quality productive land.

The CFMP area covers the seven districts of Bradford, Craven, East Riding of Yorkshire, Leeds, Pendle, Selby and Wakefield. Urban land use occupies 22 per cent of the CFMP area. The area is recognised as vital for the economy of the region, particularly due to the designation of Leeds as a city region. This will see significant economic growth and an annual net provision of 10,440 residential properties within the above districts.

There are significant lengths of strategically important transport links including the M1, M62 and M621. In addition to these major road links, Leeds Bradford International airport is situated 13 kilometres north west of Leeds city centre.

The CFMP area has a wealth of environmental and culturally recognised sites. These include 22 Site of Special Scientific Interest (SSSI), four Special Areas of Conservation (SACs) and two Special Protection Area (SPAs). There are 219 Scheduled Ancient Monuments, one World Heritage Site at Saltaire, and 22 Registered Parks and Gardens.

Map 1. The location and extent of the Aire CFMP area



↑ River Aire running through Leeds

# 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 one per cent flood has a one per cent chance or 0.01 probability of occurring in any one year.

As part of the CFMP process, we have developed a catchment wide broadscale model to determine the risk of flooding from rivers, from both main and non-main rivers, if defences were not in place. It is vital that we understand this level of risk in the event that defences are overtopped or fail. The flood risks quoted in this report are for the one per cent flood figures.

There is a long history of flooding within the Aire CFMP area. Recently 36 properties were flooded in Shipley in September 2008 whilst in June 2007; approximately 300 properties were flooded in Leeds from both river (Wyke Beck and the River Aire) and surface water sources. In 2000 over 500 properties were flooded across the whole catchment including flooding in Skipton and Bingley while in 2000 over 100 properties flooded in Gowdall.

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

- flooding from rivers, throughout the CFMP area;
- surface water drainage and sewer flooding, which have been recorded in Leeds, Skipton and Bradford;
- flooding from tidal sources within the Aire, downstream of Chappel Haddlesey;

## What is at risk?

Within the Aire catchment there are just under 13,400 properties at risk from a one per cent flood, without taking into account current flood defences. There are approximately 124 kilometres of flood defences that reduce the probability of flooding throughout the catchment including at Keighley, Knottingley and Castleford.

There are also over 300 properties at risk from surface water/sewer flooding.

The consequences of flooding are not solely related to the built environment. Analysis shows that 2.60 kilometres square of SSSI, 0.83 square kilometres of SAC and 0.01 square kilometres of SPA are at risk of flooding from rivers during a one per cent annual probability flood. The sites can be affected both positively and negatively by flooding depending on the habitat type and duration of flooding.

## Where is the risk?

The risk of flooding is spread throughout the Aire CFMP area. Table 1 outlines some of the key communities with over 100 properties at risk of flooding, not taking into consideration defences. The areas with highest risk include Leeds, Keighley and Bradford.

**Table 1. Locations of towns and villages with 100 or more properties at risk in a 1% annual probability river flood if there were no defences in place**

Number of properties at risk	Locations
2,000 to 5,000	Leeds
1,000 to 2,000	Keighley
500 to 1,000	Silsden, Bradford, Castleford, Knottingley
100 to 500	Skipton, Earby, Glusburn, Bingley, Baildon, Shipley

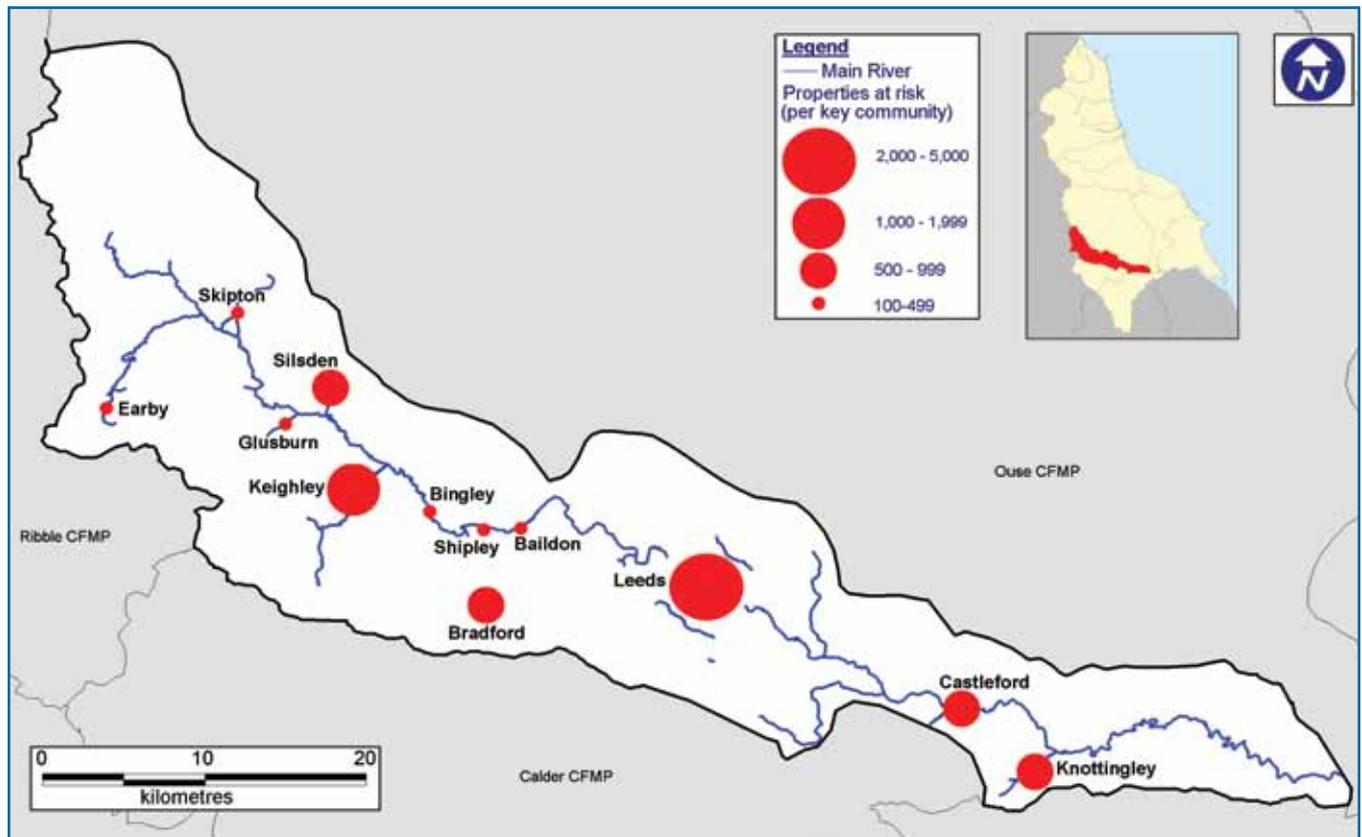
**Table 2. Critical infrastructure at risk:**

172 gas and electricity assets
10 educational facilities
11 health facilities
four wastewater treatment works
three emergency services buildings



↑ Riverside flats in Leeds city centre

Map 2. Properties at risk of flooding in the Aire catchment



## How we currently manage flood risk in the catchment

The catchment has a long history of flooding which has resulted in a number of engineering schemes being implemented to reduce the risk of flooding. Our current flood risk management is focussed on those areas where risk is highest. Within the Aire catchment there are currently 249 defences which include just under 125 kilometres of raised defences. These defences offer various standards of protection but over 70 per cent of these defences provide at least a 0.2 per cent (1 in 50 year) standard of protection.

In addition activities are carried out to reduce the probability of flooding.

- maintaining the above defences, including regular inspection to ensure condition is maintained;

- maintaining over 294 kilometres of river channels including removal of blockages likely to increase flood risk;
- working with local authorities to influence the location and layout of development, ensuring that inappropriate development is not allowed in the floodplain through the application of Planning Policy Statement 25: Development and Flood Risk (PPS25).

Further activities are carried out which reduce the consequences of flooding in the catchment including:

- understanding where flooding is likely by flood risk mapping including detailed modelling of the rivers and recording major flooding in the catchment;

- providing a flood forecasting and warning service via 92 separate flood warnings across the CFMP area. This warning service also alerts our professional partners and emergency responders to instigate flood response;
- promoting awareness of flooding to organisations and members of the public so they are prepared in case they need to take action at times of flooding;
- promote resilience and resistance measures for those properties already in the floodplain.

## The impact of climate change and future flood risk

The effect that flooding will have in the future is influenced by a range of issues such as climate change, changes in land use (e.g. development), and changes in how land is managed.

Within the Aire Catchment we carried out a catchment sensitivity analysis to a number of future flood risk drivers. These included:

- slowing runoff by large scale changes to agricultural practices;
- increased urbanisation;
- impact of climate change.

Of these circumstances the changes in agricultural land management had the potential to decrease flows by up to 10 per cent indicating that the catchment was sensitive to land management change. However, to gain this scale of benefit, changes across the whole catchment would be required which is unfeasible.

The catchment was not sensitive to increased urban development, as the total area of urban development is small compared to the total catchment area and the implementation of PPS25 reduced development within flood risk areas and controls the drainage from new development.

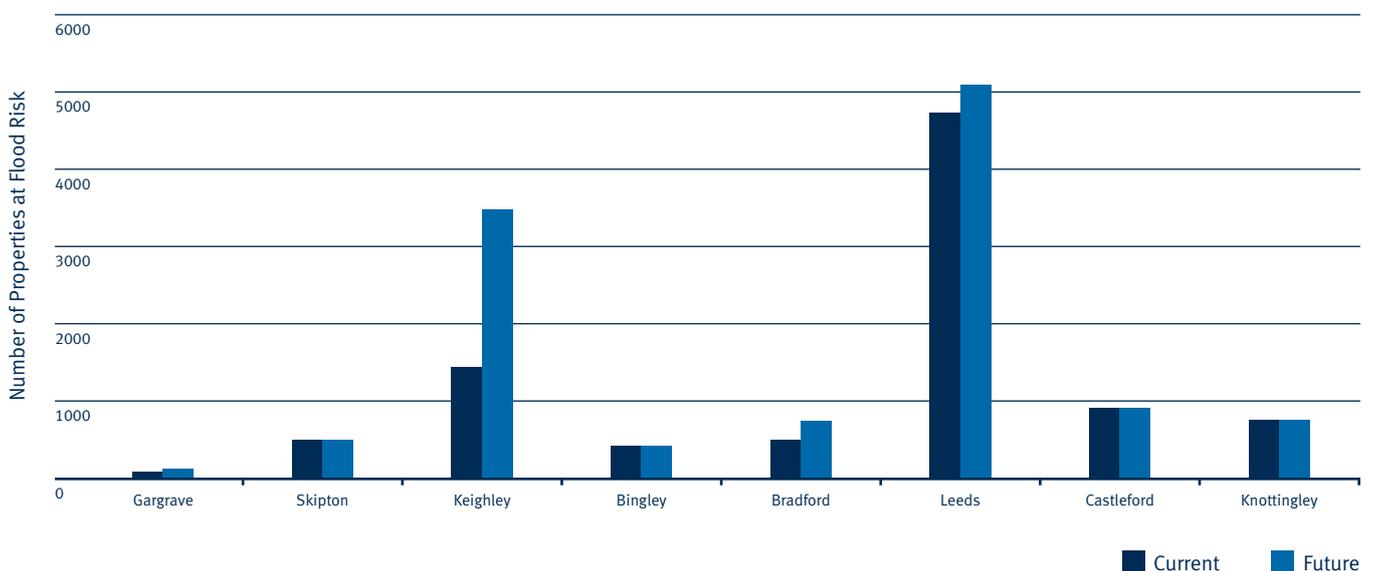
The Aire catchment is most sensitive to the impacts of climate change. The key predictions for the impact of climate change are:

- more frequent and intense storms causing more widespread and regular flooding from drainage systems and some rivers;
- increased winter rainfall increasing the likelihood of large-scale flood events.

In total the properties at risk of flooding rises from 13,377 currently to 14,034 in the future. This indicates that there will be limited increases in the damage caused by flooding within the catchment. Major changes in flood risk will be increased frequency of flooding and increased depth and speed of flood water flows in the communities already at risk.

The increased intensity of rainfall will increase the occurrence of surface water and sewer flooding as existing drainage networks will be stretched to cope with the additional volumes of water.

**Figure 2. Current and future (2100) flood risk to property from a one per cent annual probability river flood, not taking into account current flood defences.**



# Future direction for flood risk management

## Approaches in each sub-area

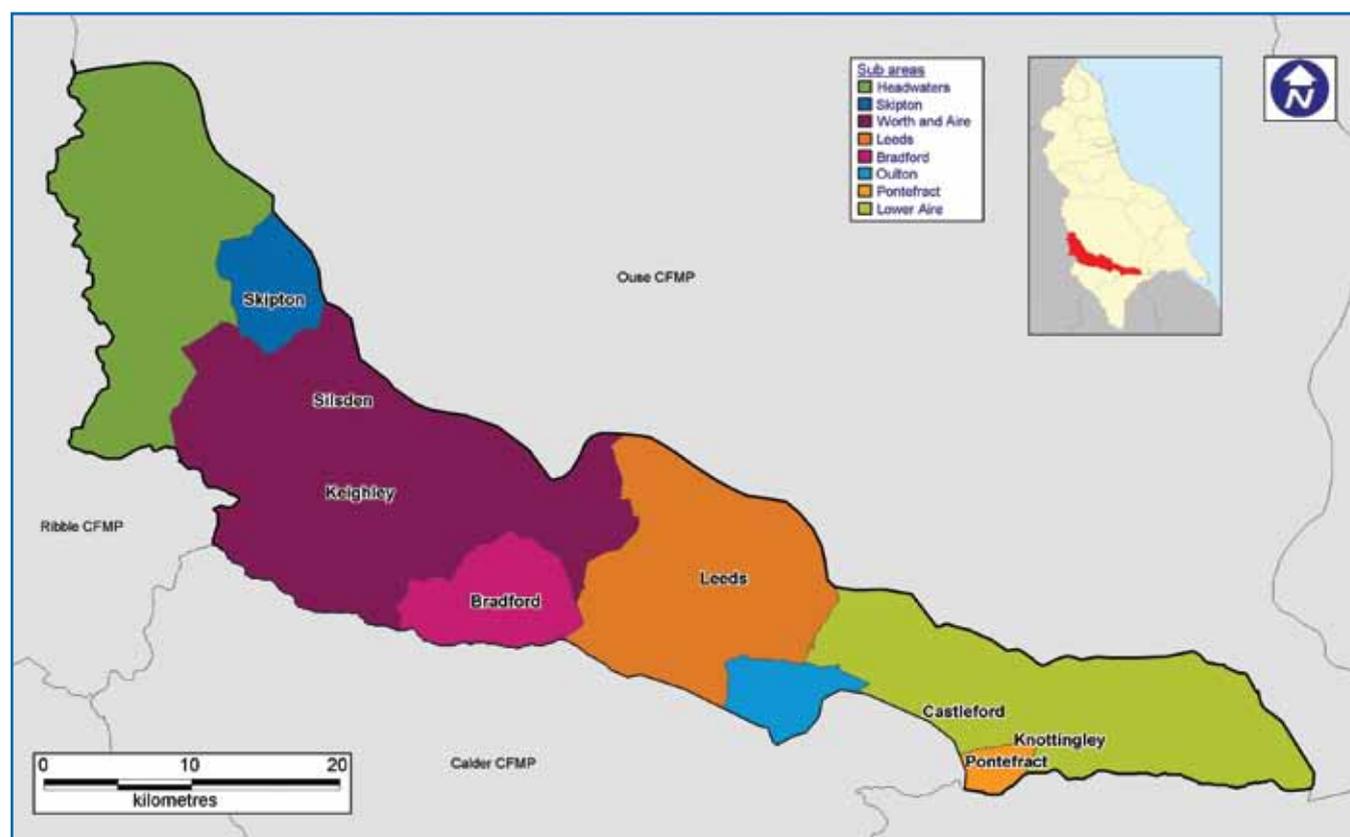
The risk of flooding is not the same in all of the catchment. We have divided the Aire catchment into eight sub areas which have similar physical characteristics, sources of flooding and level of risk. We have identified the most appropriate approach to managing the risk of flooding for each of the sub-areas 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.

In the following sections we outline the approach in each sub area by highlighting:

- key issues and messages for each sub area;
- our policy and vision for future management;
- key actions to deliver the policy.

Map 3. Catchment sub areas



## Table 3 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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# Headwaters

## Our key partners are:

Local Authorities

Airedale Internal Drainage Board

Natural England

Earby and Salterforth Internal Drainage Board

Yorkshire Water

British Waterways

RSPB

Yorkshire Wildlife Trust

Landowners and farmers

## The issues in this sub-area

The Headwaters sub area covers the uplands of the River Aire catchment from its source near Malham down to Inghey Bridge near Funkirk and the uplands of the Earby Beck catchment, through Earby and to where it meets with the River Aire near Inghey Bridge.

This sub-area is mainly rural with steep gradients. Much of the land is designated as SPA, SAC and Ramsar. However the communities of Earby and Gargrave are located within the sub area. The River Aire, Eshton, Earby and Broughton Beck cause river flooding. Flooding also comes from the Leeds and Liverpool canal and surface water runoff.

There are 132 properties at risk in a one per cent probability flood, if undefended. Over half of these properties lie in Earby and Gargrave.

Climate change will increase the risk of flooding to 198 properties across the sub area.

## The vision and policy

Under **Policy Option 6** our vision for the sub area is that the condition and function of the upland environment will be improved to reduce runoff rates and the high frequency of local flooding. As climate change develops, these upland changes will help to mitigate the effects. In following this policy we will contribute to wider environmental benefits by working with partner organisations to maximise the range of benefits that can be achieved. To ensure flood risk management is sustainable we need to ensure that an integrated approach is developed and multiple approaches to managing risk are explored. The area and its character will become a safer location through greater appreciation of flood risk and the application of sustainable development and regeneration.

## The key messages

- Some communities are susceptible to rapid flooding from thunderstorms. Emergency response and flood awareness are particularly important.
- The constrained channel and environmental concerns mean that further flood defences will be difficult, expensive and

unsustainable. We need to reduce surface water runoff and reduce the risk of flooding locally.

## Actions to implement the policy

- Produce a system asset management plan to determine the requirements for maintaining current infrastructure and channel structure whilst reducing surface runoff and increasing flood storage capacity.
- Increase the take-up of Flood Warnings Direct.
- Continued operation of the washlands.
- Develop the role of a land management specialist to identify the potential for land management change in the headwaters and the long term affect on flood generation.
- Promote voluntary flood wardens in Earby and Kellbrook.
- Carry out a feasibility study for Broughton Beck to establish the best approach to managing the risk of flooding. This study should focus on the utilisation of the floodplain to store flood waters and manage runoff.
- Investigate the interaction between the River Aire and the Leeds and Liverpool Canal.

# Skipton

## Our key partners are:

**British Waterways**

**Craven District Council**

**Natural England**

**Yorkshire Water**

**Landowners and farmers**

## The issues in this sub-area

This area covers the Eller Beck from its source, through Skipton, to its confluence with the River Aire near Snaygill Industrial Park. The main watercourses are the Eller-Embsay Beck, Waller Hill Beck and Ings Beck. Waller Hill Beck is an urban watercourse running through Skipton while Ings Beck runs to the west of Skipton. Flooding also comes from the Leeds and Liverpool canal, rapid runoff, surface water and sewers. There are defences on Eller Beck at Back Bridge Street and Waller Hill Beck. There are 479 properties at risk of river flooding, if undefended. This will increase to 515 properties in the future, while flooding from other sources will also increase.

## The vision and policy

Under Policy Option 5 our vision is that we develop an approach to working in partnership to reduce the risk of flooding from all sources. To ensure flood risk management is sustainable we need to ensure an integrated approach is developed and multiple approaches to managing risk are explored through the implementation of the Upper Aire Strategy and Multi Objective Projects. The area will become a safer location through greater appreciation of flood risk and the application of sustainable development and regeneration.

## The key messages

- The potential for mixed source flooding, the risk to life and the role of the local economy means that we need to work together to reduce the risk of flooding.
- The location, layout and design of developments are important factors in managing future flood risk. Regeneration and re-development offers an opportunity to reduce flood risk; for example re-establishing river corridors and more effective management of runoff.

## Actions to implement the policy

- Produce and implement a system asset management plan.
- Continued operation of the washlands.
- Work in partnership with the lead local flood authority to reduce the risk of surface water flooding.
- Develop the role of a land management specialist to identify the potential for land management change in the sub area.
- Investigate the interaction between the Leeds and Liverpool Canal and the River Aire.
- Produce a surface water management plan.
- Progress proposals to reduce risk.
- Investigate improvements to the flood warning service to include surface water and canal flooding and improve take up of service.
- Carryout a feasibility study and project appraisal for setting back raised defences at Ings Lane and Snaygill Industrial Estate.

# Worth and Aire

## Our key partners are:

Bradford Metropolitan  
District Council

Craven District Council

Pendle Borough Council

Natural England

Yorkshire Electricity Distribution Ltd

Airedale IDB

Airedale Primary Care Trust

Yorkshire Water

almost 3,880 properties in the sub area. Potential flooding from the canal, surface water and sewers is also likely to increase in the future. Future development could influence flood risk in the sub area.

## The vision and policy

Under Policy Option 5 our vision for the Worth and Aire sub area is that we develop an approach to working in partnership to reduce the risk of flooding from all sources. To ensure flood risk management is sustainable we need to ensure that an integrated approach is developed and multiple approaches to managing risk are explored through the implementation of the Upper Aire Strategy. The area and its character will become a safer location through greater appreciation of flood risk and the application of sustainable development and regeneration. We will work in close partnership to ensure that upstream flood risk management actions help reduce the risk of flooding in this sub area.

## The key messages

- The variety of risk within the sub area results in complex risks to local communities. The potential for mixed source flooding, risk to life and role of the local economy means that we need to work together to reduce the risk of flooding from all sources.
- We need to review our management of the watercourses and structural assets to ensure that these are contributing towards delivering this policy and approach. In some cases we may be able to develop further schemes to reduce the risk of flooding however, we need to work together to develop an approach that reduces the risk of flooding from all sources.
- Redevelopment and regeneration offer opportunities to reduce flood risk. We want to achieve resilient buildings; more flood compatible site layout's following redevelopment and continued flood compatible uses of existing open space.

## The issues in this sub-area

The area covers the River Aire from Inghey Bridge to Calverley Bridge and includes the River Worth joining the River Aire at Keighley.

A number of urban areas are located in the sub area including Bingley, Shipley, Keighley and Silsden. The Leeds and Liverpool canal also flows through the sub area.

A number of the rivers are steep leading to rapid onset of flooding from rivers, surface water and sewer flooding. Currently there are just over 3,630 properties at risk from the one per cent flood not taking into consideration defences. In the future this risk could increase to

## Actions to implement the policy

- Implement a system asset management plan to determine the most sustainable approach to reducing flood risk.
- Ensure that emergency response plans are reviewed. Vulnerable communities should be identified to ensure that emergency response is risk based.
- Carry out a flood warning feasibility study to address the potential to improve our flood warning service.
- With Airedale Internal Drainage Board (IDB), investigate the long term approach to managing agricultural defences.
- Continued operation of the washlands.
- Determine in detail the risk of flooding to gas and electricity assets, health facilities and transport routes and the consequences of loss of these during flooding. Following the identification of flood risk to these facilities, ensure alternative routes and emergency plans are developed and reviewed.
- Work with landowners and others to change the way land is managed to reduce runoff.



↑ The Leeds and Liverpool canal

# Leeds

## Our key partners are:

Bradford City Council

British Waterways

Flood Protection and Resilience Board

Highways Agency

Leeds City Council

Network Rail

Yorkshire Electricity Distribution Ltd

Yorkshire Water

## The issues in this sub-area

This is a heavily urbanised sub-area with fast responding tributaries. River flooding comes from the River Aire and its tributaries, including Meanwood Beck, Wyke Beck, Farnley Wood Beck and Wortley Beck. Flooding also comes from sewers and the urban drainage system, including culverts. There are approximately 4,724 properties at risk of river flooding currently, if undefended. Climate change will increase the risk of river flooding to a total of 5,105 properties. Due to the urban nature of the sub area surface water and sewer flooding are likely to increase as well.

## The vision and policy

Under **Policy Option 5** our vision for the sub area is that we develop a partnership approach to reduce the risk of flooding from all sources. To ensure flood risk management is sustainable we need to ensure that an integrated approach is developed to managing risk through the implementation of the Upper Aire Strategy and Leeds (River Aire) Flood Alleviation Scheme. Of particular importance to this vision is the improved standard of protection at high risk locations within the city centre as well as the improved knowledge of risk from multiple sources. The area and its character will become a safer location through greater awareness of the risk of flooding and sustainable development and regeneration.

## The key messages

- The variety of risk within the sub area results in complex risks to local communities. The potential for mixed source flooding, risk to life and role of the local economy means that we need to work together to reduce the risk of flooding from all sources.
- The location, layout and design of developments – in that order – are the most vital factors in managing future flood risk. Regeneration and re-development of some areas offers an opportunity to reduce flood risk; for example re-establishing river corridors and more effective management of runoff.

## Actions to implement the policy

- Produce and implement a system asset management plan to determine the most sustainable approach to reducing flood risk.
- Working with our partners, implement the Leeds (River Aire) Flood Alleviation Scheme in Leeds city centre.
- Ensure that emergency response plans are reviewed regularly. Vulnerable communities should be identified to ensure that emergency response is risk based.
- Work with the local authorities to produce developer contribution policies.
- Carry out flood warning feasibility studies for the Wortley Beck and Meanwood Beck.
- Produce a register of culverts and outfalls, to identify capacity and other issues.
- Investigate the interaction between the Leeds and Liverpool Canal and the River Aire.
- Complete the flood alleviation scheme along Wyke Beck..



↑ The River Aire runs through the heavily urbanised parts of Leeds

# Bradford

## Our key partners are:

**Bradford City Council**

**British Waterways**

**Flood Protection and Resilience Board**

**Highways Agency**

**Yorkshire Electricity Distribution PLC**

**Yorkshire Water**

Climate change will increase the risk of flooding to property from all sources significantly. Future regeneration and redevelopment offer opportunities to address the existing risk of flooding.

## The vision and policy

Through **Policy Option 4**, our vision for the sub area is that implications of climate change will not result in further risk to people and property. The long term regeneration of Bradford will be safeguarded through the use of innovative urban design principles which manage the water environment effectively. Flood risk comes from a number of sources and the current approach to managing flood risk is shared between organisations. As this is the case, we believe that a joint approach to managing these multiple sources is required. This will ensure that our joint understanding of the risk flooding poses to communities within this sub area is fully understood. Our approach will be risk based and co-ordinated.

## The key messages

- We want the rivers to be part of the urban landscape. At present they are often culverted and hidden away. Previous modifications to these watercourses now cause some flooding. We want to learn from previous decisions.
- We need to work with the Category 1 (Emergency Services and Local Authorities) and Category 2 responders (utility companies) through the local resilience forum to raise awareness of the difficulties with flood warning and help promote this message to residential and commercial properties.

## The issues in this sub-area

The sub area covers the city of Bradford and is a heavily urbanised area which is important for the economic growth of the Yorkshire and Humber region. Due to its importance, there is significant pressure for development in the area, particularly along the riverside where, due to its industrial history, previously developed sites are located. The floodplain is very constrained by development. Bradford Beck, Clayton Beck and Pitty Beck cause river flooding. Flooding also comes from sewers and the urban drainage system, including culverts. There are currently 1,047 properties at risk of river flooding, assuming no defences from the one per cent probability flood. This rises to 1,086 in the future.

## Actions to implement the policy

- Produce a system asset management plan to determine the best approach to sustaining the current level of flood risk, into the future.
- Work in partnership to develop a feasibility study for Bradford Beck.
- Produce a register of culverts and outfalls and identify capacity and other issues.
- Investigate the interaction between the Leeds and Liverpool Canal and the River Aire.
- Determine in greater detail the risk of flooding to gas and electricity assets.
- Develop and implement a study to establish the long term approach to managing flood risk, as identified by the Upper Aire Strategy.
- Promote the use of sustainable design techniques to reduce flood risk.
- Significantly improve public awareness of the risk of flooding from all sources.



↑ Properties are built along the riverside in the sub area

# Oulton

## Our key partners are:

Highways Agency

Leeds City Council

Wakefield Metropolitan  
District Council

Yorkshire Water

## The issues in this sub-area

The sub area is mainly urbanised, with the main settlements being Rothwell, Lofthouse, Middleton and Oulton. The area is drained by Oulton Beck which runs from Thorpe-on-the-Hill to the confluence with the River Aire downstream of Oulton. There are flood defences on Oulton Beck. Flooding in this sub area comes from the River Aire and Oulton Beck and from the sewers and the urban drainage system, including culverts. However, compared to the other sub areas the risk of flooding is low with 69 properties being at risk of river flooding during the one per cent flood, in the future this rises to 71. The risk of sewer and drainage flooding will also increase as rainfall totals and intensity increases over time.

## The vision and policy

Under **Policy Option 3** our vision for the Oulton sub area is that our understanding of flood risk from all sources will be increased to ensure

that the implications of climate change are fully understood. Continued maintenance of our flood defences and river channels will ensure that communities within the sub area remain sustainable. Flood risk comes from a number of sources and the current approach to managing flood risk is shared between organisations. As this is the case, we believe that a joint approach to managing these multiple sources is required. This will ensure that our joint understanding of the risk flooding poses to communities within this sub area is fully understood. As well as this our approach to managing this risk will be risk based and co-ordinated.

## The key messages

- Flood risk is limited in this heavily urbanised sub area and the main risk of flooding in the future is likely to be from locally heavy precipitation resulting in surface water problems.
- Further understanding of the risk of flooding from non fluvial sources is required. It should assess the existing assets and their role in delivering the flood risk management policy and approach throughout the Oulton sub area. This will enable us to plan for long term management and also provide a major tool to inform partners, planning decisions and developers.

## Actions to implement the policy

- Produce and implement a system asset management plan to determine the best approach to maintaining the current level of risk.
- Further understand the risk of flooding from urban sources. This study should identify:
  - consider the benefit of existing defences;
  - implication of climate change.
- The findings of this study should be fed into a review of SFRA's and the CFMP to ensure that all sources of flooding are taken into account and managed appropriately.
- Establish and maintain a register of structures or features which are likely to have a significant effect on flood risk.

# Pontefract

## Our key partners are:

British Waterways

Wakefield Metropolitan  
District Council

Wakefield Primary Care Trust

Yorkshire Water

## The issues in this sub-area

This sub area covers the urban areas of Pontefract and the west of Knottingley. The main watercourse is Wash Dike running from Pontefract northeast towards Knottingley where it joins the River Aire. River flooding comes from the River Aire and Wash Dike and from the Aire and Calder Navigation. Additionally flooding from sewers and surface water has been recorded in parts of the sub area. The runoff in this area is heavily modified by the urban settlements and parts of the M62, M1 and A1 road network. There are approximately 204 properties at risk of river flooding currently, if undefended. Climate change will increase the risk of river flooding to 216 properties and increase the frequency of surface water and sewer flooding.

## The vision and policy

We will follow a **policy option 5** approach. Our vision for the Pontefract sub area is that flood risk will be reduced through improved flood risk management both within this sub area and upstream. As part of this we will look to reduce runoff, improve structures and reappraise floodplain development in the long term. The condition and function of the washlands within neighbouring sub areas will be improved to reduce the risk of flooding from the River Aire at Knottingley. As climate changes, these washlands will help to mitigate the effects. Taking this into account, no further work within the Pontefract sub area is required to reduce the risk of flooding from the River Aire at Knottingley. The management of flood risk will be focussed on flood risk from Wash Dike and its tributaries.

## The key messages

- It is not possible to provide flood warnings for Wash Dike due to the rapid response of the watercourse and resulting short lead time. We therefore need to raise awareness and ensure that resilience is built into new developments which take place in flood risk areas.

## Actions to implement the policy

- Produce a system asset management plan to determine the most sustainable approach to reducing flood risk.
- Working with our partners, implement the Wash Dike flood alleviation scheme to reduce the risk of flooding from Wash Dike.
- Work with Wakefield MDC to reduce the risk of surface water flooding.
- Work in partnership to raise public awareness of the effects fly tipping and inappropriate waste management may have on flood risk. Reduce the number of fly tipping incidents and inappropriate waste management issues throughout Pontefract to ensure that flood risk is not increased due to channel and culvert blockages.
- Produce a register of culverts and outfalls and identify capacity and other issues.
- Investigate the interaction between the Aire & Calder Navigation and the River Aire.

# Lower Aire

## Our key partners are:

Local Authorities

Highways Agency

Natural England

Network Rail

RSPB

Yorkshire Wildlife Trust

British Waterways

Yorkshire Electricity Distribution Ltd

Yorkshire Water

Landowners and farmers

## The issues in this sub-area

This is a predominantly flat sub-area from the fringe of Leeds to the Humber, including the communities of Castleford and Knottingley. River flooding comes from the River Aire, the Aire and Calder Navigation and the tidal influence of the Humber Estuary. Flooding also comes from surface water and sewers.

There are currently 2,577 properties at risk of flooding from the river which rises to 2,758 in the future not taking into consideration the existing defences which do reduce the risk. They are currently assessed to provide a 1.3 per cent standard of protection. The area has a large number of controlled washlands which store water during a flood.

The lower end of the sub area is affected by the Humber Estuary, currently a major study is nearing completion on the Humber. The outputs of this study will need to be considered for this sub area.

## The vision and policy

Under **Policy 6** our vision for the sub area is that the condition and function of the washlands will be improved to reduce runoff rates and the high frequency of local flood events. As climate change develops, these washlands will help to mitigate the effects. As well as optimising the role of our washlands, we will develop a greater shared knowledge of the consequence flooding poses to local communities and endeavour to reduce these impacts. In following this approach we will contribute to wider environmental benefits by working with partner organisations to maximise the range of benefits that can be achieved. The area and its character will become a safer location through greater appreciation of flood risk and the application of sustainable development and regeneration.

## The key messages

- We need to continue to raise people's awareness of the importance of our washlands.
- We are currently reviewing the role of washlands on the Lower Aire to understand better the condition and function of the washlands.
- Flood risk will increase in this sub area in the future. We can mitigate some of this risk however some will remain.
- Washlands are vital in the management of flood risk. Creating additional flood storage capacity and improving our current assets, will enable us to control the movement of water away from the built environment.

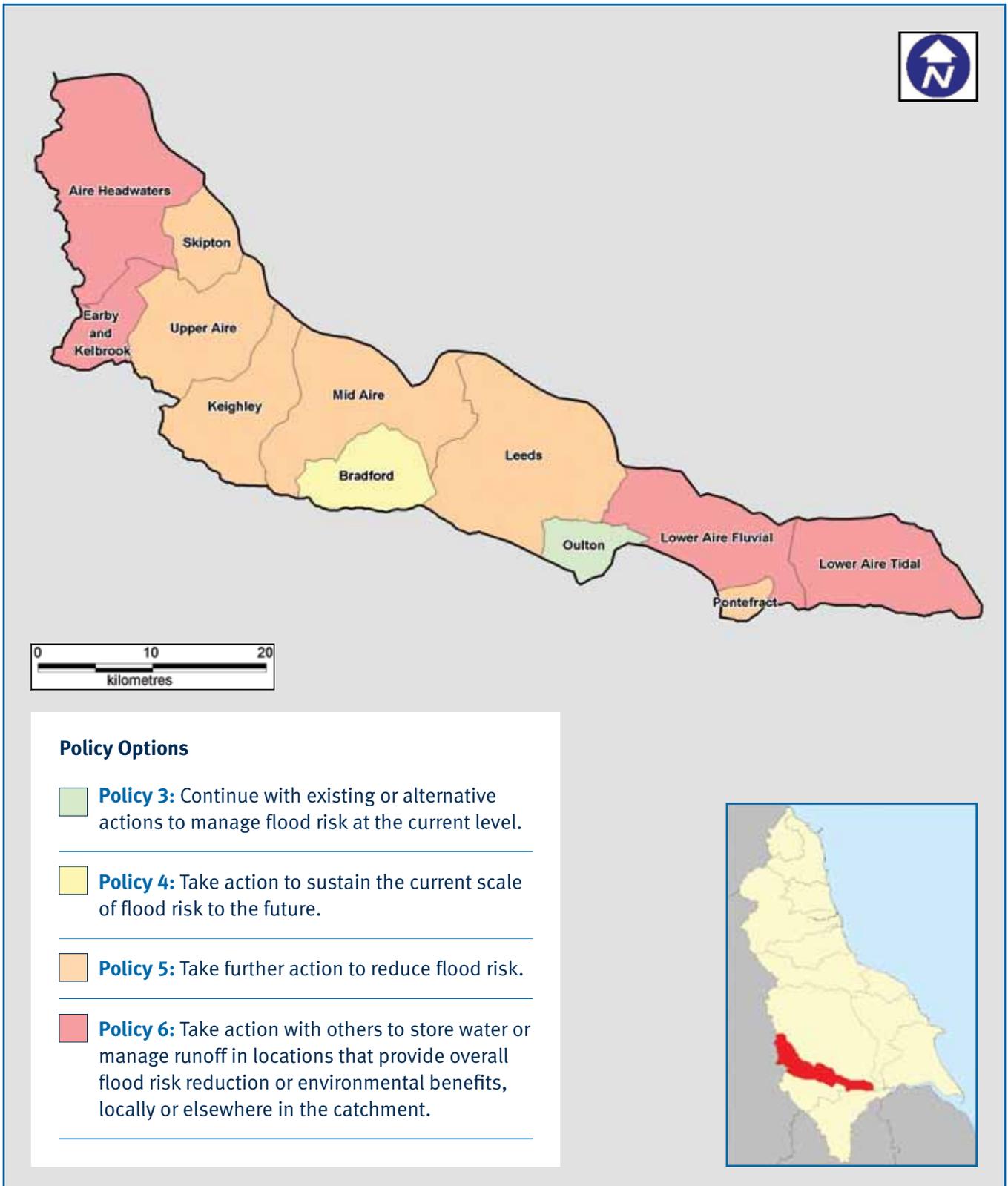
## Actions to implement the policy

- Produce a system asset management plan to maintain current infrastructure and channel structure. Work in partnership to take into account all sources of flooding as well as the implications of climate change to develop the most sustainable long term approach to managing flood risk within the sub area, particularly through the utilisation of existing washlands.
- With the Humber Strategy, establish the potential for wetland creation, flood storage and managed realignment within the Humber Estuary.
- Develop the flood risk management regional habitat creation programme. This should look to provide environmental benefits through future flood risk management works.
- Work in partnership to complete the Flood Risk Management Strategy for the Lower Aire.
- Develop a programme of works to enable partnerships to implement long term sustainable land management.



↑ The sub area is relatively flat

# Map of CFMP policies





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