North West River Basin District Flood Risk Management Plan 2021 to 2027

December 2022

This is a joint plan prepared by the following Risk Management Authorities:

Blackburn with Darwen Borough Council
Blackpool Council
Bolton Council
Bury Council
Cheshire East Council
Cheshire West and Chester Council
Cumbria County Council
Environment Agency
Halton Borough Council
Knowsley Council
Lancashire City Council
Liverpool City Council
Manchester City Council
Oldham Council
Salford City Council
Sefton Council
St Helens Borough Council
Stockport Metropolitan Borough Council
Tameside Metropolitan Borough Council
Trafford Council
United Utilities
Warrington Borough Council
Wigan Council
Wirral Council

We are the Environment Agency. We protect and improve the environment.

We help people and wildlife adapt to climate change and reduce its impacts, including flooding, drought, sea level rise and coastal erosion.

We improve the quality of our water, land and air by tackling pollution. We work with businesses to help them comply with environmental regulations. A healthy and diverse environment enhances people's lives and contributes to economic growth.

We can't do this alone. We work as part of the Defra group (Department for Environment, Food & Rural Affairs), with the rest of government, local councils, businesses, civil society groups and local communities to create a better place for people and wildlife.

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Foreword

Nearly seven million people live and work in the North West River Basin District, which extends from Cumbria to Staffordshire taking in Merseyside and parts of North Yorkshire.

There is a history of flooding across the North West, with the floods of 2015 and 2020 having particularly significant and widespread impacts on

- communities
- businesses
- infrastructure
- rural areas and
- the environment

Flooding can arise from multiple sources. The main sources are:

- rivers
- the sea
- surface water
- sewers

There are more than 370,000 people at risk of flooding from rivers and the sea**,** and over 600,000 people at risk of flooding from surface water in the North West River Basin District.

With a rapidly changing climate, the need to plan together to improve the overall resilience of our local places is more important than ever before.

Partnerships are key. The more we plan together, the more we can deliver together for local people, places and our environment.

Over the last two years we have worked together with Lead Local Flood Authorities and other partners to develop these Flood Risk Management Plans (FRMPs). This has been a challenging time because of winter flooding and the impacts of coronavirus which have served as a reminder about how precious the environment around us is for our health and wellbeing, and about the importance of protecting and enhancing it.

FRMPs are an important contribution towards delivering the ambitions of the ‘National Flood and Coastal Erosion Risk Management Strategy for England’ and the government’s 25 Year Environment Plan. They focus on the more significant areas of flooding and describe the risk of flooding both now and in the future. They will help to:

- identify actions that will reduce the likelihood and consequences of flooding
- refresh plans to improve resilience whilst informing the delivery of existing flood programmes

- work in partnership to explore wider resilience measures – including nature-based solutions for flood and water
- set longer term, adaptive approaches to help improve our nation's resilience

To support these plans, we have developed the Flood Plan Explorer which is a new, online, map-based tool. It will make plans more accessible and show all the proposed actions in a visual format. It will also help people to see what is planned, where and when. The aim is to stimulate even more opportunities for collaboration and co-operation in local places.

I am pleased to have this opportunity to share the FRMP for the North West and I encourage you all to get involved and to have your say.

Sue Longstone, Operations Director for (North) Environment Agency

Contents

Introduction to the FRMP

You can find all the FRMP documents for the North West River Basin District on GOV.UK. The plan is supported by the:

- North West River Basin District Second Cycle Flood Risk Management Plan Habitats Regulations Assessment – a report on the findings of the habitats regulations assessment (HRA)
- North West River Basin District Second Cycle Flood Risk Management Plan Habitats Regulations Assessment non-technical summary – a summary of the findings in the full HRA report
- North West River Basin District Statement of Environmental Particulars (SOEP) – a report on the potential impacts on people and the environment when implementing the measures in the FRMP
- Annex 1 spreadsheet – a list containing the implementation status of each measure published in the first FRMP cycle

You can use Flood Plan Explorer, a new, interactive mapping tool that displays information about the measures included within this plan.

Developing the FRMP

The second cycle Flood Risk Management Plan (FRMP) is a plan to manage significant flood risks within the North West River Basin District (RBD). The plan focuses in particular on areas that have been designated as being at particular risk of flooding from either rivers and sea or surface water. These areas are called Flood Risk Areas (FRAs). In England FRAs were designated nationally in 2018 following a nationally consistent approach. Producing the plan for these areas is a requirement of the Flood Risk Regulations (2009). More information on the background to FRMPs, the Flood Risk Regulations and how FRAs were identified is in Part A National Overview of Flood Risk Management in England for second cycle FRMPs.

Flooding can cause significant impacts on communities outside of designated Flood Risk Areas. The Environment Agency and other Risk Management Authorities (RMAs) will continue to plan for and manage the risk of flooding to all communities and places. This is regardless of whether they are in a FRA or not. For example, RMAs will support communities to prepare for, respond to and recovery from flooding. They will also warn and inform people of the risk as well as plan and implement works to maintain or improve their resilience to flooding.

There are many communities in the North West RBD that are at risk of and have experienced flooding that are outside of FRAs. The plan for the North West RBD has therefore been expanded to include measures that apply to all or specific areas of the RBD. This allows us to target actions where needed across the RBD and helps us to provide appropriate support to all our communities that are at risk of flooding. This is

similar to how the first cycle of FRMPs were developed. The first cycle of FRMPs covered the period 2015 to 2021.

The Environment Agency and other RMAs, in particular Lead Local Flood Authorities (LLFAs) worked together to develop the first cycle FRMP. This was in order to create a plan to manage the risk from all sources of flooding. The second cycle FRMP will build on this approach. The ambition is that the FRMP is a strategic, place-based plan which shows what is happening in flood risk management across the RBD. It is closely aligned with the:

- government's 25 year environment plan
- National Flood and Coastal Erosion Risk Management Strategy for England (FCERM strategy)

The second cycle FRMP will encourage ways of working between RMAs that will help to achieve its revised objectives and measures. These revised objectives and measures align with the ambitions of the FCERM strategy. They also support achieving wider environmental and growth ambitions of society. The FRMP is also aligned with the River Basin Management Plan for the North West RBD. Together, these plans set the strategic goals and approaches to managing water and flood risk within the RBD.

Contributors to the FRMP

The Environment Agency has worked with LLFAs and other RMAs to develop the FRMP. The Environment Agency and those LLFAs with a surface water FRA within their administrative area must produce a FRMP. These FRAs are listed below and in Table 1 respectively. Other RMAs without FRAs have also contributed to the FRMP. This is to show what is happening to manage the risk of flooding across the North West RBD.

The second cycle FRMP for the North West RBD identifies measures across the RBD and for FRAs. It has been developed with contributions from other RMAs as listed below. This includes contributions from other RMAs that do not have FRAs and have therefore volunteered to be part of the FRA development. The ambition of the plan is to be strategic and address all sources of flood risk. However, due to the strategic nature of the second cycle FRMP this means there may be places and flood risk management activities that are not included. This does not change anything planned for those places. All RMAs across the North West RBD will continue to plan for and manage the risk of flooding as appropriate. You can find information about the national-level measures that the Environment Agency and LLFAs carry out as part of their routine day to day work in the interactive mapping tool Flood Plan Explorer.

Developing the FRMP has been impacted by the extraordinary events of the past few years. Despite these challenges, the Environment Agency and RMA partners have set out measures for FRAs, ensuring that the requirements of the 'Flood Risk Regulations 2009' are met. Where we have been able to do so in the time available, we have taken a place-based approach when developing these measures for FRAs. For the rest of the RBD we have:

- included relevant place-based measures from the first cycle FRMP that have not been completed - either individually or aggregated
- included new measures - mostly reflecting where we already had plans to work in the period 2021-2027, several of which have been developed using a strategic place-based approach
- included water and biodiversity objectives wherever possible in measures

We have engaged with LLFAs and United Utilities during the development of the second cycle FRMP. We have identified the measures in which they would like to be involved.

Our ambition for the period 2021-2027 is to continue to drive catchment-based delivery in the North West RBD that offers multiple benefits to communities and the environment. This catchment-based approach is a key part of the Environment Agency's ambition to meet net zero carbon, along with low carbon innovation and carbon offsetting. It is also integral to achieving the Environment Agency's biodiversity net gain targets which support the ambitions of the government's '25 Year Environment Plan'.

Working in partnership is the most effective way to address the issues of flooding and climate change and to deliver multiple benefits. During the period 2021-2027 the Environment Agency and RMA partners will continue to work together to produce strategic plans such as the:

- evolving drainage and wastewater management plans - led by water companies
- review of the local flood risk management strategies - led by LLFAs
- review of the 'North West Shoreline Management Plan' - led by the relevant Coastal Groups

The Environment Agency and many other RMAs work with partners in the River Basin District including:

- catchment partnerships
- landscape partnerships
- catchment based groups
- non-government organisations
- Flood Action Groups
- Coastal Groups
- other active community organisations

We value the contribution these partners make, including in:

- linking people and groups
- bringing in local knowledge, data and expertise
- developing and delivery of projects

We intend to continue developing and strengthening our working with others to identify, develop and deliver solutions that will increase resilience to flooding and climate change and aid nature recovery in the River Basin District. The FRMPs are not intended to cover the detail of this partnership working.

Environment Agency Flood Risk Areas for main rivers and the sea

- Ambleside
- Atherton
- Ellesmere Port
- Higher Folds
- Kendal
- Preston
- Warrington

LLFAs with surface water FRAs within their administrative boundary

Table 1: LLFA FRAs

Flood Risk Area name	LLFA name(s)
Ashton-under-Lyne	Tameside Metropolitan Borough Council
Blackburn	Blackburn with Darwen Borough Council
Burnley	Lancashire County Council
Formby	Sefton Council
Liverpool	Liverpool City Council, Sefton Council
Macclesfield	Cheshire East Council
Rawtenstall	Lancashire County Council
Southport	Sefton Council

Other RMAs and organisations that have contributed to the FRMP

1. United Utilities
2. Cheshire East Highways
3. Greater Manchester Combined Authority
4. Cumbria County Council
5. Regional Flood Coastal Committee
6. North West Coastal Group
7. Cumbria Strategic Flood Partnership

8. Lancashire Strategic Flood Partnership
9. Greater Manchester Strategic Flood Partnership
10. Merseyside Strategic Flood Partnership
11. Cheshire Mid-Mersey Strategic Flood Partnership

In preparing the FRMP, RMAs reviewed the first cycle FRMP objectives and measures together with existing and evolving national and local plans and strategies. For this FRMP, relevant plans and strategies include the:

- National Flood and Coastal Erosion Risk Management Strategy for England (FCERM Strategy)
- North West River Basin Management Plan (RBMP)
- Local Flood Risk Management Strategies for each LLFA, available from the Flood Hub or Council website
- Cumbria Coastal Strategy
- United Utilities Water company drainage and wastewater management plans
- North West Shoreline Management Plan (Great Ormes Head to Scotland - North West England and North Wales)
- Local Plans
- The National Planning Policy Framework (NPPF)

For the second cycle of FRMPs, there is nationally consistent set of objectives which are closely linked to the:

- Flood Risk Regulations 2009
- National Flood and Coastal Erosion Risk Management (FCERM) Strategy and Roadmap
- 25 year environment plan

The full list of these objectives is in the Part A National Overview of Flood Risk Management in England for Second Cycle FRMPs.

In drawing the objectives and measures together, RMAs have:

- revisited the priorities
- ensured there is a shared understanding of the main flood risks and how best to manage them

The North West RBD

Overview of the North West RBD

The North West River Basin District (RBD) covers approximately 13,200km^2. It extends from Cumbria in the north and includes parts of Staffordshire to the south, parts of North Yorkshire in the east and Merseyside to the west. In total, nearly 7 million people live and work in the North West and the district includes large urban areas such as Liverpool and Manchester.

The North West RBD has a rich diversity of wildlife and habitats, supporting many species of global and national importance. These include migratory salmon rivers with native white clawed crayfish and pearl mussel populations and lakes containing the Arctic char and the rare vendace. The management catchments that make up the River Basin District include many interconnected rivers, lakes, groundwater and coastal waters. These catchments include, for example, lakes and rivers in the Lake District and significant sandstone aquifers used for public water abstraction.

Around 80% of the river basin district is rural, with the majority of land being used for agriculture. Livestock farming is the most common rural land use, which has shaped much of the landscape and contributes to the local economy. The Lake District and Lancashire coast are tourism centres and make a significant contribution to the local economy.

Within the North West RBD there are:

- 7 FRAs for significant risk of flooding from main rivers and the sea (Figure 1)
- 8 FRAs for significant risk of flooding from surface water (Figure 2)

Each of these defined areas are discussed in more detail in the Flood Risk Areas section of this document.

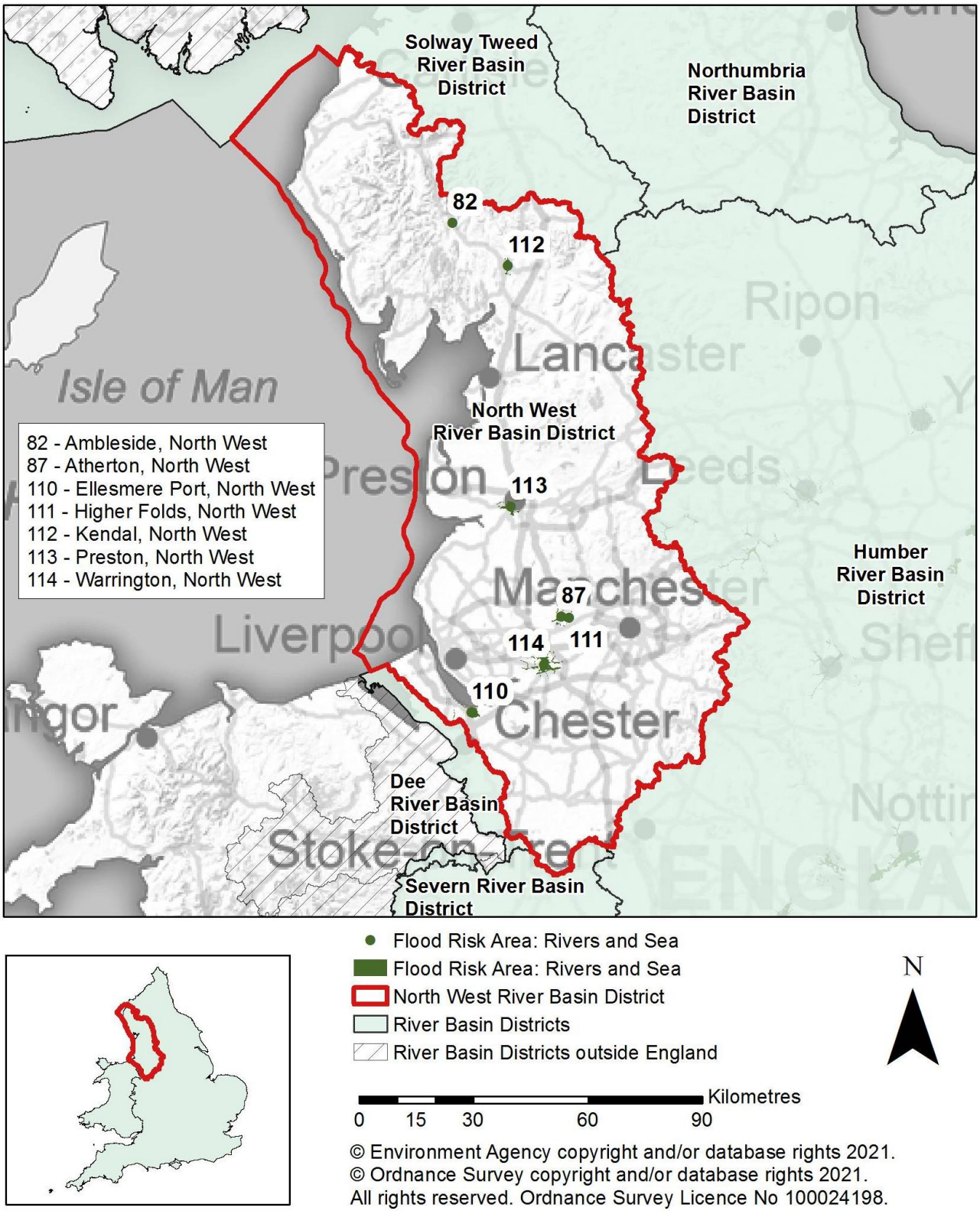


Figure 1: Map showing the rivers and sea flood risk areas in the North West River Basin District

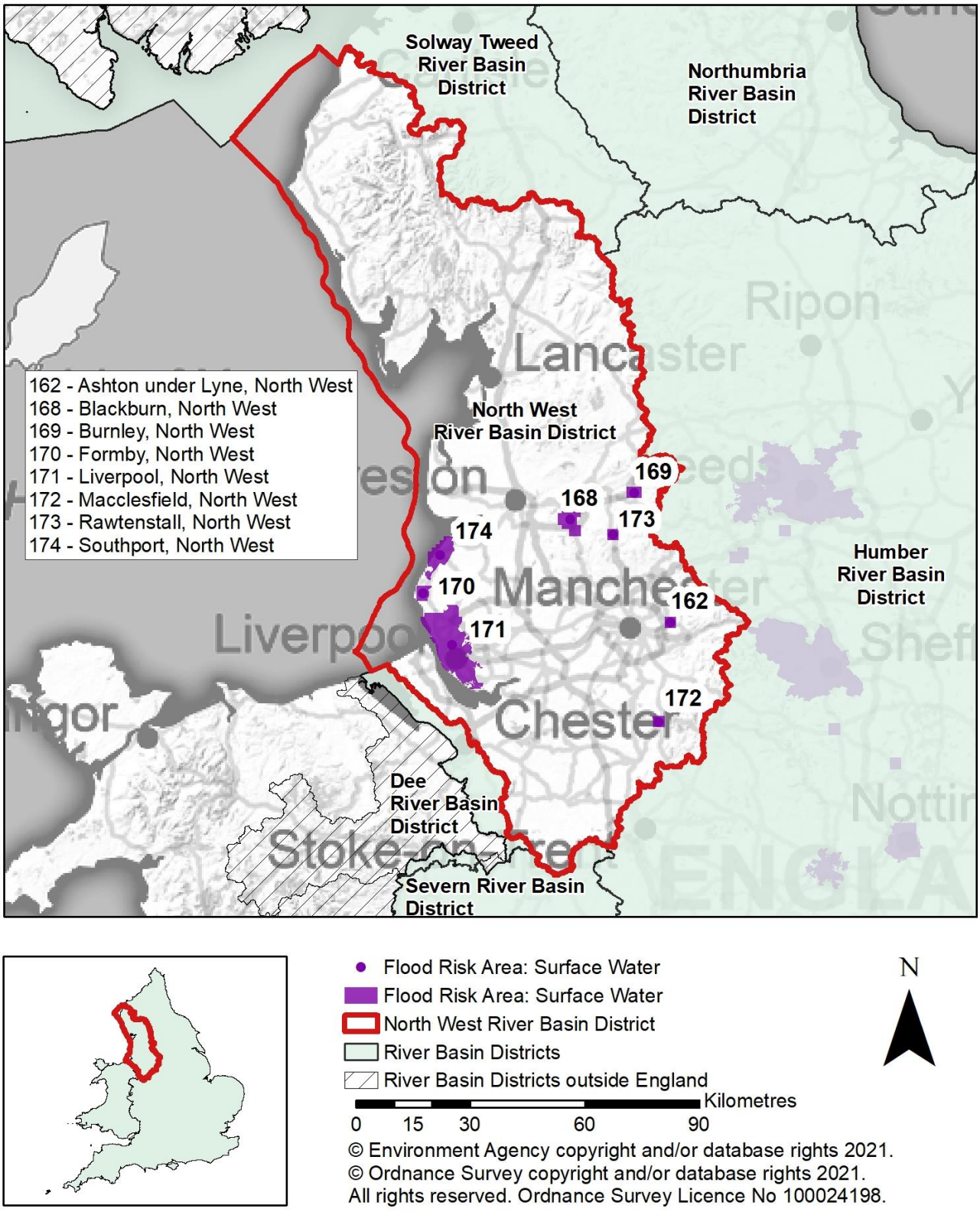


Figure 2: Map showing the surface water flood risk areas in the North West River Basin District

For further information about the North West RBD, please read the accompanying SEA Environmental Report. This includes information on topics such as the landscape, geology and cultural heritage of the North West RBD.

The main flood risk issues and changes in the North West RBD

In the North West River Basin District (RBD) over 35,000 people are estimated to live in areas at high risk of flooding from surface water.

31,000 people are also estimated to live in areas at high risk of flooding from rivers and the sea. High risk is defined as up to a 1 in 30 chance of flooding in any given year.

A further 97,500 people are estimated to live in areas at moderate risk of flooding from surface water. 46,500 are also estimated to live in areas at moderate risk of flooding from rivers and sea. Moderate risk is defined as between a 1 in 30 and 1 in 100 chance of flooding in any given year. Many more people in this category are potentially affected by surface water flooding than by flooding from rivers and the sea.

Flooding in the North West can arise from multiple sources. These sources are:

- rivers
- the sea
- surface water
- sewers
- groundwater

There is also some risk of flooding associated with reservoirs and canals. During significant flood events flooding may occur from multiple sources and in multiple areas. Risk Management Authorities (RMAs) work together to help reduce the risk of flooding across the River Basin District and to help communities respond and recover during and following flooding.

Risks of flooding from different sources are managed by different Risk Management Authorities. Further information is available at Flood and coastal erosion: risk management authorities.

River flood risk

River flooding occurs when the volume of water in a river channel is too great to be contained and it overspills on to surrounding land. This is often a result of prolonged or heavy rainfall, where waterlogging of the surrounding land prevents rainfall from draining into the ground.

The risk and consequence of flooding from rivers is influenced by a range of factors including:

- the topography of the surrounding land
- the permeability of the underlying geology
- the proximity of communities to natural flood plains

The North West RBD has many different types of rivers ranging from small steep upland watercourses in the Pennine hills to broad, meandering, slower flowing ones on lowland plains of Cheshire and Lancashire closer to the coast. Compared to other RBD in the country the principal rivers are generally shorter and respond more quickly to prevailing weather conditions.

Over time the rivers have been modified to serve a variety of purposes, including:

- reservoir dams for water supply
- weirs for power supply or navigation
- realignment, river walls, bridges and land raising for industrial or housing development
- flood plain drainage and realignment to improve agriculture

Managing the risk of flooding from rivers can involve a variety of different actives including:

- estimating the level of flood risk on the river network both now and into the future
- supporting businesses and communities to understand the risk the face, to be prepared to respond to and recover from flooding
- providing a flood warning service to alert people that flooding could occur
- maintaining river channels free from obstructions
- planning, designing and constructing works with communities to reduce the risk of flooding
- operating, inspecting, maintaining and repairing flood risk management assets
- advising planning authorities and developers on the siting and nature of development

Flood risk from rivers is estimated by the Environment Agency using computer models that are calibrated and validated using locally collected rainfall, river level ad river flow data. These models are also used to predict how this risk could increase as a consequence of climate change. This information is used not only to inform Flood and Coastal Risk Management (FCRM) investment and activity but also to inform the public, businesses, developers and planning authorities. 87% of the main river network in the northwest of England has been modelled, some 5676km, 21% of which has been updated since 2015.

The Environment Agency work together with other RMAs to plan and undertake activities that increase the resilience of communities to flooding. These activities include helping communities to respond to and recover from flooding. The Environment Agency and other RMAs work with over 80 community and business groups who are at risk of or who have experienced flooding. We help them to prepare flood plans so as to be ready when they are warned of possible flooding. We also advise on measures that could make their

property more resilient to flooding. To complement this work The Flood Hub website has been developed. The Flood Hub is a one stop shop for flood information and resources to support householders, businesses and communities across the North West in becoming more flood resilient.

The Environment Agency operate a Flood Warning Service to alert and warn communities at risk of flooding when there is an increased likelihood of this happening. The warnings are informed by river level forecasts based on computer models and real time of rainfall and river level measurements. There are 431 flood warning areas in the northwest of England that enable specific warnings to be provided to some 151,900 properties at risk of flooding. However we are currently only able to warn a maximum of 72% of these and regularly run campaigns to promote the service. More generic flood alerts are also issued that cover all locations at risk of flooding.

Rivers in the northwest take many forms ranging from a fully natural state through to being heavily modified through the construction of river channel assets. These include river walls, weirs and culverts amongst others. Natural processes that see the transportation and deposition of sediment within the channel can have implications for flood risk. Similarly, the growth of vegetation in and adjacent to the river channel can obstruct flows or provide materials that contribute to the formation blockages downstream. In urban areas other materials, for example shopping trolley and garden waste, can also contribute to such blockage risks.

The North West of England has over 3,000 culverts on main river alone. These can be particularly susceptible to blockage and are often fitted with debris screens to prevent woody debris and other detritus being washed into the culvert. These screens are cleared periodically and in advance and during high flow events. Significant resources are needed to clear blockages during flooding incidents. Where culverts are no longer required the Environment Agency liaise with land owners and Local Planning Authorities (LPAs) to seek their removal.

The Environment Agency undertake routine river channel inspection and vegetation management activities, prioritised on locations with the greatest susceptibility to flooding from this. Periodic sustainable maintenance activity can also be undertaken by RMAs to manage river shoals or siltation where there are flood risk implications. RMAs will also work with owners of river channel assets in poor condition that will increase flood risk if they fail, to remedy the situation.

The Environment Agency is an accredited asset management organisation and considers assets over their whole life from their inception through to their decommissioning or demolition.

New flood risk management works on rivers are delivered by the RMAs in line with government policy and funding criteria. They can take many forms ranging from flood defence walls or embankments to river pumping stations or upstream flood storage. Many properties in the northwest of England benefit from existing flood risk management schemes. New schemes are currently being developed or delivered at a number of places

across the northwest of England including Bury, Rochdale, Preston, Kendal and Carlisle. Flood risk management assets are regularly inspected and maintained. Defects identified are repaired and any more significant issues could lead to assets being replacement or upgrade.

The Environment Agency and Lead Local Flood Authorities (LLFAs) provide advice to LPAs with regard to proposed development within areas considered to be at risk of flooding. The Environment Agency responded to over 1100 planning applications in the northwest of England during the year. The Environment Agency and LLFAs also work closely with Combined Authorities and LPAs to ensure flood risk is properly accounted for in their long-term strategic plans for the area.

Coastal and tidal flood risk and coastal erosion

The North West has 800 km of coastline, which is generally low-lying with vast intertidal mudflats, wide sandy beaches and spectacular views across estuaries and bays. There are extensive salt marsh and sand dune habitats including the largest continuous sand dune system in England on the Sefton coast. There are also areas of vegetated shingle, particularly on the Cumbrian coast, and small areas of maritime cliff habitat such as St Bees in Cumbria.

As a consequence of a generally soft sedimentary coast and a large tidal range of around 10 metres the coastline is highly dynamic. This is illustrated by:

- parts of the Sefton coast erode by up to 4 metres per year
- the constant moving and reshaping of the tidal flats and channels in Morecambe Bay and other estuaries

The largest areas of developed coastal flood plain include: the Fylde peninsula of Lancashire, the Wirral, Southport, Morecambe, and Barrow-in-Furness.

There are many thousands of properties behind sea and tidal defences, which protect them from a flood with a 1 in 200 chance in any given year. These defences provide a high standard of protection for people living and working in these areas, however, an extreme flood or a defence failure could still pose a major hazard to people and property due to possible sudden inundation. This issue is particularly relevant to coastal and estuary towns such as New Brighton, West Kirby, Warrington, Preston, Lancaster, Blackpool, Morecambe, Barrow, Whitehaven and Workington.

To guard against this, defences are regularly inspected and maintained and replaced when they can no longer provide the necessary protection. In December 2013 some 1500 properties in Warrington were protected from flooding by the Environment Agency’s newly completed tidal defences.

The Environment Agency has a Strategic Overview of the coast in England. The coastal overview joins up coastal management activities to ensure flooding and erosion risk is

managed effectively. The overview encourages authorities to work together in partnership to achieve effective management of flooding from the sea and coastal erosion.

Coastal and tidal flood risk and coastal erosion is managed via the North West Shoreline Management Plan published in 2010 (SMP2). The SMP is going through a refresh process to test that the content remains relevant since its introduction over 10 years ago. The SMP provides a broad scale assessment of the risk associated with coastal processes to people and the developed, historic and natural environment. It also provides a policy framework for managing these risks in a sustainable manner into the future. The implementation of the plan is overseen by the North West Coastal Group. This group is made up of Risk Management Authorities with powers for coast protection or flood risk. It includes the Environment Agency, Lead Local Flood Authorities and Coast Protection Authorities.

Some of the River Basin District measures included in this FRMP reflect actions in the SMP2 and its refresh. The SMP measures included in this FRMP are those that are most relevant to flooding from the sea.

Surface water flood risk

Surface water flooding can occur anywhere across the North West. It can occur suddenly within minutes of intense rain and affect small, localised areas. It can have a number of contributory factors which include:

- storm intensity and duration
- ground topography, permeability and saturation
- inadequacy of drainage systems including insufficient capacity, damage or blockage high river levels that impede drainage into them

Forecasting surface water flooding is difficult, particularly in summer months when dynamic thunderstorm conditions arise. This is exacerbated by the proximity of the Pennines with the Irish Sea generating complex weather systems.

In addition to its 8 surface water Flood Risk Areas, the North West has 140 rapid response catchments, which is one of the highest numbers in England. These are typically steep upland catchments where flooding may occur quickly during heavy rainfall, sometimes without a flood warning being possible. The speed and depth of floodwater arising from the rapid run-off can be particularly hazardous to people and property.

Given the nature of surface water flooding problems can occur in several areas at once and Local Council's resources can easily become over stretched. To help avoid this good practice is to plan for drains and watercourses becoming overwhelmed and analyse the flow paths that floodwater may take. Once known these flow paths can be kept free from obstructions and potentially adapted to safely channel water away from properties to open spaces.

Managing surface water flood risk for new development plays a key role in managing the risks of surface water flooding. Lead Local Flood Authorities (LLFAs) provide local

planning authorities with comments on surface water management for new development. Many LLFAs have developed specific strategies to manage surface water flood risk, and these documents are included on The Flood Hub.

In the long-term, Sustainable Drainage Systems (SuDS) may relieve some pressures, and Local Councils encourage the use of sustainable drainage in new developments. SuDS are usually above ground and can limit site run-off and filter out some silt and contaminants. Discharge of surface water to sewer is generally only acceptable if preferable approaches such as infiltration, attenuation or discharge to watercourse are impractical.

Groundwater flood risk

Groundwater is naturally stored in the ground below the water table level. Where the water table reaches ground level, water starts to emerge onto the surface and flooding can happen. Once on the surface this groundwater may flow or pond. Groundwater flooding is closely linked to ground conditions and is not as widespread an issue in the North West as it is in other parts of England.

Historically, water has been abstracted from rivers and boreholes for use by manufacturing industries, which artificially reduced groundwater levels. With the decline of these industries, for example coal mining, groundwater levels have recovered to more natural levels in parts of Lancashire, Greater Manchester and Merseyside.

Groundwater flooding can be an issue in low lying areas near the coast, for example near the Sefton coast, where the water table is influenced by sea levels. In the North West, some parts of Kendal and Stockport have experienced some groundwater flooding.

Sewer flood risk

United Utilities manage the water and wastewater network in the North West of England. Wastewater is collected by United Utilities and treated from three million homes and 200,000 businesses.

Wastewater and surface water are carried down drains and into the sewer network. There are 79,000km of sewers in the North West region. Wastewater is transported through this network of sewers to one of 569 wastewater treatment works. Once it’s been treated, it’s clean enough to go back into our rivers and seas.

Many of the sewers were built decades ago. To make sure they continue to cope with the amount of wastewater that today’s population generates they are continuously maintaining and improving their sewer network.

One of the risks associated with sewerage infrastructure is flooding, where flow transported through the network can’t keep flowing and surcharges out into open spaces, gardens, properties and businesses. Drainage systems are complex and interact, so

climate change, development and urban creep all act to increase the risk to network capacity.

The primary cause of sewer flooding incidents are blockages (over 60% and up to 85% in some years) with other causes including, structural issues and hydraulic inadequacy. . Over 75% of floods caused by sewer blockages are caused by items that should not be flushed or poured into drainage systems.

To manage the risk of sewer flooding, a balanced programme of work across the asset base is carried out. This is in addition to partnership working projects and engagement with customers. These activities include:

- reactive resolution to avoid repeat incidents
- sewer maintenance to invest where risk is highest
- network monitoring to understand real time performance
- proactive cyclic cleaning to ensure systems are running smoothly
- high consequence sewers monitoring that reduce the occurrence of major collapses
- customer engagement campaigns
- capacity increases where repeat flooding has been experienced or to accommodate for new development
- modelling to enable better solution development

United Utilities apply a Catchment Systems Thinking (CaST) approach. This means that they account for the wider environment when addressing these challenges. Examples of this are working with partners to apply sustainable surface water management through

- Sustainable Drainage Systems (SuDS)
- Natural Flood Management (NFM)
- surface water separation schemes

Managing our environment better ultimately reduces the need to use expensive and traditional hard engineered grey solutions to address capacity. Planning for this with our partners through the embedment in plans such as the Flood Risk Management Plans (FRMP) by the Environment Agency are critical to this.

United Utilities plan to invest £256m in reducing flood risk to homes and businesses between 2020 and 2025. Research and observed customer preferences have been used to set the targets that United Utilities are aiming to meet by 2025. This will go towards reducing sewer flooding by 30% then to target an industry upper quartile performance. United Utilities aim to be an industry leading performer for sewer flooding by 2030.

Canal flood risk

There are many canals in the North West, most of which are owned and operated by the Canal and River Trust. These include:

- the Leeds and Liverpool Canal, including the Leigh Branch canal
- the Ashton canal

- the Peak Forest canal
- the Rochdale canal
- the Huddersfield Narrow canal
- the Sankey canal (managed by the Sankey Canal Partnership)
- the Trent and Mersey canal
- the Shropshire Union canal
- the Lancaster canal
- the Bridgewater (owned and operated by the Peel Group)
- the Manchester Ship Canal (owned and operated by Peel Group)
- the Weaver Navigation

Reservoirs supply water to canals at intervals along their length to compensate for minor water losses from leakage, evaporation and the operation of canal locks. Surface water run-off from areas near to canals also drains into them. Overflow weirs at intervals along canal banks maintain a fairly constant water level and these outfall into watercourses passing nearby or underneath. Canals can alleviate flood risk due to the large storage volume represented by a small level increase along several kilometres of waterbody. They can also move water artificially within or between a catchment and delay the timing of flood peaks. However, canals constitute linear impoundments of significant bodies of water between locks and temporary closure points. Flood risk can arise if a canal embankment, that is above the level of nearby property, breaches or a culvert beneath the canal collapses. Flooding can also arise when high inflow from tributary watercourses exceeds the capacity of the canal or navigable waterway and water overspills the banks. The nature of canal flooding, although relatively rare, means that it can be serious and happens without warning. For example, over 200 properties are known to have flooded due to a canal breach in Maghull in 1994. Locations adjacent to the Manchester Ship Canal (2015) and the Weaver Navigation (2019) have also been affected in recent times.

Most canal breach events are not associated with heavy rainfall or flooding and will have resulted from another cause. The Weaver Navigation is a navigable river rather than an artificial canal, and therefore the water levels and flows in the river are largely determined by the antecedent weather and hydrological conditions.

The Canal and River Trust and the Manchester Ship Canal Company are not a designated Risk Management Authorities within the Flood and Water Management Act, 2010. They do have responsibilities for managing their infrastructure to minimise risk to others, including during incidents.

Reservoir flood risk

The North West has many reservoirs, largely as a legacy of its industrial past. Some 290 are classified as large raised reservoirs as they can hold over 25,000 cubic metres of water above normal ground level. These are predominantly used for water supply and operators include United Utilities and the Canal and River Trust.

The Environment Agency regulates large, raised reservoirs in relation to flood risk, and provides guidance to reservoir ‘undertakers’ to help them manage their asset. Enforcement action may then be taken to seek improvements in some circumstances. The flood risk from reservoirs map shows the extent, depth and speed of flooding that could affect over 300,000 people in the North West River Basin District.

There are many more, smaller reservoirs that are used for a variety of purposes that are not regulated. Although the impact of failure for such reservoirs may not be as great the uncertainty of their condition and the ability of the owner / undertaker to keep them in good repair is cause for concern. The Flood and Water Management Act (2010) included provision to regulate reservoirs over 10,000 cubic meters but this has not yet been enacted.

Few catastrophic reservoir failures have occurred in the UK and there has been no loss of life due to dam disasters here since 1925. Since then, however, there have been embankment failures most recently at Toddbrook Reservoir in Whaley Bridge. Thankfully catastrophic failure was averted through the preparedness and prompt response of relevant authorities and the owner.

Land management and flooding

How our land is managed is important to the sustainable management of flood risk as it increases as a result of climate change. The Environment Agency, LLFAs and other RMAs work with LPAs and Combined Authorities to influence their strategic development plans so that they flood risk is fully accounted for. We engage with property and landowners to help them improve their resilience to flooding and contribute to the resilience of their communities. This can include the reduction of impermeable surfaces and the introduction of vegetated buffer strips adjacent to watercourse to trap soil runoff.

The Environment Agency work with LLFAs, Local Flood Partnerships, Rivers Trusts and community groups to reduce flood risk by using Natural Flood Management (NFM) techniques. The aim of these techniques is to reduce, slow and store runoff, particularly in minor watercourses and upper catchments to reduce the risk of downstream flooding. The techniques include:

- 'soft-stopping' small channels with large woody debris to slow the flow
- creating space for a river to adopt a more natural channel profile with increased flood capacity
- tree or bankside vegetation planting, which can reduce erosion and downstream sedimentation risk

NFM approaches are typically easy and cost-effective to install and maintain and can bring additional benefit to water quality and biodiversity. NFM can help address the increase risk from climate change as well as form an important component of major Flood Risk Management (FRM) schemes.

Some recent NFM projects in the North West RBD include:

- South West Peak - tree and Sphagnum Moss planting, peat grip blocking
- Smithhills, Bolton – tree planting and ‘soft stopping’
- St Helens – ‘soft stopping’ and other techniques
- Ribble Life (natural flood management and fish and eel passes)
- Whit Beck, Derwent (river restoration and tree planting)

Managing flood risk in rural areas

Rural areas face specific challenges in relation to flood risk management. Agriculture and horticulture are economically significant land uses that are vulnerable to extreme weather and climate change. Significant flooding, particularly on land used for arable farming and horticulture can have potential to affect food production.

Investment in flood risk management is prioritised according to government policy, the National Flood and Coastal Erosion Risk Management (FCERM) Strategy and HM Treasury Green Book on economic appraisal.

Flood and Coastal Risk Management (FCRM) Resources are currently targeted where flood risk to people and property is highest. In rural areas where the flood hazard to people and flood damage to property is low the Environment Agency may reduce its flood risk management activities on some watercourses. The Environment Agency is in contact with affected landowners about this, to look at the options and strike the right balance.

The Government are introducing Environmental Land Management Schemes to support the rural economy. These are aimed at achieving the goals of the ‘25 Year Environment Plan’ and a commitment to net zero emissions by 2050. The Environment Agency are working with other organisations to understand how such support can be used to complement FCRM activity, such as NFM techniques. The Environment Agency will continue to work with farmers and other land managers maximise the flood risk benefit of this opportunity.

Managing flood risk in urban areas

Development in larger settlements has resulted in many man-made structures affecting the river environment, including river channel retaining walls, weirs and culverts. These structures are as prevalent in towns and suburbs as they are in the large cities of Manchester and Liverpool. Effective flood risk management requires the holistic management of culverted systems. However, culverts and other assets within a system may have multiple owners and the existence and location of culverted watercourses is not always known. This can present serious challenges for new development or if collapses and blockages occur.

The Irwell catchment alone has 1,300 culverts. Problems with debris at culverts arise on both small and large watercourses. Levels can rise quickly and flooding on some can start in less than two hours from a blockage occurring, making preventative action very difficult.

Risk Management Authorities work to both reduce current day flood risk and meet future challenges of increasing risk due to climate change. The Environment Agency encourages Local Planning Authorities to adopt a Green Infrastructure approach in the context of planning for flood risk. It should be planned and managed in a similar way to critical infrastructure. It should set out the climate change adaptation response that builds a community's overall resilience to climate change. A Green Infrastructure strategy, as with other approaches to natural flood risk management, should be developed with consideration of broad scale ecological connectivity.

Sustainable Drainage Systems (SuDS) form a significant aspect of this. These are typically swales, ditches or ponds that temporarily store water that either infiltrates the ground or is subsequently released at an acceptable rate into the drainage system. These water environments can make a significant improvement to the local environment and public amenity. They can also be formed of buried tanks located for example under car parks.

History of flooding

This section of the FRMP provides a summary of significant flood events and their consequences since the first cycle FRMP in 2015. Significant is defined as an event which affected more than 20 residential properties. The first cycle FRMP for the North West RBD contains information on historic flood events and their consequences before this date. More detailed information on why flood records and evidence are important and how they are used is in Part A National Overview of Flood Risk Management in England for Second Cycle FRMPs.

In the North West there have been several substantial and widespread periods of flooding between 2015 and 2021, with many thousands of properties affected. These are typically associated with either prolonged periods of heavy winter rainfall or intense summer storms.

Table 2: historical flood events from all sources since 2015. Number of properties rounded to the nearest 10.

Date of flood	Location and approximate number of properties affected shown in brackets	Source of flood water
September 2015	Wirral (50)	Main river, surface water and sewer
November 2015	Cumbria (14)	Main River
December 2015	Cumbria (Kendal, Cockermouth, Keswick and many other smaller communities) and north Lancashire (Lancaster and St Michael's on Wyre) (4510)	Main River

Date of flood	Location and approximate number of properties affected shown in brackets	Source of flood water
December 2015	Whalley, Ribchester, St Michaels-on-Wyre, Croston and Padiham, North and East of Lancashire River Irwell catchment, Greater Manchester, Merseyside and Cheshire (1710) Lymm / Thelwall (40)	Main River and Fluvial
June 2016	Offerton Green (Stockport) and Poynton (Cheshire East), Bramhall, Gatley, Cheadle Hulme, Hazel Grove, Disley and High Lane Greater Manchester, Merseyside and Cheshire Area (80) Winstanley Area, Wigan (20), Skelmersdale (Lancashire) (70), Ellesmere Port, Cheshire (140)	Main River, surface water, drainage and sewer
August 2016	Cumbria and Lancashire (Churchtown) (30)	Main River Surface Water
September 2016	Stockport (670)	Surface water, Sewer
September 2017	Tameside (10), Cumbria (Millom & Windermere) (160)	Main river/Ordinary watercourse, surface water and lake
November 2016	High Peak district (New Mills, Whalley Bridge)	Surface water
November 2017	Cumbria (Cartmel) (20), Thornton-Cleveleys / Pressal / Lancaster (270)	Fluvial, Surface water source and drainage
December 2018	Warrington (30)	Pluvial
February 2020	Cumbria (74)	Main River, Surface Water, Ordinary Watercourse, Unknown

Date of flood	Location and approximate number of properties affected shown in brackets	Source of flood water
January 2020 – March 2020	Lancashire and Blackpool (220) Knowsley, Liverpool, Sefton, Wirral (190) Cheshire East, Cheshire West and Chester, Halton, St Helens, Warrington (30)	Main River, Coastal Coastal, Surface Water, Main River Surface Water, Main River
February 2020	North West (350)	Culvert surcharge, Main River, Surface Water
June 2020	Merseyside (Liverpool, Wirral, Sefton, Southport) (100) Cheshire Mid Mersey (Cheshire East, Cheshire West and Chester, Crewe, Winsford, Northwich, Middlewich, Sandbach, Macclesfield, Stoke-on-Trent, Warrington, Frodsham, Runcorn, Newton-le-Willows, Lymm) (50) Greater Manchester (Rochdale, Middleton, Wigan, Altrincham, Urmston, Partington, Bury, Irlam, Oldham, Rochdale, Stockport, Hyde, High Peak) (420) Lancashire (Whitworth, Shawforth, Bacup, Nelson, Newton, Longridge, Whalley, Scarisbrick, Wrigtington, Leyland, Broughton, Woodplumpton, Garstang, Blackburn-with-Darwen, Accrington, Ormskirk, Preston, Chorley, Skelmersdale) (160) Cumbria (Sedbergh, Penrith, Cockermouth) (6)	Surface Water, , Combined surface water/sewer

Date of flood	Location and approximate number of properties affected shown in brackets	Source of flood water
August 2020	Merseyside (Liverpool, Sefton, Wirral, Knowsley, Birkenhead, Wallasey, Wirral, Southport) (200) Cheshire Mid Mersey (Broxton, Chester, Tattenhall, Tarporley, Malpas) (10) Greater Manchester (Bolton, Bury, Oldham, Rochdale, Stockport, Tameside, Wigan) (100) Lancashire (Longridge, Lancaster, Fylde, Wyre) (90) Cumbria (Kirkby Lonsdale, Holme, Swarthmoor, Middleton, Workington, Whitehaven, Allerdale, Barrow in Furness, Copeland, South Lakeland)	Surface water, Sewer flooding, Watercourse, Main River, Blocked Culvert
November 2020 – December 2020	Merseyside (Liverpool, Sefton, Wirral, Knowsley) (90) Lancashire, Blackpool, Blackburn-with-Darwen (20) Cumbria (Penrith, Dent, Kendal, Barrow-in-Furness, Windermere, Burton in Kendal, Middleton, Gatebeck, Ulverston) (14)	Surface water, sewer, Ordinary Watercourse, damaged culvert, blocked drain
January 2021	Warrington (440) Cheshire West (220) Cheshire East (30)	Main river, surface water, sewer

Climate change and the North West RBD

This section sets out what we know are likely to be the implications of climate change in the North West RBD. We use allowances for different climate scenarios over different epochs or periods of time, over the coming century.

A percentile describes the proportion of possible scenarios that fall below an allowance level. The:

- central allowance is based on the 50th percentile
- higher central allowance is based on the 70th percentile
- upper end allowance is based on the 95th percentile

An allowance based on the 50th percentile is exceeded by 50% of the projections in the range. At the 70th percentile it's exceeded by 30%. At the 95th percentile it's exceeded by 5%. The 'H++' allowance is an extreme climate change scenario which applies up to the year 2100 for sea level rise.

Coastal flood risk

As sea levels rise, it means coastal flooding will become more frequent. This is because higher water levels will be seen more often. Predicting coastal flooding is complicated because it's a combination of:

- a still water level
- a surge component
- wave conditions

Future changes in sea levels are primarily accounted for by increases to the mean sea level. Changes in storminess and wave conditions are not as well understood or are not likely to change significantly. Future changes in wave conditions are thought to be heavily variable by geographical area and are an area of further research. Table 1 sets out how we expect mean sea levels to rise along the coastline by 2125.

Table 3: Cumulative mean sea level rise between 2000 and 2125 (metres)*

Allowance	Sea level rise
Extreme (H++)	1.90m**
Upper end	1.41m
Higher central	1.01m

* Data source: flood risk assessments: climate change allowances

** This applies up to the year 2100.

Fluvial (river) flood risk

Rainfall intensity is expected to increase in the future, which will cause river flows to increase. Flood risk assessments: climate change allowances sets out how much we expect peak river flows might increase by 2125 for management catchments. A 'Management Catchment' is a designated river catchment designated under the Water Framework Directive (The Water Environment (Water Framework Directive) Regulations 2017). This subdivides river catchment areas for easier management within the River Basin District.

As river flows increase, it means that fluvial flooding will become more frequent. This is because higher river flows will be seen more often.

RBDs cover large areas. We know that some areas will be more affected by climate change than others. The range of increases for the North West RBD for the upper end scenario is from 63% to 106%. This range reflects a difference in anticipated change across management catchments within the RBD.

Surface water flood risk

In winter, more rainfall and 'wet days' are projected. In summer less rainfall and fewer 'wet days' are projected. For all seasons, rainfall intensity is projected to increase.

Intense rainfall can cause surface water flooding, particularly when the ground is already wet or following a prolonged dry spell. This is when clay soils can form an impermeable crust. As rainfall intensity increases, it means that surface water flooding will become more frequent, because higher rainfall totals will be seen more often.

Flood risk assessments: climate change allowances set out how much we expect rainfall intensity might increase by 2125 for management catchments in the North West RBD.

How our understanding of the impact of climate change on flood risk might change

Our understanding of the impact of climate change on flood risk will evolve as more climate modelling and research is undertaken. The climate change allowances provided are based on the latest UK climate change projections in UKCP18 and UKCP Local (2.2km). We will review, and where needed update, the climate change allowances as new climate change projections and research is published, working with the Met Office and other experts such as at universities. Before using the climate change allowances in this document, check if there have been any updates to the allowances in 'Flood risk assessments: climate change allowances'.

Traditional methods used to estimate the likelihood and size of floods assume 'stationarity' of extreme events. This means that flooding in the past is assumed to represent the behaviour of future flooding.

Due to recent large-scale flood events on our rivers and coasts, many hydrologists are now considering ‘non-stationarity’. This recognises statistically significant changes over time.

We’re working with universities to actively research what this might mean for future increases in flood risk. This means that our understanding of how likely extreme floods will be in the future, and what contributes to this, is likely to change.

More information on climate change considerations in the FRMPs is in ‘Part A: National Overview of Flood Risk Management in England for Second Cycle Flood Risk Management Plans’.

Progress review of implementing the first cycle FRMP

This section assesses the achievements and what has happened across the North West River Basin District (RBD) since the first cycle Flood Risk Management Plan (FRMP) was produced in 2015. It describes how the first cycle FRMP was reviewed.

It reports on the status of the measures and a summary of progress made towards achieving the objectives in the first cycle FRMP. It gives reasons if progress has not been made.

How we assessed progress

The Flood Risk Regulations 2009 (FRR) require that the Environment Agency and Lead Local Flood Authorities (LLFAs) review the first cycle FRMP. The FRRs state that this review must:

- include an assessment of the progress made towards implementing the measures
- include a statement of the reasons why any measures proposed in the previous flood risk management plan have not been implemented

The Environment Agency and LLFAs followed these steps to complete the review within the North West RBD:

1. The status of each measure was reviewed and assigned an implementation status as of 31 March 2021.
2. For measures assigned an implementation status of 'not started' or 'superseded' reasons were given why they have not been progressed.
3. Additional measures were identified that have implemented since 2015 which have made a material difference to achieving the first cycle FRMP objectives.
4. Assessed how well the measures have contributed towards achieving the first cycle FRMP objectives.

The review of first cycle FRMPs is presented in this section by:

- summary statistics to show an overview of measure implementation
- a selection of case studies to demonstrate what has been achieved since 2015
- a summary of additional measures implemented since 2015
- an overview of how well first cycle FRMP objectives have been met

Summary of progress of implementing the measures since 2015

Table 4 shows a summary of the implementation status of all the measures in the North West RBD since 2015, as of 31 March 2021.

Table 4: Implementation status of measures for the North West RBD

Progress	Number of measures
Ongoing	235
Ongoing construction	0
Completed	87
Superseded	90
Not started - proposed	18
Not started - agreed	5

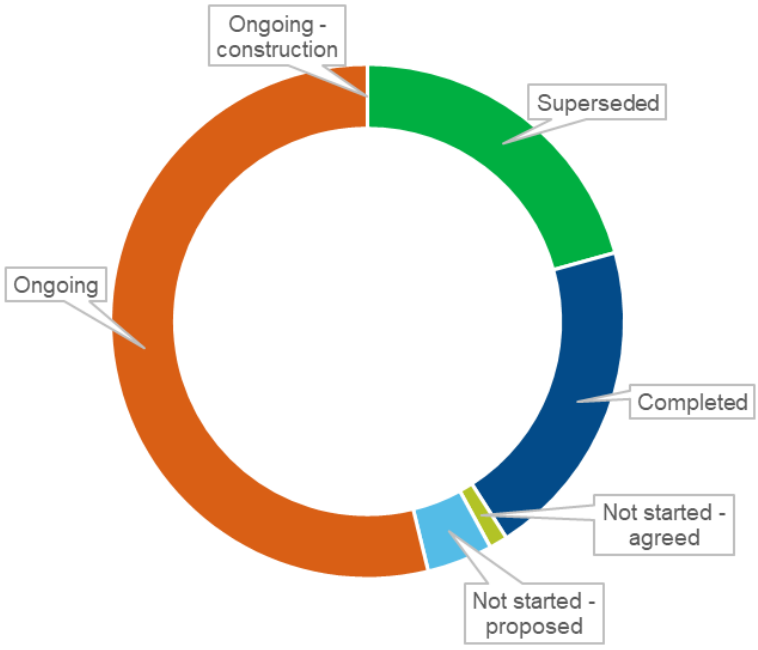


Chart 1: Implementation Status for the North West RBD

The Chart 1 above entitled 'Implementation Status for the North West RBD' shows the proportion of measures by implementation status. It shows that 20% of the measures published in the first cycle FRMP have been completed. None of the measures are ongoing in construction. 54% of the measures are ongoing. These measures include day to day activities which have been carried out by risk management authorities in 2015-2021. These measures have contributed towards achieving the objectives of the first cycle FRMP. These activities will continue in the period 2021-2027 and have been included as national level or River Basin District Wide Measures. These national level measures can be found in the interactive mapping tool – Flood Plan Explorer.

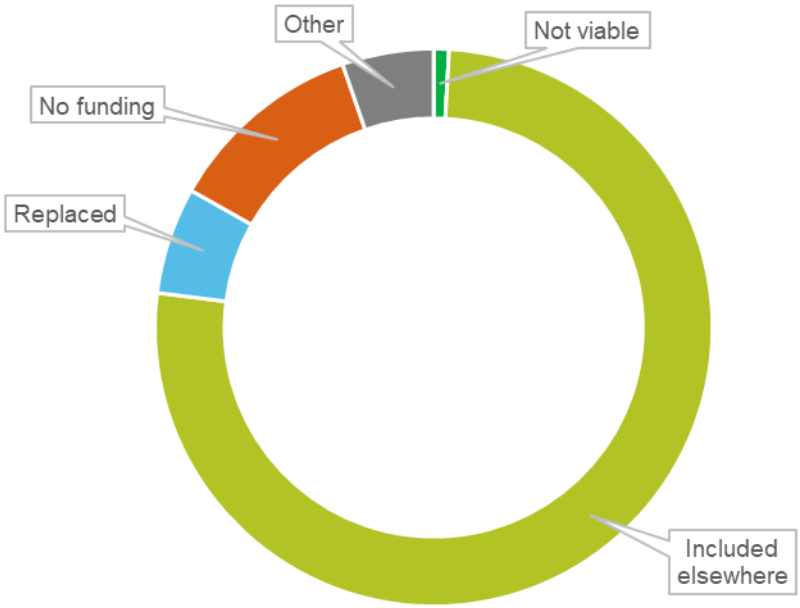


Chart 2: Reasons for not progressing measures for the North West RBD

Some of the measures proposed in the first cycle FRMP have not been implemented. These include the measures that are not started – agreed, not started – proposed and superseded. About 93% of the superseded measures are measures superseded due to being included within the North West Shoreline Management Plan.

Chart 2 entitled 'Reasons for not progressing measures for the North West RBD' shows the breakdown of reasons for measures which have not been progressed and their proportion. The primary reasons for this are:

- further work showed it was not viable
- it has been included in another piece of work
- it has been replaced by another measure
- it does not yet have funding

Other reasons include:

- the measure was superseded as it is no longer relevant

How these measures were implemented, and the main outcomes achieved

The Flood Risk Regulations (FRR) state that the FRMP must include measures relating to the following areas:

- the prevention of flooding
- the protection of individuals, communities, and the environment against the consequences of flooding

- arrangements for forecasting and warning

To meet these requirements measures included in the first cycle FRMP were grouped into themed approaches:

- preventing flooding
- protecting against flooding
- preparing for flooding
- recovery and review following flooding

Prevention of flooding

5.7% of completed measures and 9.4% of ongoing measures have contributed to the prevention of flooding in the North West RBD. For example, the FRMP included a measure for all catchments within the RBD to reduce/slow run off at source. This involved working with other organisations to influence proposals and project designs. The aim was to help ensure that run-off infiltrates naturally into the ground or drains to rivers where possible or overland flood flows are channelled away from property. This is known as Natural Flood Management (NFM) and there are many examples where this has been effective in the North West RBD.

Below are some examples of the Environment Agency working with different partners to deliver Natural Flood Risk Management works at sites across Greater Manchester, Merseyside and Cheshire. Partners have included Local Authorities, private organisations and 3rd sector organisations such as River, Woodland and Wildlife Trusts. These works undertaken between 2018 and 2020 cost £267,000 and have benefited 337 properties. They provide the capability to safely store some 13,500m^3 of water. They have also created almost 29ha woodland and 20ha wet grassland habitats as well as restoring 6km of watercourse to good ecological condition.

Smithills, near Bolton

Figure 3: This image shows leaky woody barriers upstream Woodlands Trust, Smithills Estate NFM project. Live, of Bolton. Sep 2019.

This project built 25 leaky dams providing 12,300m3 of flood attenuation. It was undertaken in partnership with the Woodlands Trust Smithills Estate, Liverpool University and Mersey Forest. The dams helped reduce the risk of flooding to 20 properties downstream. It also created 65 Ha of woodland habitat and improved the condition of 7.0 km watercourse.

Bickershaw, Wigan

Figure 4: Wigan Council, Lancashire wildlife Trust Bickershaw NFM project. River/floodplain re-connectivity. Dec 2019.

This project provided 5,000 m^3 of flood attenuation using different interventions including flood bunds and channel re-meandering. It was carried out in Partnership with Lancashire Wildlife Trust and Wigan MBC. The project reduced the risk of flooding to 20 properties downstream in Common Lane. It also created 30 Ha of woodland habitat created and 3.5 km length of watercourse improved.

NFM Stalybridge

Figure 5: Stone Dam NFM interventions - before (left) and after (right)

This project provided 5,000 m^3 of flood attenuation using peatland interventions. It was undertaken in partnership with Moors for the Future and Manchester University, and helped reduce the risk of flooding to properties downstream in Carrbrook. The performance of the interventions is being led by Manchester University under the NERC sponsored NFM-Protect project.

Protection from flooding

59.8% of completed measures and 65.9% of ongoing measures have helped to protect individuals, communities, and the environment against the consequences of flooding. These projects will or have significantly reduced flood risk to residential properties.

Kendal Flood Risk Management Scheme

An example of a measure in the River Kent Catchment was to maintain and improve flood defence assets in Kendal. Funding was obtained to progress investigations into how flood defences could be improved. This has resulted in further funding being made available to develop proposals to reduce the risk of flooding to approximately 1400 homes and 1000 local businesses within the FRA.

The current Phase 1 of linear defences through Kendal will also provide further indirect economic benefits to over 1500 businesses employing over 6,000 people, which is worth many millions of pounds to the annual local economy. Phase 1 will also reduce the risk of flooding to 82 community facilities and improve 5 hectares of habitat and recreational space, including 3km of riverside footpath improvements.

A further proposed 2 phases of the Scheme will reduce flood damages by £880 million and in combination with the current ongoing works is aiming to reduce the risk of flooding to 1% chance in any one year.

For further information regarding Kendal Flood Risk Area and measures to manage flood risk in the Flood Risk Area, please see The Kendal Rivers and the Sea Flood Risk Area.

And for details regarding the Flood Risk Management Scheme please see [The Flood Hub - Kendal Flood Risk Management Scheme].

The Salford Flood Risk Management Scheme

Figure 6: Aerial photo of Castle Irwell Flood Storage reservoir, Salford

Another example, in the River Irwell catchment, was to address fluvial flood risk from the River Irwell in Broughton, Salford. There is a long history of flooding in Salford with the most severe event occurring in 1946 when over 5000 properties were flooded. The latest scheme in combination with earlier works that reduces the risk of flooding to some 1,900 homes and businesses. The construction of a large flood storage reservoir, at Castle Irwell, reduced the risk of flooding to less than a 1% chance in anyone year. The construction works started in March 2015 and the basin, which has a capacity of 650,000,000 litres, became operational in December 2016. The site was open to the public in early 2018.

The scheme also helped to regenerate a deprived urban area and improve the local environment and its public amenity. There was a lot of public interest in the site with a big aspiration to create an asset for the local community. The local community were an integral part of the steering group that helped guide the design for the urban wetland that was created. The wetland forms the heart of the site and is surrounded by a network of paths which provide good opportunities to observe wildlife. A large mound, named Harry's Hill, sits next to the wetland and from the top there are great views over the site and beyond to the Salford skyline.

Ongoing FRMP measures also include maintenance activities, such as:

- improvements to trash screens

- producing and maintaining Flood Risk Asset Registers
- improving inspection reporting
- replacing and repairing culverts and removing debris
- improving information on websites relating to riparian responsibilities

And these have resulted in activities which have helped contribute to the prevention of flooding and also to protection from flooding.

NW Coastal Risk Management

The cycle 1 FRMP included a measure along the northwest coastline to identify potential options and promote works to reduce the likelihood of flooding in ‘at risk’ areas. The Northwest River Basin has a long coastline which has been subject to significant flooding in the past and this measure has contributed to 4 major schemes that have been delivered within the Governments current Comprehensive Spending Review (CSR). Figure 7Figure 7 below illustrates these schemes with their locations, costs, completion dates and numbers of properties protected. All to a 1/200 SOP and 100yr design life. These schemes were delivered via the North West Shoreline Management Plan (SMP):

- Wave Reflection Wall, Morecambe (£11 million) completed in spring 2018 with 11,400 properties protected
- Rossal, Wyre (£63 million) completed in spring 2018 with 7,500 properties protected
- Anchorsholme, Blackpool (£27 million) completed in November 2017 with 4,800 properties protected
- Fairhaven to Church Scar, Flyde (£21.8 million) completed in summer 2020 with 2,347 properties protected

The schemes have led to 26,047 properties being protected, almost 9% of the national 300,000 targe

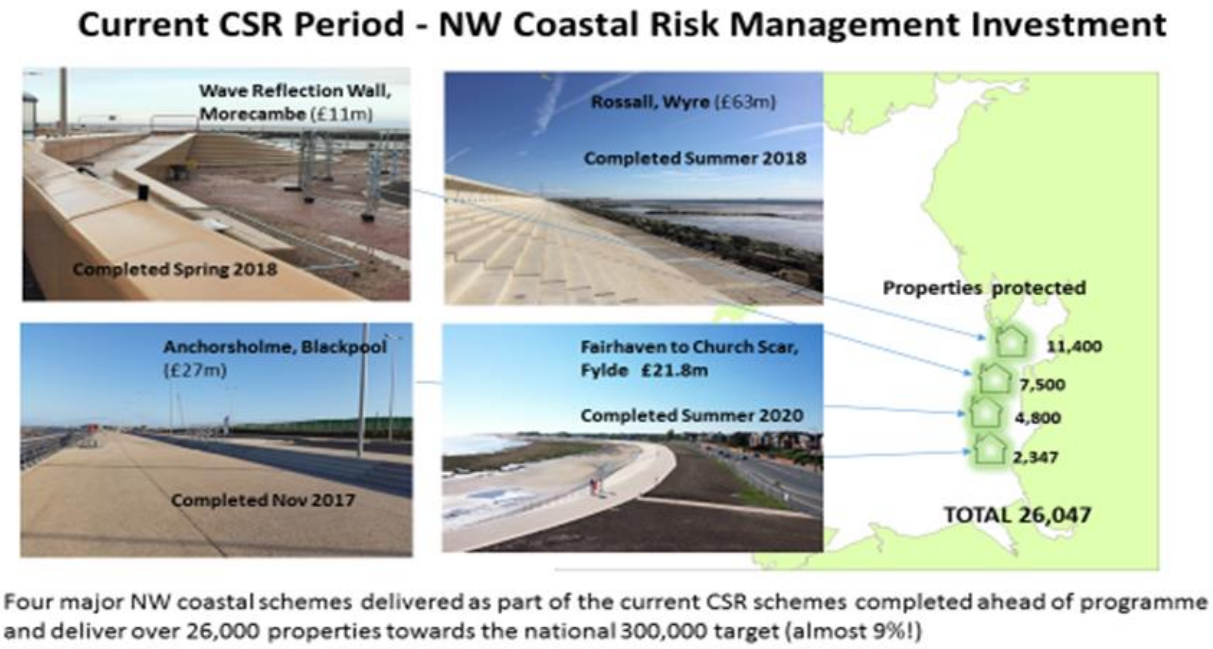


Figure 7: North West Coastal Risk Management Schemes

Preparing for and recover from flooding

33.3% of completed measures and 23.8% of ongoing measures have helped to prepare people for flooding and 0.9% of the ongoing measures have helped to support communities to recover from flooding. In the first cycle FRMP there were a number of Northwest River Basin wide measures that aimed to improve flood group, community and businesses understanding of flood risk and their ability to respond effectively to flooding. 1.2% of completed measures have contributed to other reasons such as to institute a CO2 calculator and auditing report system to report on annual CO2 emissions from Environment Agency pumping stations within the policy unit.

The Flood Hub was developed to help people to prepare for and recover from flooding. It is a dedicated website which supports our communities to manage flood and coastal risk. It was developed by Newground on behalf of the North West RFCC and the Risk Management Authorities. It has been designed to be a one stop shop for flood information and resources to support householders, businesses and communities in becoming more flood resilient. It pulls together multiple sources of guidance to produce a hub of information that gives an overview of flood resilience and its many related topics.

In the last year, the Flood Hub has been visited over 115,000 times by some 42,500 users, who downloaded almost 10,000 resources. It provides an invaluable facility to support our community engagement work and direct members of the public to who want to learn more about flooding.

The Knowledge Hub contains a variety of downloadable flood risk information and guidance document. The Your Local Area pages provide information on community groups, flood works and events on an easy to use interactive map. The Flood Risk

Management Scheme pages is where Risk Management Authorities can share up-to-date information and progress reports on proposed and ongoing flood schemes.

Ongoing measures that have contributed to managing flood risk

In addition to the completed measures, the first cycle FRMP also included ongoing measures that reflect the day-to-day activities undertaken by RMAs which contribute to managing flood risk. These measures have continued throughout the period 2015-21. For example:

- RMAs have operated and maintained flood risk assets to help protect individuals, communities, and the environment
- The Environment Agency issued flood warnings between 2015 and 2021, which warned and informed the public of the risk of flooding

Also, day to day activities carried out in 2015-2021 that have contributed to preventing flooding include:

- flood risk activity permits
- consultee in the planning process
- modelling programme
- publishing of updates to flood risk mapping
- monitoring of the Northwest Regional Coastal Monitoring Programme
- repairing and refurbishing flood risk management assets
- routine maintenance of flood risk management assets
- reservoir management and regulation
- capital schemes
- incident response including:
- monitoring and operating defences
- erecting demountable and temporary barriers
- clearing debris from watercourses to allow water to flow freely

Day to day activities carried out in 2015-2021 that have helped people to prepare for flooding include:

- maintenance and improvement of river recording gauges used to warn and inform
- improvements to flood forecasting
- continued maintenance and improvement of the Environment Agency's flood warning service
- monitoring rainfall and river levels during flood events to inform partners' emergency response decision making
- issuing forecasts and warnings for river flooding to many thousands of people including during winter floods of 2015/16 and 2019/20
- working with partners to provide media and stakeholder briefings during flood events to keep the public informed

In addition to the measures in the first cycle FRMP, the following day to day activities carried out in 2015-2021 have aided communities to recover from flooding:

- capital investment projects to repair flood risk management assets damaged during flooding
- Environment Agency staff have visited communities during flooding
- RMAs work together to hold site visits and drop in events with communities and businesses affected by flooding
- RMAs work together during and after flooding to help communities recover
- RMAs work together to review flooding incidents to help further improve our response

All RMAs will continue to carry out day to day activities to manage the risk of flooding during the second cycle FRMP period 2021-2027.

Additional measures implemented since 2015

Measures have been implemented which have emerged since the publication of the first cycle flood risk management plan. These have arisen as a result of flooding experienced, preliminary investigations completed or new partnership investment opportunities. They are typically relatively small scale and would today be considered as covered by the National level measures.

Of the 14 additional measures completed since 2015, 12 are protection measures to complete detailed investigation and develop project proposals for later delivery.

A measure along the northwest coastline identified options and promoted works to reduce the likelihood of flooding in at risk areas. This contributed to 4 major schemes that were delivered within the current comprehensive spending review. Two of the additional measures are prevention measures to investigate how flood risk could be reduced.

How well these measures have achieved the FRMP1 objectives

The FRR require the FRMP to include details of objectives for the purpose of managing flood risk and measures to set out how the objectives will be achieved. FRMP1 objectives were grouped into categories: social, economic, and environmental. Information on these objectives for the North West River Basin District FRMP1 can be found in Part B of the FRMP1.

Overall, the measures included in the first cycle FRMPs have successfully achieved the objectives set out across all of categories, delivering a great improvement to the social, economic and environmental well-being of the North West River Basin District.

The first cycle FRMP showed which objective category/ies each measure would help to deliver. The following describes measures under the objective category which they

primarily benefit. One of the completed measures has been recorded as contributing to achieving more than one of the objective categories. This means that the sum of the percentages shown below is greater than 100%.

23% of completed measures contributed to achieving social objectives. These objectives aim to:

- minimise the impact of flooding from all sources on people, property and critical infrastructure and services
- support communities and businesses to be more resilient to and recover quicker from flooding
- promote and improve the public amenity value of the water environment through our flood risk management work

For example, the Flood Warning Service has been expanded by some 7.7% between 2015 and 2021 over the North West of England to enable a total of 152,331 residential and business properties to be warned. This work have involved the installation of addition river and rainfall monitoring gauges, establishing warning criteria as well as recruiting and informing service users so that they are prepared and able to respond when they receive warnings. New flood warning areas that have been established during this time include Kendal, Ulverston, Wigton, Windermere, Nelson, Leyland, Ormskirk, Atherton, Lymm and Thelwall.

71% of completed measures contributed to achieving economic objectives. These objectives aim to:

- minimise the impact of flooding so that business is resilient and sustainable growth is supported
- ensure development is resilient, meets the demands of economic and population growth and where possible benefits existing communities

For example, the River Mersey at Warrington FRMS was completed in 2018 at a cost of £34.1m. It reduced the risk of flooding to 1995 homes, 161 businesses and 9 employment and 21 residential development sites. By supporting these exist and potential businesses the schemes help contribute a up to £99.4m gross value added to the local economy. These works also reduced the risk of flooding to a High Voltage Sub-Station whilst enhancing the local environment and its public amenity value.

Similarly, the Northwich FRMS was delivered in 2016 that has benefitted some 400 homes and businesses and 15 hectares of development land. It has also helped secure 1,500 permanent jobs in the town centre and add potentially £60m to the value of the local economy.

8% of completed measures contributed to achieving environmental objectives. These objectives aim to:

- contribute to the integrated management of the water environment
- work with natural processes to conserve and improve the water environment and to manage flood risk

- adapt to climate change in a sustainable way
- conserve built and natural heritage

Delivery of natural flood risk management projects provide good examples of how we have integrated improvements to the natural environment and biodiversity whilst reducing flood risk. These projects are often undertaken by partner organisations and form part of wider package of works that include offsetting carbon emissions or delivering RBMP outcomes.

Second cycle summary of flood risk for the North West RBD

This section shows a summary of flood risk in the RBD from:

- Rivers and sea
- Surface water

The data in tables 5 to 10 has been calculated from data available in December 2019. This data takes into account the presence and condition of defences. The risk is presented in flood risk likelihood categories. These indicate the chance of flooding in any given year:

- high risk means that each year an area has a chance of flooding of greater than 3.3%
- medium risk means that each year an area has a chance of flooding between 1% and 3.3%
- low risk means that each year an area has a chance of flooding of between 0.1% and 1%
- very low risk means that each year an area has a chance of flooding of less than 0.1%

Table 5 summarises the risk of flooding from rivers and sea to people in the RBD.

Table 5: Summary of river and sea flood risk to people in the North West RBD

Risk to people	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Number of people in RBD	7,614,405	23,060	77,224	201,663	69,187
Number of services	41,520	330	723	1,436	399

There are 7,614,405 people in the RBD. Of these:

- 4.9% are in areas at risk of flooding from rivers and the sea
- 0.3% are in areas at high risk of flooding

There are 41,520 services in the RBD. Of these:

- 7% are in areas at risk of flooding from rivers and the sea
- 0.8% are in areas at high risk

Table 6 summarises the risk of flooding from rivers and the sea to the economic activity in the RBD.

Table 6: Summary of river and sea flood risk to economic activity in the North West RBD

Risk to economic activity	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Number of non-residential properties	285,251	2,915	6,673	11,886	2,144
Number of airports	3	1	0	0	0
Length of road (kilometres (km))	2,794	22	58	74	17
Length of railway (km)	1,792	27	48	76	18
Agricultural land (hectares (ha))	437,389	15,098	15,246	18,453	6,765

There are 285,251 non-residential properties in the RBD. Of these:

- 8.2% are in areas at risk of flooding from rivers and the sea
- 1% are in areas at high risk of flooding

One airport in the RBD is within the areas at risk of flooding from rivers and the sea.

There are 2,794 km of roads in the RBD. Of these:

- 6.1% are in areas at risk of flooding from rivers and the sea
- 0.8% are in areas at high risk of flooding

There are 1792 km of railways in the RBD. Of these:

- 9.5% are in areas at risk of flooding from rivers and the sea
- 1.5% are in areas at high risk of flooding

There are 437,389 hectares of agricultural land in the RBD. Of these:

- 12.7% are in areas at risk of flooding from rivers and the sea
- 3.5% are in areas at high risk of flooding

Table 7 summarises the risk of flooding from rivers and the sea to the natural and historic environment in the RBD.

Table 7: Summary of river and sea flood risk to the natural and historic environment in the North West RBD

Risk to the natural and historic environment	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Number of EU designated bathing waters within 50 metres (m)	13	13	0	0	0
Number of Environmental Permitting Regulations (EPR) installations within 50m	535	55	20	39	8
Area of Special Area of Conservation (SAC) within area (ha)	124,558	17,557	190	396	128
Area of Special Protection Area (SPA) within area (ha)	155,817	21,463	187	460	64
Area of Ramsar site within area (ha)	67,332	19,818	114	476	64
Area of World Heritage Site within area (ha)	189,565	10,219	4,860	1,970	602
Area of Site of Special Scientific Interest (SSSI) within area (ha)	165,130	24,511	822	779	241
Area of parks and gardens within area (ha)	8,735	261	169	102	23
Area of scheduled ancient monument within area (ha)	2,195	30	48	20	3
Number of listed buildings within area	22,052	600	533	488	112
Number of licensed water abstractions within the area	1,943	429	130	93	11

It should be noted that some of the environmentally designated sites at risk within the RBD are reliant to some degree on flooding. It is needed to maintain their interest features.

The 13 EU designated bathing waters in this RBD are in areas at high risk of flooding from rivers and the sea due to their fundamental features.

There are 535 Environmental Permitting Regulations (EPR) installations in the RBD. Of these:

- 22.9% are in areas at risk of river and sea flooding
- 10.3% are in areas at high risk of flooding

There are 124,558 hectares of Special Area of Conservation (SAC) in the RBD. Of these:

- 14.7% are in areas at risk of flooding from rivers and the sea
- 14% are in areas at high risk of flooding

There are 155,817 hectares of Special Protection Area (SPA) in the RBD. Of these:

- 14.2% are in areas at risk of flooding from rivers and the sea
- 13.8% are in areas at high risk of flooding

There are 67,332.5 hectares of Ramsar sites in the RBD. Of these:

- 30.4% are in areas at risk of flooding from rivers and the sea
- 29.4% are in areas at high risk of flooding

There are 189,565 hectares of World Heritage Site in the RBD. Of these:

- 9.3% are in areas at risk of flooding from rivers and the sea
- 5.4% are in areas at high risk of flooding

There are 165,130 hectares of Site of Special Scientific Interest (SSSI) in the RBD. Of these:

- 16% are in areas at risk of flooding from rivers and the sea
- 14.8% are in areas at high risk of flooding

There are 8,735 hectares of parks and gardens in the RBD. Of these:

- 6.4% are in areas at risk of flooding from rivers and the sea
- 3% are in areas at high risk of flooding

There are 2,195 hectares of scheduled ancient monument in the RBD. Of these:

- 4.6% are in areas at risk of flooding from rivers and the sea
- 1.4% are in areas at high risk of flooding

There are 22,052 listed buildings in the RBD. Of these:

- 7.8% are in areas at risk of flooding from rivers and the sea
- 2.7% are in areas at high risk of flooding

There are 1,943 licensed water abstractions in the RBD. Of these:

- 34.1% are in areas at risk of flooding from rivers and the sea

- 22.1% are in areas at high risk of flooding

Table 8 summarises the risk of flooding from surface water to people in the RBD.

Table 8: Summary of surface water flood risk to people in the North West RBD

Risk to people	Total in RBD	High risk	Medium risk	Low risk
Number of people in RBD	7,614,405	60,480	92,809	472,742
Number of services	41,520	485	617	2,644

Of the 7,614,405 people in the RBD:

- 8.2% are in areas at risk of flooding from surface water
- 0.8% are in areas at high risk of flooding

Of the 41,520 services in the RBD:

- 9% are in areas at risk of flooding from surface water
- 1.2% are in areas at high risk

Table 9 summarises the risk of flooding from surface water to economic activity in the RBD.

Table 9: Summary of surface water flood risk to economic activity in the North West RBD

Risk to economic activity	Total in RBD	High risk	Medium risk	Low risk
Number of non-residential properties	285,251	5,036	6,254	28,387
Number of airports	3	3	0	0
Length of road (kilometres (km))	2,794	110	121	383
Length of railway (km)	1,792	139	128	269
Agricultural land (hectares (ha))	437,389	10,019	6,234	24,432

Of the 285,251 non-residential properties in the RBD:

- 13.9% are in areas at risk of flooding from surface water
- 1.8% are in areas at high risk of flooding

The 3 airports in the RBD are in areas at high risk of flooding from surface water.

Of the 2,794 km of roads in the RBD:

- 22% are in areas at risk of flooding from surface water
- 3.9% are in areas at high risk of flooding

Of the 1,792 km of railways in the RBD:

- 30% are in areas at risk of flooding from surface water
- 7.8% are in areas at high risk of flooding

Of the 437,389 hectares of agricultural land in the RBD:

- 9.3% are in areas at risk of flooding from surface water
- 2.3% are in areas at high risk of flooding

Table 10 summarises the risk of flooding from surface water to the natural and historic environment in the RBD.

Table 10: Summary of surface water flood risk to the natural and historic environment in the North West RBD

Risk to the natural and historic environment	Total in RBD	High risk	Medium risk	Low risk
Number of EU designated bathing waters within 50 metres (m)	13	2	0	1
Number of Environmental Permitting Regulations (EPR) installations within 50m	535	219	120	126
Area of Special Area of Conservation (SAC) within area (ha)	1245,58	1,691	746	2,986
Area of Special Protection Area (SPA) within area (ha)	155,817	549	382	2,655
Area of Ramsar site within area (ha)	67,333	506	202	622
Area of World Heritage Site within area (ha)	189,565	4,461	2,627	8,775
Area of Site of Special Scientific Interest (SSSI) within area (ha)	165,130	2,852	1,452	6,079
Area of parks and gardens within area (ha)	8,735	204	146	519

Risk to the natural and historic environment	Total in RBD	High risk	Medium risk	Low risk
Area of scheduled ancient monument within area (ha)	2,195	35	21	94
Number of listed buildings within area	22,052	562	203	811
Number of licensed water abstractions within the area	1,943	275	120	325

It should be noted that some of the environmentally designated sites at risk within the RBD are reliant to some degree on flooding. It is needed to maintain their interest features.

2 of the 13 EU designated bathing waters in this RBD are in areas at high risk of flooding from surface water and 1 is in area at low risk of flooding from surface water.

Of the 535 Environmental Permitting Regulations (EPR) installations in the RBD:

- 87% are in areas at risk of surface water flooding
- 41% are in areas at high risk of flooding

Of the 124,558 hectares of Special Area of Conservation (SAC) in the RBD:

- 4.3% are in areas at risk of flooding from surface water
- 1.4% are in areas at high risk of flooding

Of the 155,817 hectares of Special Protection Area (SPA) in the RBD:

- 2.3% are in areas at risk of flooding from surface water
- 0.3% are in areas at high risk of flooding

Of the 67,332 hectares of Ramsar sites in the RBD:

- 2% are in areas at risk of flooding from surface water
- 0.7% are in areas at high risk of flooding

Of the 189,565 hectares of World Heritage Site in the RBD:

- 8.4% are in areas at risk of flooding from surface water
- 2.3% are in areas at high risk of flooding

Of the 165,130 hectares of Site of Special Scientific Interest (SSSI) in the RBD:

- 6.3% are in areas at risk of flooding from surface water
- 1.7% are in areas at high risk of flooding

Of the 8,735 hectares of parks and gardens in the RBD:

- 10% are in areas at risk of flooding from surface water

- 2.3% are in areas at high risk of flooding

Of the 2,194 hectares of scheduled ancient monument in the RBD:

- 6.8% are in areas at risk of flooding from surface water
- 1.6% are in areas at high risk of flooding

Of the 22,052 listed buildings in the RBD:

- 7.1% are in areas at risk of flooding from surface water
- 35.6% are in areas at high risk of flooding

Of the 1,943 licensed water abstractions in the RBD:

- 37% are in areas at risk of flooding from surface water
- 14.1% are in areas at high risk of flooding

Second cycle objectives and measures

A full list of the objectives are in the Part A National Overview of Flood Risk Management in England for second cycle Flood Risk Management Plans (FRMPs).

In developing the FRMP, the Risk Management Plans (RMAs) have:

- drawn conclusions from the hazard and risk maps and other sources of information - this helps us all to understand the risks or opportunities
- taken account of the likely impact of climate change on the occurrence of floods
- selected appropriate objectives from the national list to reduce the adverse consequences of flooding for human health, economic activity and the environment (including cultural heritage), and reduce the likelihood of flooding
- identified the likely approach (the measures) to achieve these objectives using the categories: preparing**,** preventing**,** protecting and recovery and review

In determining the proposed measures for the FRMP, the RMAs considered several different factors. The main ones are outlined in the Part A National Overview of Flood Risk Management in England for second cycle FRMPs.

Measures that have been included in the second cycle are strategic. The FRMP is not intended to cover all detail of the measure. Further, the level of the detail that is included may vary depending on whether the measure is at the planning or implementation stage. Not all measures have secured funding and so they are not guaranteed to be implemented.

Finding the second cycle measures

For this second cycle of flood risk management planning, the Environment Agency has developed a new interactive mapping tool called Flood Plan Explorer. You can use flood plan explorer to discover information about all of the measures proposed as part of this plan. This information mainly includes:

- where the measure is
- a description of the measure and what it is aiming to achieve
- which objectives the measure will help to achieve
- who is responsible for implementing the measure
- when the measure is planned to be implemented

You can find more information on how to use Flood Plan Explorer within the tool itself. This will be updated with additional instructions over time.

National level objectives and measures

There are a number of measures which are applicable to every Flood Risk Area (FRA) in England. The Environment Agency will seek to implement these national-level measures as part of its routine day to day work as a risk management authority. The Environment

Agency is responsible for the national-level measures that apply to every FRA for main rivers and the sea.

Lead Local Flood Authorities (LLFAs) are responsible for the national-level measures that apply to every FRA for surface water. Some of these measures are statutory (the work is required by law) and others are optional. LLFAs implement their day to day work in different ways depending on local priorities and resources. You should look at LLFA websites and their local flood risk management strategies for more information on how they carry out their day to day work.

You can find information about each of these measures in the interactive mapping tool - Flood Plan Explorer.

RBD level objectives and measures

Measures have been developed which apply specifically to the whole North West RBD or apply to areas within the RBD. These measures have been developed in addition to measures which cover other spatial scales. You can find information about each of these measures in the interactive mapping tool - Flood Plan Explorer.

The River Basin District measures were developed and refined at a series of workshops by an extended group of practitioners and stakeholders. The workshops were focussed on long-term ambitions as set out in the FCERM strategy for England, on different themes that reflected the FRMP Objectives. The themes were:

- Flood Resilient Places
- Adaptive Pathways
- Environmental Enhancement
- Growth and Development
- Infrastructure Resilience
- Ready to Respond and Recovery

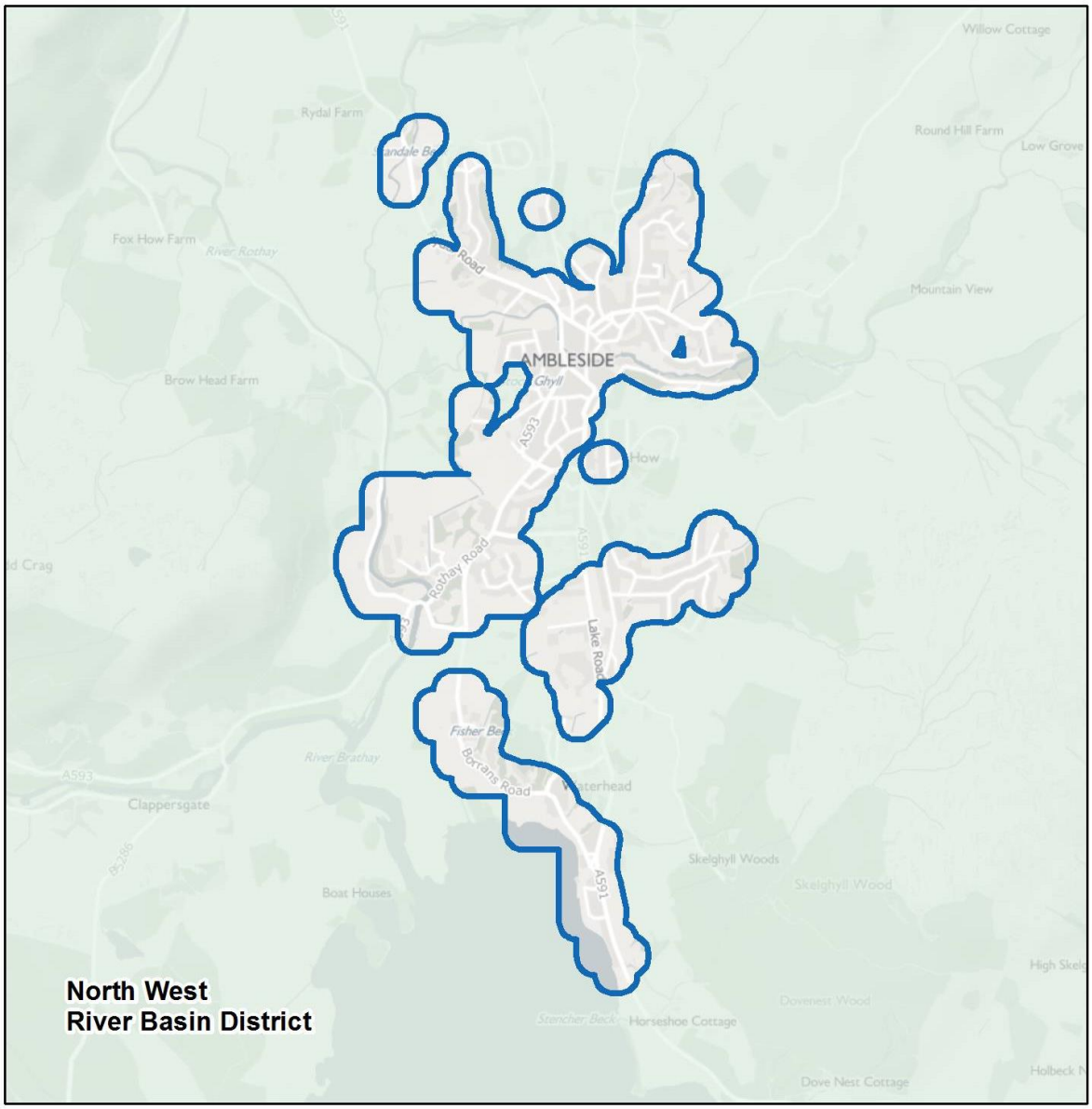
Flood risk within the North West River Basin District continues to be from a variety of sources: rivers, the sea, surface water, ordinary watercourses, reservoirs and sewers. The information from the hazard and risk maps was considered by experienced practitioners and recognised experts from different Risk Management Authorities and stakeholders in the North West RBD. This consideration also captured their knowledge of the practical challenges that exist within the flood risk management community in the North West RBD. They concluded that strategic River Basin District measures would be beneficial in directing FRM activity in the North West RBD over the next 6 years.

Flood Risk Area measures

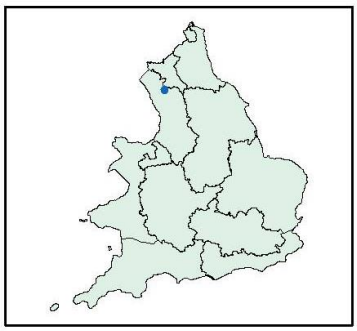
There are 145 measures applicable to managing flood risk in the nationally identified Flood Risk Areas (FRAs) in the North West River Basin District (RBD). This is 75% of the total number of measures in this Flood Risk Management Plan (FRMP). The full list of FRAs in

the North West RBD can be found in the introduction of this plan. More information on how FRAs were identified can be found in the 'Part A: National Overview of Flood Risk Management in England for the second cycle FRMPs'. The FRAs are described below.

The Ambleside Rivers and the Sea Flood Risk Area



Flood Risk Area: Ambleside, North West



Flood Risk Area: Rivers and Sea
River Basin Districts

N

0 0.5 1 1.5 Kilometres

Figure 8: A map showing boundary of Ambleside Rivers and the Sea Flood Risk Area

Introduction to the Ambleside Rivers and the Sea Flood Risk Area

The Ambleside Flood Risk Area (FRA) has been identified as the flood risk from rivers and the sea is considered nationally significant.

The Environment Agency take the lead on the development and delivery of the FRMP for this FRA, whose remit includes flood risk from rivers and the sea.

Cumbria County Council are the Lead Local Flood Authority responsible for managing flood risk from 'local' sources. These local sources of flooding are surface water, groundwater and ordinary watercourses.

United Utilities is the Water and Sewage Company that own, operate and maintain the sewer network and waste water treatment infrastructure in the FRA.

The Ambleside FRA covers many of the urban districts of Ambleside. It includes residential, business, tourist amenities and other amenity areas. It is surrounded by a green belt of mainly agricultural land and the lake of Windermere lies to the south of the FRA.

The county has a complex underlying geology, with superficial deposits formed during glaciation making flooding from groundwater a potential risk.

A number of listed buildings are located within the Ambleside FRA, primarily clustered at the town centre, including the Grade I listed ‘Bridge House’. The FRA falls within ‘The English Lake District’ World Heritage Site, designated as a result of its global uniqueness and significance. Part of the Ambleside Roman fort, associated vicus and Roman road, a Scheduled Ancient Monument, is located within the Ambleside FRA. Rydal Hall, a registered park and garden, is housed within the FRA.

The Ambleside FRA is located within the Lake District National Park. A number of Local Wildlife Sites (LWS) are situated within the FRA including Brathay Farm Borrans and Birdhouse Fields, Windermere and Stock Ghyll. Stock Ghyll Force Wood is a Site of Special Scientific Interest (SSSI) located within the Ambleside FRA.

The River Rothay, Fisher Beck, Stock Ghyll, Kirkfield Drain and Greenbank Ghyll convey water from the Leven operational catchment through the Ambleside FRA. The Leven catchment lies largely within the Lake District National Park, including England’s largest lake, Windermere, and drains via the River Leven into Morecambe Bay to the south.

Due to the steep nature of the local watercourse catchments that drain into Ambleside, the various watercourses that flow through the town respond very rapidly to heavy rainfall. The rapid response of the local watercourses to heavy rainfall means that Ambleside is classified as being at high risk of flash flooding.

Ambleside has a complex sewerage and drainage network which has evolved over time as the urban expansion of the town has progressed from early times. There are several

culverted watercourses many of which are subject to capacity exceedance and blockage during flood events. For example, on Fisher Beck during previous flood events, large volumes of debris in the beck have reduced the capacity of the channel, and blockages on debris screens at culvert entrances.

Current flood risk

The Ambleside FRA has experienced a history of flooding, more recently as a result of Storm Desmond in December 2015. The Waterhead and Borrans Road areas were flooded directly from the lake of Windermere. Other areas in Ambleside were affected by flooding from watercourses including the River Rothay, Stock Ghyll, Greenbank Ghyll and Fisher Beck. Due to the steep nature of the local topography in Ambleside, there were also flooding impacts from surface water runoff.

In November 2009 the flood event that caused widespread flooding across Cumbria affected 16 residential and commercial properties in Ambleside. Prior to November 2009, Ambleside has also experienced flooding in 1999, 2005 and 2008.

The flood hazard and risk maps show that in the Ambleside Flood Risk Area 3,342 people live in areas at risk of flooding from rivers and the sea. The FRA include approximately 1,400 residential properties, of which 14.9% are in areas of high risk.

Also shown to be at risk of flooding from rivers and the sea are:

- 247 non-residential properties, including hospitals, schools/colleges and public utilities for example, the Ambleside Wastewater Treatment Works east of the River Rothay in the west of the FRA
- 1.38km of roads including parts of the A5075, A591 and A593
- several listed buildings, parks and gardens, heritage sites, ancient monuments, and water abstraction points

The Flood Risk Maps for Rivers and Sea in England - December 2019 provide more detailed information on the likelihood and consequence of flooding for the Ambleside FRA.

Based on this information it is concluded that further steps should be taken to reduce the likelihood of flooding and its impact. In particular, the impact it can have on people, the economy and the environment both for now and the future.

How the risk is currently managed

The management of flood risk from rivers and the sea is led by the Environment Agency in collaboration with other Risk Management Authorities (RMAs), for example Cumbria County Council and United Utilities, and other stakeholders.

The Environment Agency monitors river flow at 1 site on the River Rothay within the FRA.

This information is used to inform activities related to a flood warning area within the FRA by the lake of Windermere. It enables people to receive a warning when flooding could occur. This data also informs the operational response during a flood incident.

The Environment Agency maintain flood risk management assets for example screens at the entrances of culverts on the main river, channels and culverts, throughout the FRA. Cumbria County Council LLFA and United Utilities similarly maintain assets that perform a flood risk management function on the drainage network.

Flood risk reduction measures and options were appraised between 2016 and 2019 as part of the Environment Agency Kendal Appraisal Package. No economically viable measures or options were identified at this stage. Outputs from this appraisal continue to be investigated and opportunities are being explored for the Stony Lane and Galava Gate areas of Ambleside. And a grid improvement scheme is in the design stage for the top headwall on Fisher Beck, with completion due by March 2022.

Routine maintenance has continued. Channel clearance if flows are impeded and a blockage has been remediated on the downstream side of Lake Road.

The impact of climate change and future flood risk

As rainfall intensity increases, it means that surface water flooding will become more frequent as higher rainfall totals will be seen more often.

Please refer to section Climate change and the North West RBD for more information on what we know are likely to be the implications of climate change in the North West River Basin District.

Objectives and measures for the Ambleside FRA

Measures have been developed which apply specifically to the Ambleside FRA. These measures have been developed in addition to measures covering a wider geographic area but which also apply to the Ambleside FRA. You can find information about all of the measures which apply to the Ambleside FRA in the interactive mapping tool - Flood Plan Explorer. This includes information on which national objectives each measure helps to achieve.

The Ashton under Lyne Surface Water Flood Risk Area

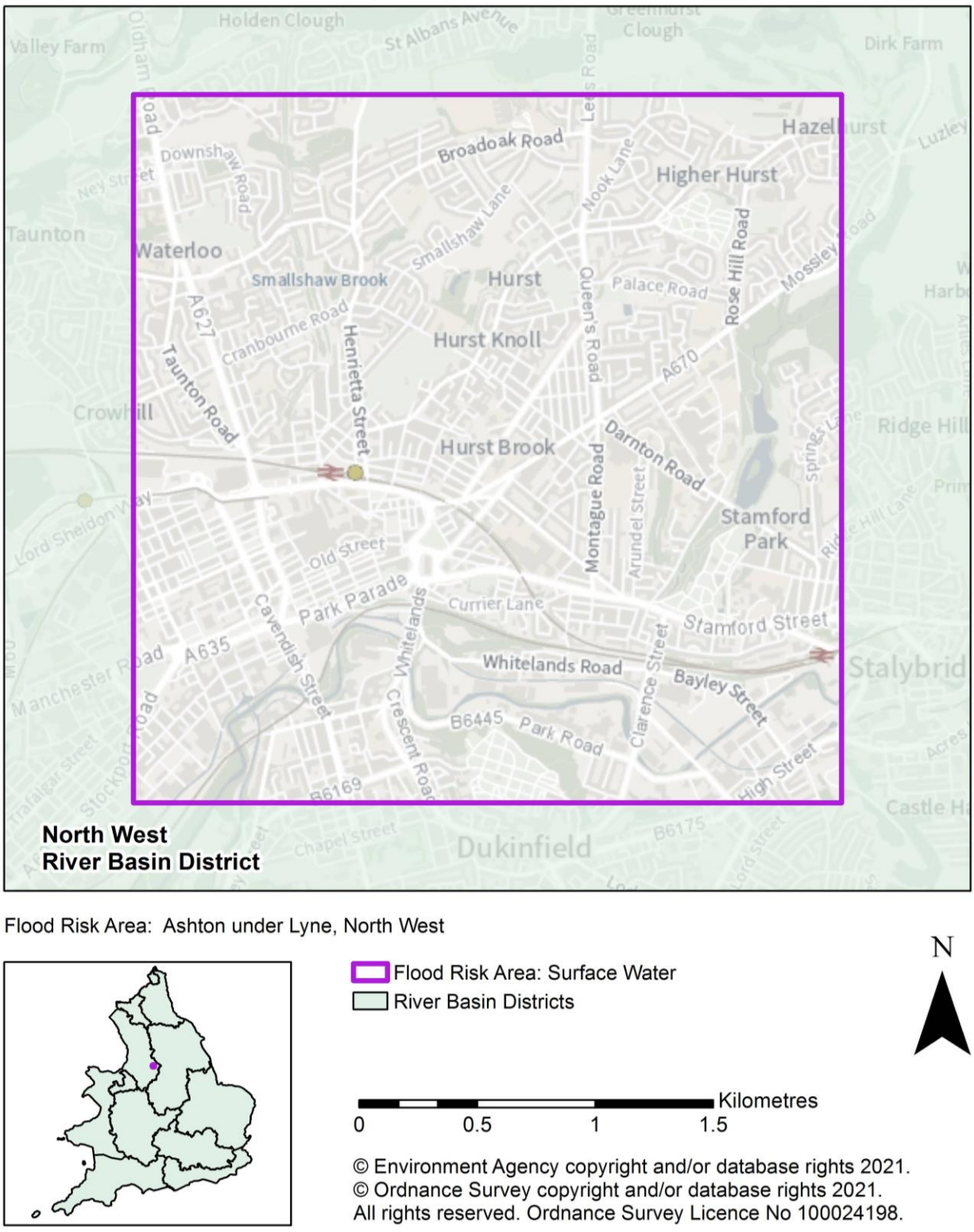


Figure 9: A map showing the boundary of the Ashton under Lyne Surface Water Flood Risk Area

Introduction to the Ashton under Lyne Surface Water Flood Risk Area

The Ashton under Lyne Flood Risk Area (FRA) has been identified as a flood risk from surface water. This is considered nationally significant.

Tameside Metropolitan Borough Council take the lead on the development and delivery of the FRMP for this FRA as the Lead Local Flood Authority (LLFA). The LLFA are responsible for managing flood risk from 'local' sources. These local sources of flooding are surface water, groundwater and ordinary watercourses.

The Environment Agency's remit includes flood risk from rivers and the sea.

United Utilities is the Water and Sewage Company that own, operate and maintain the sewer network and waste water treatment infrastructure in the FRA.

The Ashton under Lyne FRA covers many of the urban districts of Ashton under Lyne and parts of Stalybridge and includes residential, business and amenity areas. Many of the natural water courses or drainage routes have been culverted or incorporated into the sewerage system.

Ashton under Lyne's underlying geology is a bed of mudstone, siltstone and sandstone interspersed with bands of sandstone. There are superficial till deposits and soils are typically seasonally waterlogged loam over clay.

High intensity rainfall events can generate streams of fast moving water that pond in low-lying areas and lead to surface water flooding. The presence of buildings, infrastructure, steep sloping impermeable ground and limited capacity or blockage of the underlying drainage system can all exacerbate the situation.

Known problem locations are often associated with culverts along ordinary watercourses, which can become blocked or exceeded during large rainfall events. In some areas, this type of flooding may present a more significant risk than other sources of flooding, including that from rivers.

The Ashton under Lyne FRA lies partly in the Tame catchment and partly in the Medlock catchment. Cock Brook drains Stamford Park to the east of the FRA and flows in a south westerly direction to join the river Tame. Smallshaw Brook and Taunton Brook flow westward in the north of the FRA and join the river Medlock further west. The industrial areas adjacent to the river Tame in the south of the FRA is the principal area at risk of flooding from rivers.

Much of the FRA is serviced by a combined (foul and surface water) sewerage system, particularly in the older parts of the FRA. More modern parts of the town, including parts of Hazelhurst have separate foul and surface water systems.

The Ashton canal lies within the FRA, owned and maintained by the Canal and River Trust. The Ashton Canal does not pose a direct flood risk as it is a controlled water body

with regulated flows. However, a low risk of flooding remains from overtopping as a result of high inflows exceeding the canal capacity during storm events.

Several Local Wildlife Sites (LWS) are located within the Ashton under Lyne FRA. The LWS include Stamford Park Lake, Taunton Brook Clough and parts of the Ashton Canal, Huddersfield Narrow Canal and Peak Forest Canal. A Site of Special Scientific Interest (SSSI), the Huddersfield Narrow Canal, falls within the FRA.

Several listed buildings are housed within the FRA, including the Grade I Listed Church of Saint Michael and all Angels. When considering Heritage at Risk, part of Stalybridge town centre is in the Stalybridge Conservation Area, within the FRA. Stamford Park is a Registered Park and Garden.

Current flood risk

Limited flooding has been reported within the Ashton under Lyne FRA and few properties affected. Surface water flooding has been reported in August 2004, June 2016, November 2016.

On 15 June 2020, sewer flooding was recorded in Ashton under Lyne following heavy thunderstorms across Greater Manchester.

4,489 people are in areas at risk from flooding from surface water in the Ashton under Lyne FRA. This is equivalent to approximately 1,870 residential properties. 4.1% of these are in areas of high flood risk.

Also shown to be at risk of flooding from surface water are:

- 4,465 non-residential properties, including hospitals, schools/colleges and shopping centres
- 3.17km of roads including parts of the A6043 and B6194
- 3.03km of railway
- areas of environmental designated sites, listed buildings, and parks and gardens

The Flood Risk Maps for Surface Water in England - December 2019 provide more detailed information on the likelihood and consequence of flooding for the Ashton under Lyne FRA.

Based on this information it is concluded that further steps should be taken to improve the understanding of surface water flood risk within the FRA. Steps should then be taken to manage the impact it can have on people, the economy and the environment both for now and the future.

How the risk is currently managed

The management of surface water flood risk is led by Tameside Metropolitan Borough Council in collaboration with other Risk Management Authorities (RMAs) and other stakeholders, including United Utilities and the Environment Agency.

There are regular meetings between Tameside MBC, United Utilities and Environment Agency to discuss and resolve any operational issues.

The Environment Agency monitors surface water level of the river Tame within the Ashton under Lyne FRA. This information is used to inform activities related to 5 flood warning areas for the river Tame in the FRA. This enables people to receive a warning when flooding could occur and informs the operational response during a flood incident.

Tameside Metropolitan Borough Council LLFA and United Utilities maintain assets that perform a flood risk management function on the drainage network. The Environment Agency similarly maintains flood risk management assets on the river Tame and Taunton Brook.

The Canal and River Trust maintains the Ashton Canal as a navigable waterway.

The impact of climate change and future flood risk

As rainfall volumes and intensity increases, it means that surface water flooding will become more frequent as higher rainfall totals will be seen more often.

This will also lead to higher river flows and levels and increased risk of flooding from rivers.

Please refer to section Climate change and the North West RBD for more information on what we know are likely to be the implications of climate change in the North West River Basin District.

Objectives and measures for the Ashton Under Lyne FRA

Measures for the Ashton under Lyne FRA have been developed to contribute towards achieving the National FRMP objective. These specific measures have been developed in addition to measures covering a wider geographic area but which also apply to the Ashton under Lyne FRA.

You can find information about all the measures which apply to the Ashton under Lyne FRA in the interactive mapping tool - Flood Plan Explorer. This includes information on which national objectives each measure helps to achieve.

The Atherton Rivers and the Sea Flood Risk Area

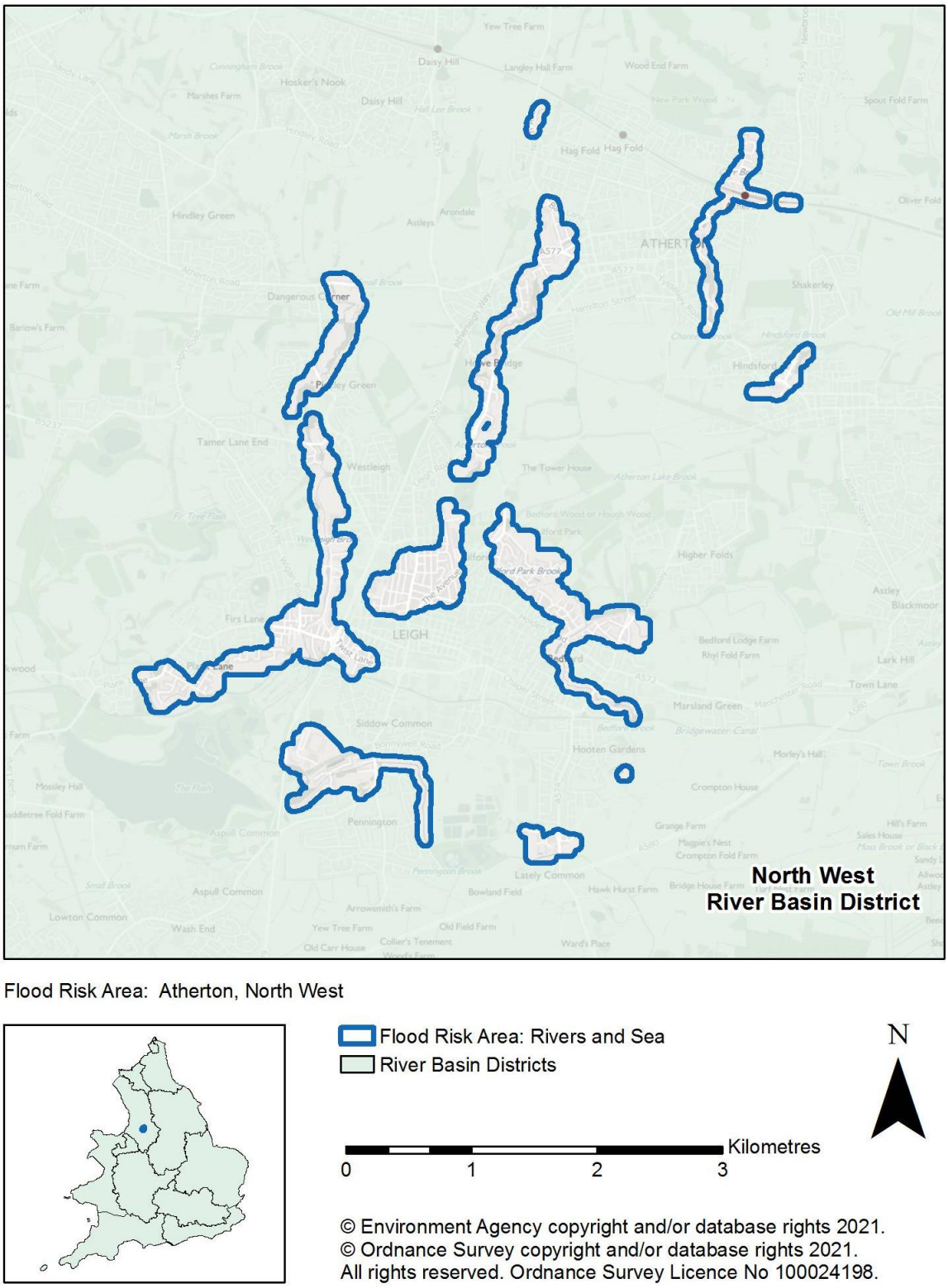


Figure 10: A map showing the boundary of the Atherton Rivers and the Sea Flood Risk Area

Introduction to the Atherton Flood Risk Area

The Atherton Flood Risk Area (FRA) has been identified as the flood risk from rivers and the sea is considered nationally significant. The Environment Agency take the lead on the development and delivery of the FRMP for this FRA.

Wigan Borough Council is the Lead Local Flood Authority (LLFA) whose remit includes flood risk from surface water and ordinary watercourses.

United Utilities is the Water and Sewerage Company that own, operate and maintain the sewer network and waste water treatment infrastructure in the FRA.

The Atherton FRA contains urban areas of Leigh, Atherton and Tyldesley and is surrounded by other urban districts and areas of farmland. It is characterised by a number 'flashes' or subsistence ponds a legacy of the extensive deep mining activity previously undertaken in this area.

The Leigh branch of the Leeds Liverpool canal joins with the Bridgewater canal in Leigh.

The Abram Flashes to the west of the FRA are designated as a Site of Special Scientific Interest (SSSI) as is Astley and Bedford Mosses situated to the south east of the FRA. Pennington Flash is designated as a Local Nature Reserve and it along with Lilford Park and Hope Carr (east of Penninton) are Local Wildlife Sites. Tyldesley Town Centre and Leigh Bridge in Leigh are designated as heritage Conservation Areas.

This area around Leigh has developed through the industrial revolution initially through the textile industry and then the coal mining industry. The connecting of Leigh to industrial cities through the opening of the Bridgewater (1795) and the Leeds – Liverpool (1820) canals were key to this. The mining industry which finally closed in 1992 impacted the landscape by the disposal of spoil and areas of land subsidence, some of which became flooded to form 'flashes'. Groundwater levels that were lowered for the mining are now considered to have largely recovered to natural levels.

The watercourses that pass through the FRA fall within 2 catchments the Glaze catchment to the east and the Moss Brook catchment to the west.

The Glaze catchment covers some 10,500ha. It drains an area south of Horwich and east of Wigan in a south easterly direction into the Manchester Ship Canal west of Partington. The catchment includes the site of the old Bickershaw colliery and the associated landscaped spoil deposits and subsistence flashes including Pennington Flash. Westleigh Brook drains the area around West Houghton south through the western side of the FRA. Borsdane Brook / Hey brook drains the rest of the catchment and forms Pennington Brook at the confluence with Westleigh Brook. Pennington Brook passes through the 2 southerly elements of the FRA.

The Moss Brook catchment covers some 5,800ha but only roughly half of which of which drains through the FRA. This includes the area to the north and east of Atherton and Tyldsley as well as the eastern side of Leigh. Mining subsidence has greatly impacted this

part of the FRA. To prevent the formation of a ‘flash’ in the east of Leigh with the permanent loss of some 300 properties a pumping station was built on Bedford Brook in1943. In 1964 in response to flooding in the 1950’s the direction of flow was reversed on Atherton Brook to divert flows through Lilford Park and away for the centre of Leigh. A flood storage reservoir was construction in Lilford Park to temporarily store river water at times of high river flows. The Bedford pumping station was upgraded at that time to convey increased river flows out of the area. Following flooding in the 1970’s and 1980’s the pumping station was upgraded in 1990. The pumping Station was last upgraded in 2013 to improve its efficiency.

Some places are at risk of surface water flooding for example, north central Leigh and Plank Lane but the risk is quite localised and affect comparatively few properties.

Current flood risk

The FRA has periodically experienced flooding most recently in 2021 when storm Christoph caused disruption to the A574. Other notable recent flooding occurred in 2015 at Lilford (14 properties), in 2002 at west Leigh (Clifton andCorn Street, 13 properties) and in 2000 at Plank Lane (10 properties).

The flood hazard and risk map for the Atherton FRA shows 6,548 people to be in areas at risk of flooding. 21% of these are in areas of high risk.

Also shown to be in areas at risk of flooding from rivers and the sea are:

- 184 non-residential properties, including hospitals, care homes, schools/colleges and public utilities.
- 0.43km of roads including parts of the A579 and A577
- 0.88km of railway
- 56.22ha of agricultural land
- listed buildings, parks and gardens and water abstraction points

The Flood Risk Maps for Rivers and Sea in England - December 2019 provide more detailed information on the likelihood and consequence of flooding for the Atherton FRA.

Based on this information it is concluded that further steps should be taken to reduce the likelihood and impact of flooding. This should consider the potential impact on people, the economy and the environment both now and in the future.

How the risk is currently managed

The management of flood risk from rivers and the sea is led by the Environment Agency. This work is performed in collaboration with other Risk Management Authorities (RMAs) and stakeholders. For this FRA these include Wigan Borough Council, United Utilities and the Lower Mersey Catchment Partnership.

There are regular operational meeting organised by Wigan Borough Council for the RMAs to discuss work programmes and resolve any operational issues. The Greater Manchester FCRM Partnership group enable broader (catchment scale) tactical and strategic approaches to be agreed with neighbouring LLFAs.

The Environment Agency monitor river and rainfall conditions at 9 sites in and immediately adjacent to the FRA. These collect data on river levels (7 sites), river flows (1 site) and rainfall (1 site).

This data is used to inform activities related to 6 flood warning areas that cover the FRA. This enables people to receive a warning when flooding could occur. This data is also used to inform the operational response of RMAs for example, the operation of the Lilford Park Flood Storage Reservoir.

The water level and flow information is also used to inform and calibrate mathematical modelling of the river network. All the main river watercourses have river models within the FRA dating from after 2015. Some models were last updated prior to 2010 for example, for rivers north of Tyldesley.

Flood risk maps are published based on the outputs from the mathematical modelling to inform:

- the public and businesses of their flood risk
- potential developers and local planning authorities
- the assessment and design of flood risk management works

Throughout the FRA the Environment Agency routinely inspect and periodically maintain flood risk management assets in working order.

These include:

- river channels
- culverts
- flood defence walls
- embankments

Wigan LLFA and United Utilities similarly maintain their assets that perform a flood risk management function on the drainage network.

The part of the Moss Brook catchment that drains through the Atherton FRA is actively managed to reduce the risk of flooding in Leigh. This is done primarily by the operation of Bedford Pumping Station in tandem with the Lilford Park Flood Storage Reservoir. The capacity of the pumping station has been set to match the capacity of the downstream capacity of the Bedford Brook river channel. At times of high flows, when the capacity of Bedford Brook would be exceeded, river water is stored in the Lilford Park Flood Storage Reservoir. This water is then released back into the river system once flows have reduced and it is considered safe to do so.

Both the Bedford Pumping Station and the Lilford Park Flood Storage Reservoir are routinely inspected and maintained. The Lilford Park Flood Storage Reservoir qualifies as a large raise reservoir and is subject to the provisions of the Reservoirs Act 1975. Individual flood risk assets, for example, pumps, are periodically reviewed and replaced or upgraded to ensure the functionality of the sites. This flood risk management approach, that benefits over 500 properties, is currently subject to a strategic review. This review will determine the best approach for managing flood risk for the future.

In the Glaze catchment flood risk management assets reduce the risk of flooding to Pennington, Siddow Common, Lately Common, Plank Lane and West Leigh. These assets include earth embankments, walls, culverts and debris screens.

A Flood Risk Management Scheme was completed in 2017 for west Leigh and benefits 230 properties. Proposals for a Flood Risk Management Scheme are currently under development for the Plank Lane area.

In Pennington and Lately Common the Environment Agency operate pumping stations to reduce flood risk in areas that have suffered from mining subsistence. It is proposed that the Pennington, Siddow Common and Lately Common area is subject to a strategic review in the coming years.

The impact of climate change and future flood risk

The amount of rainfall and its intensity is expected to increase in the future, causing higher river flows and levels. This means that flooding from rivers will become more frequent.

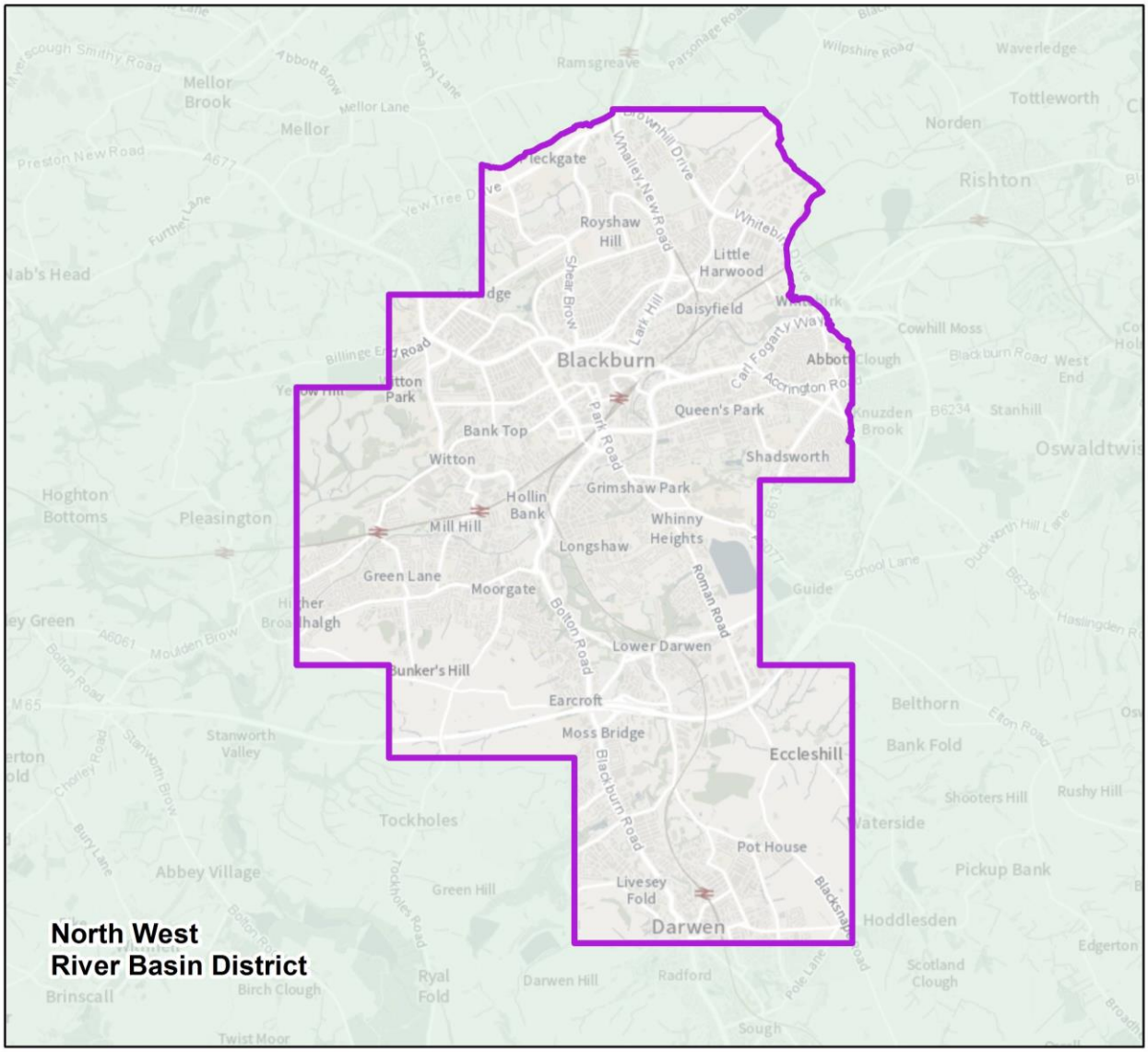
Section Climate change and the North West RBD provides information on the likely implications of climate change in the North West River Basin District. Estimates of increases in peak river flows by 2115 for the Lower Mersey catchment are consistent with the RBD estimates.

The approach to managing flood risk in the Atherton FRA will need to adapt to take account of these predictions.

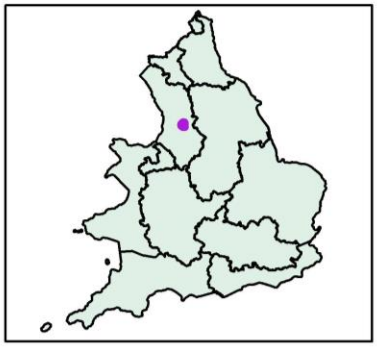
Objectives and measures for the Atherton FRA

Measures have been developed which apply specifically to the Atherton FRA. These measures are in addition to measures covering the North West River Basin District or the whole of the country. You can find information about all the measures which apply to the Atherton FRA in the interactive mapping tool - Flood Plan Explorer. This includes information on which national objectives each measure helps to achieve.

The Blackburn Surface Water Flood Risk Area



Flood Risk Area: Blackburn, North West



Flood Risk Area: Surface Water
River Basin Districts

N

Kilometres
0 1 2 3

Figure 11: A map showing the boundary of the Blackburn Surface Water Flood Risk Area

Introduction to the Blackburn Surface Water Flood Risk Area

Blackburn is bounded to the south by Darwen, with which it forms the unitary authority area of Blackburn with Darwen Borough. Located in Lancashire in the North West of England, the unitary authority covers an area of 137 square kilometres.

The original settlement of Blackburn was located to the north of the River Blakewater with Darwen located within the steep narrow sided River Darwen valley. The Leeds Liverpool Canal flows through the northern part of the borough for approximately 7.5km.

The Borough is characterised by relatively compact urban areas set within countryside. This is most pronounced in Darwen, much of which sits within a relatively steep-sided valley with ridgelines to the east and west.

The Blackburn Flood Risk Area (FRA) risk from surface water flooding is considered nationally significant.

Blackburn with Darwen Borough Council take the lead on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA as it is the Lead Local Flood Authority (LLFA). The LLFA is responsible for managing flood risk from local sources. These local sources of flooding are surface water, groundwater and ordinary watercourses.

The Environment Agency's remit covers flood risk from rivers and the sea.

United Utilities is the Water and Sewage Company that own, operate and maintain the sewerage network and wastewater treatment infrastructure in the FRA.

The Leeds and Liverpool canal lies within the FRA and is owned and maintained by the Canal and River Trust.

The relatively impermeable Coal and Millstone Grit and the steep nature of the upper catchments of the both the Darwen and Blakewater, give rise to limited infiltration and a rapid response to rainfall events. Several reservoirs exist in the upper catchments.

Part of the West Pennine Moors Site of Special Scientific Interest (SSSI) is located within the Blackburn FRA. Several listed buildings are located within the FRA including the entrance gateway and flanking lodges at Corporation Park. A Scheduled Ancient Monument, part of Witton Old Hall medieval lordly residence 340m north east of Feniscliffe Bridge, falls within the Blackburn FRA.

There is an extensive and well-documented flooding history of the borough. The records have been reproduced in Blackburn with Darwen Borough Council SFRA Level 1.

Much of the FRA is serviced by a combined (foul and surface water) sewerage system, particularly in the older parts of the FRA. More modern parts of the town, including Waterloo, Moorgate, Fernhurst Wood and Shadsworth have separate foul and surface

water systems. Several outfalls from the system discharge into the River Darwen, River Blakewater and Davyfield Brook.

The River Darwen conveys water from the Darwen catchment through the Blackburn FRA to the Ribble estuary in the west. The River Blakewater flows into the River Darwen from the north east through the FRA. Other watercourses including the Davyfield Brook drain smaller more local areas through the Blackburn FRA. These watercourses have been straightened, walled channels and culverted overtime.

Constrictions in the river channel, can cause river levels to be raised particularly when debris gets trapped against them during high flows. For example, at culverts, bridges or pipe crossings.

Several areas within Blackburn and Darwen suffer from pluvial flooding. During intense rainfall periods, due to a high river level, it creates restrictions in the operation of highway drainage networks.

The emergence of groundwater after prolonged period of rain can also contribute.

Current flood risk

The Blackburn with Darwen Borough has experienced major flood incidents across the borough, especially throughout the summer of 2012. In June 2020 the Blackburn FRA was also affected by flash flooding, where roads and several properties were flooded. Including 44 residential and 14 business properties on Whalley New Road.

The flood hazard and risk maps show that in the Blackburn Flood Risk Area 12,217 people live in areas at risk from flooding from surface water. Of which 9.7% are in areas of high risk.

Also shown to be in areas at risk of flooding from surface water are:

- 2,159 non-residential properties, including community centres, hospitals, schools/colleges, retail parks and public utilities. For example, the Darwen Wastewater Treatment Works south of the M65
- 14.58km of roads including parts of the A666, A674, A6077, A6078 and M65
- 5.10km of railway
- 47.32ha of agricultural land
- areas of environmental designated sites, listed buildings, parks and gardens and water abstraction points

The Flood Risk Maps for Surface Water in England - December 2019 provide more detailed information on the likelihood and consequence of flooding for the Blackburn FRA.

Based on this information it is concluded that further steps should be taken to reduce the likelihood of flooding and its impact. The impact it can have on people, the economy and the environment both for now and the future.

How the risk is currently managed

Blackburn with Darwen Borough Council in collaboration with other Risk Management Authorities (RMAs) and other stakeholders lead the management of surface water flood risk. For example: United Utilities, Highways Agency, and Network Rail as well as others.

There are regular operational meetings organised by Blackburn with Darwen Borough Council for the RMAs to discuss work programmes and resolve any operational issues. The Lancashire FCRM Partnership group enable broader (catchment scale) tactical and strategic approaches to be agreed with neighbouring LLFAs.

The Environment Agency monitors river and rainfall conditions at 3 sites in and immediately adjacent to the FRA. These collect data on river levels, river flows, and rainfall data.

This information is used to inform activities related to 3 flood warning areas that cover the FRA which enable people to receive a warning when flooding could occur.

The water level and flow information are also used to inform and calibrate mathematical modelling of the river network.

Flood risk maps are published based on the outputs from the mathematical modelling to inform:

- the public and business of their flood risk
- potential developers and local planning authorities
- the assessment and design of flood risk management works

The Environment Agency maintain flood risk management assets for example river channels, flood defence walls or embankments, throughout the FRA. Blackburn with Darwen Borough LLFA and United Utilities similarly maintain assets that perform a flood risk management function on the drainage network.

Blackburn with Darwen Borough Council is represented on the North West Regional Flood and Coastal Committee (RFCC) via the Lancashire Partnership representatives. It is one of twelve RFCC's established in England by the Environment Agency under Section 22 of the Flood and Water Management Act. The RFCC brings together members (Councillors) appointed by Lead Local Flood Authorities (LLFAs) and independent members with relevant experience for three key purposes:

1. To ensure there are coherent plans for identifying, communicating and managing food and coastal erosion risks across catchments and shorelines.
2. To provide a link between the Environment Agency, LLFAs, other risk management authorities, and other relevant bodies to build a mutual understanding of flood and coastal erosion risks in its area.
3. To use this understanding to encourage efficient, targeted and risk-based investment in flood and coastal erosion risk management that represents value for money and benefits local communities.

Blackburn with Darwen Borough Council LLFAs and United Utilities operate and maintain assets that perform a flood risk management function on the drainage network. Blackburn with Darwen Borough Council also maintain several other structures and defences on ordinary watercourses.

The Environment Agency similarly operates and maintains flood risk management assets on the main watercourses in the FRA. These include:

- flood defence walls
- flood gates
- channels
- culverts
- debris screens

This work includes routine inspection and clearance activities as well as periodic repair and replacement of assets.

The Canal and River Trust maintains the Leeds and Liverpool Canal as a navigable waterway.

The current investment in the FCRM 6-year programme will see a potential investment of at least £4 million to protect 231 properties and improve 12 hectares of landscape for natural flood management.

The Old Gates Drive surface water management scheme increased the protection of 41 properties in Blackburn and has been completed in March 2021.

Other flood risk improvement works that benefit the Blackburn FRA completed recently by the Environment Agency include:

- Wrangling Scheme, Blackburn, which was completed in 2017 at a cost of £3.3 million, protecting 66 residential properties
- decommissioning of the old reservoir at Jacks Key, Darwen, was decommissioned and completed in 2019 - this protects 1,100 properties from the risk of reservoir collapse

The impact of climate change and future flood risk

As rainfall intensity increases, it means that surface water flooding will become more frequent as higher rainfall totals will be seen more often.

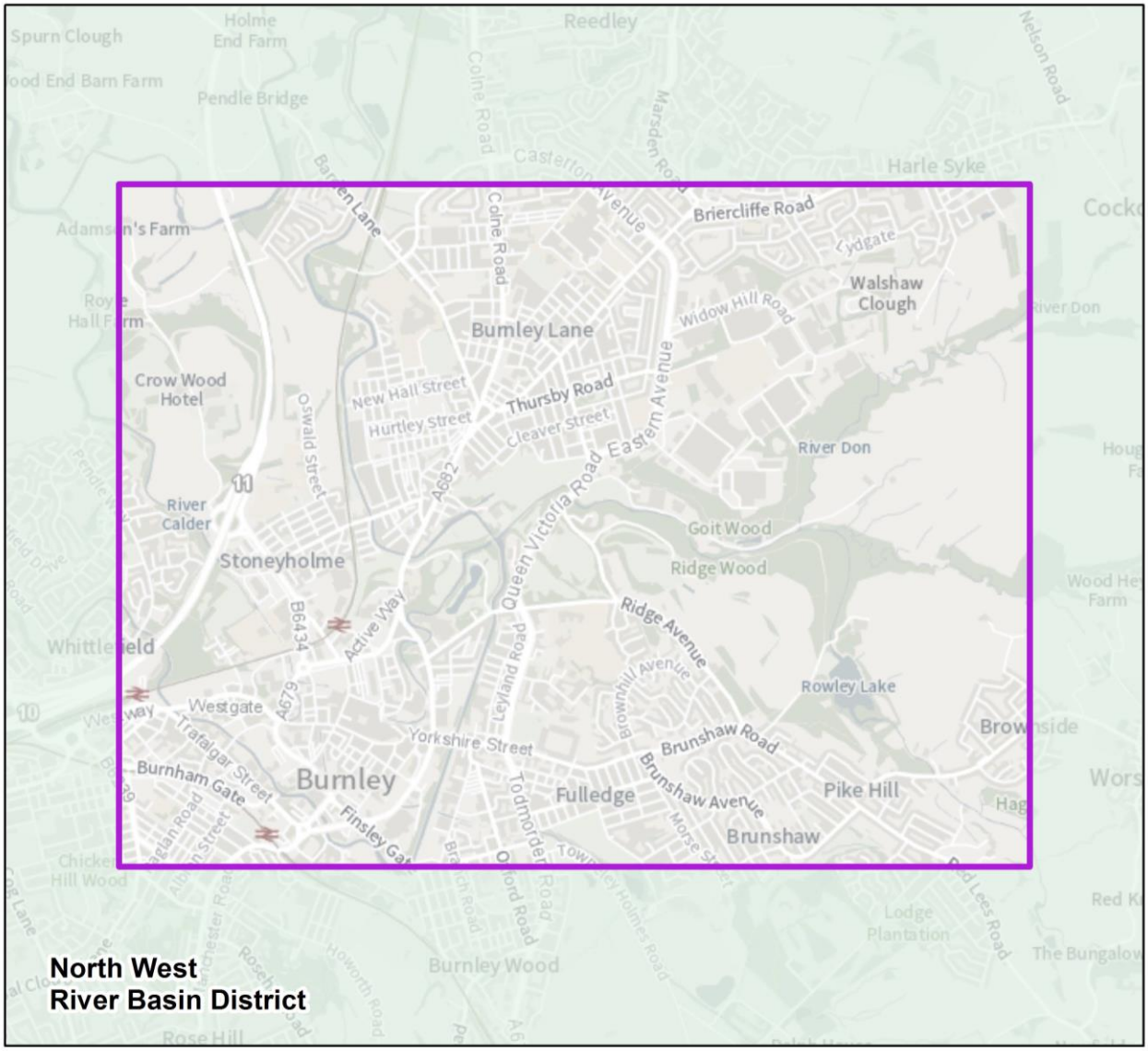
Please refer to section Climate change and the North West RBD in the document. for more information on what we know are likely to be the implications of climate change in the North West River Basin District.

Objectives and measures for the Blackburn FRA

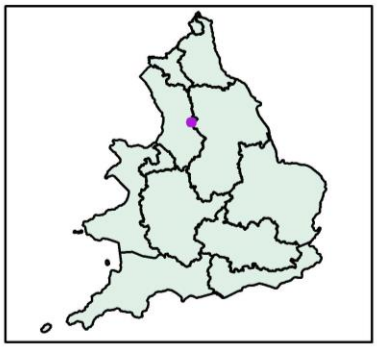
Measures have been developed which apply specifically to the Blackburn FRA. These measures are in addition to measures covering a wider geographic area, but which also

apply to the Blackburn FRA. You can find information about all the measures, which apply, to the Blackburn FRA in the interactive mapping tool - Flood Plan Explorer. This includes information on which national objectives each measure helps to achieve.

The Burnley Surface Water Flood Risk Area



Flood Risk Area: Burnley, North West



Flood Risk Area: Surface Water
River Basin Districts

N

Kilometres
0 0.5 1 1.5

Figure 12: A map showing the boundary of the Burnley Surface Water Flood Risk Area

Introduction to the Burnley Surface Water Flood Risk Area

The Burnley Flood Risk Area (FRA) has been identified as the flood risk from surface water is considered nationally significant.

Lancashire County Council take the lead on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA. They are the Lead Local Flood Authority (LLFA) responsible for managing flood risk from local sources. These local sources of flooding are surface water, groundwater and ordinary watercourses.

The Environment Agency's remit includes flood risk from rivers and the sea.

United Utilities is the Water and Sewage Company that own, operate and maintain the sewer network and waste water treatment infrastructure in the FRA.

The Burnley FRA covers many of the urban districts of Burnley. It includes residential, business and amenity areas and surrounded by a green belt of mainly parkland.

Millstone grits form an almost complete circle around Burnley and make up the hills which surround the town. A major topographical feature, the Burnley syncline (downfold), part of The Lower Coal Measures series, outcrops over almost the entire area of the Borough.

Several Local Wildlife Sites (LWS) are located within the FRA. It includes the River Don – Brun valley, parts of the Leeds and Liverpool Canal, Heald Wood, Houghton Hag, Spring Wood and Oswald Street.

Many listed buildings are located within the FRA. Several registered parks and gardens fall within the FRA boundary including the Grade II listed Queen's Park and Thompson Park.

Many of Burnley's urban watercourses, both main rivers and ordinary watercourses, are culverted to some extent. The heavily culverted watercourses combined with the rapidly reacting upland catchment upstream. The flood risk posed by open rivers result in the FRA being at high risk of flooding.

Much of the FRA is serviced by a combined (foul and surface water) sewerage system, particularly in the older parts of the FRA. More modern parts of the town, including parts of Brownside have separate foul and surface water systems.

The Burnley FRA is located at the confluence of the River Calder and the River Brun. The FRA falls within the River Ribble management catchment which drains areas of North Yorkshire and Lancashire. It covers around 110km from its source in the Yorkshire Dales to its mouth at the Ribble estuary between Preston and Blackpool. The River Calder, the Borough's principal river, is one of the Ribble's main tributaries. The River Don flows in a south-westerly through the FRA to join the River Brun.

The Leeds and Liverpool canal lies within the FRA, owned and maintained by the Canal and River Trust. The Canal does not pose a direct flood risk as it is a controlled waterbody with regulated flows that is managed by the Trust and has a very low risk of breach.

Current flood risk

There is a long history of flooding within Burnley. In December 2015, unprecedented rainfall events across Lancashire led to flooding in 9 Burnley communities varying in extent from 1 to 147 properties affected by internal flooding.

The flood hazard and risk maps show that in the Burnley Flood Risk Area some 4,408 people live in areas at risk of flooding from surface water. It covers approximately 1,837 residential properties, of which 6.4% are in areas of high risk.

Also shown to be at risk of flooding from surface water are:

- 746 non-residential properties, including hospitals, schools/colleges, retail parks and a leisure centre
- 2.57km of roads including parts of the M65 and A6114
- 1.38km of railway
- 11.92ha of agricultural land
- listed buildings and parks and gardens

The Flood Risk Maps for Surface Water in England - December 2019 provide more detailed information on the likelihood and consequence of flooding for the Burnley FRA.

Based on this information it is concluded that further steps should be taken to reduce the likelihood of flooding and its impact. In particular, the impact it can have on people, the economy and the environment both for now and the future.

How the risk is currently managed

The management of surface water flood risk is led by Lancashire County Council in collaboration with other Risk Management Authorities (RMAs) and other stakeholders, including the Environment Agency, United Utilities, National Highways and district and borough councils. The potential overlaps between them are the reasons why the Lancashire drainage authorities must continue to work together to understand and manage flood risk.

A clear illustration of the types of flooding and who is responsible for managing flood risk can be found on the Flood Hub. The potential overlaps between them are the reasons why the Lancashire drainage authorities must continue to work together to understand and manage flood risk.

Our Local Flood Risk Management Strategy is currently under review (expected to be finalised and adopted Autumn 2021). We also work constructively with other stakeholders as need and opportunity arises including:

- riparian owners and private landowners
- developers
- rivers trusts
- canal and river trust

- wildlife and conservation groups
- agricultural businesses
- catchment partnerships
- educational and research establishments
- flood action groups and other community groups
- members of the Lancashire resilience forum

The Lancashire FCERM Partnership is a collective grouping of flood risk management authorities who come together quarterly to take an overview of flood and coastal erosion risk management across Lancashire. They identify priorities and steer the use of our resources, to vote on changes to the Local Levy. They also support investment which is good value for money and benefits our communities.

There are two levels to partnership:

1. Strategic Partnership Group: Elected Members and senior representatives from Risk Management Authorities meet four times a year. This group is chaired by a Councilor. It sets the strategic direction for joint working and management of flood and coastal erosion risk of the Partnership against its resources, local risks and challenges. Group agrees the timetable delivery of actions identified in the Strategy's Business Plan. It is according to many factors such as delivery timescales and what will have the greatest benefit to our at-risk communities.
2. Tactical Officers Group: This is chaired by a local authority officer and is where technical lead officers deliver actions set by the Strategic Partnership Group. The group meets four times a year to coordinate delivery, share skills and implement decisions. Lead officers also report on issues, successes and identify ways to continually improve the management of flooding and coastal erosion risks into the future.

We also support operational Making Space for Water Groups. They are district-level technical partnership groups set up to discuss locally specific flood and coastal, where applicable, issues within their Local Authority area. They also provide a forum to drive forward solutions, where possible, through working in partnership.

These technical meetings are arranged and chaired by Local Authorities. Where applicable, feed outcomes of this meeting up to Tactical Officers Group and to the Northern Coastal Sub-Group. They also feed information down to the Operational 'Making Space for Water' Group.

The Environment Agency monitors surface water level (including tide and lake level) at 3 sites within the Burnley FRA. The Environment Agency also monitors river flow at a site immediately north of the FRA.

This information is used to inform activities related to 5 flood warning areas that cover the FRA which enable people to receive a warning when flooding could occur. This data also informs the operational response during a flood incident.

This Flood Risk Area was not identified as at high flooding risk by the LLFA's Level 1 Surface Water Management Plan for Pendle, Burnley and Hyndburn (completed July 2012). It was not progressed to a Level 2 Surface Water Management Plan in 2015.

Lancashire County Council owns assets that perform a flood risk management function in the public highway network, for example:

- culverts
- bridge structures
- gullies
- trash screens

The County Council's Highway Service Authority maintains these assets. The Environment Agency similarly maintains flood risk management assets including flood wall defences, channels and culverts, throughout the FRA.

United Utilities is responsible for the management of the urban drainage system including surface water and foul sewerage. Water company assets include:

- wastewater treatment works
- combined sewer overflows
- pumping stations
- detention tanks
- sewer networks
- manholes

Flood risk management within the study area is provided predominantly in the form of river walls. Some of which are walls of historical mill buildings, raised defences and natural floodplain storage. Within the FRA, retaining walls, weirs and culverts constrain parts of the River Calder at old mill sites.

The Canal and River Trust maintains the Leeds and Liverpool Canal as a navigable waterway.

There are no known flood risk improvement schemes since 2015 or known current investment plans and work programmes.

The impact of climate change and future flood risk

As rainfall intensity increases, it means that surface water flooding will become more frequent as higher rainfall totals will be seen more often.

Please refer to the Climate change and the North West RBD section for more information on what we know are likely to be the implications of climate change in the North West River Basin District.

Objectives and measures for the Burnley FRA

Measures have been developed which apply specifically to the Burnley FRA. These measures have been developed in addition to measures covering a wider geographic area, but which also apply to the Burnley FRA. You can find information about all the measures which apply to the Burnley FRA in the interactive mapping tool - Flood Plan Explorer. This includes information on which national objectives each measure helps to achieve.

The Ellesmere Port Rivers and the Sea Flood Risk Area

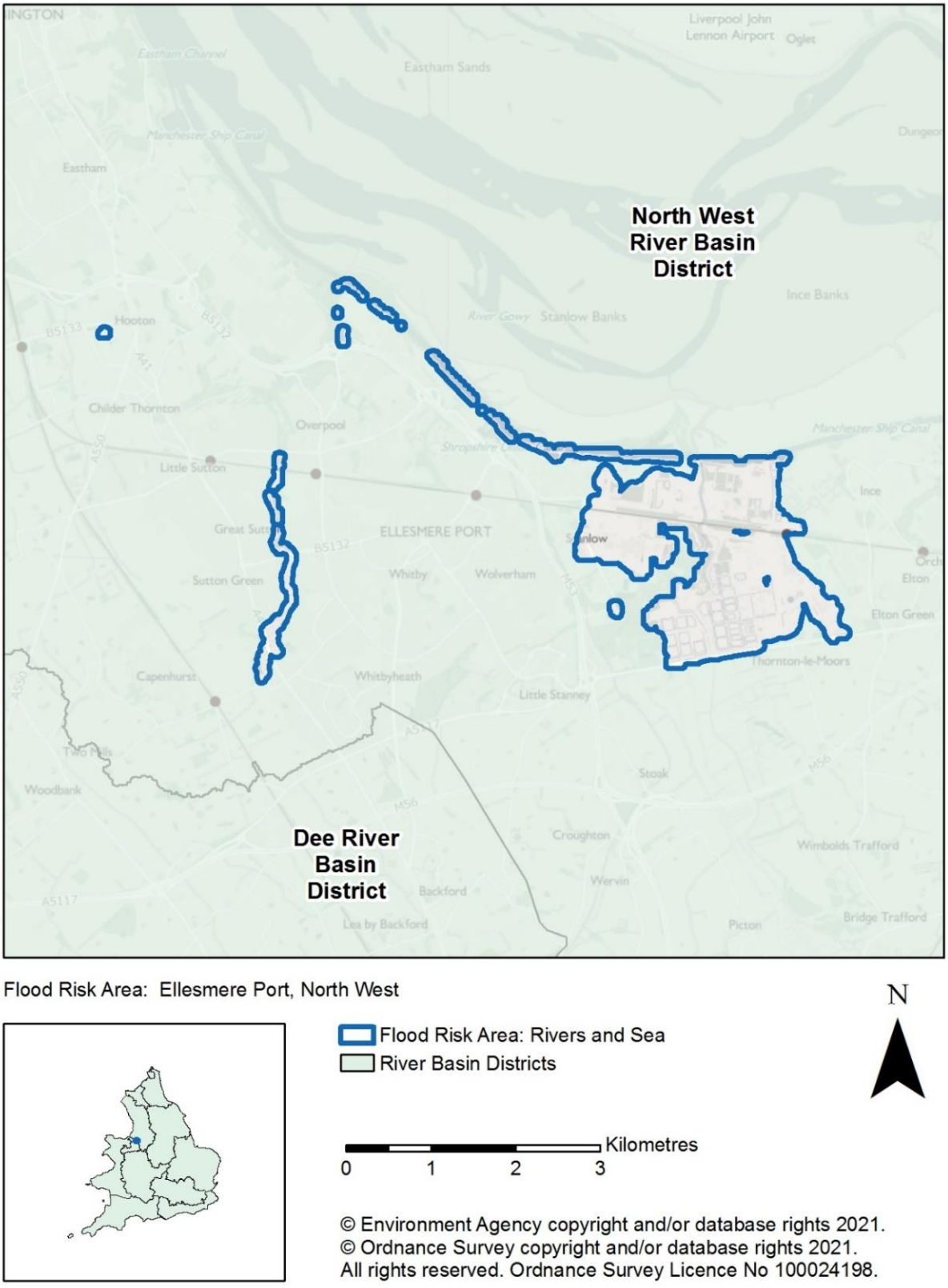


Figure 13: A map showing the boundary of the Ellesmere Port Flood Risk Area

Introduction to the Ellesmere Port Flood Risk Area

The Ellesmere Port Flood Risk Area (FRA) has been identified as the flood risk from rivers and the sea is considered nationally significant. The FRA includes the Stanlow Oil Refinery which is classified as national critical energy infrastructure. The Environment Agency take the lead on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA.

Cheshire West and Chester Borough Council are the Lead Local Flood Authority (LLFA) whose remit includes flood risk from surface water and ordinary watercourses.

United Utilities is the Water and Sewerage Company that own, operate and maintain the sewer network and waste water treatment infrastructure in the FRA.

The Ellesmere Port FRA is bounded to the north by the Mersey estuary and the Manchester Ship canal. It includes:

- residential districts adjacent to Riveacre Brook to the west of the town
- business and industrial areas to the north and the east where the river Gowy and its tributaries flow to the estuary. Most notably of these is the Stanlow oil refinery complex

There is farmland and amenity areas further the east, south and west of the FRA.

The Mersey Estuary Site of Special Scientific Interest (SSSI), Special Protection Area (SPA) and Ramsar Site lies to the north of the FRA. These designations reflect its importance to wildfowl. There are Local Wildlife Sites at Riveacre Valley and Boston Wood at the north of Riveacre Brook.

Gowy Meadows and Ditches to the south of the A5117The river Gowy is designated as a salmonoid river and therefore sensitive to sediment and gravel management. The site of Stanlow Abbey adjacent to the River Gowy north of the Manchester Ship Canal is a Scheduled Ancient Monument.

The Riveacre Brook catchment is urban and relatively small, being just under 1700ha. It drains an area from Capenhurst and Whitbyheath in a north north easterly direction. Districts of the town include:

- Great Sutton
- Whitby
- Little Sutton
- Overpool

The River Gowy catchment is much larger, some 18,300ha, of predominantly farmland. It drains an area from Peckforton, Bunbury and Tarporley broadly in a north westerly direction passed Tarvin, Kelsall and Guilden Sutton before reaching the FRA. None of the Chester City urban area drains to the catchment.

The Ellesmere Port sewerage system that covers the FRA drains to United Utilities (UU) A5117 treatment works located in the Gowy catchment.

The Manchester Ship Canal is owned and operated by Peel Ports, part of the Peel Group.

High tides on the Mersey Estuary are prevented from entering Riveacre Brook by tidal flap gates that are located immediately upstream of the Manchester Ship Canal. Similarly tidal flap gates on the river Gowy and its tributaries, Gale Brook and Thornton Brook, prevented high tides travelling further upstream. These tidal flap gates are located approximately 1km south of the Manchester Ship Canal.

Ellesmere Port has developed from the Viking settlement of Whitby and has expanded as the result of progressive industrialisation. The port initially developed on the Mersey with the construction of the Shropshire Union Canal in the late 17th Century. The arrival of the Manchester Ship Canal in the late 18th Century and then the petro-chemical industry in the 1920s saw the town grow. This latter development was built on cheap marshy land away from the main residential areas.

The construction of flood defences assets and realignment of watercourses has mainly been on the river Gowy and its tributaries. These protect the industrial site from flooding from both high tides and high river levels. The flood defence assets were last upgraded in 2004. This work also saw Thornton Brook diverted and the Gowy Meadows south of the A5117 being used to store high river flows.

Riveacre Brook has seen the installation tidal flap gates and debris screens. These screens trap floating debris and prevent it from blocking road crossings or longer culverts.

Current flood risk

The parts of the Stanlow refinery site were affected by tidal flooding in December 2013 but operations were not affected. 5 properties were reported to have flooded in Great Sutton from Storm Christoph in January 2021.

The Ellesmere Port area was also affected by surface water flooding in June 2016. 48 properties experienced internal flooding in the Ellesmere Port, Little Stanney and Little Sutton districts of the town. Flooding to highways, garden and open space was also experienced throughout the town and arose from the high rainfall intensity over a prolonged period.

The flood hazard and risk map for the Ellesmere Port FRA show 105 non-residential properties to be in areas of flood risk. Of these 36% are in high risk areas and a further 56% in medium risk areas. This includes the economically important Stanlow refinery site that is classified as national critical energy infrastructure. 128 people (approximately 55 residential properties) are shown to be in areas of flood risk. Of which 28% are in high risk areas and a further 43% in medium risk areas. This is comparable with the numbers of properties impacted by the June 2016 surface water flood event.

Also shown to be in areas of flood risk from rivers and the sea 1.2 km of the trunk road network and 2.0km of railway. Small elements of much larger environmental designated sites fall within the FRA, most of which are in areas of high flood risk. 15 water abstraction points, and some 8 discharge points are also in areas of flood risk.

The Flood Risk Maps for Rivers and Sea in England - December 2019 provide more detailed information on the likelihood and consequence of flooding for the Ellesmere Port FRA.

Based on this information it is concluded that further steps should be taken to reduce the likelihood and impact of flooding. This should consider the potential impact on people, the economy and the environment both now and in the future.

How the risk is currently managed

The management of flood risk from rivers and the sea is led by the Environment Agency. This work is performed in collaboration with other Risk Management Authorities (RMAs) and stakeholders. For this FRA these include Cheshire West and Chester Borough Council, United Utilities and the Weaver Gowy Catchment Partnership.

There are periodic operational meetings organised by Cheshire West and Chester Council for the RMAs to discuss work programmes and resolve any operational issues. The Cheshire Mid-Mersey FCRM Partnership group enable broader (catchment scale) tactical and strategic approaches to be agreed. This group includes:

- neighbouring LLFAs (Cheshire East, Cheshire West & Chester, Halton, St Helens, Staffordshire and Warrington)
- the Environment Agency
- United Utilities
- Lower Mersey and Weaver / Gowy Catchment Partnership hosts

The Environment Agency monitor river and rainfall conditions at 3 sites in the FRA. These collect data on river levels (2 sites), and rainfall (1 site).

This data is used to inform activities related to 5 flood warning areas that cover the FRA This enables people to receive a warning when flooding could occur. This data is also used to inform the operational incident response of RMAs.

The water level and flow information is also used to inform and calibrate mathematical modelling of watercourses in the FRA. River models exist for the:

- Mersey Estuary
- Manchester Ship Canal
- Riveacre Brook
- Gowy river system

All these river models except forthe upper reach of the Riveacre Brook last updated after 2015.

Flood risk maps are published based on the outputs from this mathematical modelling to inform:

- the public and business of their flood risk
- potential developers and local planning authorities
- the assessment and design of flood risk management works

Flood risk management assets reduce the risk of flooding to the Stanlow area on the river Gowy and its tributaries. This area is exposed to the risk of flooding from both river flows and high tides. This area, between the M56 and the Mersey Estuary, was last reviewed in the early 2000's and led to improvement works being completed by 2005. These consisted of earth embankments and tidal flap gates within the Stanlow refinery site. In addition, an upstream wetland flood storage area was improved by diverting Thornton Brook. The Folly Gates tidal flap gates have been identified as a category A Strategically Important Flood Risk Management Asset.

A review of all the assets at this location is currently being undertaken. This review will determine the best approach for the managing flood risk for the future and the role of each the stakeholders in it.

Cheshire West and Chester LLFA operate a tidal flap gate and a pumping station on an ordinary watercourse, North Ditch, within the refinery site. These assets reduce the risk of flooding on the surface water drainage system because of high tides.

Rivacre Brook to the west of the FRA has several debris screens as it passes through largely a residential area. There is also a tidal flap gate at its outfall into the Mersey Estuary.

Peel Ports maintain the Manchester Ship Canal as a navigable waterway and to permit the continued drainage of watercourses under or into the canal.

United Utilities maintain assets that perform a flood risk management function on the sewerage system.

The impact of climate change and future flood risk

The amount of rainfall and its intensity is expected to increase in the future, causing higher river flows and levels. Sea levels are also expected to rise. This means that flooding from rivers and the sea will become more frequent.

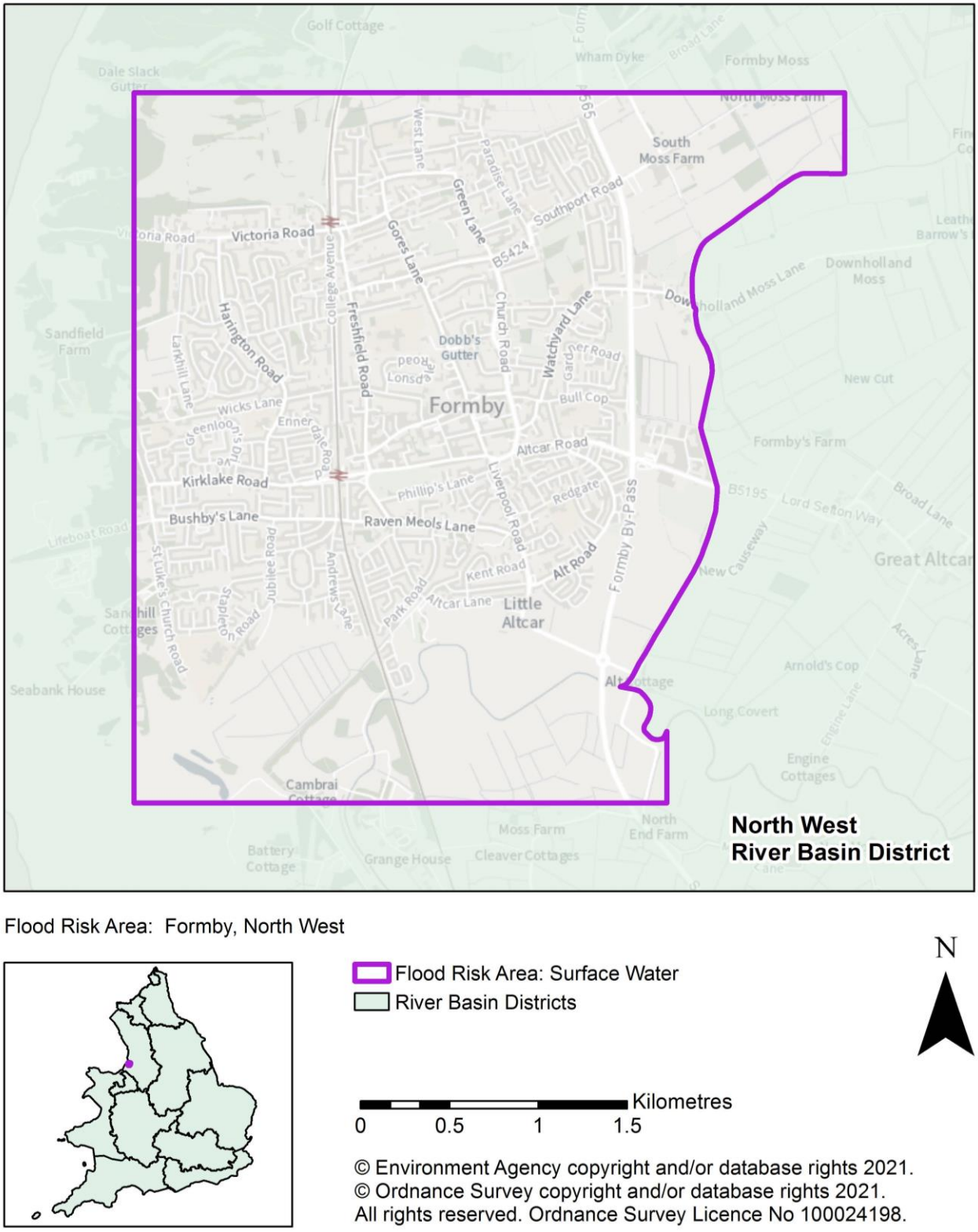
Section Climate change and the North West RBD provides information on the likely implications of climate change in the North West River Basin District. More detailed estimates of increases in peak river flows by 2115 for the Weaver Gowy catchment are approximately 25% great than the RBD estimates.

The approach to managing flood risk in the Ellesmere Port FRA will need to adapt to take account of these predictions and those for sea level rise.

Objectives and measures for the Ellesmere Port FRA

Measures have been developed which apply specifically to the Ellesmere Port FRA. These measures are in addition to measures covering the North West River Basin District or the whole of the country. You can find information about all the measures which apply to the Ellesmere Port FRA in the interactive mapping tool - Flood Plan Explorer. This includes information on which national objectives each measure helps to achieve.

The Formby Surface Water Flood Risk Area



Flood Risk Area: Formby, North West

Flood Risk Area: Surface Water
River Basin Districts

N

Kilometres
0 0.5 1 1.5

Figure 14: A map showing the boundary of the Formby Surface Water Flood Risk Area

Introduction to the Formby Surface Water Flood Risk Area

The Formby Flood Risk Area (FRA) has been identified as the flood risk from surface water is considered nationally significant.

Sefton Metropolitan Borough Council take the lead on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA. It is identified as the Lead Local Flood Authorities (LLFA) responsible for managing flood risk from local sources. These local sources of flooding are surface water, groundwater and ordinary watercourses.

The Environment Agency's remit includes flood risk from rivers and the sea.

United Utilities is the Water and Sewage Company that own, operate and maintain the sewer network and waste water treatment infrastructure in the FRA.

The Formby FRA covers many of the urban districts of Formby which includes residential, business and amenity areas. The FRA is surrounded by a green belt of mainly woodland, dunes and agricultural land.

Formby sits on a mudstone bedrock with much of the area covered with a superficial deposit of blown sand. The South east corner of the area has superficial deposits of alluvium surrounding the path of the River Alt. The west of Formby is protected from the sea by a band of sand dunes.

A Site of Special Scientific Interest (SSSI), a Special Area of Conservation (SAC), a Ramsar site, the Ribble and Alt Estuaries are located within the FRA. Several Local Wildlife Sites (LWS), several smaller Local Nature Reserves (LNR) and National Nature Reserves (NNR) are also present within the FRA.

The LWS include:

- Formby Moss
- Wham Dyke Meadows
- Freshfield Dune Heath
- Woodvale Airfield
- Willow Bank Caravan Park
- Formby Gold Club
- National Trust and associated fields

A number of other LWS are also present along the coastline.

Several listed buildings are present within the Formby FRA including the Grade II Listed Church of Saint Peter.

Formby was historically a fishing and farming area but when the railway between Liverpool and Southport was built in 1848 the development moved toward residential. In the period after the 1940s there was further expansion to the west of the railway line with residential development abutting the coastal sand dune system.

Recent residential developments to the town are taking place to the north east and south east and will drain into existing network of watercourses.

Formby is susceptible to surface water flooding due the low-lying nature of the borough. The water needs to be pumped through it for it to drain out into the sea. Surface water and ordinary watercourse systems drain into several main rivers that flow east into Downholland Brook or directly into the River Alt to the south. The River Alt is pumped out to sea via the Alt pumping station which is operated by the Environment Agency.

Several sewage discharge outlets are present across the FRA, including on the River Alt.

Much of the FRA is serviced by separate foul and surface water systems. Some parts of the town have a combined (foul and surface water) sewerage system. As a result, some areas have experienced flooding from sewers which occurs when their capacity is overcome by the amount of water trying to enter the network. The sand dunes protecting Formby are at risk of erosion by the sea, with high storm surges affecting the coastline. The dunes have been eroding for many decades though the depth of sand dunes will provide protection for the foreseeable future. Tidal flood risk is limited due to the width of sand dunes.

The River Alt flows in a south-westerly direction through the Formby FRA.

High water levels in the River Alt and Downholland Brook can prevent the surface water and ordinary watercourse systems in Formby discharging. This would result in water backs up along the system leading to flooding.

Current flood risk

The Formby FRA has had several historic incidents primarily relating to surface water. In September 2012, there were records of flooding at Hawksworth Drive. In December 2013 through to January 2014 a high storm surge affected areas along the Sefton coastline. Although there was no flooding to property, the sand dunes at Formby were affected. Following the winter 2013 to 2014 storms, despite Sefton Councils attempt to manage this issue using fencing and vegetation, it lost around 30 metres. In August 2020 there were reports of sewer flooding in the Formby region. Storm Christoph in January 2021 led to widespread surface water flooding across the area.

The flood hazard and risk maps show that in the Formby Flood Risk Area 7,257 people live in areas at risk of flooding from surface water. It covers approximately 3,024 residential properties, of which 22% are in areas of high risk.

Also shown to be at risk of flooding from surface water are:

- 179 non-residential properties, including schools/colleges and a golf course
- 0.74km of roads including part of the Formby Bypass
- 2.21km of railway
- 92.48ha of agricultural land

- areas of environmental designated sites, listed buildings and water abstraction points

The Flood Risk Maps for Surface Water in England - December 2019 provide more detailed information on the likelihood and consequence of flooding for the Formby FRA.

Based on this information it is concluded that further steps should be taken to reduce the likelihood of flooding and its impact. In particular, the impact it can have on people, the economy and the environment both for now and the future.

How the risk is currently managed

The management of surface water flood risk is led by Sefton Metropolitan Borough Council in collaboration with other Risk Management Authorities (RMAs) and other stakeholders. For example, the Formby Flood Action Group.

The Merseyside Flood Risk Partnership brings together the RMAs and other relevant stakeholders, to coordinate and maximise flood risk management across the area. For example, The Healthy Rivers Trust. A strategic partnership with elected members from each authority steers the direction of flood risk management and represents Merseyside at the North West Regional Flood and Coastal Committee (RFCC). A tactical partnership of lead officers supports the strategic group through the provision of technical advice and sharing of best practice. Sefton Council has an operational group where officers from the RMAs assess and seek to resolve local flood risk issues.

A Formby Flood Action Group was established in 2016 to implement action at a local level led by local councillors. The group have been working to develop surface water flood warning systems for the town to enable action to be undertaken early during an event.

Reported flood incidences are recorded on the relevant RMAs data systems.

The Environment Agency monitors groundwater levels at 1 site within the FRA.

This information is used to inform activities related to 1 flood warning areas that cover the FRA which enable people to receive a warning when flooding could occur. This data also informs the operational response during a flood incident.

Surface water flood modelling was undertaken in 2011 as part of the Surface Water Management Plan. This modelling is currently being updated and will be included in updates of the national surface water flood mapping.

Sefton Metropolitan Borough Council LLFA and United Utilities maintain assets that perform a flood risk management function on the drainage network that they have a responsibility for. Sefton Council maintain watercourse and structures which are located on land it owns. There are many riparian owners with responsibility for maintenance of watercourses, most of these are private residences. Sefton Council also uses its permissive powers to undertake maintenance on Dobbs Gutter watercourse due to its

significance in the drainage of the town. However, this does not remove the responsibility from the riparian owners.

The Environment Agency similarly maintains flood risk management assets on the main watercourses in the FRA. These include:

- screens
- outfalls
- flood defence embankments
- open channels

The impact of climate change and future flood risk

As rainfall intensity increases, it means that surface water flooding will become more frequent as higher rainfall totals will be seen more often. Rainfall across the wider catchment with see levels in Downholland and the River Alt be high more frequently. This will affect the gravity discharge of the surface water systems and ordinary watercourses within this FRA.

Sea level rise and increased storminess is likely to increase the risks of tidal flooding and erosion across this section. This can also impact on the ability of surface water systems to discharge during higher tides. Monitoring of this section of coastline is critical in assessing the rates of accretion against sea level rise.

Please refer to section Climate change and North West RBD for more information on what we know are likely to be the implications of climate change in the North West River Basin District.

Objectives and measures for the Formby FRA

Measures have been developed which apply specifically to the Formby FRA. These measures have been developed in addition to measures covering a wider geographic area, but which also apply to the Formby FRA. You can find information about all the measures which apply to the Formby FRA in the interactive mapping tool - Flood Plan Explorer. This includes information on which national objectives each measure helps to achieve.

The Higher Folds Rivers and the Sea Flood Risk Area

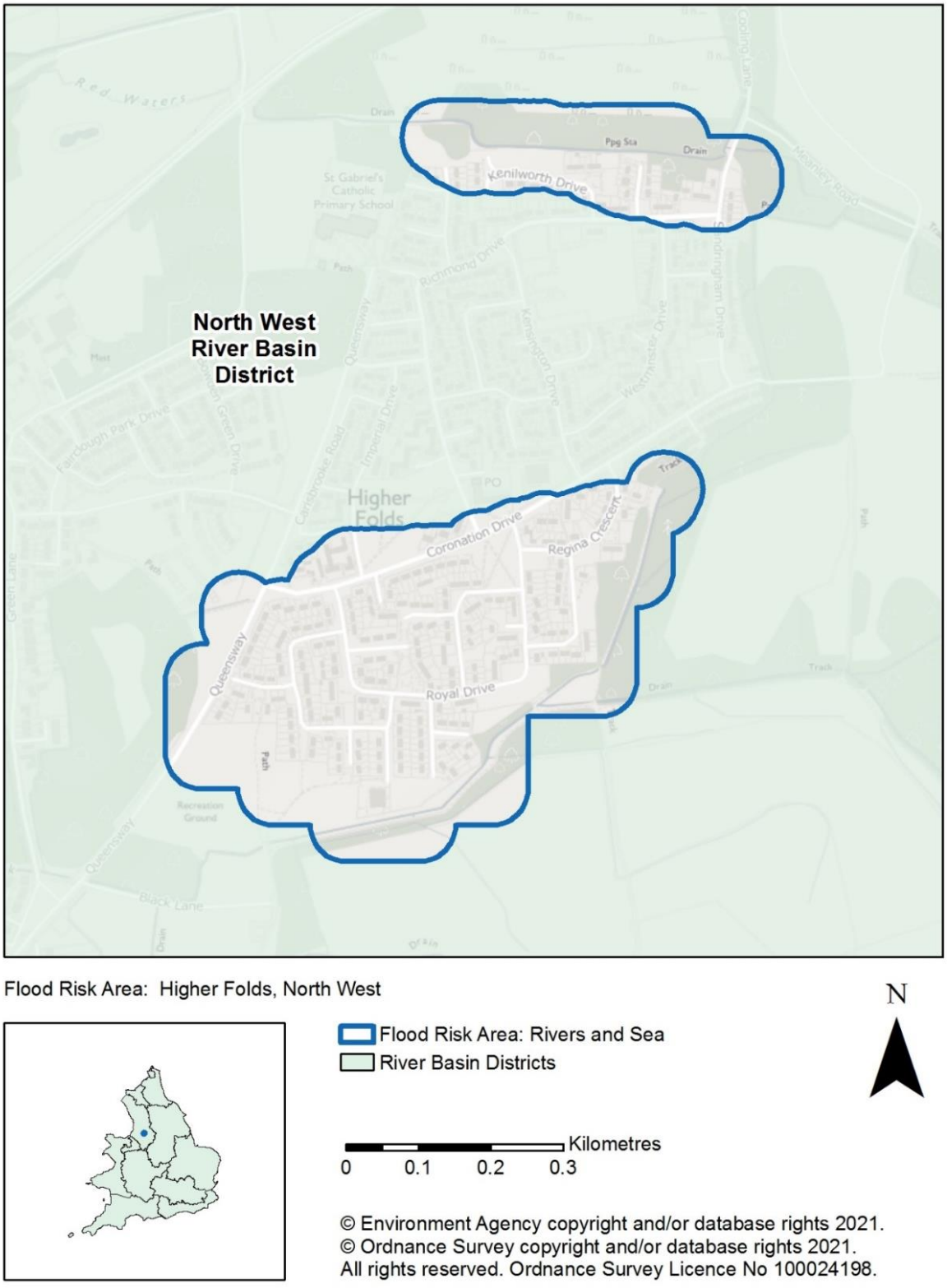


Figure 15: A map showing the boundary of the Higher Folds Flood Risk Area

Introduction to the Higher Folds Flood Risk Area

The Higher Folds Flood Risk Area (FRA) has been identified because the flood risk from rivers is considered nationally significant. The Environment Agency take the lead on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA.

Wigan Borough Council is the Lead Local Flood Authority (LLFA) whose remit includes flood risk from surface water and ordinary watercourses.

United Utilities is the Water and Sewerage Company that own, operate and maintain the sewer network and waste water treatment infrastructure in the FRA.

The Higher Folds FRA comprises the urban areas of the town and is surrounded by areas of farmland and other urban districts. These include Bedford to the south west, Lilford to the west, Atherton to the north and Tyldesley to the north east. The flood risk management of these other districts is covered in the Atherton FRA section.

The Leigh branch of the Leeds Liverpool canal joins with the Bridgewater canal in Leigh.

The Abram Flashes to the west of the FRA are designated as a Site of Special Scientific Interest (SSSI) as is Astley and Bedford Mosses situated to the SE of the FRA. Pennington Flash is designated as a Local Nature Reserve (LNR) and it along with Lilford Park and Hope Carr (east of Pennington) are Local Wildlife Sites (LWS). Tyldesley Town Centre and Leigh Bridge in Leigh are designated as heritage Conservation Areas (HCA).

This area around Leigh has developed through the industrial revolution initially through the textile industry and then the coal mining industry. The connecting of Leigh to industrial cities through the opening of the Bridgewater (1795) and the Leeds – Liverpool (1820) canals were key to this. The mining industry which finally closed in 1992 impacted the landscape by the disposal of spoil and areas of land subsidence, some of which became flooded to form flashes. Groundwater levels that were lowered for the mining are now considered to have largely recovered to natural levels.

Cooling Lane Brook that runs through the FRA drains a small area south east from Tyldesley. It is part of the much larger Bedford Brook catchment. As Cooling Brook flows away from the FRA it becomes Penleach Brook before entering the Atherton FRA.

A large proportion of properties in the Higher Folds FRA considered to be at risk of flooding from Cooling Lane Brook are also considered to be at risk of flooding from surface water.

The Bedford Brook Flood Risk Management Scheme provides an integrated approach to managing flood risk that benefits both the Higher Folds and the Atherton FRAs. In developing future proposals the two FRA have been considered together. The Bedford Brook Flood Risk Management Scheme is described under the Atherton FRA section.

Current flood risk

The FRA has experienced flooding most recently in 2021 when 7 properties are reported to have flooded from surface water due to storm Christoph. Due to the operation of the Bedford Brook Flood Risk Management Scheme no flooding from the river has been report in the FRA since 2000.

The flood hazard and risk maps show that in the Higher Folds Flood Risk Area 841 people (approximately 350 residential properties) live in areas at risk of flooding from rivers and the sea of which 43% are at high risk.

Also shown to be at risk of flooding from rivers and the sea are:

- 5 non-residential properties, including a community centre
- 21.71ha of agricultural land

The Flood Risk Maps for Rivers and the Sea in England – December 2019 provide more detailed information on the likelihood and consequence of flooding for the Higher Folds FRA.

Based on this information it is concluded that further steps should be taken to reduce the likelihood and impact of flooding. This should consider the impact on people, the economy and the environment both now and in the future.

How the risk is currently managed

The management of flood risk from rivers and the sea is led by the Environment Agency in collaboration with other Risk Management Authorities and stakeholders. For this FRA these include Wigan Borough Council, United Utilities and the Lower Mersey Catchment Partnership.

There are regular operational meeting organised by Wigan Borough Council for the RMAs to discuss work programmes and resolve any operational issues. The Greater Manchester FCRM Partnership group enable broader (catchment scale) tactical and strategic approaches to be agreed with neighbouring LLFAs.

The Environment Agency monitor river and rainfall conditions at 9 sites in the vicinity of this FRA. These collect data on river levels (7 sites), river flows (1 site) and rainfall (1 site).

This data is used to inform activities related to 2 flood warning areas that cover the FRA. This enables people to receive a warning when flooding could occur. This data is also used to inform the operational response of RMAs eg the operation of Bedford Brook Pumping Station.

The water level and flow information is also used to inform and calibrate mathematical modelling of the river network. All the main river watercourses have A river model exists for Cooling Lane Brook within the FRA dating from after 2015.

Flood risk maps are published based on the outputs from the mathematical modelling to inform:

- the public and businesses of their flood risk
- potential developers and local planning authorities
- the assessment and design of flood risk management works

Throughout the FRA the Environment Agency routinely inspect and periodically maintain flood risk management assets in working order. These include river channels, culverts and debris screens. Wigan LLFA and United Utilities similarly maintain their assets that perform a flood risk management function on the drainage network.

The part of the Bedford Brook catchment that drains through the Atherton and Higher Folds FRAs is actively managed to reduce the risk of flooding in the Leigh area. This is done primarily by the operation of Bedford Pumping Station in tandem with the Lilford Park Flood Storage Reservoir (FSR). The capacity of the pumping station has been set to match the capacity of the downstream Bedford Brook river channel.

At times of high flows, when the capacity of Bedford Brook would be exceeded, river water is stored in the Lilford Park FSR. This allows Penleach Brook to continue to drain the Higher Folds area. Water stored in the Lilford Park FSR is then released back into the river system once flows have reduced and it is considered safe to do so.

Both the Bedford Pumping Station and the Lilford Park FSR are routine inspected and maintained. The Lilford Park FSR qualifies as a large raise reservoir and is subject to the provisions of the Reservoirs Act 1975. Individual flood risk assets, for example, a pump, are periodically reviewed and replaced or upgraded to ensure the functionality of the sites.

This flood risk management approach, that benefits over 500 properties, is currently subject to a strategic review. This review will determine the best approach for managing from flood risk in the Higher Folds and Atherton FRAs for the future.

The impact of climate change and future flood risk

The amount of rainfall and its intensity is expected to increase in the future, causing higher river flows and levels. This means that flooding from rivers will become more frequent.

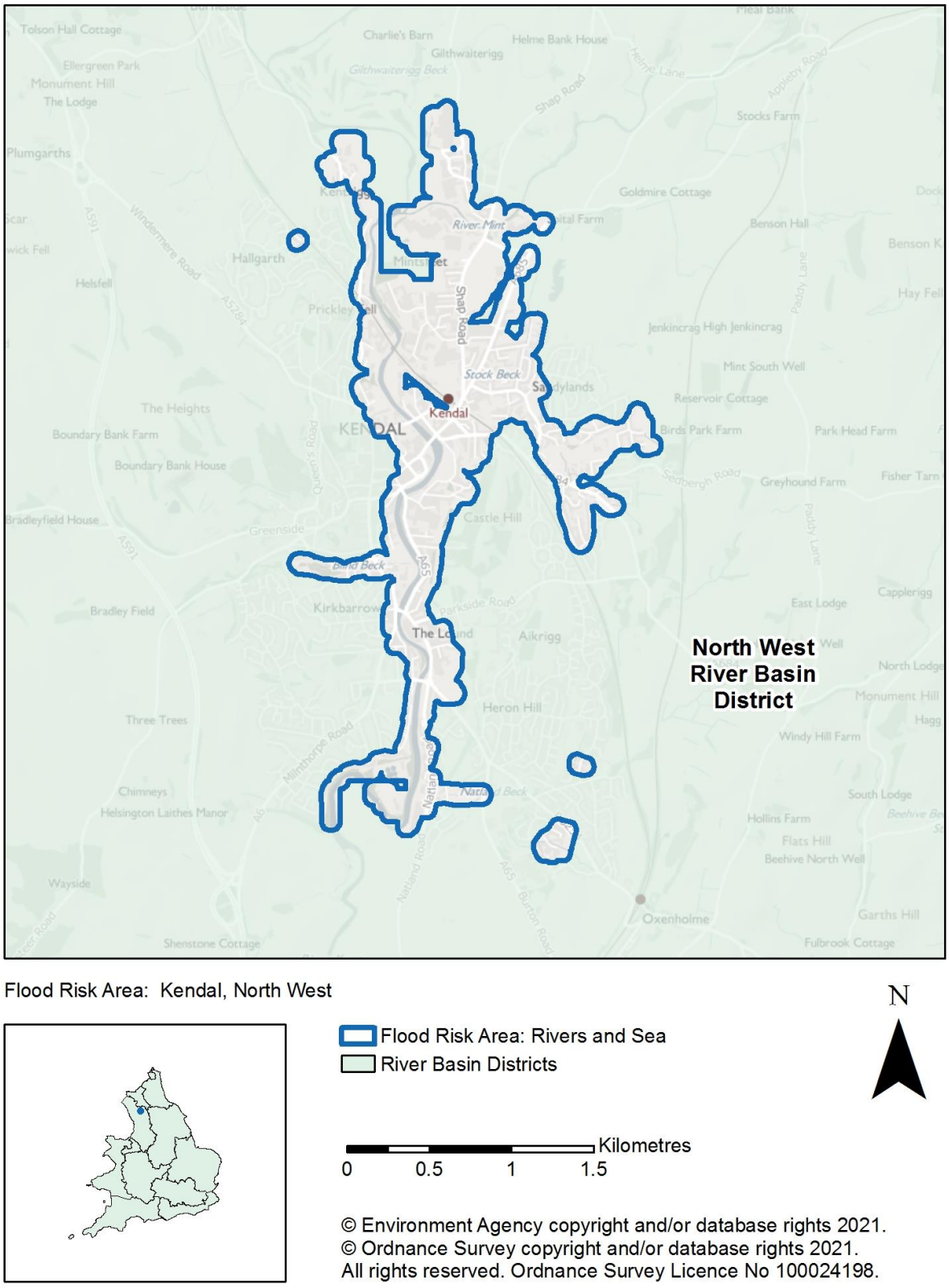
Section Climate change and the North West RBD provides information on the likely implications of climate change in the North West River Basin District. Estimates of increases in peak river flows by 2115 for the Lower Mersey catchment are consistent with the RBD estimates.

The approach to managing flood risk in the Higher Folds FRA will need to adapt to take account of these predictions.

Objectives and measures for the Higher Folds FRA

Measures have been developed which apply specifically to the Higher Folds FRA. These measures are in addition to measures covering the North West River Basin District or the whole of the country. You can find information about all the measures which apply to the Higher Folds FRA in the interactive mapping tool - Flood Plan Explorer. This includes information on which national objectives each measure helps to achieve.

The Kendal Rivers and the Sea Flood Risk Area



Flood Risk Area: Kendal, North West

Flood Risk Area: Rivers and Sea

River Basin Districts

N

Kilometres

0 0.5 1 1.5

Figure 16: A map showing the boundary of the Kendal Rivers and the Sea Flood Risk Area

Introduction to the Kendal Rivers and the Sea Flood Risk Area

The Kendal Flood Risk Area (FRA) has been identified as the flood risk from rivers and the sea is considered nationally significant.

The Environment Agency take the lead on the development and delivery of the Flood Risk management Plan (FRMP) for this FRA, whose remit includes flood risk from rivers and the sea.

Cumbria County Council is the Lead Local Flood Authority (LLFA) responsible for managing flood risk from local sources. These local sources of flooding are surface water, groundwater and ordinary watercourses.

United Utilities is the Water and Sewage Company that own, operate and maintain the sewer network and waste water treatment infrastructure in the FRA.

The Kendal FRA covers many of the urban districts of Kendal which includes residential, business and amenity areas and surrounded by a green belt of agricultural land.

The impermeable bedrock and thin soils combined with the steep nature of the upper catchments of the River Kent give rise to limited infiltration and a rapid response to rainfall events in the Kendal FRA. The geology in this area is limestone. High groundwater levels do not persist and tend to drop quickly after a rainfall event.

The River Kent and tributaries are a Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC) located within the Kendal FRA.

A Scheduled Ancient Monument, Watercrook Roman Fort and civil settlement falls within the FRA. Several listed buildings are located within the FRA including the Grade II listed Church of Holy Trinity and Saint George.

The River Kent conveys water from the Kent operational catchment through the Kendal FRA to the Kent Estuary in the south. Rising in the south eastern Lakeland fells, this operational catchment is dominated by the River Kent and its tributaries. The River Mint and Natland Beck, the River Sprint and Stock Beck, drain smaller more local areas throughout the Kendal FRA.

Heavy rainfall on the steep catchments of the surrounding hills, and many watercourses in a dense built environment can lead to flash flooding. During storm events, the Kendal FRA is very prone to this type of flooding. This is partly due to the topography and the geology of the region but also because of dense development that constrains the watercourses, leading to surcharging and flooding of properties.

Additionally, lack of vegetation and damaged peatlands in these upper catchments reduces the capacity of the land to hold water and speeds the flow into the river channels. This increases the peak flow of flood waters and the risk of flooding in the FRA.

Groundwater flooding in the Kendal FRA usually occurs when river levels of the Kent and local watercourses are high. This suggests an interconnection with high water levels in the main river, through the permeable gravel deposits on the valley floor.

Current flood risk

The Kendal FRA experienced the largest flood event ever recorded in December 2015 because of the Storm Desmond. 2,150 properties were directly affected by flooding, with the majority of these located in the Mintsfeet and Sandylands areas of Kendal.

Kendal has a long history of flooding dating back as far as the 17th century. In November 1898 Kendal experienced a significant flood event, as well as in December 1954 when 300 residential and 70 commercial properties were impacted. Following further significant flood events in 1964 and 1968, the River Kent-Kendal flood alleviation scheme was completed in 1979 and incorporated widening and deepening the river channel to help achieve the required flow capacity through the town.

In February 2004, a fluvial event flooded 80 properties in central Kendal and the Mintsfeet area. Very heavy rainfall in January 2005 resulted in the flooding of over 100 properties. The main areas affected during this event were Mintsfeet, Busher Walk, Aynam Road, and Aikrigg End. A further flood event occurred in November 2009 causing significant flooding in Cockermouth, Keswick, and Workington in north-west Cumbria.

The flood hazard and risk maps show that in the Kendal Flood Risk Area 5,366 people (2,236 residential properties) live in areas at risk of flooding from rivers and the sea of which 42.45% are in areas of high risk.

Also shown to be at risk of flooding from rivers and the sea are:

- 681 non-residential properties, including schools/colleges, business parks, shopping centres and public utilities e.g. the Kendal Wastewater Treatment Works south of the FRA
- 4.01km of roads including parts of the A6 and A65
- 0.19km of railway
- 29.71ha of agricultural land
- areas of environmental designated sites, listed buildings, scheduled monuments and water abstraction and discharge points

The Flood Risk Maps for Rivers and Sea in England - December 2019 provide more detailed information on the likelihood and consequence of flooding for the Kendal FRA.

Based on this information it is concluded that further steps should be taken to reduce the likelihood of flooding and the impact it can have on people, the economy and the environment both for now and the future.

How the risk is currently managed

The management of flood risk from rivers and the sea is led by the Environment Agency in collaboration with other Risk Management Authorities (RMAs), for example Cumbria County Council and United Utilities, and other stakeholders.

The Environment Agency monitors river level at 9 sites in and adjacent to the FRA. This information is used to inform activities related to flood warning areas that cover the FRA which enable people to receive a warning when flooding could occur. This data also informs the operational response during a flood incident.

The Environment Agency has also carried out investigations to identify options for improving flood risk within the FRA. As part of this work mathematical modelling has been undertaken during the appraisal and design stage of the project to improve the understanding of the flood risk and to develop options to reduce the risk of flooding.

This has continued with the development of a three phase Flood Risk Management Scheme to better protect residential and business properties from flooding in the Kent catchment and improve the local environment and community amenities. The preferred option takes a catchment based approach and includes a combination of linear defences, improved pumping and conveyance, upstream storage, complimentary natural flood management interventions and wider environmental improvements. Kendal Town is the first phase, and construction started in 2020 with work continuing the development of designs for the next two phases.

Cumbria County Council LLFA and United Utilities maintain assets that perform a flood risk management function on the drainage network. And the Environment Agency similarly maintains flood risk management assets for example screens and defences including embankments and channels throughout the FRA.

The impact of climate change and future flood risk

As rainfall intensity increases, it means that surface water flooding will become more frequent as higher rainfall totals will be seen more often.

Please refer to section Climate change and the North West RBD for more information on what we know are likely to be the implications of climate change in the North West River Basin District.

Objectives and measures for the Kendal FRA

Measures have been developed which apply specifically to the Kendal FRA. These measures have been developed in addition to measures covering a wider geographic area, but which also apply to the Kendal FRA. You can find information about all the measures which apply to the Kendal FRA in the interactive mapping tool - Flood Plan Explorer. This includes information on which national objectives each measure helps to achieve.

The Liverpool Surface Water Flood Risk Area

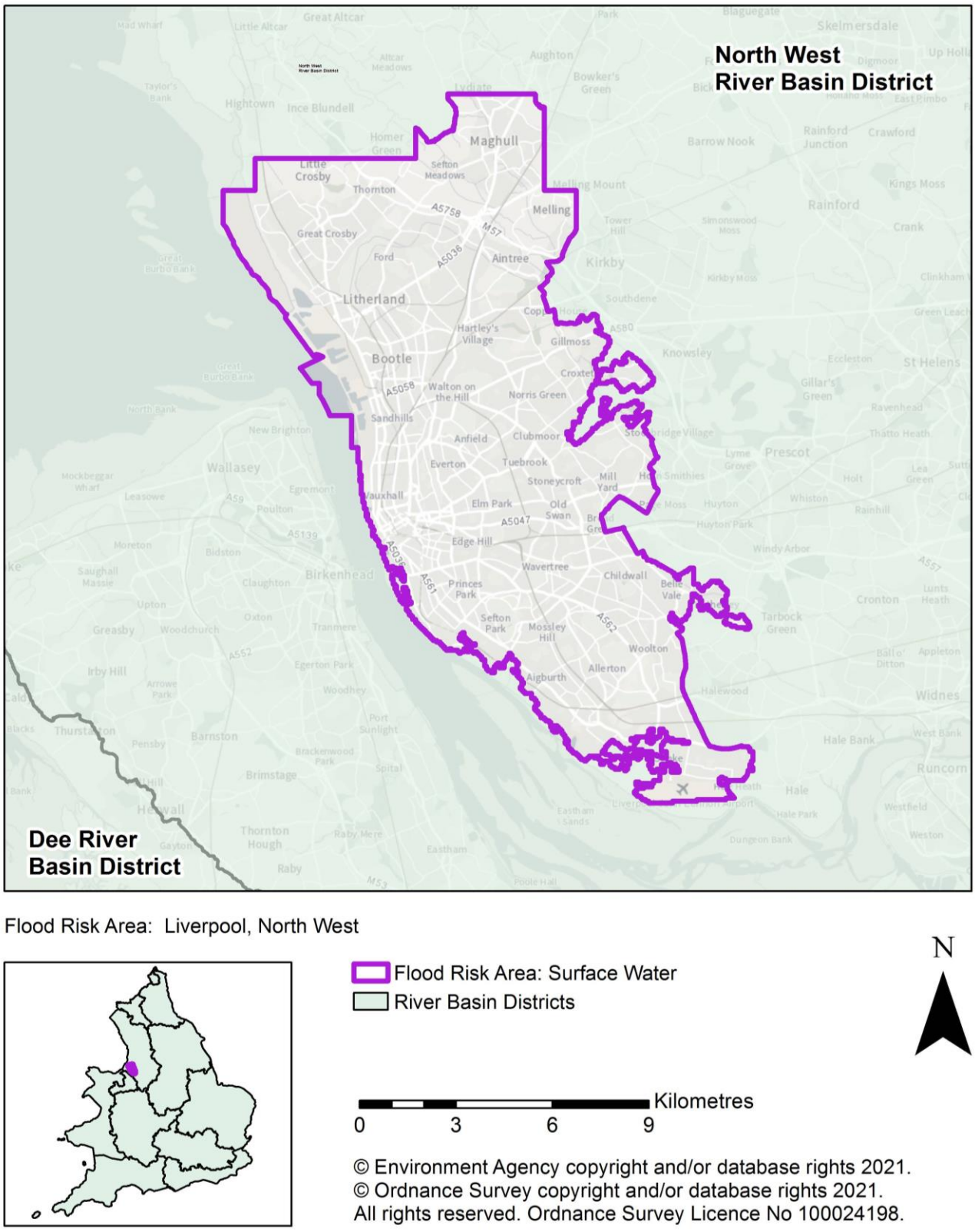


Figure 17: A map showing the boundary of the Liverpool Surface Water Flood Risk Area

Introduction to the Liverpool Surface Water Flood Risk Area

The Liverpool Flood Risk Area (FRA) has been identified as the flood risk from surface water is considered nationally significant.

Liverpool City Council and Sefton Metropolitan Borough Council take the lead on the development and delivery of the Flood Risk management Plan (FRMP) for this FRA. It is identified as the Lead Local Flood Authorities (LLFA) responsible for managing flood risk from local sources. These local sources of flooding are surface water, groundwater and ordinary watercourses.

The Environment Agency's remit covers flood risk from rivers and the sea.

United Utilities is the Water and Sewage Company that own, operate and maintain the sewerage network and waste water treatment infrastructure in the FRA.

The Liverpool FRA covers many of the urban districts of Walton, Anfield, Wavertree, Waterloo and Bootle which includes residential, business and amenity areas. The FRA is surrounded by a green belt of agricultural land to the north and the Mersey estuary to the south and west.

The Liverpool FRA lies upon a sandstone aquifer, exploited in the past for various uses such as industry, mining and water supply. Since industry has declined, groundwater exploitation has reduced dramatically, causing the natural process of groundwater recharge and the raising of the water table. The superficial deposits in Liverpool are glacial till of clay, sand and gravel. The superficial deposits across Sefton from Crosby to Maghull are a patchwork of sand and a glacial till of clay, sand and gravel. There is also a strip of alluvial deposits along the course of the River Alt.

Part of the Mersey Estuary Special Protected Area (SPA), Site of Special Scientific Interest (SSSI), Ramsar site and Coastal Reserve is located within the FRA. Sefton Coast Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC) are found within the FRA. Several Local Wildlife Sites (LWS) are found within the FRA. The LWS include Sefton Park, Loop Line and adjacent sites, Crosby Marine lake and park, Rimrose Valley and canal and others.

Two Ancient Woodland sites, Stocktons Wood and Fullwood Wood are located within the FRA. Liverpool Bay is a designated SPA and Croxteth Local Nature Reserve (LNR) and Brook Vale LNR, plus others, are located within the FRA. The FRA includes a Special Protected Area and Ramsar site, the Ribble and Alt estuaries.

Many listed buildings are housed within the FRA, in addition to several 'Heritage at Risk' sites. It includes areas in the Liverpool Conservation Area, Old Hall moated site and fishponds which is also a Scheduled Monument.

Historically Liverpool's story begins at the river, the pool which was a tributary of the River Mersey which is now buried beneath Liverpool One shopping centre. This area was home to a small fishing village in the 13th Century. Growth occurred when its port boomed

during the 17th and 18th century via the slave and cotton trades which helped the City to prosper and grow.

Liverpool was historically drained by a network of open channels, brooks and rivers. These discharged into the River Alt to the North and East, and the River Mersey to the South and West of the City. As Liverpool developed, the surface water system grew around the existing open channel network. The resultant drainage system comprised a series of small sub-catchments linked by ditches and watercourses.

Dense housing developed to the north of Liverpool to support the shipping trade this was serviced with piped drainage systems. Further north Crosby largely developed on coastal dunes. In the 1920s several properties were undermined as the River Alt was pushed against the coast due to sediment drifting south. This resulted in the Alt Training wall being built in the 1930s.

Following this there was an ad-hoc approach to coastal protection that was consolidated in the late 1960s and early 1970s with the current seawall. The continual drift of sediment to the south has led to a build-up of beach levels at Waterloo, the development of dunes on the beach in front of the sea wall and inland of the seawall. These higher beach levels offer significant protection to the existing sea wall. The northern end of the coast has seen lowering of beach levels due to wave driven sediment draw down.

Further inland, the Maghull developed on an area that was partly the historic flood plain of the River Alt giving way to higher ground to the north east. Numerous watercourses flow through the town to the River Alt to provide drainage. The Leeds and Liverpool canal started construction in 1770 and now bisects the town. Its path meanders through Bootle and on into Liverpool Docks.

Liverpool is now a predominantly urban area covering approximately 114km^2. It is particularly vulnerable to surface water flooding due to runoff from impermeable surfaces.

Over time, minor channels within the FRA were either culverted, laid with land drains and backfilled, or filled in, leading to a reduction in the efficiency of the original land drainage system. Potential collapses or blockages within culverts within the FRA pose a considerable risk of future flooding.

Many of Liverpool’s culverted watercourses are incorporated into the sewer system. Each of Liverpool’s culverted watercourses has inlet and outlet structures and debris screens. Without adequate maintenance to ensure free flow they could potentially increase flood risk to adjacent areas.

Sefton is susceptible to surface water flooding due the low-lying nature of the borough. The water needs to be pumped through it for it to drain out into the sea. The surface water system drains into numerous watercourse that flow through the north east of the FRA. Maghull drains by gravity into the River Alt.

Several sewage discharge outlets are present across the FRA.

Much of the FRA is serviced by a combined (foul and surface water) sewerage system, particularly in the older parts of the FRA. As a result, some areas have experienced flooding from sewers which occurs when their capacity is overcome by the amount of water trying to enter the network. More modern parts of the town in Maghull and Aintree have separate foul and surface water systems.

Surface water in the Liverpool FRA drains via ditches and watercourses to the Rivers Alt and Mersey. It drains directly or via the eight brooks that have been designated as main rivers by the Environment Agency. However, the high level of the ground water table during wet conditions can result in high water levels in these ditches and watercourses. It prevents the sub-catchments from discharging surface water effectively. High levels in the River Alt prevents many larger watercourses from discharging effectively and water backs up in the system leading to flooding.

High groundwater levels cause localised flooding in the FRA. Perched water tables are also present in Liverpool due to localised areas of less permeable material and most common in areas where the underlying geology is clay. It is estimated that the underlying clay strata is present across the vast majority of the City. In other areas, primarily in the City Centre the dense sandstone bedrock provides little infiltration.

Tidal flooding on the River Mersey occurs during high spring tides which causes a rapid increase in water levels together with strong winds. This flooding is most likely to occur within low lying areas or areas directly adjacent to the River Mersey estuary. Particularly when high astronomical tide levels combine with low atmospheric pressure conditions in combination with powerful onshore wind direction.

Sefton is at risk from flooding and erosion from the sea, with high storm surges affecting the coastline from High Town to Crosby. The coastal defences along the Crosby frontage can suffer damage during these events. Overtopping and flooding of coastal car parks is common at the northern end. Erosion of the made ground to the north also occurs.

The Leeds and Liverpool canal lies within the FRA, owned and maintained by the Canal and River Trust.

Current flood risk

In July 2010, Liverpool experienced a high intensity rainfall event. It resulted in widespread flooding across the city, affecting properties and transport networks in three known flooding locations, Crawford Close, Churchdown Road and Leyfield Road. In this event, approximately 257 properties flooded internally.

In June and August 2020 parts of South Liverpool flooded including the Dovecot, Mossley Hill and Garston areas of the City.

In December 2020, the West Derby and Deysbrook areas of the City suffered from internal property flooding. It caused severe disruption to the Highway Network. This incident triggered a Section 19 Flood Investigation.

In the early nineties the Leeds and Liverpool Canal burst its banks flooding over 200 properties. In July 2010, 50 properties were flooded in Seaforth and in September 2012, 40 properties in Maghull were flooded.

The winter of 2013/2014 saw a series of storm events that significantly impact the coastline with widespread damage, erosion and overtopping of defences in Sefton.

In December 2015, widespread flooding impacted roads and properties in Sefton. In Autumn 2019 the Dover's Brook overtopped its bank and properties narrowly avoided flooding due to preventative action by the residents and RMA.

In June 2020, widespread ponding on the highway network across Sefton. In August 2020, flooding was recorded in the Maghull, Thornton, Southport, Crossens and Formby areas of Sefton.

In January 2021, significant rainfall brought by Storm Christoph led to the Environment Agency issuing two Severe Flood Warnings in Maghull, covering 439 properties within the flood warning areas. The record river levels experienced during Storm Christoph breached flood defences on the River Alt next to the Environment Agency's Lunt Meadows Flood Storage Basin and nature reserve, managed by Lancashire Wildlife Trust. The predicted flooding did not happen as forecast as less rain was received than forecast, along with river levels dropping rapidly. This appears to have been key in preventing the extensive flooding forecast in Maghull.

The flood hazard and risk maps show that in the Liverpool Flood Risk Area 90,041 people live in areas at risk from flooding from surface water. It covers approximately 37,517 residential properties, of which 17.68% are in areas of high risk.

Also shown to be at risk of flooding from surface water are:

- 4,557 non-residential properties, including golf courses, schools/colleges, hospitals, retail parks, industrial parks and public utilities
- 1 Airport
- 38.83km of roads
- 41.65km of railway
- 526.69ha of agricultural land
- areas of environmental designated sites, parks and gardens, scheduled monuments, heritage sites, listed buildings and water abstraction points

The Flood Risk Maps for Surface Water in England - December 2019 provide more detailed information on the likelihood and consequence of flooding for the Liverpool FRA.

Based on this information it is concluded that further steps should be taken to reduce the likelihood of flooding and its impact. In particular, the impact it can have on people, the economy and the environment both for now and the future.

How the risk is currently managed

The management of surface water flood risk is led by Liverpool City Council & Sefton Metropolitan Borough in collaboration with other Risk Management Authorities (RMAs) and other stakeholders. For example, Mersey Rivers Trust, the Canal and Rivers Trust.

Under Section 13 of the Flood and Water Management Act 2010, RMAs are required to work in partnership and cooperate to help holistically manage flood and coastal erosion risks in their area.

Operational, tactical and strategic level meetings (chaired by a local councillor) between RMAs and stakeholders are held on a quarterly basis. The aim of the meetings is to help meet the agreed actions set out within the Partnership's annual Business Plan.

The Merseyside Flood Risk Partnership brings together the RMAs and other relevant stakeholders, to coordinate and maximise flood risk management across the area for example, The Healthy Rivers Trust.

A strategic partnership with elected members from each authority steers the direction of flood risk management and represents Merseyside at the North West Regional Flood and Coastal Committee (RFCC).

A tactical partnership of lead officers supports the strategic group through the provision of technical advice and sharing of best practice. Sefton Council has an operational group where officers from the RMAs assess and seek to resolve local flood risk issues.

The Environment Agency monitors groundwater level at 8 sites within the Liverpool & Sefton FRA. The Environment Agency also monitors surface water levels at 3 sites in the FRA.

Reported flood incidences are recorded on the relevant RMAs data systems.

This information is used to inform activities related to 6 flood warning areas that cover the Liverpool FRA. It enables people to receive a warning when flooding could occur. This data also informs the operational response during a flood incident.

Liverpool City Council, United Utilities and the Environment Agency have undertaken an integrated modelling study to provide Flood mapping for the Liverpool City Council area.

The flood maps were reviewed and validated against United Utilities DG5 Register, flooding records from Liverpool City Council and local knowledge held by the various stakeholders. The United Utilities DG5 Register include record of reported sewer flooding to properties. The flood maps have been found to perform very well, showing good correlation to known Flood Risk Areas across the city.

The modelling provided a previously unknown understanding of the performance of the culverted watercourse network within the City. It is now a vital tool which is regularly used

for providing LLFA responses to planning applications, developing capital schemes and the identification of capacity issues.

Liverpool City Council and Sefton Borough Council LLFAs and United Utilities maintain assets that perform a flood risk management function on the drainage network that they have responsibility for. Liverpool City Council also maintain several other structures and defences on ordinary watercourses such as debris screens. There are many riparian owners with responsibility for maintenance of watercourses including private residences.

Sefton Council maintain the hard-coastal defences at Crosby.

The Environment Agency similarly maintains flood risk management assets on the main watercourses in the Liverpool FRA.

These include:

- screens
- outfalls
- control gates
- spillways
- flood defence embankments
- open channels

The Alt Pumping station is maintained by the Environment Agency. The Canals and Rivers Trust maintains the Leeds and Liverpool Canal as a navigable waterway.

The impact of climate change and future flood risk

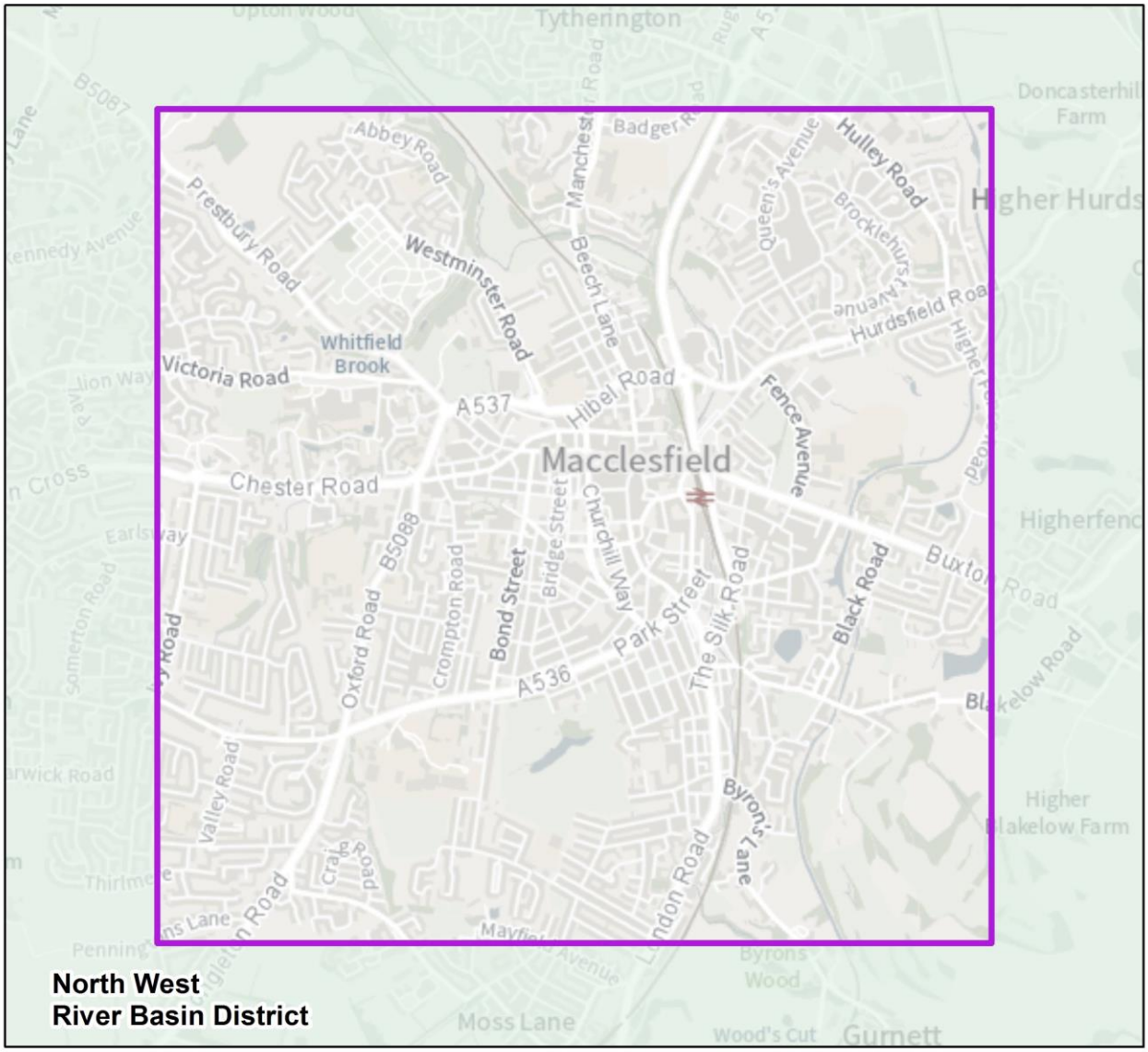
As rainfall intensity increases, it means that surface water flooding will become more frequent as higher rainfall totals will be seen more often.

Please refer to section Climate change and North West RBD for more information on what we know are likely to be the implications of climate change in the North West River Basin District.

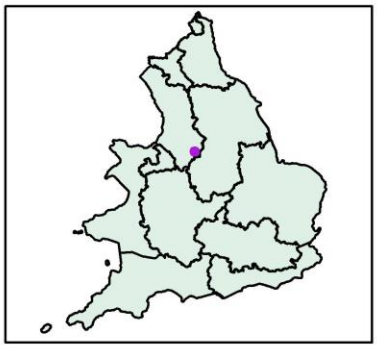
Objectives and measures for the Liverpool FRA

Measures have been developed which apply specifically to the Liverpool FRA. These measures have been developed in addition to measures covering a wider geographic area, but which also apply to the Liverpool FRA. You can find information about all the measures which apply to the Liverpool FRA in the interactive mapping tool - Flood Plan Explorer. This includes information on which national objectives each measure helps to achieve.

The Macclesfield Surface Water Flood Risk Area



Flood Risk Area: Macclesfield, North West



Flood Risk Area: Surface Water
River Basin Districts

N

Kilometres
0 0.4 0.8 1.2

Figure 18: A map showing the boundary of Macclesfield Surface Water Flood Risk Area

Introduction to the Macclesfield Surface Water Flood Risk Area

The Cheshire East Lead Local Flood Authority (LLFA) undertook a review of the Preliminary Flood Risk Assessment (PFRA) in 2016. It identified Macclesfield as a Flood Risk Area (FRA). This FRA is nationally significant.

Those Risk Management Authorities with responsibilities for managing the flood risk in the Macclesfield FRA are:

- Cheshire East Council as a Lead Local Flood Authority (LLFA) are responsible for managing the risk of surface water, groundwater and ordinary watercourse flooding
- The Environment Agency's responsibilities include managing flood risk from Main Rivers including the River Bollin
- United Utilities is the Water and Sewage Company that own, operate and maintain the sewer network and waste water treatment infrastructure

The Macclesfield FRA covers many of the urban districts of Macclesfield which includes residential, business and amenity areas.

Land use, soils and geology determines the surface water flood risk of an area. The Macclesfield area includes lots of areas of clayey soil. Clay is a very slowly permeable soil type. This makes the area more vulnerable to flooding because the land will become saturated with water more likely to flow from the land as overland flow.

Areas of interest in the Macclesfield FRA include:

- Macclesfield canal flows through the FRA, owned and maintained by the Canals and Rivers Trust
- Local Nature Reserve (LNR) Riverside Park
- area of ancient woodland lies to the north west
- several listed buildings including the Grade II* Listed Town Hall
- West Park, a registered park and garden

During the industrial revolution Macclesfield developed as a centre of the textile industry with silk being the main trade. The canal was built during this time.

The Macclesfield FRA has a high potential risk from surface water flooding.

In addition to the visible open watercourses there are many channels and culverts running underground through the area. Due to the age of many of these assets and the extent of development they may be significantly under capacity.

Culverts are enclosed watercourses located underground that are used to divert or drain water from land above it – they are sometimes very large. Many historical culverts in Macclesfield are largely not mapped making them hard to monitor. This also creates the main flood risk in the area since they are susceptible to collapsing.

Deculverting or daylighting culverts is promoted by Cheshire East Council and the other multi-agency partners as part of any planning or development proposal within Macclesfield as it is across Cheshire East.

In addition to surface water flooding, Macclesfield also has the potential to flood from the River Bollin, Main River and the sewer network.

The River Bollin conveys water from the Bollin Dean Mersey Upper operational catchment through the Macclesfield FRA. This operational catchment runs from the edge of the Peak District National Park to the Manchester Ship Canal. Other watercourses including the Shoresclough Brook drain smaller more local areas throughout the Macclesfield FRA.

Whilst pluvial flooding from heavy rainfall can occur anywhere across Cheshire East, there are certain locations where these mechanisms are more prominent. This is due to the urban nature of the catchment, complex hydraulic interactions between watercourses and surface water and combined sewer systems.

Current flood risk

The Macclesfield FRA has a high potential risk from surface water flooding.

In June 2016 and July 2019 there were reports of flooding to properties in Macclesfield.

Severe flooding was experienced across the Cheshire East region in 2012, 2016, 2019, 2020 and 2021 with flooding of homes, businesses, agricultural land, road railways and public services.

An ordinary watercourse flowing in a culvert underneath Hobson Street and neighbouring Ryle Street collapsed in February 2020 causing sinkhole damage on both streets. A property on Ryle street had to be demolished due to the extent of the damage. Local repairs have been undertaken to make the area safe. Wider investigations are ongoing into the future requirements of this culvert and the impact on its riparian owners.

The flood hazard and risk maps show that in the Macclesfield Flood Risk Area 3,207 people live in areas at risk of surface water flooding. The FRA include approximately 1,336 residential properties, of which 9.4% are in areas of high risk.

Also shown to be at risk of flooding from surface water are:

- 404 non-residential properties, including hospitals, schools/colleges and shopping centres
- 3.65km of roads including parts of A523, A537 and A536
- 1.63km of railway
- 4.49ha of agricultural land
- 92 grade II listed buildings

The Flood Risk Maps for Surface Water in England - December 2019 provide more detailed information on the likelihood and consequence of flooding for the Macclesfield FRA.

Based on this information it is concluded that further steps should be taken to reduce the likelihood of flooding and its impact. In particular, the impact it can have on people, the economy and the environment both for now and the future.

How the risk is currently managed

The management of surface water flood risk is outlined in the Cheshire East Local Flood Risk Management Strategy.

Cheshire East Council work in partnership with a wider multi-agency team including the other local Risk Management Authorities (RMAs).

Cheshire East Council continue to:

- consent and manage appropriate works on local watercourses systems undertaken by the Council and/or local riparian owners
- provide guidance as a statutory consultee on major planning applications within this area with regards to flooding and drainage

The Environment Agency monitors flow and river levels (River Bollin) providing an established flood warning system across two areas in Macclesfield.

Cheshire East Council, LLFA, Environment Agency and United Utilities maintain assets that perform a flood risk management function on the drainage networks.

The Canals and Rivers Trust maintains the Macclesfield Canal as a navigable waterway.

The impact of climate change and future flood risk

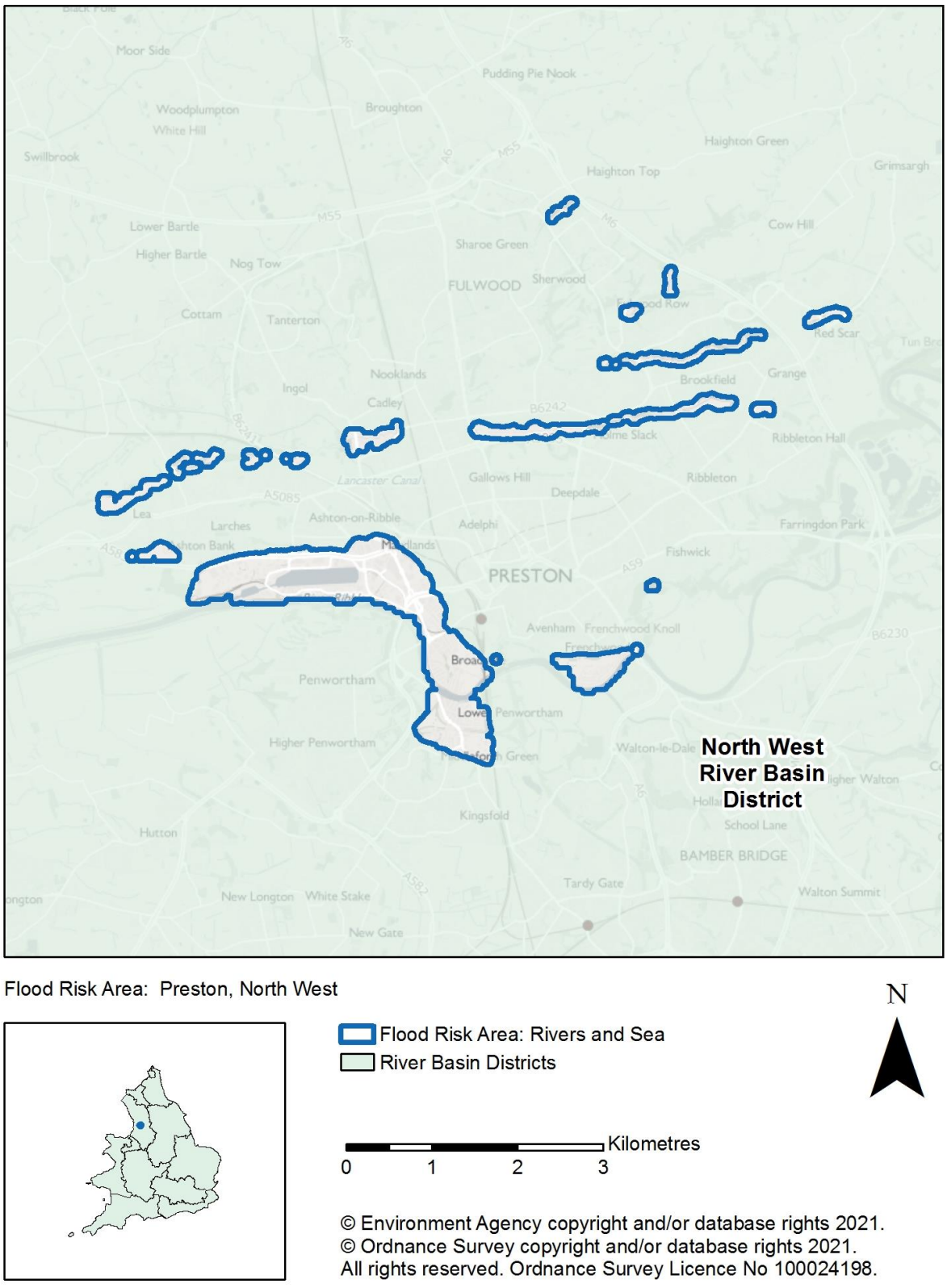
As rainfall intensity increases, it means that surface water flooding will become more frequent as higher rainfall totals will be seen more often.

Please refer to section Climate change and North West RBD for more information on what we know are likely to be the implications of climate change in the North West River Basin District.

Objectives and measures for the Macclesfield FRA

Measures have been developed which apply specifically to the Macclesfield FRA. These measures have been developed in addition to measures covering a wider geographic area, but which also apply to the Macclesfield FRA. You can find information about all the measures which apply to the Macclesfield FRA in the interactive mapping tool - Flood Plan Explorer. This includes information on which national objectives each measure helps to achieve

The Preston Rivers and the Sea Flood Risk Area



Flood Risk Area: Preston, North West

Flood Risk Area: Rivers and Sea
River Basin Districts

N

Kilometres
0 1 2 3

Figure 19: A map showing the boundary of the Preston Rivers and the Sea Flood Risk Area

Introduction to the Preston Rivers and the Sea Flood Risk Area

The Preston Flood Risk Area (FRA) has been identified as the flood risk from rivers and the sea is considered nationally significant.

The Environment Agency take the lead on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA, whose remit includes flood risk from rivers and the sea.

Lancashire County Council is the Lead Local Flood Authority (LLFA) responsible for managing flood risk from local sources. These local sources of flooding are surface water, groundwater and ordinary watercourses.

United Utilities is the Water and Sewage Company that own, operate and maintain the sewer network and waste water treatment infrastructure in the FRA.

The Preston FRA covers many of the urban districts of Preston and Lea, which includes residential, business and amenity areas.

Downstream of the River Calder confluence to the M6 motorway is Carboniferous Millstone Grit, which together with the overlying soils tend to generate rapid flow to watercourses. Further west, between the M6 and the Preston estuary, are Permo-Triassic Sandstones, which are classified as major aquifers.

The Lancaster Canal lies within the FRA, owned and maintained by the Canals and Rivers Trust.

Several Local Nature Reserves (LNR) are located within the Preston FRA. The LNR includes Preston Junction and adjacent habitats, Fishwick Bottom, Hills and Hollows and Grange Valley. Several Local Wildlife Sites (LWS) fall within the FRA, including the River Ribble upper and lower tidal sections, Lancaster Canal, Sandy Brook and Fishwick Bottoms.

The FRA houses many listed buildings, including the Grade II listed Town Hall. Fishergate Hill is identified as Heritage at Risk within the FRA and the FRA houses several registered parks and gardens.

Preston has a population of approximately 142,000 (based on 2016 census data estimates). The Ribble and Darwen are the major watercourses in Preston. These watercourses flow through the south of the city before discharging into the Irish Sea between Lytham and Southport.

Over four and a half thousand homes and 350 businesses lie in this flood corridor. In addition, around 2000 properties lie downstream of Garstang Road on Savick Brook. These properties have reduced flood risk due to a flood attenuation reservoir in Highgate Park.

New development has been mainly driven away from the main river corridor. Commercial analysis of Lancashire's strategic employment sites identifies Preston as Lancashire's main office market. It also identifies as one capable of growing its role as a financial and professional service sector location (Strategic commercial development advice, Colliers, 2014). Docklands is a location containing numerous service sector offices.

The River Ribble conveys water from the Ribble management catchment through the Preston FRA to the Ribble estuary in the west. The River Ribble drains a total area of 1,490 km2 in North Yorkshire and Lancashire. It covers around 100 km from source to mouth. Other watercourses including the Savick Brook drain smaller more local areas throughout the Preston FRA.

Approximately 12% of the Ribble catchment is urban. The development in the natural floodplain over time has increased the risk of flooding at locations including Preston. The tidal extent of the Ribble catchment falls within the FRA and some watercourses are tidally influenced.

Much of the flood risk across the Preston FRA is predominately linked to the capacity of the drainage networks. It includes piped networks in urban areas and open drainage ditches in both urban and rural areas. In many locations there is a complex relationship between drainage systems, open watercourses and the sea. The flooding occurs as a result of the interaction of several sources.

Current flood risk

On Boxing Day 2015, 192 homes and businesses were impacted by flooding. It was a near miss event for other properties and businesses as it only just missed high tides.

In February 2020 Preston was impacted by flooding as a result of storm Ciara. In June, July and August 2020, several properties were flooded in Preston. Historic flood records show flood events in the eighteenth century, in addition to 1923, 1936, 1995, 2000 and 2007.

The flood hazard and risk maps show that, in the Preston Flood Risk Area 7,785 people live in areas at risk of flooding from rivers and the sea. It includes approximately 3,244 residential properties of which 0.4% are in areas of high risk.

Also shown to be at risk of flooding from rivers and the sea are:

- 461 non-residential properties, including schools/colleges, business parks and sports grounds
- 2.17km of roads including part of the A583
- 3km of railway
- 24.84ha of agricultural land
- listed buildings, ancient monuments and parks and gardens

The Flood Risk Maps for Rivers and Sea in England - December 2019 provide more detailed information on the likelihood and consequence of flooding for the Preston FRA.

Based on this information it is concluded that further steps should be taken to reduce the likelihood of flooding and its impact. In particular, the impact it can have on people, the economy and the environment both for now and the future.

How the risk is currently managed

The management of flood risk from rivers and the sea is led by the Environment Agency in collaboration with other Risk Management Authorities (RMAs) and stakeholders. The stakeholders include Lancashire County Council, United Utilities and District Councils.

Flood Risk Governance is through the Lancashire Flood Risk Partnership which operates at strategic, operational and tactical Level across the county and includes Preston. All groups are run by the LLFA with Regional Flood and Coastal Committee (RFCC) representatives sitting on the Strategic Group with United Utilities. LLFA, District Council and United Utilities representatives sit on the tactical and operational groups.

The Environment Agency monitors rainfall and levels (including tide and river level) at 5 sites relevant to the Preston FRA. There is a rain gauge at Haighton and river recorder at Savick Brook Flood Storage Basin. On the River Ribble, there are river level recorders at Walton le Dale (adjacent to London Road Bridge) and Samlesbury. There is also a tidal recorder at Lower Penwortham (opposite Broadgate).

This information is used to inform activities related to 5 flood warning areas that cover the FRA which enable people to receive a warning when flooding could occur. This data also informs the operational response during a flood incident.

The flood warning areas include Fulwood and Cadley (2,022 properties), Samlesbury (20 properties), Walton le Dale (832 properties), Penwortham (954 properties) and Ribble at Docklands (1,418 properties).

Standard Flood Risk Modelling for the fluvial and tidal flood maps has been completed for the Preston FRA

Lancashire County Council LLFA and United Utilities maintain assets that perform a flood risk management function on the drainage network. The Environment Agency similarly maintains flood risk management assets for example screens, outfalls, and defences including flood defence walls, embankments, and channels throughout the FRA.

Upstream of Garstang Road on Savick Brook, the Environment Agency operates a flood storage reservoir that is managed and operated in accordance with the Reservoirs Act. This basin reduces flood risk to the Fulwood and Cadley Flood Warning Area.

The Canals and Rivers Trust maintains the Lancaster Canal as a navigable waterway.

There are extensive flood walls and embankments along the rivers Ribble and Darwen that are coming to the end of their useful life, some over 70 years old. Design of the Preston and South Ribble Flood Risk Management Scheme is ongoing. It will commence

within the next year and deliver improvements between Preston Dock and the M6 motorway.

The impact of climate change and future flood risk

As rainfall intensity increases, it means that surface water flooding will become more frequent as higher rainfall totals will be seen more often.

Please refer to the Climate change and the North West RBD section for more information on what we know are likely to be the implications of climate change in the North West River Basin District.

Objectives and measures for the Preston FRA

Measures have been developed which apply specifically to the Preston FRA. These measures have been developed in addition to measures covering a wider geographic area, but which also apply to the Preston FRA. You can find information about all the measures which apply to the Preston FRA in the interactive mapping tool - Flood Plan Explorer. This includes information on which national objectives each measure helps to achieve.

The Rawtenstall Surface Water Flood Risk Area

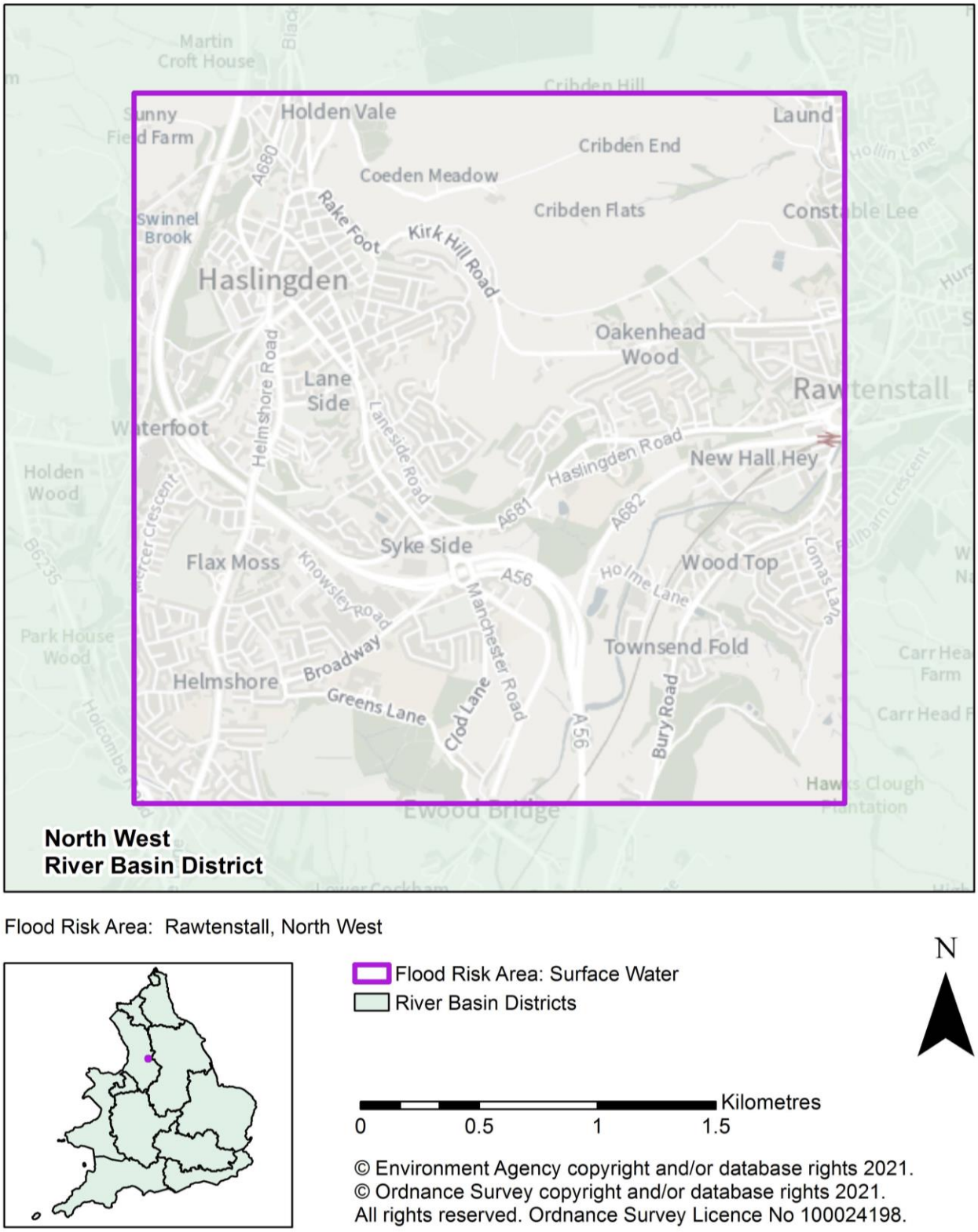


Figure 20: A map showing the boundary of the Rawtenstall Surface Water Flood Risk Area

Introduction to the Rawtenstall Surface Water Flood Risk Area

The Rawtenstall Flood Risk Area (FRA) has been identified as the flood risk from surface water is considered nationally significant.

Lancashire County Council take the lead on the development and delivery of the Flood Risk management Plan (FRMP) for this FRA as the Lead Local Flood Authority (LLFA). They are responsible for managing flood risk from local sources. These local sources of flooding are surface water, groundwater and ordinary watercourses.

The Environment Agency's remit includes flood risk from rivers and the sea.

United Utilities is the Water and Sewage Company that own, operate and maintain the sewer network and waste water treatment infrastructure in the FRA.

The Rawtenstall FRA covers urban districts of Haslingden, Helmshore and New Hall Hey. It includes residential, business and amenity areas and surrounded by a green belt of agricultural land and moorland.

The steep nature of the upper catchments of Irwell and Swinnel Brook would give rise to limited infiltration and a rapid response to rainfall events.

Part of the Hawks Clough Local Wildlife Site (LWS) falls within the south-eastern part of the FRA. Several listed buildings are located within the FRA.

Much of the FRA is serviced by a combined (foul and surface water) sewerage system, particularly in the older parts of the FRA. More modern parts of the town, including Syke Side, Oakenhead Wood, Helmshore and Townsend Fold have separate foul and surface water systems.

The River Irwell conveys water in a south-westerly direction from Croal Irwell operational catchment through the Rawtenstall FRA. This Surface Water catchment covers the local councils of:

- Rossendale
- Bury
- Blackburn with Darwen
- Bolton
- Salford
- Trafford

There are a range of issues in the catchment which has upland rural areas and heavily urbanised water courses in the lowland areas. The River Ogden and its tributary, Swinnel Brook, flow through the FRA.

Current flood risk

In February 2020 Rawtenstall was impacted by flooding as a result of storm Ciara. In August 2020 a small number of residential properties were flooded. In June 2012, record river levels were reached on the upper River Irwell in the Bacup and Rawtenstall areas. Several properties were flooded in the wider Rossendale region.

On Boxing Day 2015, 50 properties are known to have suffered from internal flooding in Rawtenstall. In 2017, further flooding led to flooded properties and road closures in Rawtenstall.

The flood hazard and risk maps show that in the Rawtenstall Flood Risk Area 1,678 people live in areas at risk of surface water flooding. It covers approximately 700 residential properties, of which 10% are at high risk. This compares with some 50,700 properties at risk of flooding from local sources in the wider Lancashire and Blackpool region.

Also shown to be at risk of surface water flooding are:

- 301 non-residential properties, including schools/colleges, a golf course, business parks and industrial estates
- 2.56km of roads including part of the A56
- 1.15km of railway
- listed buildings

The Flood Risk Maps for Surface Water in England - December 2019 provide more detailed information on the likelihood and consequence of flooding for the Rawtenstall FRA.

Based on this information it is concluded that further steps should be taken to reduce the likelihood of flooding and its impact. In particular, the impact it can have on people, the economy and the environment both for now and the future.

How the risk is currently managed

The management of surface water flood risk is led by Lancashire County Council in collaboration with other Risk Management Authorities (RMAs) and other stakeholders.

A clear illustration of the types of flooding and who is responsible for managing flood risk can be found on the Flood Hub. The potential overlaps between them are the reasons why the Lancashire drainage authorities must continue to work together to understand and manage flood risk.

Our Local Flood Risk Management Strategy is currently under review (expected to be finalised and adopted Autumn 2021).

We also work with other stakeholders including:

- riparian owners and private landowners

- developers
- rivers trusts
- canal and rivers trust
- wildlife and conservation groups
- agricultural businesses
- catchment partnerships
- educational and research establishments
- flood action groups and other community groups
- members of the Lancashire resilience forum

The Lancashire FCERM Partnership is a collective group of RMAs who come together quarterly to take an overview of flood and coastal erosion risk management across Lancashire. They identify priorities and steer the use of our resources, to vote on changes to the Local Levy, and to support investment which is good value for money and benefits our communities with two levels of partnership.

Strategic Partnership Group are elected members and senior representatives from Risk Management Authorities who meet four times a year. This group is chaired by a councilor. It sets the strategic direction for joint working and management of flood and coastal erosion risk of the partnership against its resources, local risks and challenges. The group agrees with the timetable delivery of actions identified in the Strategy's Business Plan. It is according to many factors such as delivery timescales and what will have the greatest benefit to our at-risk communities.

Tactical Officers Group is chaired by a local authority officer and is where technical lead officers deliver actions set by the Strategic Partnership Group. The group meets four times a year to coordinate delivery, share skills and implement decisions. Lead officers also report on issues, successes and identify ways to continually improve the management of flooding and coastal erosion risks into the future.

We also support operational Making Space for Water groups, which are district-level technical partnership groups. They are set up to discuss locally specific flood and coastal, where applicable, issues within their Local Authority area. They also provide a forum to drive forward solutions, where possible, through working in partnership.

These technical meetings are arranged and chaired by Local Authorities. Where applicable, they feed outcomes of this meeting up to Tactical Officers Group and to the Northern Coastal sub-group. They also feed information down to the operational Making Space for Water group.

The Environment Agency monitors surface water level (including tide and lake level) at 3 sites adjacent to the FRA.

This information is used to inform activities related to 2 flood warning areas that cover the FRA which enable people to receive a warning when flooding could occur. This data also informs the operational response during a flood incident.

The Upper Irwell Level 1 Surface Water Management Plan was completed in July 2012. It identified 23 areas across the district of Rossendale where the risk from surface water flooding is greatest. Some have been investigated in more detail as ordinary watercourse studies or the level 2 Surface Water Management Plans (completed in February 2015) in order to develop the understanding of risk through flood risk hazard mapping.

Several the identified high-risk locations have since been mitigated through targeted works informed by these studies. Some others including locations identified within this Flood Risk Area require further investigation and consideration to identify viable and deliverable improvement actions.

Lancashire County Council owns assets that perform a flood risk management function in the public highway network, these include:

- culverts
- bridge structures
- gullies
- trash screens

The County Council's Highway Service Authority maintains these assets.

United Utilities is responsible for the management of the urban drainage system including surface water and foul sewerage. Water company assets include:

- wastewater treatment works
- combined sewer overflows
- pumping stations
- detention tanks
- sewer networks
- manholes

The Environment Agency similarly maintains flood risk management assets including an open channel.

There are no known flood risk improvement schemes since 2015 or known current investment plans and work programmes.

The impact of climate change and future flood risk

As rainfall intensity increases, it means that surface water flooding will become more frequent as higher rainfall totals will be seen more often.

Please refer to section Climate change and North West RBD for more information on what we know are likely to be the implications of climate change in the North West River Basin District.

Objectives and measures for the Rawtenstall FRA

Measures have been developed which apply specifically to the Rawtenstall FRA. These measures have been developed in addition to measures covering a wider geographic area, but which also apply to the Rawtenstall FRA. You can find information about all the measures which apply to the Rawtenstall FRA in the interactive mapping tool - Flood Plan Explorer. This includes information on which national objectives each measure helps to achieve.

The Southport Surface Water Flood Risk Area

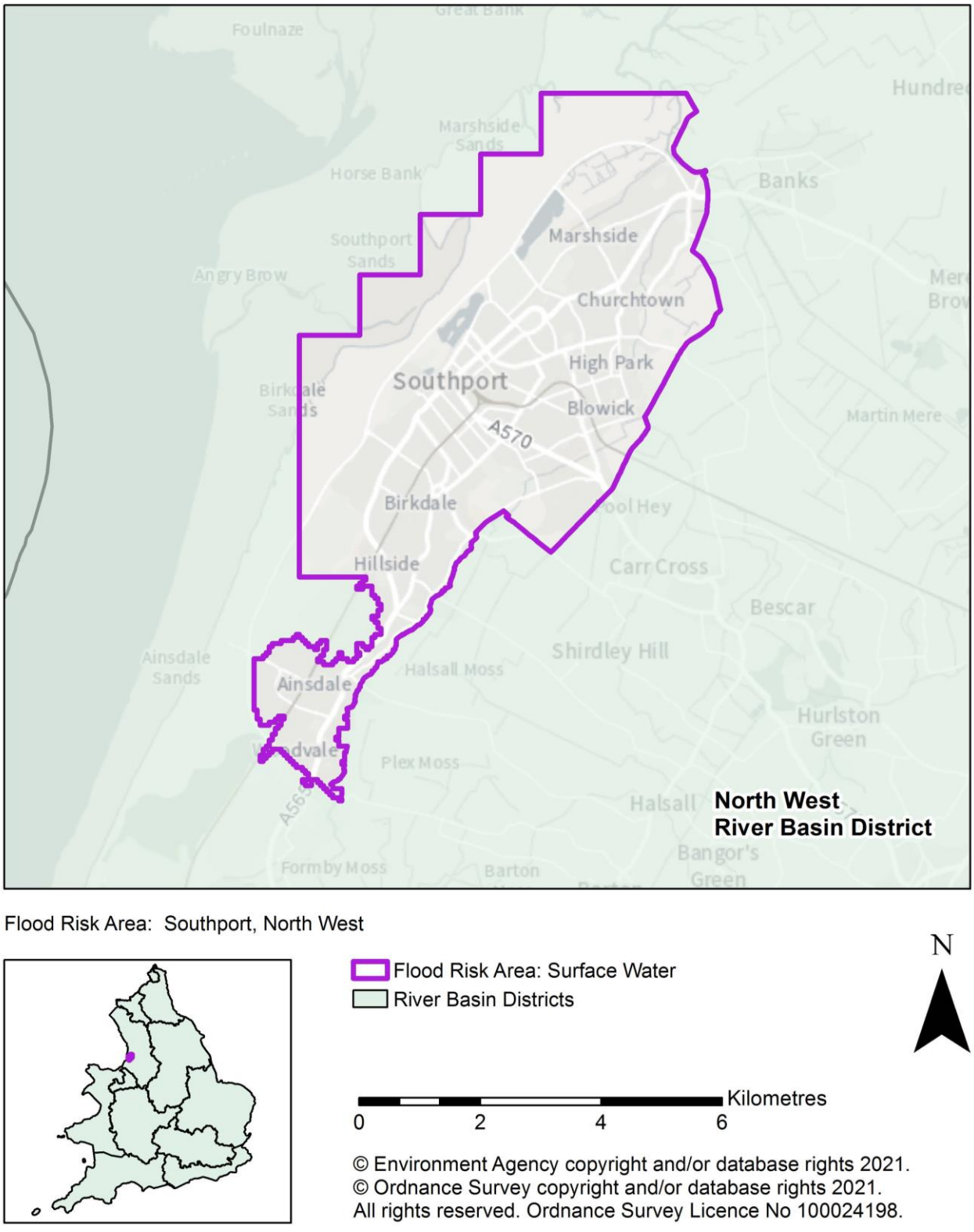


Figure 21: A map showing the boundary of the Southport Surface Water Flood Risk Area

Introduction to the Southport Surface Water Flood Risk Area

The Southport Flood Risk Area (FRA) has been identified as the flood risk from surface water is considered nationally significant.

Sefton Metropolitan Borough Council take the lead on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA. It is identified as the Lead Local Flood Authority (LLFA) responsible for managing flood risk from local sources. These local sources of flooding are surface water, groundwater and ordinary watercourses.

The Environment Agency's remit covers flood risk from rivers and the sea.

United Utilities is the Water and Sewage Company that own, operate and maintain the sewerage network and waste water treatment infrastructure in the FRA.

The Southport FRA covers many of the urban districts of Churchtown, Birkdale and Ainsdale which includes residential, business and amenity areas. The FRA is surrounded by a green belt of mainly agricultural land and coastline.

Southport's underlying geology is a bed of mudstone. There are superficial deposits of blown sand to the southern half of the FRA. It gives way to saltmarsh on the northern coast and tidal flat deposits to the north and east.

Several Sites of Special Scientific Interest (SSSI) are located within the Southport FRA including the Ribble estuary, Sefton coast and Hesketh golf links. In addition, several Local Wildlife Sites (LWS) are found within the FRA including Martin Mere Mosslands and several others along the coastline, including the Ribble estuary. Sefton coast is a designated Special Area of Conservation (SAC) within the FRA, and the Ribble and Alt estuaries are a designated Special Protected Area (SPA) and Ramsar site. A Local Nature Reserve (LNR), Ainsdale and Birkdale hills, is found within the FRA, in addition to a National Nature Reserve (NNR), the Ribble estuary.

Many listed buildings are located within the Southport FRA, particularly clustered around the Lord Street and Promenade Conservation Areas, both of which are designated as Heritage at Risk.

Historically Southport was a small fishing community before seabathing was embraced by Victorians and the development of the town followed. There were several reclamation schemes along the coastline from the mid-1800s through to the 1980s driven both by an accreting coastline and the need for development land. The town's drainage network flows inland towards the lower lying hinterland and the Three Pools watercourse. There are only a few small watercourses to the south of the FRA that drain directly to the sea but are along an accreting coastline.

The rebuilding of the seawall was completed in 2002 and reduced the frequent flooding of the coastal road. The design of the seawall allows for the crest to be raised to respond to predicted sea level rise.

Development of the town has put pressure onto the capacity of the original drainage systems.

Southport is susceptible to surface water flooding due the low-lying nature of the borough. The water drains to the Three Pools and needs to be pumped in order for it to drain out into the sea at Crossen's Pumping station. A few small pumping stations aid in moving water around the FRA.

The majority of the FRA is serviced by a combined (foul and surface water) sewerage system, particularly in the older parts of the FRA. As a result, some areas have experienced flooding from sewers which occurs when their capacity is overcome by the amount of water trying to enter the network. More modern parts of the town have separate foul and surface water systems.

The groundwater table is high in parts of the Southport FRA and can cause flooding following periods of heavy rain. This flooding tends to persist until the groundwater level subsides.

A number of small watercourses convey water through the Southport FRA including Back drain, The Pool, Sandy Brook and Fine Jane's Brook, draining local areas throughout the FRA. These ultimately end up at Crossen's pumping station, except a few small watercourse to the south of the area that discharge straight to the coast.

Southport is at risk from flooding and erosion from the sea, with high storm surges affecting the coastline. The coastline is protected to the north by saltmarsh in front of the coastal road, behind which sits a raised embankment. The southern coastline is protected by a seawall that gives way to a sand dune system.

Current flood risk

Southport had a number of historic flooding events including those in 2010, 2009, 2008, 2004, 1996, and 1994. A secondary sea defence embankment in Crossens was breached in the late seventies, flooding 110 properties.

The winter of 2013/2014 saw a series of storm events that significantly impacted the coastline with widespread damage, erosion and overtopping of defences. In December 2015 widespread flooding impacted roads and properties.

In June and August 2020 prolonged flooding was recorded in Southport, with residential properties affected. Storm Christoph in January 2021 led to widespread surface water flooding across the area, this was followed by several reports of groundwater flooding affecting basements and gardens. Large areas of open ground were waterlogged for a prolonged period.

The flood hazard and risk maps show that in the Southport Flood Risk Area 30,822 people live in areas at risk of flooding from surface water. It covers approximately 12,842 residential properties, of which 22.88% are in areas of high risk.

Also shown to be at risk of flooding from surface water are:

- 1,097 non-residential properties, including hospitals, schools/colleges, golf courses, retail parks and industrial estates
- 10.1km of roads including part of the A565 and A570
- 8.70km of railway
- 180.95ha of agricultural land
- areas of environmental designated sites, parks and gardens, listed buildings and water abstraction points

The Flood Risk Maps for Surface Water in England - December 2019 provide more detailed information on the likelihood and consequence of flooding for the Southport FRA.

Based on this information it is concluded that further steps should be taken to reduce the likelihood of flooding and its impact. In particular, the impact it can have on people, the economy and the environment both for now and the future.

How the risk is currently managed

The management of surface water flood risk is led by Sefton Metropolitan Borough Council in collaboration with other Risk Management Authorities (RMAs).

The Merseyside Flood Risk Partnership brings together the RMAs and other relevant stakeholders, to coordinate and maximise flood risk management across the area. For example, The Healthy Rivers Trust. A strategic partnership with elected members from each authority steers the direction of flood risk management and represents Merseyside at the North West Regional Flood and Coastal Committee. A tactical partnership of lead officers supports the strategic group through the provision of technical advice and sharing of best practice. Sefton Council has an operational group where officers from the RMAs assess and seek to resolve local flood risk issues.

Reported flood incidences are recorded on the relevant RMAs data systems.

The Environment Agency monitors groundwater level at 1 site within the Southport FRA.

This information is used to inform activities related to 2 flood warning areas that cover the FRA which enable people to receive a warning when flooding could occur. This data also informs the operational response during a flood incident.

Surface water flood modelling was undertaken in 2011 as part of the Surface Water Management Plan. This modelling is currently being updated and will be included in updates of the national surface water flood mapping.

Sefton Metropolitan Borough Council LLFA and United Utilities maintain assets that perform a flood risk management function on the drainage network that they have a responsibility for. Sefton Metropolitan Borough Council also maintain a number of other structures and defences on ordinary watercourses which pass through its land. There are

many riparian owners with responsibility for maintenance of watercourses including private residences and golf courses.

Sefton Council maintain the hard-coastal defences at Southport. Habitat management works takes place on the sand dune belt to maintain the protected site, which also acts as a coastal defence. The accreting coast reduces the risk of tidal flooding and the saltmarsh removes a significant amount of wave energy that would otherwise impact on the coastline.

The Environment Agency similarly maintains flood risk management assets on the main watercourses in the FRA.

These include:

- screens
- outfalls
- control gates
- inspection chambers
- flood defence embankments
- open channels
- culverts

The Crossen's pumping station is maintained by the Environment Agency.

Recent flood risk improvements within the Southport FRA include the Nile Investigation, protecting 15 homes by December 2019.

Coastal understanding has improved through the availability of data from the North West Regional Strategic Coastal Monitoring Programme.

A scheme along the Pool watercourse in Churchtown is in development that will seek to reduce the risk to properties as well as create new habitat. The project is in partnership with United Utilities who have installed a significant storage tank that reduced the risk of foul flooding to properties in the area.

The impact of climate change and future flood risk

As rainfall intensity increases, it means that surface water flooding will become more frequent as higher rainfall totals will be seen more often. This can also increase the risks of groundwater flooding.

Please refer to section Climate change and the North West RBD for more information on what we know are likely to be the implications of climate change in the North West River Basin District.

Sea level rise and increased storminess is likely to increase the risks of tidal flooding and erosion across this section. This can also impact on the ability of surface water systems to

discharge during higher tides. Monitoring of this section of coastline is critical in assessing the rates of accretion against sea level rise.

Objectives and measures for the Southport FRA

Measures have been developed which apply specifically to the Southport FRA. These measures have been developed in addition to measures covering a wider geographic area, but which also apply to the Southport FRA. You can find information about all the measures which apply to the Southport FRA in the interactive mapping tool - Flood Plan Explorer. This includes information on which national objectives each measure helps to achieve.

The Warrington Rivers and Sea Flood Risk Area

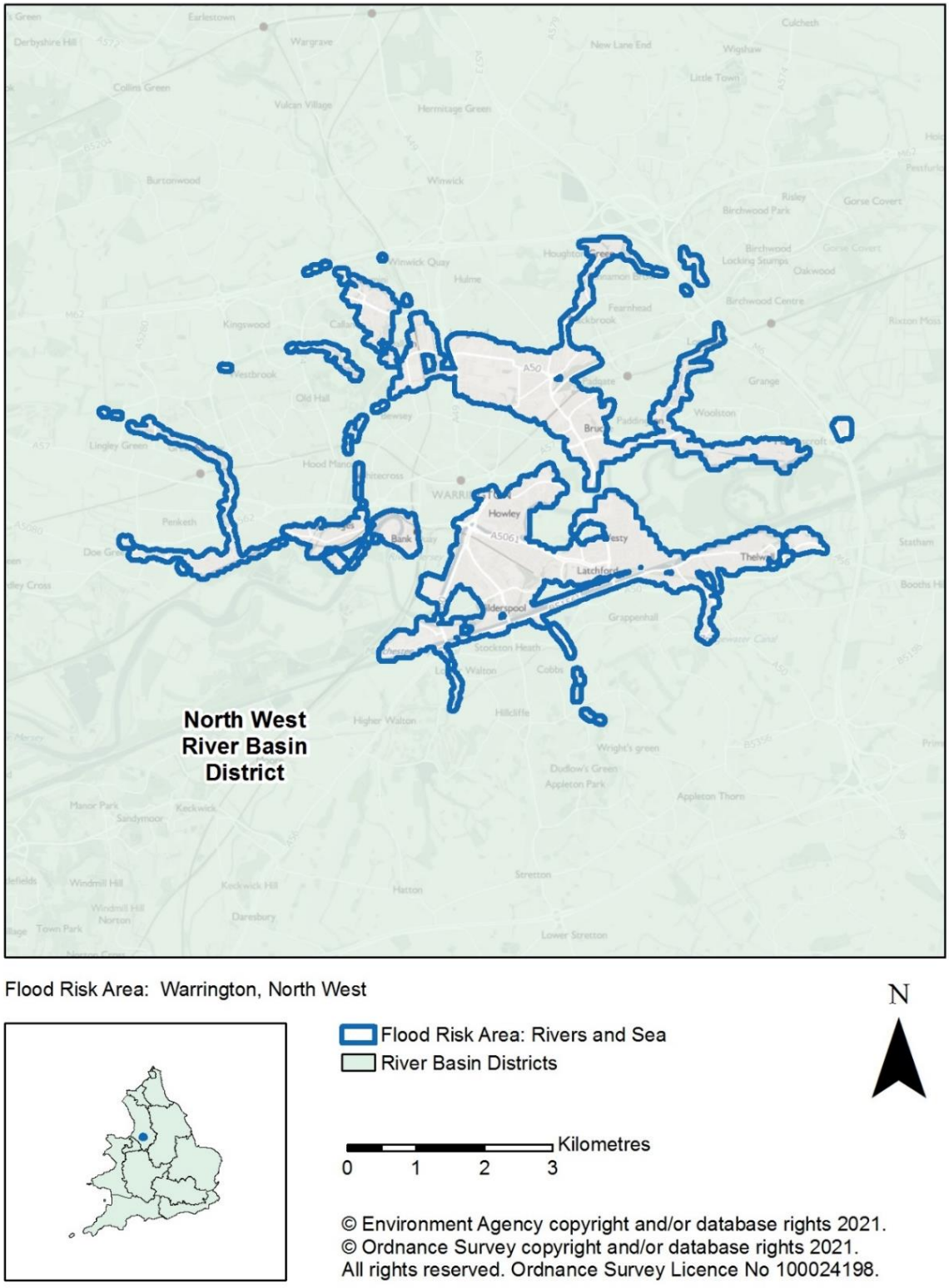


Figure 22: A map showing the boundary of the Warrington Flood Risk Area

Introduction to the Warrington Flood Risk Area

The Warrington Flood Risk Area (FRA) has been identified as the flood risk from rivers and the sea is considered nationally significant. The Environment Agency take the lead on the development and delivery of the Flood Risk Management Plan (FRMP) for this FRA.

Warrington Borough Council are the Lead Local Flood Authority (LLFA) whose remit includes flood risk from surface water and ordinary watercourses.

United Utilities is the Water and Sewerage Company that own, operate and maintain the sewer network and waste water treatment infrastructure in the FRA.

The Warrington FRA covers residential, business and amenity areas in the urban districts of Warrington and is surrounded by mainly farmland.

The Woolston Eyes Site of Special Scienfic Interest (SSSI) is located within the Warrington FRA. The Mersey Estuary SSSI, Special Protection Area (SPA) and Ramsar Site lies some 10km downstream. A number of Local Wildlife Sites exist on or adjacent to the watercourses in the FRA including:

- Paddington Meadows
- Bewsey Meadows
- Gemini Wetlands
- the Twiggeries
- the Upper Mersey Estuary
- Gatewarth and Walton locks

The River Mersey and the Manchester Ship Canal drain water from the Glaze, Irwell and Upper Mersey catchments through the Warrington FRA to the Mersey estuary. The area of these catchments is some 2000 km^2 and includes the Greater Manchester conurbation as well as the south pennine moors. Sankey Brook flows from the north through the FRA into the River Mersey. It drains an area bounded by Prescot, Rainford, Ashton in Makerfield and Winwick. Other watercourses drain smaller more local areas to the north and south of the river Mersey through the FRA.

The FRA is susceptible to flooding from the sea during times of high spring tides. The normal tidal limit on the River Mersey is at Howley weir, just south east of Warrington town centre. High tide levels cause river levels to rise on connecting watercourses or restrict their ability to discharge. These affects increase the risk of flooding in the FRA.

The Manchester Ship Canal is owned and operated by part of the Peel Group as is the Bridgewater Canal in the south of the FRA. The Sankey Canal in the north and west of the FRA is owned and maintained by Warrington Borough Council within its borough limits.

Historically, Warrington has developed around being a strategic crossing point of the river Mersey. The construction of the Manchester Ship Canal in the later 1800s provided an additional watercourse that could help carry river flows through the town. This reduced the risk of flooding and facilitated its expansion. As the town developed, marshy areas of

floodplain have been progressively drained or infilled. These areas are particularly to the north around Dallam, Bewsey and Orford as well as locations more adjacent to the River Mersey.

The construction of flood defence assets and the realignment of watercourses to manage flood risk has occurred piecemeal over time as development progressed. This included the diversion of Sankey Brook from its original course through Dallam into the disused Sankey Canal. This approach has left a legacy of flood risk assets of variable effectiveness and residual life.

The surface water drainage network requires pumped, particularly at times of high river levels, due to the relatively flat topography in parts of the FRA.

Current flood risk

Unfortunately, a number of places in the FRA were badly affected by flooding as a result of Storm Christoph on 21 January 2021. This included Sankey Bridges, Bewsey, Dallam, Longford, Orford and Gemini on Sankey Brook.

These locations have been affected by earlier storm events but not as severely as in 2021. They have benefited from progressive improvement of flood defences over the years. Penketh and Padgate are other areas that have experience flooding and benefitted from improvement works.

The Knutsford Road area was affected by tidal flooding in 1990 and experienced near misses in 2001 and 2006. Flood risk protection works were constructed here in 2013. A tidal event in December 2013 was contained by these works that otherwise would have affected up to some 1500 properties.

In the Warrington FRA 32,725 people are estimated to be in areas at risk of flooding from rivers and the sea. 5% of these are in areas of high risk. This compares with 40,000 people throughout the Warrington Borough Council area estimated to be at risk from surface water flooding. 1.2% of these are at high risk.

Also considered to be at risk of flooding from rivers and the sea are:

- 1,270 non-residential properties. These include hospitals, schools/colleges and public utilities eg the Gatewarth Wastewater Treatment Works
- 8.14km of roads, including parts of the trunk road network
- 2.4km of railway
- 190ha of agricultural land
- areas of environmental designated sites, listed buildings, heritage sites, water abstraction and discharge points

The Flood Risk Maps for Rivers and the Sea in England – December 2019 provide more detailed information on the likelihood and consequence of flooding for the Warrington FRA.

Based on this information it is concluded that further steps should be taken to reduce the likelihood and impact of flooding. This should consider the impact on people, the economy and the environment both now and in the future.

How the risk is currently managed

The management of flood risk from rivers and the sea is led by the Environment Agency. This work is performed in collaboration with other Risk Management Authorities (RMAs) and stakeholders. For this FRA these include Warrington Borough Council, United Utilities and the Lower Mersey Catchment Partnership.

There are regular operational meeting organised by Warrington Borough Council for the RMAs to discuss work programmes and resolve any operational issues within the borough. The Cheshire Mid-Mersey FCRM Partnership group enable broader (catchment scale) tactical and strategic approaches to be agreed. This group includes:

- neighbouring LLFAs (Cheshire East, Cheshire West & Chester, Halton, St Helens, Staffordshire and Warrington)
- the Environment Agency
- United Utilities
- Lower Mersey and Weaver / Gowy Catchment Partnership hosts

The Environment Agency monitor river and rainfall conditions at 12 sites in and immediately adjacent to the FRA. These collect data on river levels (10 sites), river flows (2 sites) and rainfall (2 sites).

This data is used to inform activities related to 10 flood warning areas that cover the FRA. This enables people to receive a warning when flooding could occur. This data is also used to inform the operational incident response of RMAs.

The water level and flow information is also used to inform and calibrate mathematical modelling of the river network. All the main river watercourses have hydraulic models with only 2 (The Sankey Canal and Lumb Brook) that predate 2010.

Flood risk maps are published based on the outputs from the mathematical modelling to inform:

- the public and business of their flood risk
- potential developers and local planning authorities
- the assessment and design of flood risk management works

The Environment Agency maintain flood risk management assets for example river channels, flood defence walls or embankments, throughout the FRA. Warrington LLFA and United Utilities similarly maintain assets that perform a flood risk management function on the drainage network.

Peel Ports maintain the Manchester Ship Canal as a navigable waterway. They control the amount of flow directed from the canal into the River Mersey where they separate at Bollin

Point. Bollin Point is approximately 2km east of the M6 motorway and upstream of the Warrington FRA.

Between 2009 and 2012 a strategic review of flooding from rivers and the sea was undertaken for the Warrington area. This examined the current and future levels of flood risk with the condition and performance of existing flood risk management assets. It determined the best future flood risk management approach for 13 areas of the town. Improvement works were delivered by 2018 that benefited areas adjacent to the River Mersey between Woolston and Lower Walton, in Padgate and in Cinnamon Brow. Further improvement works are under investigation or in preparation for delivery between 2021 and 2027 in Penketh, Callands, Longford, Dallam, and Sankey Bridges.

The impact of climate change and future flood risk

The amount of rainfall and its intensity is expected to increase in the future, causing higher river flows and levels. Sea levels are also expected to rise. This means that flooding from rivers and the sea will become more frequent.

The Climate change and North West RBD section provides information on the likely implications of climate change in the North West River Basin District. Estimates of increases in peak river flows by 2115 for the Lower Mersey catchment are consistent with the RBD estimates.

The approach to managing flood risk in the Warrington FRA will need to adapt to take account of these predictions and those for sea level rise.

Objectives and measures for the Warrington FRA

Measures have been developed which apply specifically to the Warrington FRA. These measures are in addition to measures covering the North West River Basin District or the whole of the country. You can find information about all the measures which apply to the Warrington FRA in the interactive mapping tool - Flood Plan Explorer. This includes information on which national objectives each measure helps to achieve.

Links between the FRMP and the RBMP

In parallel to flood risk management planning, the Environment Agency works with others to protect and improve the quality of the water environment. It does this through river basin management. The Environment Agency aims to co-ordinate the Flood Risk Management Plans (FRMPs) and the River Basin Management Plans (RBMPs) so that all organisations can do more for the environment. By developing the plans together, ways to achieve objectives for flood risk and drought management, and the water environment, including water quality and biodiversity, can be joined together wherever possible.

This is particularly important in order to achieve the main aim of the Water Environment (Water Framework Directive (WFD) England and Wales) Regulations 2017. The main aim of these regulations is to establish a framework for the protection of inland surface waters, estuaries, coastal waters and groundwater. You can find more information about this in the North West RBMP.

In a consultation in 2019/20, the Environment Agency sought views on:

- the challenges that our waters face
- the choices and changes we all need to make to help tackle those challenges

Further information on the responses received can be found in the Challenges and Choices consultation summary report.

The Environment Agency has worked with Lead Local Flood Authorities (LLFAs) and other Risk Management Authorities (RMAs) to develop joint measures to reduce flood risk and improve the wider water environment. Aligning measures also helps to simplify the delivery of outcomes and make it more efficient.

By visiting the North West RBMP, you can find out more information on the objectives and measures for the North West RBMP.

How we will monitor implementation of the FRMP

For the duration of the second cycle (2021 to 2027), the Environment Agency will work with Lead Local Flood Authorities (LLFAs) and other Risk Management Authorities (RMAs) to monitor progress in achieving all of the measures set out in the Flood Risk Management Plan (FRMP). This is a summary of the steps we will follow:

1. The implementation status of each measure in the FRMP will be reviewed and updated every year. This will be done by the authority responsible for implementing the measure.
2. This updated information will be collated by the Environment Agency and analysed to identify any trends in the data. This will allow the identification of possible common interventions which may help measure delivery.
3. Summary statistics will be produced to show how much progress has been made in that year.
4. These statistics and other key messages will be included in the annual report produced under section 18 of the Flood and Water Management Act (2010). This report is published each year and submitted to the relevant regional flood and coastal committee for review. It will also be available online to the public.
5. The updated status of each measure will also be viewable in flood plan explorer.
6. At the end of the 6 year planning cycle, the FRMP will be reviewed and a summary of implementation progress over the duration of the planning cycle will be included. This is a requirement of the Flood Risk Regulations (2009).

List of abbreviations

This list of abbreviations is intended as a reference tool. It includes the main abbreviations and terms used in the second cycle flood risk management plans.

Short form	Long form
AONB	Area of Outstanding Natural Beauty
CaBA	Catchment Based Approach
CDE	Catchment Data Explorer
Defra	Department for Environment, Food and Rural Affairs
DWMP	Drainage and Wastewater Management Plan
EIA	Environmental Impact Assessment
ELMS	Environmental Land Management Scheme
EPR	Environmental Permitting Regulations
FAG	Flood Action Group
FCERM	Flood and coastal erosion risk management
FPE	Flood Plan Explorer
FRA	Flood Risk Area (as identified under the Flood Risk Regulations 2009)
FRM	Flood Risk Management
FRMP	Flood Risk Management Plan
FRR	Flood Risk Regulations 2009
FWMA	Flood and Water Management Act 2010
HRA	Habitats Regulations Assessment

Short form	Long form
IDB	Internal Drainage Board
LEP	Local Enterprise Partnership
LFRMS	Local Flood Risk Management Strategy
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
MHCLG	Ministry of Housing, Communities and Local Government
MMO	Marine Management Organisation
NaFRA	National Flood Risk Assessment
NFM	Natural Flood Management
NNR	National Nature Reserve
NPPF	National Planning Policy Framework
NRW	Natural Resources Wales
PFRA	Preliminary Flood Risk Assessment
RBD	River Basin District
RBMP	River Basin Management Plan
RFCC	Regional Flood and Coastal Committee
RMA	Risk Management Authority
RoFSW	Risk of Flooding from Surface Water
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment

Short form	Long form
SEPA	Scottish Environment Protection Agency
SMP	Shoreline Management Plan
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
UKCP18	UK Climate Projections 2018
WFD	Water Framework Directive

Glossary

This glossary is intended as a reference tool. It includes the main terms used in the second cycle flood risk management plans and a short description of what they are.

25 Year Environment Plan

A plan produced by government which sets out goals for improving the environment, within a generation and leaving it in a better state. It details how government will work with communities and businesses to do this over the next 25 years.

Catchment

The area from which precipitation contributes to the flow from a borehole spring, river or lake. For rivers and lakes this includes tributaries (a river or stream flowing into a large river or lake) and the areas they drain.

Coastal erosion

The loss of land due to the effects of waves and, in the case of coastal cliffs, slope processes (such as high groundwater levels). This may include cliff instability, where coastal processes result in landslides or rock falls.

Flood Risk Area

Areas identified through the PFRA process where the risk of flooding is significant nationally for people, the economy or the environment (including cultural heritage).

Flood Risk Management Plan

A statutory plan prepared by the Environment Agency and LLFAs under the Flood Risk Regulations 2009. The plans are reviewed and updated every 6 years. The current plans cover the period 2021 to 2027.

Flood Risk and Hazard Mapping

Maps prepared under the Flood Risk Regulations 2009 to show potential risks and impacts of flooding in identified Flood Risk Areas. They are reviewed and updated every 6 years. The current maps use data and risk assessment data available in December 2019.

Flood Plan Explorer

A new, online, map-based tool which displays all of the measures proposed as part of the second cycle of flood risk management plans in England.

Fluvial flooding

Flooding from/of rivers.

Groundwater flooding

Occurs when water levels in the ground rise above the natural surface. Low-lying areas underlain by permeable layers are particularly susceptible.

Internal Drainage Board

A public body that manages water levels in areas known as internal drainage districts.

Internal Drainage District

Areas where there are special drainage needs, managed by internal drainage boards.

Lead Local Flood Authority

These are County, Unitary or Metropolitan Boroughs that are responsible for managing flooding from surface water, smaller watercourses and groundwater. There are 152 in England.

Local Flood Risk Management Strategy

Statutory strategies produced by Lead Local Flood Authorities under the Flood and Water Management Act 2010.

Main river

A watercourse shown as such on the main river map. They are usually the larger rivers and streams, and for which the Environment Agency has responsibilities and powers.

Management catchment

An amalgamation of a number of river water body catchments that provide a management unit.

National Flood and Coastal Erosion Risk Management Strategy

A statutory strategy prepared under the Flood and Water Management Act 2010, by the Environment Agency for England.

Ordinary watercourse

A watercourse that does not form part of a main river and is not shown on the main river map. LLFAs, district councils and internal drainage boards may carry out flood risk management work on ordinary watercourses.

Preliminary Flood Risk Assessment

The first stage in the six-year planning cycle to deliver the Flood Risk Regulations. The latest PFRAs were reviewed in 2017 for local sources of flood risk and 2018 for main rivers, the sea and reservoirs.

Preparedness measure

A measure (action) which aims to prepare people for flooding. Examples include flood forecasting and warning, flood emergency response planning and improving public preparedness for flooding.

Prevention measure

A measure (action) which aims to avoid putting people or the environment at risk of flooding. Examples include watercourse regulation, flood risk modelling and mapping and development planning and control.

Protection measure

A measure (action) which aims to better protect people from the risk of flooding. Examples include building flood defences, nature based solutions and asset maintenance.

Recovery and review measure

A measure (action) which aims to use learning from flood incidents. Examples include reviewing lessons learnt from flood response, supporting communities businesses and the environment to recover from flooding.

Reservoirs

A natural or artificial lake where water is collected and stored until needed. Reservoir owners and operators (‘undertakers’) must meet certain requirements under the Reservoir Act 1975.

River Basin District

Large river catchments in England. They cover an entire river system, including river, lake, groundwater, estuarine and coastal water bodies.

River Basin Management Plan

Statutory plans developed by the Environment Agency which set out how organisations, stakeholders and communities will work together to improve the water environment.

River flooding

Occurs when water levels in a channel overwhelms the capacity of the channel.

Services

Services include schools, hospitals, nursing/care/retirement homes, police stations, fire and ambulance stations, prisons, sewerage treatment works and electricity installations.

Sewer flooding

Flooding as a result of overloading of the sewerage system due to limited system capacity or failure of sewer asset.

Strategic Area

A locally defined area included in the Flood Risk Management Plans. They are areas with a similar geography or strategic ambition where it is important to consider flood risk management across administrative boundaries and river catchments.

Surface water flooding

Occurs when intense rainfall overwhelms local drainage capacities.

Tidal flooding

The temporary inundation of coastal areas during exceptionally high tides or storm surges.

Tide locking

Occurs when the level of the incoming high tide stops the river water from flowing out to sea. This can increase the risk of river flooding.

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