

Greater Manchester Strategic Flood Risk Management Framework

Final Report

September 2018

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COMBINED
AUTHORITY**

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This report describes work commissioned by David Hodcroft, on behalf of Greater Manchester Combined Authority Planning and Housing Team, by a letter dated 14 June 2017. The lead representative for the contract was David Hodcroft. Rachel Brisley, Mike Williamson and Charlotte Lloyd-Randall of JBA Consulting carried out this work.

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Purpose

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Acknowledgements

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Executive Summary

Introduction

The purpose of the Greater Manchester Strategic Flood Risk Management Framework (GM SFRMF) is to provide a spatial framework for FRM across Greater Manchester, highlighting the key strategic flood risks including cross-boundary issues within and outside the City Region and recommending key priorities for intervention taking account of previous, existing and planned interventions delivered or to be delivered by Risk Management Authorities (RMAs).

This Strategy is high level and focused on the management of those flood risk issues that are of importance to the Manchester City Region, as a whole, and that have the potential to contribute to or affect its economic, social and environmental sustainability. Subsequently it highlights flood risk issues that cross local authority (LA) and City Region boundaries. As a result, there may be local FRM issues that, whilst important to local economies and communities, are not highlighted as they are better addressed at the local authority level via the local planning authority (LPA) or lead local flood authority (LLFA). GMCA's constituent LAs are all unitary authorities and therefore hold both LPA and LLFA functions. Ultimately, the SFRMF is intended to be an overarching strategic framework for the policies and activities developed and implemented by GM LAs rather than duplicating or replacing them.

The overall aim of the GM SFRMF is to:

Manage current and future flood risk to enable the sustainable development of Greater Manchester by adopting a catchment-based approach and working with natural processes where possible.

This will be achieved by:

- Developing and maintaining a strategic flood risk evidence base across Greater Manchester and using this to inform FRM
 - including an understanding of the location of and potential impacts of FRM for the most vulnerable communities
- Avoiding development in areas that are most at risk of flooding now and in the future
 - unless approaches can be identified that ensure the safety of communities and avoid flood risk elsewhere
- Adopting a catchment based approach to the development of FRM initiatives that focuses on working with natural processes
 - linking upstream processes with impacts downstream
- Focusing interventions in the areas of Greater Manchester that present the most significant risk now, and in the future
 - taking into account the ability of local communities to prepare for, respond to and recover from flooding and working with them to manage residual risk, and;
 - considering adaptive approaches that facilitate changes in approach over time as climate change impacts become more apparent/understood.
- Developing a consistent approach to the management of surface water flood risk
 - including Critical Drainage Area management, the development and delivery of Sustainable Drainage Systems and asset management and maintenance.
- Working in partnership across local authorities, with the Environment Agency and other stakeholders
 - to maximise resources and achieve synergy through approaches that address multiple objectives and achieve multiple benefits.

Wider context

The GMSF is intended to support an ambitious growth agenda across Greater Manchester involving a step change in development that needs to be planned sustainably ensuring that current and future flood risk is not increased. The legislative and policy context for the SFRMF is set out at European, national and City Region levels; across all of these there is strong alignment regarding the role of FRM in protecting communities, the environment and the economy, and evidence of growing support for working with natural processes (WwNP) and natural flood management (NfM).

FRM governance is carried out by a range of different organisations with different responsibilities working in the same locations; the water governance review that is currently underway is a positive step towards improving governance to better achieve FRM outcomes.

Funding is largely provided by public sector sources but can be supplemented by a range of public and private sector funding sources.

Areas of strategic flood risk

River flooding is a significant risk across Greater Manchester particularly for Salford, Manchester, Trafford, Wigan, Bolton and Rochdale.

According to national broadscale flood risk mapping, the majority of Greater Manchester is at risk of surface water flooding - the SFRA has identified CDAs across the City Region and large areas of Manchester, Stockport, Tameside and the town centres of Bolton, Rochdale, Bury and Wigan are within CDAs.

Groundwater flooding may present a risk in Manchester, Oldham, Rochdale, Salford, Stockport and Wigan based on the location of SPZs.

There are potentially multiple cumulative, cross-boundary impacts within Greater Manchester and with adjacent LPAs outside of the City Region.

SFRMF recommendations

Below the SFRMF recommendations are set out in relation to each of the earlier identified strategic objectives:

- Develop and maintain a strategic flood risk evidence base across Greater Manchester and use this to inform FRM
- including an understanding of the location of and potential impacts of FRM for the most vulnerable communities

Recommendations:

- Review data gaps identified from the SFRA and identify how best to address these
- Improve data sharing and access to data across GMCA and with local authorities and other stakeholders.
- Move towards and identify options for the development of a single data platform across Greater Manchester where all flood data is held.
- Avoid development in areas that are most at risk of flooding now and in the future
- unless approaches can be identified that ensure the safety of communities and avoid flood risk elsewhere
- Adopting a catchment based approach to the development of FRM initiatives that focuses on working with natural processes
- linking upstream processes with impacts downstream

Recommendations

- The GMSF should be updated with evidence from the SFRA and SFRMF to promote a catchment based approach to the management of flood risk. This should include dialogue with adjacent LPAs (within and outside Greater Manchester) to manage cumulative and cross-boundary flood risk.
- NfM and wider Natural Capital measures should be promoted through GMSF and Local Plan policies focusing on implementation in the upper catchments to manage flood risk further downstream.
- A strategic, catchment approach to pursuing NfM/Natural Capital opportunities should be developed and implemented once mapping complete. This should consider wider benefits, such as for biodiversity, health and climate change and the benefits downstream in the more flood prone heavily urbanised areas
- Focus interventions in the areas of GM that present the most significant risk now, and in the future
- taking into account the ability of local communities to prepare for, respond to and recover from flooding and working with them to manage residual risk, and;

- considering adaptive approaches that facilitate changes in approach over time as climate change impacts become more apparent/understood.

Recommendations:

- GMCA and its constituent LPAs should look to developing catchment based solutions with multiple partners from the outset to achieve integrated solutions and maximise funding opportunities.
 - Potential surface water schemes could benefit from a packaged approach across Greater Manchester to maximise the achievement of Outcome Measures that will in turn influence the funding that can be secured. This should build on the current tracking and oversight provided by the Greater Manchester Flood and Water Management Board.
 - PFR schemes should be considered for groups of properties by LLFAs where residual risk needs to be managed.
 - Development in areas at flood risk needs to include resilient design and consider the development of long term climate adaptation strategies for areas where flood risk is likely to increase in the future.
- Develop a consistent approach to the management of surface water flood risk
 - including Critical Drainage Area management, the development and delivery of SUDS and asset management and maintenance

Recommendation:

- Integrate SuDS requirements with large development and redevelopment opportunities and through development strategies to avoid piecemeal development that could contribute to overall surface water flood risk.
 - Develop integrated approach to SuDS in the GMSF to achieve flood risk and biodiversity benefits. This should include consideration of adoption and maintenance issues.
 - Update the current SWMP with updated information on surface water flood risk and using 21st Century Drainage outputs, and ensure delivery is actioned and monitored.
 - As detailed in the SFRA, all LLFAs should assess the structures and features on their FRM Asset Registers to inform the capital programme and prioritise maintenance work.
 - Asset management should be prioritised based on condition, capacity and resultant damages to manage liability and the risk of flooding from LLFA assets.
 - Consider opportunities for asset data sharing between RMAs
- Working in partnership across local authorities, with the Environment Agency and other stakeholders
 - to maximise resources and achieve synergy through approaches that address multiple objectives and achieve multiple benefits

Recommendations:

- Use the findings of the water governance review to establish a governance structure that maximises opportunities for collaborative and coordinated working at the catchment scale.

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Abbreviations

AEP	Annual Exceedance Probability
CaBA.....	Catchment Based Approach
CC	Climate change
CDA	Critical Drainage Area
CFMP	Catchment Flood Management Plan
DCLG	Department for Communities and Local Government
DPD	Development Plan Documents
DTM	Digital Terrain Model
EA	Environment Agency
FAA	Flood Alert Area
FCERM	Flood and Coastal Erosion Risk Management
FMP	Flood Map for Planning (Rivers and Sea)
FRA.....	Flood Risk Assessment
FRCC-PPG	Flood Risk and Coastal Change Planning Practice Guidance
FRM	Flood Risk Management
FRMP.....	Flood Risk Management Plan
FRMS.....	Flood Risk Management Strategy
FRR.....	Flood Risk Regulations
FSA	Flood Storage Area
FWA.....	Flood Warning Area
FWMA	Flood and Water Management Act
GI	Green Infrastructure
GiA	Grant in Aid
GIS.....	Geographical Information Systems
GMCA	Greater Manchester Combined Authority
GMSF.....	Greater Manchester Spatial Framework
HFM	Historic Flood Map
LA.....	Local Authority
LDF	Local Development Framework
LFRMS.....	Local Flood Risk Management Strategy
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
LRF	Local Resilience Forum
NfM	Natural Flood Management
NPPF	National Planning Policy Framework
OAFCDM	Opportunity Areas for Further Critical Drainage Management
RBD	River Basin District
RBMP.....	River Basin Management Plan
RFCC.....	Regional Flood and Coastal Committee
RMA	Risk Management Authority

SA	Sustainability Appraisal
SEA.....	Strategic Environmental Assessment
SFRA	Strategic Flood Risk Assessment
SoP	Standard of Protection
SPD.....	Supplementary Planning Documents
SuDS.....	Sustainable Drainage Systems
SWMP.....	Surface Water Management Plan
UDP	Unitary Development Plan
UKCP09	UK Climate Projections 2009
UU	United Utilities
WFD.....	Water Framework Directive
WwNP	Working with Natural Processes

1 Introduction and objectives

1.1 Introduction

Greater Manchester Combined Authority (GMCA) commissioned JBA Consulting (JBA) in June 2017 to undertake a Level 1 Strategic Flood Risk Assessment (SFRA) and develop a Strategic Flood Risk Management Framework (SFRMF) to cover the ten Greater Manchester local authorities (LAs) that make up GMCA. GMCA requires this Level 1 SFRA and SFRMF to inform the Greater Manchester Spatial Framework (GMSF) and local plans for the 10 constituent local planning authorities (LPAs). This document provides the draft GM SFRMF; it has been informed by the outputs from the SFRA and discussions with the SFRA Steering Group.

The purpose of the GM SFRMF is to provide a spatial framework for FRM across Greater Manchester, highlighting the key strategic flood risks including cross-boundary issues within and outside the CA and recommending key priorities for intervention taking account of previous, existing and planned interventions delivered or to be delivered by Risk Management Authorities (RMAs).

This Framework is high level and focused on the management of those flood risk issues that are of importance to the Manchester City Region, as a whole, and that have the potential to contribute to or affect its economic, social and environmental sustainability. Subsequently it highlights flood risk issues that cross LA and City Region boundaries. As a result, there may be local FRM issues that, whilst important to local economies and communities, are not highlighted as they are better addressed at the local authority level via the LPA or lead local flood authority (LLFA). GMCA's constituent LAs are all unitary authorities and therefore hold both LPA and LLFA functions. Ultimately, the SFRMF is intended to be an overarching strategic framework for the policies and activities developed and implemented by GM LAs rather than duplicating or replacing them.

1.2 Objectives

The following objectives have been informed by national legislation; national, regional and local policy; the emerging GMSF; strategic flood risk across Greater Manchester and current initiatives to manage this. Flooding is a significant risk across Greater Manchester to communities, the economy and the environment and this risk is likely to increase in future as a result of climate change and increased development to accommodate projected population growth. The SFRMF is intended to help manage this risk enabling the City Region to meet its growth and regeneration ambitions. Adopting a catchment-based approach that works with rather than against natural processes, and managing flood risk at a strategic level, involving the pooling of resources and working on a cross-boundary basis, should enable the achievement of multiple benefits for the economy, the environment and local communities.

The overall aim of the GM SFRMF is to:

Manage current and future flood risk to enable the sustainable development of Greater Manchester by adopting a catchment-based approach and working with natural processes where possible

This will be achieved by:

- Developing and maintaining a strategic flood risk evidence base across Greater Manchester and using this to inform FRM
 - including an understanding of the location of and potential impacts of FRM for the most vulnerable communities
- Avoiding development in areas that are most at risk of flooding now and in the future
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- Adopting a catchment based approach to the development of FRM initiatives that focuses on working with natural processes
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- Focusing interventions in the areas of GM that present the most significant risk now, and in the future
 - taking into account the ability of local communities to prepare for, respond to and recover from flooding and working with them to manage residual risk, and;
 - considering adaptive approaches that facilitate changes in approach over time as climate change impacts become more apparent/understood.

- Developing a consistent approach to the management of surface water flood risk
 - including Critical Drainage Area management, the development and delivery of Sustainable Drainage Systems (SuDS) and asset management and maintenance.
- Working in partnership across local authorities, with the Environment Agency and other stakeholders
 - to maximise resources and achieve synergy through approaches that address multiple objectives and achieve multiple benefits.

The remainder of this document is comprised of the following sections:

- Section 2 - Wider context
- Section 3 - Current and future flood risk
- Section 4 - FRM in Greater Manchester
- Section 5 - Recommendations.

2 Wider context

The SFRMF will align and support European, national and local legislation and policy. FRM is directed and supported by a raft of legislation and policy. In addition, there are many local strategies and plans aiming to achieve economic, community and environmental objectives, the delivery of which will influence and be influenced by the SFRMF. This section provides an overview of the GMSF that the SFRMF will inform. It then summarises European, national and local legislation and policy for FRM and their relevance to the SFRMF followed by an overview of more local strategies and plans. The section is completed by a short overview of water governance across Greater Manchester.

2.1 Greater Manchester Spatial Framework

The GMSF is a joint plan for Greater Manchester that will provide the land for jobs and new homes across the city region, setting out ambitious plans seeking 'to make Greater Manchester one of the best places in the world'.

The Framework, which is being produced by the 10 local authorities working together in partnership, is intended to support Greater Manchester's growth ambitions by ensuring that the right time and amount of land is available in the right places to deliver the homes and jobs required by 2037, and will also identify the new infrastructure required to achieve this. By working in a coordinated way, it is hoped that the GMSF can achieve joined up decision making both locally and at a Greater Manchester level.

The Revised Draft GMSF 2019 identifies enough land to deliver an additional 218,549 homes, 5,358,041sq m of industrial and warehousing space and 2,952,705 sq m of office floorspace by 2037 and identifies 8 strategic locations are identified as being significant in terms of their economic importance and role in meeting future development needs. These are:

- **Core Growth Area - covering the central areas of Manchester and Salford**
- **City Centre**
- **Main town centres** - Altrincham, Ashton-Under-Lyne, Bolton, Bury, Oldham, Rochdale, Stockport and Wigan
- **The Quays** - Salford Quays and Trafford Wharfside
- **Port Salford**
- **Manchester Airport**
- **M62 North Eastern Corridor** - covers a stretch of the M62 corridor around its intersection with the M66.
- **Wigan Bolton Growth Corridor** - extending through the north west of Greater Manchester

The first draft of the GMSF was consulted upon in 2016 and consultation responses highlighted a number of concerns particularly in relation to the amount of greenfield land allocated for development purposes. The Revised Draft Framework, that will be published for an eight week consultation period in January 2019, is focused on making the most of Greater Manchester's brownfield sites and reducing the impact on greenbelt as well as setting out how the quality of the natural environment will be enhanced and preserved, wildlife conserved and flood risk tackled to support and accommodate sustainable growth.

The Revised Draft GMSF 2019 objectives are set out in Table 2-1.

Objective 1: Meet our housing need.

We will:

- Increase net additional dwellings (2018 – 2037);
- Focus new homes in the urban area;
- Focus new homes in the central economic zone (this includes the city centre (Manchester and Salford and the Quays) and the town centres;
- Focus new homes within 800m of public transport hubs; and
- Locate social infrastructure alongside housing.

Objective 2: Create neighbourhoods of choice.

We will:

- Increase the no. of affordable homes (2018 – 2037);
- Ensure that there is no increase in the number of homes and premises at a high risk of flooding; and
- Prioritise the use of previously developed land.

Objective 3: Create a thriving and productive economy in all parts of Greater Manchester.

We will:

- Ensure there is a diverse range of employment sites and premises;
- Increase net additional employment floorspace (2018 – 2037);
- Prioritise the use of previously developed land; and
- Facilitate the development of high value clusters in prime sectors such as:
 - Manufacturing;
 - Business, financial and professional services;
 - Creative and digital;
 - Health innovation;
 - Logistics.

Objective 4: Maximise the potential arising from our national and international assets.

We will:

- Focus development in the Central Economic Area, Manchester Airport and key economic locations;
- Improve visitor facilities in the City Centre, Quays and Manchester Airport and our international and national sporting assets;
- Enhance our cultural and heritage assets;
- Improve sustainable transport and active travel access to these locations;
- Improve access for local people to jobs in these locations;
- Ensure infrastructure provision supports growth in these locations; and
- Increase graduates staying in GM.

Objective 5: Reduce inequalities and improve prosperity.

We will:

- Promote truly inclusive growth;
- Prioritise development in well connected locations, including the City Centre (Manchester and Salford and the Quays) and the town centres;
- Strengthen the competitiveness of north Greater Manchester; and
- Reduce the number of “10% most deprived wards”.

Objective 6: Promote the efficient movement of people and goods.

We will:

- Enhance our existing transport network;
- Expand our transport network to facilitate new areas of sustainable and inclusive growth;
- Capitalise on national and regional investment in transport infrastructure;
- Ensure new development is designed to encourage and enable active and sustainable travel;
- Increase the proportion of trips made by walking, cycling and public transport; and
- Focus new development within 800m of sustainable transport hubs.

Objective 7: Promote climate resilience, reduce carbon emissions and make Greater Manchester a carbon neutral city region.

We will:

- Promote sustainable patterns of development that minimise the need to travel;
- Improve energy efficiency and the generation of renewable and low carbon energy; and
- Promote climate resilience and carbon neutrality of development.

Objective 8: Improve the quality of our natural environment and access to green spaces.

We will:

- Enhance biodiversity and geodiversity, green Infrastructure and the special landscapes across Greater Manchester;
- Improve access to the natural environment and green spaces including parks and playgrounds; and [IA]
- Promote the role of green space in climate resilience and reducing flood risk.

Objective 9: Ensure access to critical physical and social infrastructure.

We will:

- Ensure that our communities and businesses are supported by critical Infrastructure;
- Improve the capacity and network coverage of digital, energy, telecoms, transport and water in key growth locations; and
- Ensure new development provides access to or provision of social infrastructure including schools, health, social care, sports and recreation facilities.

Table 2-1: GMSF revised draft objectives

FRM can contribute to achieving these objectives in various ways, for example, by helping to direct development to the 'right' places, away from flood risk and potentially creating more green spaces in urban areas to improve local environmental quality and offset urban expansion in other areas. Also, FRM can help achieve wider benefits such as improving the cycle/footpath network through natural flood management and using green infrastructure to help manage flooding.

The current revised draft policy and supporting text on Flood Risk and the Water Environment set out the key flood risk issues for Greater Manchester and highlight the need for an integrated approach to protect the quantity and quality of water bodies and manage flood risk. Key requirements to deliver this policy objective include: returning rivers to a more practicable state where practicable, adopting flood management processes including opportunities for upstream flood water storage, locating and designing development to minimise the risks and impacts of flooding including through the management of surface water runoff, supporting the relocation of vulnerable uses and critical infrastructure away from areas at high risk of flooding,, encouraging retrofitting of flood resilience measures, investing in wastewater treatment to reduce sewer flooding and securing the remediation of contaminated land to minimise urban diffuse pollution.

2.2 European, national and regional legislative and policy framework for FRM

The wider legislative and policy framework for FRM is set out in Figure 2-1.

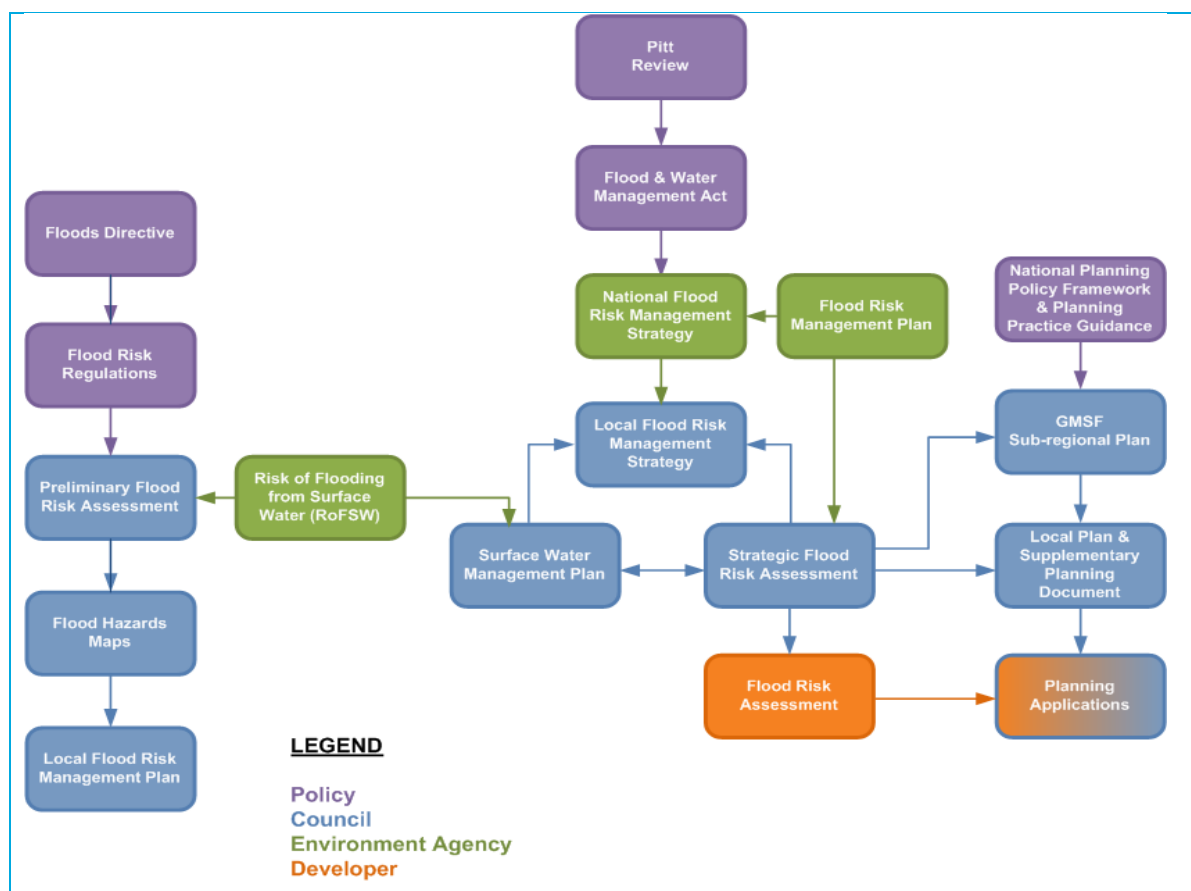


Figure 2-1: European and national legislative and policy framework for FRM

The supporting GMCA SFRA provides a summary of the components of the framework in Section 4. The following key points regarding the direction for SFRMF and strategic issues for FRM in Greater Manchester are as follows:

- **The EU Floods Directive** issued in 2007 sets out the overall approach for managing flood risk to protect the environment, communities and the economy
- Greater Manchester is within the North West River Basin District and, as identified through the first cycle PFRAs in 2011, a large area of Greater Manchester was defined as a Flood Risk Area (FRA). **The North West River Basin District Flood Risk Management Plan** (2015) states that 119,941 people were found to be at risk within the Flood Risk Area that covers nine of the ten GM authorities with Wigan not included. The Irwell and Upper Mersey catchments dominate the FRA; other main rivers within the FRA including Glaze Brook, the River Bollin, Sinderland Brook, the River Goyt and the River Etherow.
- **The Strategic Preliminary Flood Risk Assessment for Greater Manchester** produced by the Environment Agency in 2017 (required by the Flood Directive) only identified Tameside as a key flood risk area in Greater Manchester. This, at the time, was challenged by GMCA due to the considerable reduction in area, though has since been accepted. GMCA accepted that the PFRA is not used as evidence to inform the planning process, unlike this SFRA, so by accepting the reduced indicative Flood Risk Area, there should be no impact on the planning process. The Environment Agency is developing a national PFRA for river and sea flooding that will be published later this year.
- **Catchment Flood Management Plans** for the Irwell, Upper Irwell, Mersey and Douglas catchments were produced by the Environment Agency in 2009. These were superseded by River Basin District FRM plans and are almost 10 years out of date so are provided for context only:
 - **Irwell** - Salford was identified as the main area at risk (and has flooded since, in 2015). At the time of publication, the CFMP stated that an estimated 7,500

properties had a 1% probability of fluvial flooding each year. This is estimated to increase to 10,000 by 2100 as a result of climate change (NB: climate change allowances at the time have since been increased); an 8% increase on the current number. The CFMP identified following areas as being areas of moderate to high flood risk where we can generally take further action to reduce flood risk: Salford, Swinton and Eccles, and Bradford and Deansgate (Manchester City Council).

- **Upper Mersey** - covering a significant part of urban Manchester and encompassing parts of the South Pennine Moors Special Protection Area and Special Area of Conservation, the Upper Mersey catchment is identified as one of contrasts. The Upper Mersey CFMP states that over 2,600 residential and commercial properties are at a 1% annual probability of flooding from rivers in the Upper Mersey catchment. This is expected to rise to 2,900 properties in the future as a result of climate change (again, acknowledging that climate change allowances have increased since the CFMPs were published). The Tame (Oldham, Tameside, Stockport), Mersey (Trafford, Manchester, Stockport) and Upper Sinderland (Trafford, Manchester) are sub-areas identified as being at moderate to high flood risk where we can generally take further action to reduce flood risk.
- **Lower Mersey (Mersey Estuary)** - this catchment is home to much of the North West's heavy industry and major ports and catchment has a rich industrial past. Consequently, it became one of the most polluted rivers in Europe. The historic coal and chemical industries also left a legacy of contaminated land. In addition, canals such as St Helens Canal were built to link Lancashire coal mining fields and cotton manufacturing with the Port of Liverpool. Leigh (Wigan, Bolton) is identified as an Areas of moderate to high flood risk where we can generally take further action to reduce flood risk.
- **Douglas** - the River Douglas rises in the hills of South Lancashire and is fed by the Rivington reservoirs. The Douglas and its tributaries flow through the historic industrial towns of Wigan, Chorley, Leyland and Bolton before joining the Ribble Estuary. Urban pollution places significant pressures on the catchment at these locations. According to the Douglas CFMP, there are more than 2,200 properties at risk of flooding in 1% annual probability event (including some tidal flooding). An additional 329 properties across the CFMP area would be at risk of flooding from rivers or the sea in a future 1% event. Appleby Bridge and Croston in Wigan is identified as an area of moderate to high flood risk where we can generally take further action to reduce flood risk.
- **Flood and Water Management Act, 2010** was intended to improve both flood risk management and the way that water resources are managed. It created clearer roles and responsibilities for FRM and helped to define a more risk-based approach to managing flooding. This included the creation of a lead role for LAs, as LLFAs, designed to manage local flood risk (from surface water, ground water and ordinary watercourses) and to provide a strategic overview role of all flood risk for the Environment Agency. The Act recognises that "maintaining or restoring natural processes" is a way of managing flood risk and therefore permits the designation of natural features that can reduce this risk.
- **The 25 Year Environment Plan** was published by Defra in 2018. This Plan sets out Government action to help the natural world regain and retain good health. It aims to deliver cleaner air and water in our cities and rural landscapes, protect threatened species and provide richer wildlife habitats. It calls for an approach to agriculture, forestry, land use and fishing that puts the environment first. The Plan also sets out how Government will tackle the effects of climate change and promotes the need to work with nature to protect communities from flooding, slowing rivers and creating and sustaining more wetlands to reduce flood risk and offer valuable habitats. Focusing on flood risk, the Plan identifies that the National Flood and Coastal Erosion Risk Management Strategy will be updated and Government will look at current partnership arrangements ahead of a review of funding needs beyond 2021, seeking to attract more non-public sector investment, and make sure all relevant agencies are able to respond quickly and effectively to support communities if and when flooding does occur. The Plan states that the EA will use its role in statutory planning consultations to seek to make sure that new developments are flood resilient and do not increase flood risk. It also states the Government will focus on using more natural flood management solutions; increasing the uptake of SuDS, especially in new development; and improving the resilience of properties at risk of flooding and the time it takes them to recover should flooding occur.

- **The National Flood and Coastal Erosion Risk Management (FCERM) Strategy for England** was developed by the Environment Agency with the support and guidance of Defra and published in 2011. This strategy was fundamentally concerned with the roles and responsibilities of the EA in relation to managing flood risk. The Environment Agency is currently working with other RMAs to produce a revised strategy that will be published in 2019. This strategy involves all sources of flood risk and coastal erosion and, therefore, is being produced in a collaborative way involving all RMAs and other stakeholders. Addressing the fragmented nature in which FCERM is management and working with water and natural processes have been key themes in discussions regarding the development of the national strategy to date.
- **The National Planning Policy Framework, 2012** forms the national planning policy framework in England and is accompanied by a number of Planning Practice Guidance notes. It must be taken into account in the preparation of Local Plans and is a material consideration in planning decisions. It requires that Local Plans are supported by SFRAs and develop policies for FRM from all sources. It also sets out the requirement *"to apply a sequential risk-based approach to the location of development to avoid, where possible, flood risk to people and property and manage any residual risk, taking account of the impacts of climate change, by applying the Sequential Test, if necessary applying the Exception Test, safeguarding land from development that is required for current and future flood management, using opportunities offered by new development to reduce the causes and impacts of flooding and where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long term, seeking opportunities to facilitate the relocation of development including housing to more sustainable locations"*.
- **The Greater Manchester Surface Water Management Plan** was produced in 2013 and included a strategic assessment of surface water flood risk across Greater Manchester to identify 'hotspots' of significant surface water flood risk. An Action Plan was prepared with the intention that identified actions would be integrated through Local Flood Risk Management Strategies into frameworks through which each LLFA/LPA would manage future flood risk.
- **Local Plans** - each of the Greater Manchester LPAs has its own Local Plan including policies on development and FRM. These are reviewed further in Section 3 regarding current FRM in Greater Manchester.
- **Local Flood Risk Management Strategies (LFRMS)** - each of the Greater Manchester LLFAs has its own Local Plan including policies on development and FRM. These are reviewed further in Section 3 regarding current FRM in Greater Manchester.

2.3 Greater Manchester strategies and plans

In addition to the legislation and national policy regarding development and flood risk, there are a number of Greater Manchester focused plans and strategies that will be affected by and affect the SFRMF. These are illustrated in Figure 2-2 with a summary of their relevance to the SFRMF provided in Table 2-2.

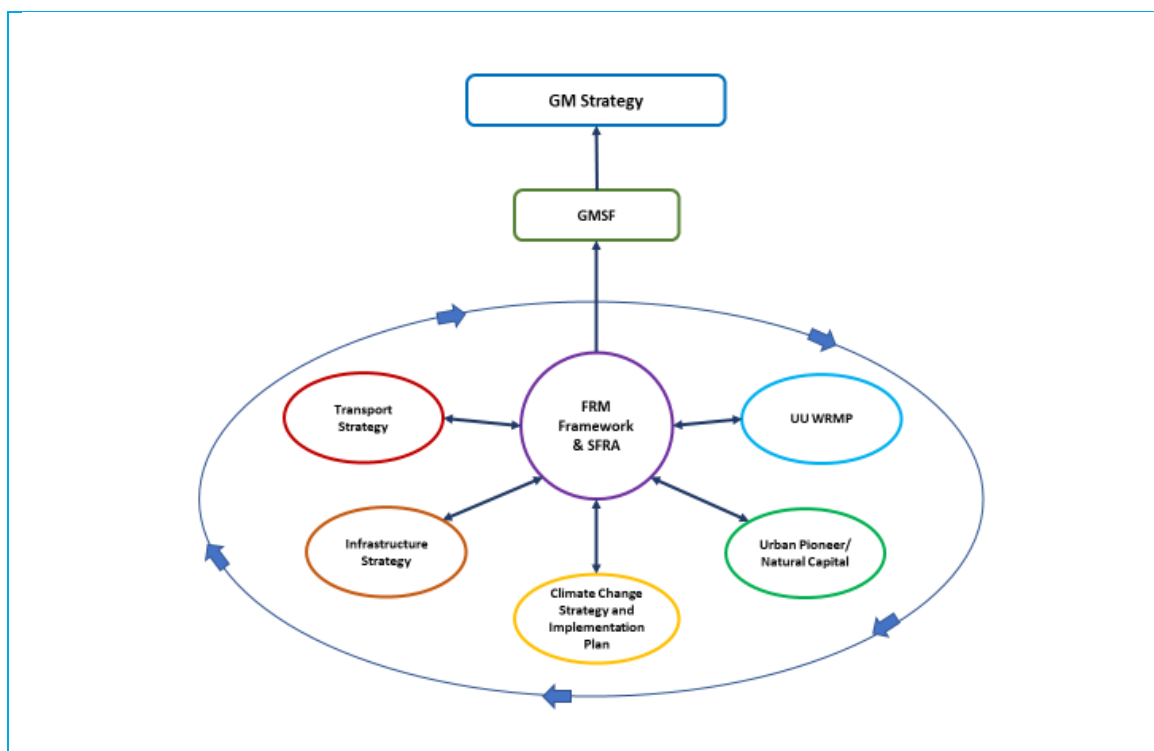


Figure 2-2: Greater Manchester strategies and plans

Legislation/plan/strategy	Produced by	Date	Purpose	Status	Relevance to GM SFRMF
GM Growth and Reform Plan	GMCA, GM LEP, AGMA	2014	Create the platform for fiscal self-reliance by seeking resources from the Local Growth Fund and developing a new place-based relationship with Government to drive public sector reform and further align local and central growth programmes.	Discretionary policy/funding direction	Importance of FRM to place and water governance link with public sector reform.
GM Strategy	GMCA, GM LEP	2017	Long-term blueprint for the future including objectives that intended to create a flourishing natural environment and resilience to climate change including flooding.	Discretionary policy	SFRMF should support objectives regarding natural environment and resilience
GMSF	GMCA, GM LEP	Under development - 2019	Joint plan for Greater Manchester aimed at providing the land for jobs and new homes that will support the sustainable growth of the City Region.	Statutory framework for Local Plans and policies	SFRMF is intended to support the GMSF and will be delivered through this, Local Plans and LFRMSs
GM Climate	AGMA	2011	Sets out Greater	Discretionary	SFRMF will support the

Legislation/plan/strategy	Produced by	Date	Purpose	Status	Relevance to GM SFRMF
Change Strategy			Manchester's plan to build a low carbon economy by 2020, reducing carbon emissions by 48% and reacting to the changing climate while creating future jobs and new industries in the 'green' sector	strategy	objectives to react and adapt to the changing climate
Climate Change and Low Emissions Implementation Plan	GMCA and Greater Manchester Low Carbon Hub	2016	Sets out actions to both address climate change and improve Greater Manchester's air quality.	Discretionary plan	SFRMF supports climate change adaptation actions
GM Infrastructure Framework 2040	GMCA, LEP, Greater Manchester Infrastructure Delivery Group	2019	Identifies the strategic infrastructure trends, challenges for Greater Manchester including FRM infrastructure and the response that is required to ensure infrastructure resilience.	Discretionary plan	Resilience to flooding and climate change essential for infrastructure assets and operations, also includes FRM infrastructure - SFRMF will support the Infrastructure Strategy
GM Transport Strategy, 2040 and Delivery Plan, 2016/17 - 2021/22	Transport for Greater Manchester	2017	Provide a long-term view of how transport system needs to change to meet objectives and respond to future economic, societal, environmental and technological trends, supported by a five year Delivery Plan	Statutory framework for Local Transport Plans and policies	Resilience to flooding and climate change essential for transport assets and operations - SFRMF will support the Transport Strategy and Delivery Plan including through delivery of wider infrastructure resilience and improvements such as cycle/foot paths.
Urban Pioneer Strategic Plan	GMC, Environment Agency, Greater Manchester local authorities	2018	The Pioneer aims to support Greater Manchester in pioneering a new model for sustainable economic growth based around a more connected, talented and greener city region, where all residents are able to contribute to and benefit from sustained prosperity and a good quality of life	Discretionary plan	SFRMF will contribute to the Plan and will be supported by its focus on working with nature including natural flood management.

Table 2-2: Greater Manchester strategies and plans

Table 2-2 illustrates the importance of FRM and the SFRMF to the achievement of multiple plans and strategies aimed to enhance Greater Manchester's environment, communities and economy.

2.4 FRM governance in Greater Manchester

The governance of FRM, nationally and across Greater Manchester, is led by numerous organisations focusing on different sources of flood risk at different spatial scales and different target outcomes. Infrastructure that either has a direct FRM role or is more incidental (e.g. railway embankments) is owned and managed by a multitude of organisations/providers and GMCA has limited control over the provision of decision-making processes within these sectors. Sharing data between stakeholders can be challenging but provides an opportunity for joint working; there is also the potential for alignment of investment between organisations to achieve similar goals and support the needs of Greater Manchester.

Current FRM governance in Greater Manchester is summarised in Table 2-3:

Risk from:	Environment Agency	LLFA	United Utilities	Highway Authority
Main river	✓			
Surface water		✓	✓	
Surface water (from highway)				✓
Sewer flooding			✓	
Ordinary watercourse		✓		
Groundwater		✓		
Reservoir	✓*	✓*	✓*	
Strategic overview of all sources of flood risk (and the coast)	✓			

Table 2-3: FRM governance, Greater Manchester¹

* NB: RMAs have different responsibilities for reservoirs such as regulation, asset management and flood incident response

In addition, the Greater Manchester Flood and Water Management Board oversees investment in, and delivery of FRM schemes across the City Region and the North West Regional Flood and Coastal Committee (RFCC) was established by the Environment Agency under the Flood and Water Management Act 2010 bringing together members appointed by LLFAs and independent members with relevant experience. The RFCC makes recommendations on investment from the Environment Agency's Grant in Aid Investment Programme and allocates Local Levy funding - these are discussed further in 2.5.

Due to the complexities and resulting delivery challenges from complex governance, GMCA has commissioned the University of Manchester to undertake a review of Water Governance across Greater Manchester. In addition to the formal roles identified above, this will consider and review the role of partnerships, networks, project and programme bodies. In addition the review will investigate the interconnectedness of water management with other areas, such as green infrastructure, agriculture and forestry, waste management, nature conservation, fishing, leisure and tourism, environmental regulation and pollution control in general.

2.5 Funding for FRM

FRM in Greater Manchester is funded through three main source for capital investments: Grant in Aid from the Environment Agency's Investment Programme, Local Levy provided by the RFCC and external contributions (public and private) to match fund Grant in Aid. These funding sources are summarised below - further detail is provided in Section 4 regarding current investment in FRM in Greater Manchester.

- **Environment Agency Investment Programme** - Government is investing £2.6 billion to better protect the country from flooding and coastal erosion between April 2015 and March 2021. This includes over 1,500 schemes that will better protect 300,000 homes in that period. Submissions are made to the Environment Agency, and considered by the RFCC, and funding is allocated through the Partnership Funding formula that takes into account Outcome Measures, which cover measures regarding numbers of properties moved from one flood risk band to another, including a focus on deprived communities and environmental outcomes, and the amount of external contributions that have been secured.
- **RFCC Local Levy** - this is obtained from Council Tax from the relevant LLFAs in the RFCC region. The Levy can be used as a discretionary contribution from the RFCC to provide the external contribution to leverage Grant in Aid, and also funds some schemes 100%. In

¹ GMCA and the Environment Agency (2016) Flood Investigation Report - 26 December 2015

addition, funding can be obtained from the General Drainage Charge for areas that are not covered by Internal Drainage Boards.

- **External contributions** - these are secured from a variety of sources to provide the additional funding required to secure Grant in Aid. Nationally these have largely been secured from public sector sources, mainly from LLFAs, however private sector funding has also been secured and is encouraged by the Environment Agency and Government. In addition, further external funding sources include s.106 and Community Infrastructure Levy developer contributions, the European Regional Development Fund (ERDF), Single Growth Fund (LEPs), National Lottery funding and other grant funding trusts and foundations.

Revenue funding is provided by the relevant RMA dependent on the type of flood risk being addressed so maintenance and revenue activities for main watercourses is funded by the Environment Agency and for ordinary water courses and surface water flood risk, by LLFAs. In addition, related activities that contribute towards FRM are undertaken and funded by highways authorities, Highways England, Network Rail and other infrastructure bodies.

2.6 Summary

The GMSF is intended to support an ambitious growth agenda across Greater Manchester involving a step change in development that needs to be planned sustainably ensuring that current and future flood risk is not increased. This is investigated further in sections 3 and 4.

The legislative and policy context for the SFRMF is set out at European, national and City Region levels; across all of these there is strong alignment regarding the role of FRM in protecting communities, the environment and the economy, and evidence of growing support for working with natural processes (WwNP) and natural flood management (NfM).

FRM governance can be fragmented and lead to silo management by flood risk source and at different spatial levels. The water governance review that is currently underway is a positive step towards improving the coherence, efficiency and effectiveness of governance to achieve FRM outcomes.

Funding is largely provided by public sector sources but can be supplemented by a range of public and private sector funding sources.

3 Existing and future strategic flood risk

This Section summarises the findings from the Greater Manchester SFRA to identify those areas most at risk of flooding now, and in the future.

3.1 Existing risk

3.1.1 Flooding from rivers

It is important to note that the Flood Map for Mapping that identifies flood zones does not include defences and flood risk across Greater Manchester is managed through defences on the River Mersey and Irwell, two basins in Salford and a major scheme planned for Rochdale; therefore, the actual flood risk presented is less than shown by the below. Visually, Manchester, Trafford, Wigan, Bolton and Rochdale appear to have the most risk. It is clear that the River Mersey and River Irwell have a significant effect on flood risk in Greater Manchester. In contrast to the Irwell, the large areas of risk from the Mersey tend to cover natural floodplain where there is no development. These areas should be kept free from future development and left as open space for flood storage. Risk from the Irwell affects several residential areas in Salford, Manchester and further upstream in Bury.

15 residential areas of Wigan are shown to have considerably sized residential areas within Flood Zone 3 whilst there are seven in Manchester; six in Bolton; five in Rochdale; four in Stockport; three in Bury and Trafford; two in Oldham and Tameside; and one in Salford. The residential area at risk in Salford is large and includes much of Lower Broughton and Lower Kersal that are shown to be at risk from the River Irwell. A key location shown to be at risk is Rochdale Town Centre. The River Roch is shown to come out of bank through much of the Town Centre and also upstream in the town of Littleborough. Another key location includes that of Brunswick and Hume, just south of Manchester City Centre.

It is important to note that the Flood Map for Planning does not include for the impact of flood defence infrastructure though flood risk across Greater Manchester is managed through defences on the River Mersey and Irwell; two basins in Salford; and a major scheme planned for Rochdale. The actual flood risk presented in Figure 3-1 therefore is much less in reality.

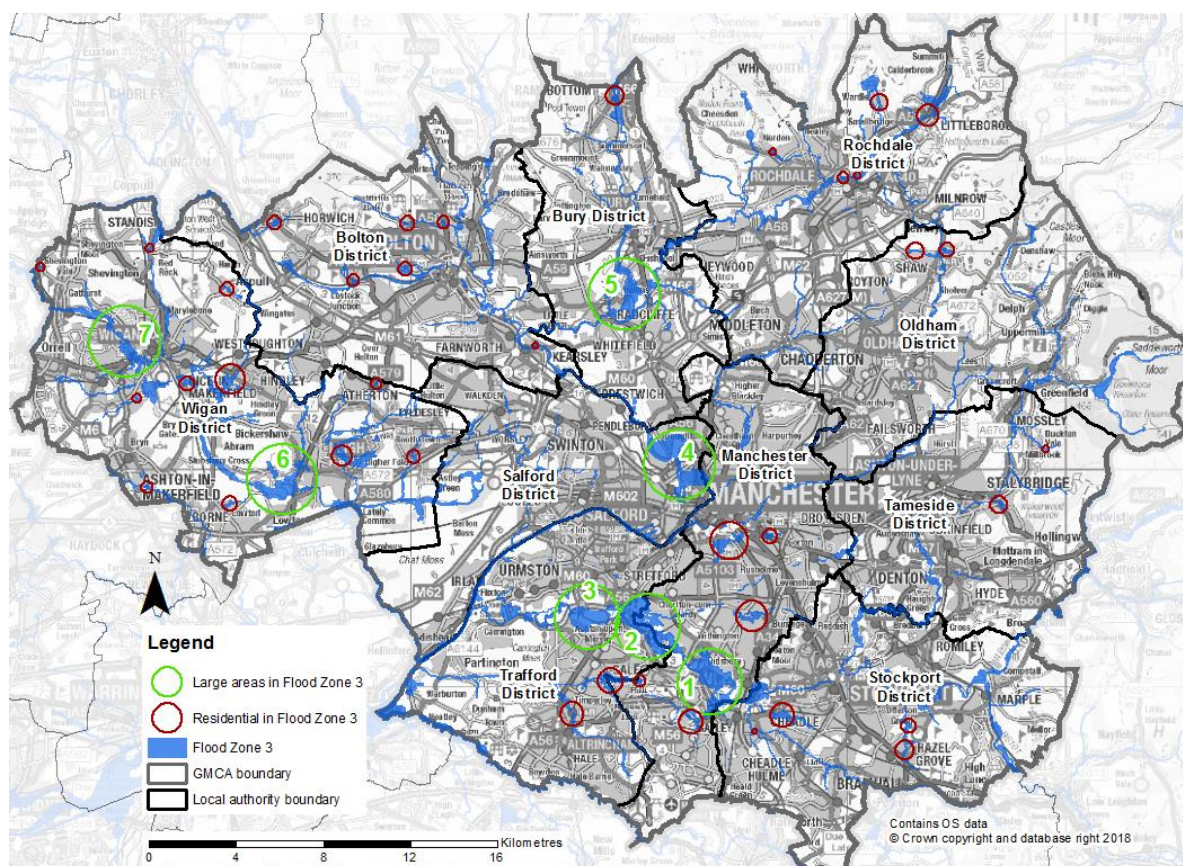


Figure 3-1: Flood Zone 3 across Greater Manchester

3.1.2 Flooding from surface water

Figure 3-2 (Figure 6-3 in the SFRA) shows a small scale map of the medium risk 1% Annual Exceedance Probability (AEP) event from the Risk of Flooding from Surface Water (RoFSW) dataset. This suggests that the majority of urban Greater Manchester is at risk from surface water flooding. Only the upland areas of the north and east of the City Region (parts of Bury, Rochdale, Oldham, Tameside and Stockport) are not covered in 'the blue' of surface water flood risk. Surface water flood risk is clearly therefore an issue for all of GM, according to the RoFSW.

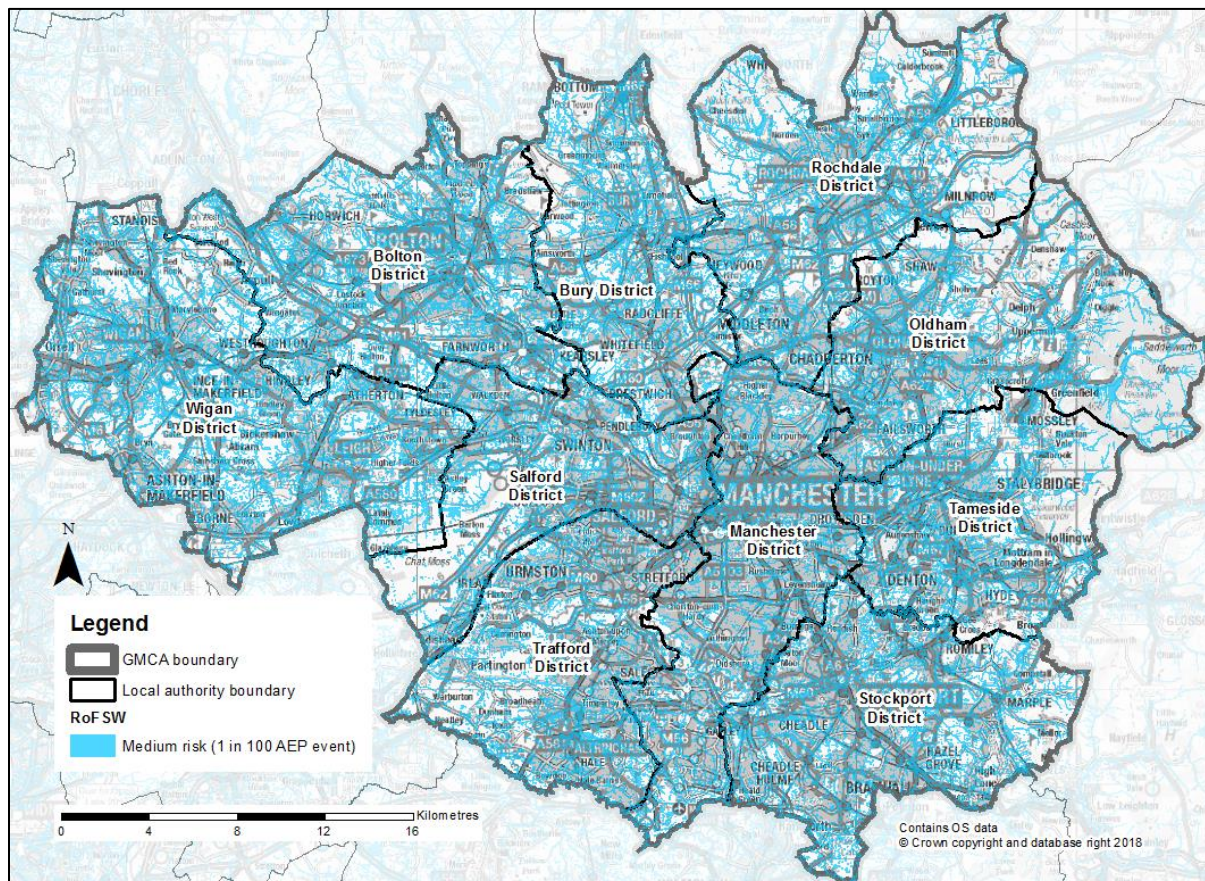


Figure 3-2: Surface water flood risk across GM (RoFSW 1 in 100 AEP event)

The RoFSW is however a national broad scale dataset therefore more detailed surface water / drainage modelling may be required at the community or development level. In order to narrow down and focus on urban areas at particularly significant surface water flood risk, Critical Drainage Areas (CDAs) were mapped by the GM authorities as part of previous SFRA (see SFRA report). CDAs can be designated by LPAs or LLFAs for their own purposes.

A high level review of the CDAs has been carried out as part of the SFRA, however, given data restrictions, the decision has been taken by GMCA that the existing CDAs should remain alongside new 'Opportunity Areas for Further Critical Drainage Management' (OAFCDM), drafted based on historic surface water flood incidents, surface water Hotspots generated from the 2013 GM SWMP and United Utilities Drainage Areas Zones (DAZ) boundary data. The CDA policy stated in Table 4-3 of the SFRA should still apply to proposed developments within a CDA, though the OAFCDMs should also be considered alongside the CDAs, by the applicable LLFA and LPA, for further critical drainage management. The CDAs are presented on the SFRA Maps in Appendix A of the SFRA.

The Environment Agency has not designated any Areas with Critical Drainage Problems (ACDPs) across Greater Manchester. Any proposed developments within these areas that are in Flood Zone 1 must conduct a Flood Risk Assessment (FRA) and therefore it is important these are designated, where appropriate, to help manage potential surface water flooding. Figure 3-3 shows a GM scale map of the OAFCDMs. It can be seen that large areas of Manchester, Stockport, Tameside and the town centres of Bolton, Rochdale, Bury and Wigan are within the OAFCDMs.

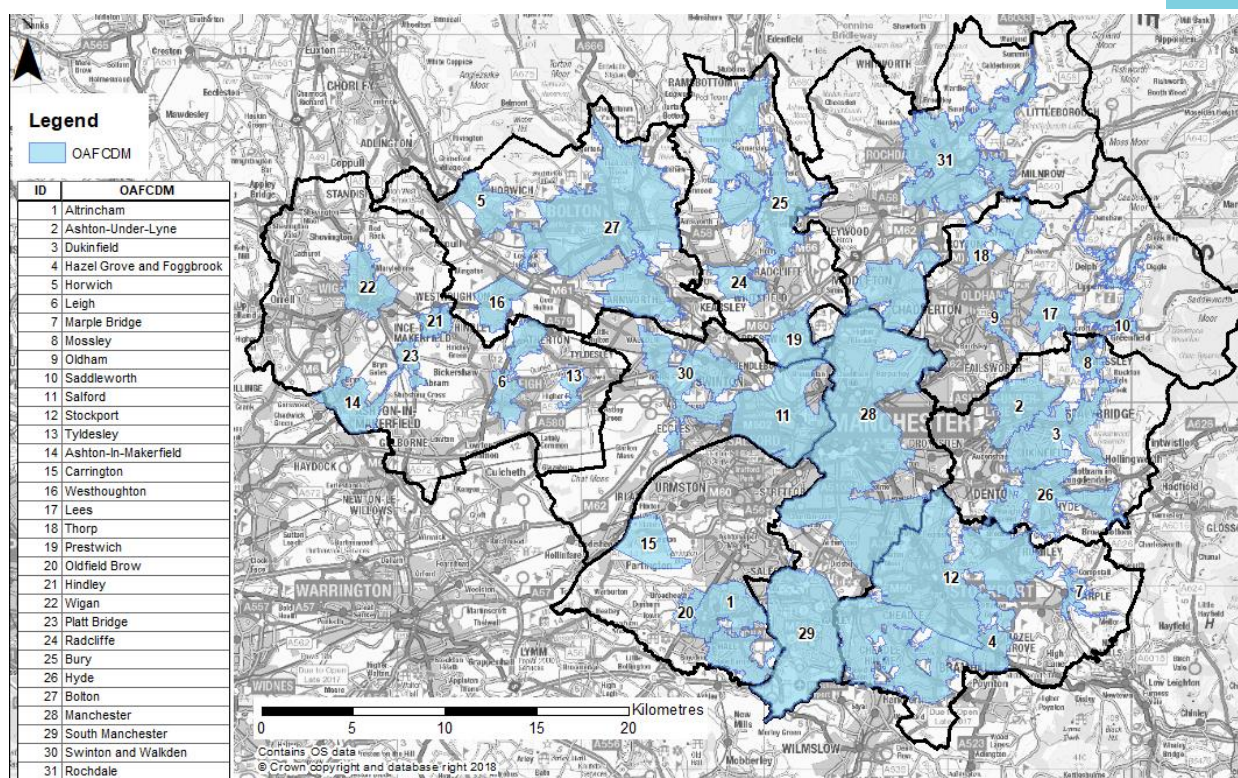


Figure 3-3: Mapped OAFCDMs

3.1.3 Sewer flooding

Just over half of GM is considered to be urban and serviced by urban drainage systems. This is based on the spatial coverage of UU's DAZs. There are 176 UU DAZ's draining the urban areas of GM totalling around 68,140 hectares. There is a risk of localised flooding associated with the drainage infrastructure of the urban areas due, in part, to undersized existing drainage capacity and sewer systems and also possible blockages of the network. UU is responsible for the management of the adopted sewerage system, including surface water and foul sewerage.

The water industry has recently initiated the 21st Century Draining programme that is intended to identify the major risks for drainage in the future and provide options for how these risks could be addressed. An initial element of this programme is improved mapping of drainage capacity. Figures 3-4 and 3-5 show Greater Manchester's Combined Sewer Overflow (CSO) and Pipe capacity. The scoring system has been developed as part of the 21st Century Drainage Programme. The score itself is based on the worst score within the hexagon. Where the score is higher, the hexagon is more sensitive to future catchment pressures (such as climate change or creep) and where efforts will be needed to ensure resilience. From a visual assessment, it appears that there are resilience constraints regarding Combined Sewer Overflows (CSOs) towards the western border of the City Region. Regarding pipe capacity, there are more areas that appear more sensitive to future catchment processes along the south and west areas. This is the first run of this work and there are likely to be refinements in future.

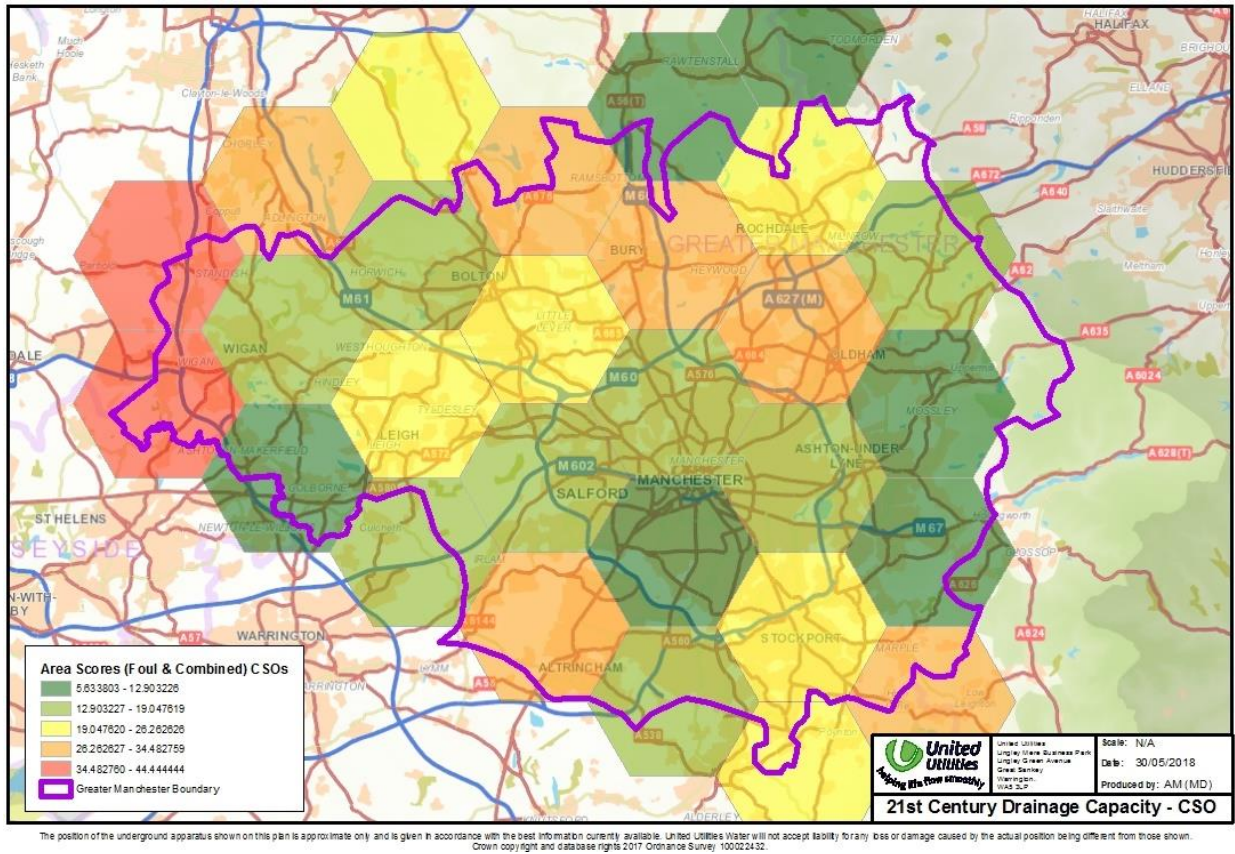


Figure 3-4: CSO capacity

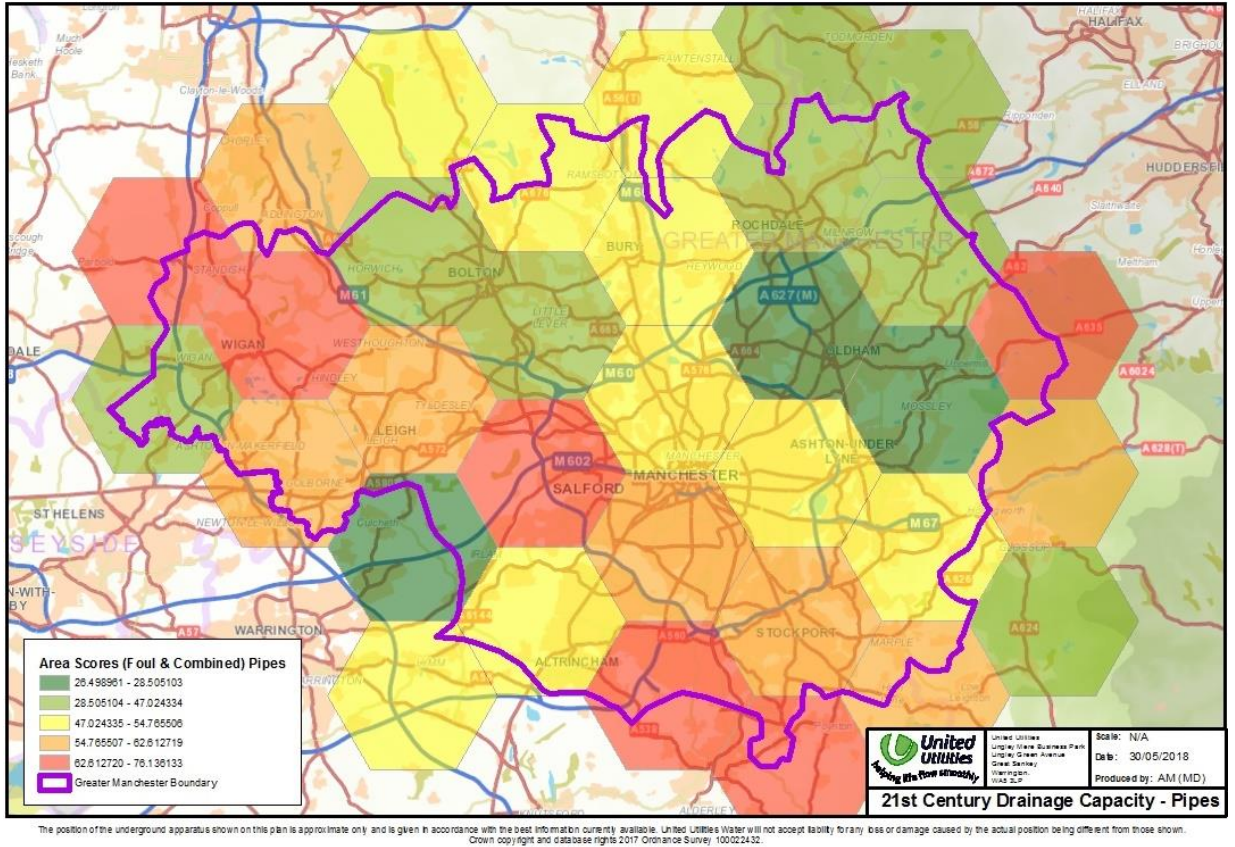


Figure 3-5: Pipe capacity

3.1.4 Groundwater flooding and Environment Agency Source Protection Zones

Groundwater flooding is caused by the emergence of water from beneath the ground, either at point or diffuse locations. Detailed groundwater information has not been made available for this SFRA. Groundwater information will be very localised and may differ significantly across GM. EA Source Protection Zones (SPZs) have been assessed however.

The EA has defined SPZs for groundwater sources such as wells, boreholes and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk.

The EA uses the zones in conjunction with the Groundwater Protection Policy to set up pollution prevention measures in areas which are at a higher risk, and to monitor the activities of potential polluters nearby. This includes consideration of new development which can have major impacts on the groundwater source

SPZs are located in Manchester, Oldham, Rochdale, Salford, Stockport and Wigan so it is possible that there would be a greater potential for flooding from groundwater in these areas.

3.1.5 Flooding from canals and reservoirs

The risk of flooding along a canal is considered to be residual and is dependent on a number of factors. As canals are manmade systems that are heavily controlled, it is unlikely they will respond in the same way as a natural watercourse during a storm event. Flooding is more likely to be associated with residual risks, similar to those associated with river defences, such as overtopping of canal banks, breaching of embanked reaches or asset (gate) failure.

Figure 6-6 of the SFRA shows the Canal & River Trust canal network through GM, along with the privately owned Bridgewater Canal and Manchester Ship Canal. The SFRA also highlights the possible risk of flooding from canals in Greater Manchester:

- **Bridgewater Canal** - potential breach zone was identified for the Bridgewater Canal that covers several developed areas in Salford, namely; Alder Forest Westwood Park, Winton, Dimplington, Stretford, Sale, Timperley and Old Trafford.
- **Huddersfield Narrow Canal** - a Canal Hazard Zone was also produced for the Huddersfield Narrow Canal in Oldham (see SFRA Maps).
- **Manchester Ship Canal** - receives waters from both the Upper Mersey and River Irwell catchments and provides an important drainage and flood alleviation function. The canal has a large capacity in Manchester and evidence of historical flooding from overtopping is limited. There are no raised flood defences along the MSC and therefore breaching is not considered a risk. However, part of the Manchester surface water drainage system drains into the canal and inflows in storm conditions could be significant.
- **Rochdale and Ashton canals** - canal breaches are most likely to occur at the lower lying areas of Chadderton and Failsworth and the aqueduct across the River Irk. Hazard zones have been identified with Zone A covering large part of Ancoats in Manchester City Centre.

There are several reservoirs located across Greater Manchester and outside the City Region that may have an effect on risk to communities in Greater Manchester. The Environment Agency's Reservoir Flood Map shows that there are a number of large reservoirs / impounded waterbodies within Greater Manchester that may affect populated areas, in the unlikely event of a breach. In particular, Manchester, including the City Centre, and the town centres of Wigan, Bury and Bolton could be significantly flooded were a dam breach to occur at certain upstream reservoirs in Greater Manchester.

3.2 Historic flooding

The SFRA provides an overview of historic flooding based on individual LLFA records; United Utilities information on historic incidents of flooding from the sewer network, due to hydraulic failure; and the Environment Agency's Historic Flood Map (HFM) and Recorded Flood Outlines (RFO). Key findings from these are as follows:

- LLFA historic flood incidents are identified in Bolton, Bury, Salford, Stockport and Tameside with far fewer events in Manchester, Oldham, Rochdale, Trafford and Wigan. However, this is not an accurate representation of historic flood risk as may relate to whether events have been recorded and if these can be represented spatially.

- United Utilities information on historic incidents of flooding from the sewer network highlighted a predominance of events in the east if Foggbrook, Stockport.
- The HFM and RFO highlight the following areas that have previously flooded:
 - HFM:
 - Lower Broughton and Lower Kersal, Salford - flooding from the River Irwell
 - Wigan Town Centre at Newtown and Wallgate.
 - Only Oldham, Tameside and Trafford authority areas do not have any areas of HFM within them.
 - RFO:
 - Most notable RFO areas, not within the HFM, include a large area in Manchester, south of Didsbury and north of the M60 motorway. Much of this land is undeveloped natural floodplain of the River Mersey.
 - Also in Bury around the areas of Redvales and Barlow Fold and also Ramsbottom, there are outlines relating to flooding from the River Irwell.
 - Littleborough in Rochdale also has a large RFO area due to flooding from the River Roch and also surface water in December 2015.
 - In terms of flood source, there are 197 records of flooding from Main River, 15 from drainage failure, 13 from ordinary watercourse, 4 from sewers, 12 from other sources and 237 unknown.

The most recent flooding event that had substantial impacts across Greater Manchester was on Boxing Day, 2015 when Storm Eva led to one of the most widespread flooding events that affected communities in nine of the ten GM LAs (all but Trafford). Approximately 2,350 properties flooded internally with 80% of the flooding from main rivers. The most seriously affected areas were Salford, Radcliffe/Redvales, Littleborough and Rochdale Town Centre.

3.3 Future risk

Climate change, leading to increased average rainfall in winter and increased frequency of intense rainstorms at all times of the year, along with the proposed increased development in the GMSF may lead to increased flood risk in the future.

Climate projections for Manchester reveal an increase in temperature and decreased summer rainfall and increased winter rainfall resulting in an increase in average rainfall overall. Following the publication of updated climate change allowances by the Environment Agency in 2016, GMCA commissioned the Environment Agency to model these allowances for critical main rivers across Greater Manchester. For those areas where modelling has not been updated with the new allowances, Flood Zones 2 and 3 of Environment Agency's Flood Map for Planning have been used as a climate change proxy to provide an indication of future risk. This is usual practice, but it is a very cautious estimate and can result in some areas being identified as potentially at risk, where they may not be and reinforces the need for climate change modelling. All LPAs have some watercourses that have not been subject to updated climate change modelling; this is the case for the majority of watercourses in Bolton, Bury, Rochdale, Salford and Stockport. Climate change implications are only modelled for fluvial flood risk; with increased frequency of intense rainfall, surface water flood risk is also likely to increase. Implications for increased risk are summarised in the following section in relation to proposed development sites.

3.4 Cumulative and cross-boundary risk

At a strategic level, it is important to understand implications of development in one area for development elsewhere. From the review of development sites, there is potential for development in Bolton to have downstream impacts along the Irwell in the more urbanised areas of Manchester and Salford, and for development outside of city/town centre areas (particularly Bolton, Rochdale, Salford and Wigan) to impact the more built up areas.

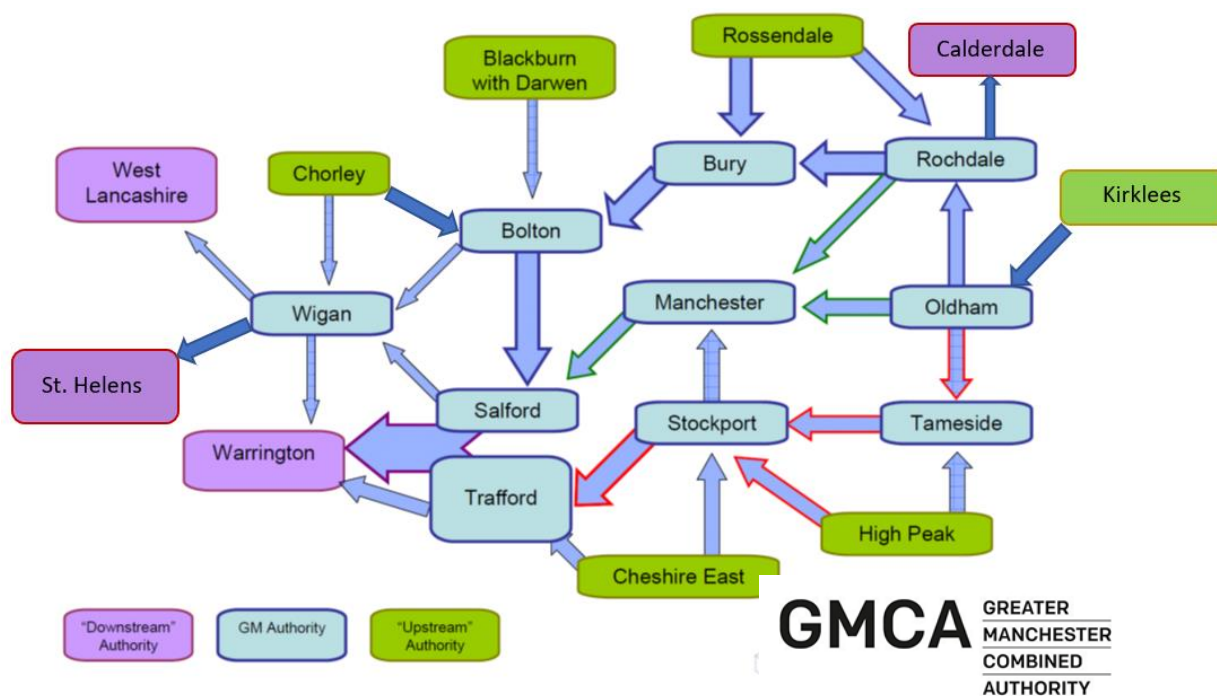


Figure 3-6: Hydraulic links across Greater Manchester²

We have undertaken a high level review of flood risk issues that cross the boundary of GMCA. These are summarised in Table 3-2.

GMCA LA	Adjacent LA	Cross-boundary review	Issues
Rochdale	Calderdale	From the boundary at Warland, the Rochdale Canal flows south into Rochdale and Walsden Water flows north into Calderdale	None
Rochdale	Rossendale	River Spodden flows south from Whitworth in Rossendale into Rochdale. FZ3b is mostly in-bank and 3a does not appear to provide a great risk to Whitworth	FRM measures or development in upstream Whitworth may affect flood risk in downstream Rochdale. Large scale FRM measures in Whitworth however unlikely due to the apparent low risk
Rochdale	Rossendale	Cheesden Brook flows into Rochdale from several waterbodies present in Rossendale. FZ3b mostly in-bank as is 3a.	Are there any controls on the upstream waterbodies? This would have an effect on Rochdale downstream
Oldham	Calderdale; Kirklees; High Peaks	Huddersfield Narrow Canal flows from close to the Aspley Basin in Huddersfield to the Ashton Canal in Tameside	None
Tameside	High Peak District	Glossop Brook flows into River Etherow which flows along the authority boundary. FZ3b is not	FRM measures or development in upstream Glossop may affect flood risk

² http://www.ciria.com/landform/pdf/2012/e12501_agma.pdf

GMCA LA	Adjacent LA	Cross-boundary review	Issues
		extensive and is mainly in-bank. FZ3a is however extensive at the tributary and further downstream at Broadbottom	in downstream villages in Tameside and further downstream in Stockport. FZ3b methodology along River Etherow should be consistent with that of High Peak District
Stockport	High Peak District; Cheshire East	River Goyt flows along the boundary between Cheshire East and High Peaks before flowing into Stockport. FZ3b is contained in channel.	FRM measures or development in Cheshire East and High Peaks will influence flood risk in the villages in downstream Stockport
Stockport	Cheshire East	Bollinhurst Brook and Norbury Brook run along the authority boundary. Middlescale Wood and Poynton Brook watercourses act as tributaries flowing through Cheshire East into Bollinhurst Brook and Norbury Brook respectively. FZ3b mainly remains in-bank on Norbury Brook and FZ3a is not extensive apart from at the Poynton Brook confluence and at the railway line in Poynton	FRM measures or development in Poynton may affect the risk along Norbury Brook though not to any great scale as risk on Norbury Brook is currently low. FZ3b methodology along Norbury and Bollinhurst brooks should be consistent with that of Cheshire East
Stockport	Cheshire East	Red Brook and River Dean run along the authority boundary. Lumb Brook is a tributary of the River Dean. FZ3b mainly remains in-bank on both watercourses. FZ3a is prominent in parts though the area is largely rural. FZ3a on the River Dean is extensive at the Red Brook confluence and on the River Dean upstream of the confluence in Cheshire East.	FRM measures on the River Dean in Cheshire East or any development in the Dean floodplain may have consequences for Stockport. FZ3b methodology along River Dean should be consistent with that of Cheshire East
Manchester	Cheshire East	River Bollin runs along the authority boundary. FZ3b is generally out of bank though not extensively and the land is mainly rural. FZ3a is not extensive	FRM measures on the River Bollin in Cheshire East or any development in the Bollin floodplain may have consequences for the rural areas in downstream Manchester. FZ3b methodology along River Bollin should be consistent with that of Cheshire East
Trafford	Cheshire East; Warrington	River Bollin runs along the authority boundaries of Trafford and Cheshire East and then Trafford and Warrington further west. Flowing from east to west FZ3b remains in-bank until the confluence with Birkin Brook. Downstream of Birkin Brook to where the Bollin enters the MSC FZ3b can be extensive in places. FZ3a is equally as extensive though much of the land is rural. Agden Brook enters the Bollin from Cheshire East	FRM measures on Birker Brook and Agden Brook or any development in the tributaries' floodplains in Cheshire East may have consequences for the rural areas along Bollin Brook. FZ3b methodology along River Bollin should be consistent with that of Cheshire East and Warrington

GMCA LA	Adjacent LA	Cross-boundary review	Issues
Salford	Warrington	Glaze Brook runs along the authority boundary. FZ3b remains in-bank. FZ3a is not extensive.	FZ3b methodology along Glaze Brook should be consistent with that of Warrington
Wigan	Warrington	Glaze Brook runs along the authority boundary and is fed by Carr Brook and a drain from Warrington . FZ3b remains in-bank. FZ3a is not extensive but for a large area straddling the boundary on Pennington Brook	There should be dialogue between both authorities on Pennington Brook. FZ3b methodology along Glaze Brook should be consistent with that of Warrington
Wigan	St Helens	A number of small watercourses run along or close to the authority boundary. FZ3b and 3a are not extensive.	FZ3b methodology along these small watercourses should be consistent with that of St Helens
Wigan	West Lancs; Chorley	River Douglas flows through West Lancs into Wigan. FZ3b in Wigan on the Douglas is extensive as is 3a. FZ3 is also extensive on the Douglas for its length throughout West Lancs. The Douglas also flows into Wigan from Chorley and FZ3b and 3a are also extensive here. Bucklow Brook flows along the Wigan and Chorley boundary	FRM measures on the Douglas in West Lancs or any development in the FZ3 floodplain in West Lancs may impact on flood risk in Wigan. The same may be said of Chorley. FZ3b methodology along Bucklow Brook should be consistent with that of Chorley
Bolton	Blackburn with Darwen	Belmont or Eagley Brook flows into Bolton from Blackburn and into Eagley Brook. FZ3b is not extensive. FZ3a is extensive at Longworth Clough in Blackburn.	FRM measures or development in the FZ3 floodplain at Longworth Clough may impact on flood risk downstream in Bolton.
Bolton	Blackburn with Darwen	Jumbles Reservoir straddles the authority boundary	Ownership and maintenance details of reservoir, emergency plans
Bolton	Chorley	River Douglas flows from Chorley DC into Bolton - from the Rivington, Yarrow and Anglezark reservoir catchments	Reservoir operators can influence flows on the Douglas into Bolton
Bury	Rossendale	River Irwell flows from Rossendale into Ramsbottom in Bury. FZ3b is extensive in places as is FZ3a	FRM measures or development along the Irwell in Rossendale could impact on flood risk downstream in Ramsbottom.

Table 3-2: Flood risk influence and impacts from outside GM

These cross-boundary impacts could potentially have significant flood risk implications and therefore it is essential that GMCA and the relevant LPAs are in dialogue with adjacent LPAs outside of the City Region to manage flood risk on an integrated, cross-boundary basis. In particular, there should be dialogue with the authorities upstream of Greater Manchester - Rossendale, Kirklees, High Peak, Cheshire East, Blackburn with Darwen and Chorley and the downstream authorities of St Helens, West Lancashire, Warrington and Calderdale that may be affected by development and FRM in Greater Manchester.

3.5 Summary

- River flooding is a significant risk across Greater Manchester particularly for Manchester, Trafford, Wigan, Bolton and Rochdale.
- According to national broadscale flood risk mapping, the majority of Greater Manchester is at risk of surface water flooding - the SFRA has identified CDAs across the City Region and large areas of Manchester, Stockport, Tameside and the town centres of Bolton, Rochdale, Bury and Wigan are within CDAs.
- Groundwater flooding may present a risk in Manchester, Oldham, Rochdale, Salford, Stockport and Wigan based on the location of SPZs.
- The assessment of proposed development sites for the draft GMSF has revealed that Rochdale, Wigan and Salford have the most sites at high risk of fluvial flooding whilst Rochdale, Wigan and Bury have the most sites at risk of surface water flooding. More than two-thirds of all proposed development sites require some further action in relation to FRM.
- There are potentially multiple cumulative, cross-boundary impacts within Greater Manchester and with adjacent LPAs outside of the City Region.

4 FRM in Greater Manchester

This section sets out current arrangements and progress in delivering FRM across Greater Manchester to address the current and future risks identified in Section 3. Each sub-section provides a brief commentary followed by recommendations for future priority action that are then highlighted in Section 5 in relation to each of the Strategic Objectives set out in Section 1.

This section has been informed by the SFRA, a review of the planning policies (Appendix B) and LFRMSs (Appendix C) for each Greater Manchester LPA/LLFA and a consideration of initiatives being delivered by other stakeholders across the City Region.

4.1 FRM evidence base

The delivery of FRM can only be effective and efficient if it is based on a robust evidence base. The Greater Manchester wide SFRA provides a high level, yet robust assessment of flood risk at the Greater Manchester level. In the development of the SFRA and this SFRMF, a number of evidence gaps have been identified that would enhance further FRM planning. These are set out below:

- Understanding of the degree to which vulnerable communities, that are less able to plan, prepare, respond and recover from flooding are at flood risk across Greater Manchester. The Environment Agency's Investment Programme has an inherent bias towards deprived communities as moving deprived communities from high to low flood risk probability bands is strongly weighted in the Partnership Funding formula, but potentially further research with the University of Manchester, that is a national pioneer in this research field, could help ensure intervention is being targeted where it is most needed.
- Groundwater information has not been made available for this SFRA. Information on Groundwater will be very localised and should be used to inform on SuDS suitability. This is usually provided as Areas Susceptible to Ground Water flooding and is very coarse data, so an updated version would provide a more robust assessment. It is important to recognise that whilst SuDS measures are very much encouraged, this can be a considerable challenge for more heavily urbanised authorities e.g. Manchester and Salford where infiltration is not possible due to former land use, groundwater table, etc.
- Flood Incident Data: the data was not provided by all LLFAs and the information that was provided was patchy and inconsistent. Mapping of historic flood events including details of date, location, weather conditions, flood source and response by any RMA is important to help learn from what has happened previously enabling better planning for the future. It is acknowledged that resource constraints may impact on the timely production of Section 19 reports; improving this would help with capturing flood incident data.
- Limited information was provided to understand the residual risks associated with the canal network and also asset owners of reservoirs.
- Each LLFA should continue to update and maintain its flood risk management register of structures and features, which are considered to have an effect on flood risk.
- Climate change modelling: we have used all the possible up to date outlines we can that were provided, however there are many recent models (2017) that were missed out due to the models not yet being available. Some outlines were not in a format that could easily be used so have not been included and many watercourses across Greater Manchester have not yet been modelled for climate change.
- Update and increase the amount of modelling on rivers within Greater Manchester for model flood outlines for 20/25 year defended and/or undefended to provide a more accurate flood zone 3b.

Better access to data and wider data sharing in GMCA, with the local authorities and with other stakeholders such as United Utilities would enable more robust mapping and recording of FRM issues related to multiple sources of risk and RMA responsibility. This should also help improve the reliability and consistency of data. The development of a single data platform across Greater Manchester where all flood data is held is recommended.

Recommendations:

- Review data gaps identified from the SFRA and identify how best to address these
- Improve data sharing and access to data across GMCA and with local authorities and other stakeholders.
- Move towards and identify options for the development of a single data platform across Greater Manchester where all flood data is held.

4.2 Avoiding development in areas at flood risk

The NPPF takes a firm stance in relation to avoiding development in areas at flood risk through the Sequential Test and Exception Test where development at areas of flood risk is unavoidable. The draft GMSF aligns with and supports the NPPF and each of the Greater Manchester LPAs have Local Plans that include local FRM policies that support the NPPF. The draft GMSF could provide more spatial specificity to its overarching development and flood risk policies using the evidence presented in the SFRA and this SFRMF.

As detailed in Section 3, flood risk will pose a challenge to GMCA and partners in realising the growth and regeneration ambitions of the draft GMSF. Large development sites within the identified Strategic Locations will need to be designed and managed carefully to avoid exacerbating flood risk on site and further afield. The assessment of cumulative risk has identified considerable cross-border linkages within and beyond the GMCA boundary where collaborative working will be essential to foster a sustainable future for communities and stakeholders.

A further challenge within Greater Manchester is that several areas earmarked for regeneration through previous Government programmes, such as Housing Market Renewal, are home to some of the City Region's most deprived communities that have been promised improved living environments for some time. These programmes ended following the change in Government in 2010 and updated planning requirements for development and flood risk (NPPF, 2012 and Environment Agency climate change allowances, 2016) mean that these some of these areas may become difficult to develop. Where developments are proceeding having passed the Exception Test, it is essential that they are delivered through resilient design and an understanding of longer time climate change impacts that could affect these communities in the future.

Recommendations

- The GMSF should be updated with evidence from the SFRA and SFRMF to promote a catchment based approach to the management of flood risk. This should include dialogue with adjacent LPAs (within and outside Greater Manchester) to manage cumulative and cross-boundary flood risk.

4.3 Recent and pipeline schemes

4.3.1 Existing defences

In total, there are 530 manmade raised flood defences across GM, according to the EA's spatial flood defence dataset. This includes flood embankments and flood walls offering protection from fluvial flooding, the majority of which tend to be along the River Mersey in Manchester and Trafford authority areas.

Recent/current large FRM schemes that should have a large impact on the alleviation of flood risk are the Castle Irwell basin in Lower Broughton, Salford and the Rochdale and Littleborough Flood Risk Scheme that is currently going through the appraisal process. This scheme combines four storage areas, raised walls, improvements to culverts and bridges and NfM measures to improve the level of protection that could include measures such as debris dams and woodland planting.

4.3.2 Asset management

LLFAs are required to maintain register of structures or features that are considered to have a significant effect on flood risk, including details on ownership and condition as a minimum. As reported in the SFRA, LLFAs were requested to provide a spatial dataset of their FRM assets that are in the most critical condition requiring remedial works or replacement to maintain FRM performance - only two LLFAs provided this information meaning the overall assessment of asset condition is very limited. This is likely to be more related to resource constraints than a lack of available data.

One of the key roles that LLFAs and highways authorities play in FRM is the ongoing maintenance and management of assets and therefore it is important that a strategic overview of condition and ongoing management is maintained.

Recommendation:

- As detailed in the SFRA, all LLFAs should assess the structures and features on their FRM Asset Registers to inform the capital programme and prioritise maintenance work.
- Asset management should be prioritised based on condition, capacity and resultant damages to manage liability and the risk of flooding from LLFA assets.
- Consider opportunities for asset data sharing between RMAs.

4.3.3 Schemes within the Environment Agency Investment Programme

The Environment Agency Investment Programme runs in six year cycles and we are currently in the middle of the current cycle. The programme runs to 2021, but it includes schemes that are more speculative beyond that period. Schemes are funded according to how they score using the Grant in Aid (GiA) Partnership Funding formula that takes into account levels of flood risk, flood risk for deprived communities and external funding contributions secured.

The following table sets out an overview of the schemes in the Programme, 75% of these schemes are classified 'defence' meaning that a higher Standard of Protection should be achieved through raised defences; such schemes may include a mix of hard engineering and NfM type approaches. 25% are classified 'capital maintenance'; these tend to sustain the current Standard of Protection but may involve major refurbishment or replacement of assets.

LLFA	No. schemes		Total cost		Total no. households moved from high to low risk band (OM2)	
	River flooding	Surface water	River flooding £	Surface water £	River flooding	Surface water
Bolton	8	4	7,883,548	4,392,000	769	459
Bury	4	0	22,641,000	0	960	0
Manchester	8	0	61,275,000	0	133	0
Oldham	3	14	3,272,000	5,020,947	42	554
Rochdale	4	1	33,129,000	440,000	1,100	200
Salford	4	1	12,062,500	75,000	1,758	15
Stockport	7	3	12,364,000	652,000	621	77
Tameside	4	1	1,759,000	180,000	515	19
Trafford	7	0	57,795,000	0	869	0
Wigan	11	0	13,676,881	0	2,270	0
Total	72	24	225,857,929	10829947	9,037	1,324
Total all sources	96		236,687,876		10,367	

Table 4-1: Environment Agency Investment Programme, 2017-18 - Greater Manchester allocations

The above shows that there are currently 96 FRM schemes in Greater Manchester within the six year Investment Programme intending to protect 10,367 properties at a cost of £236.7m. It is

important to note that this analysis presents a snapshot of current interventions in the pipeline that evolves and iterates on an annual basis depending on the stage to which schemes have progressed. In addition, the long term programme i.e. schemes that may be realised until well beyond 2021 is speculative to a degree as some of these still have to go through an appraisal process to determine what the best option for delivery will be (i.e. type of scheme/intervention).

However, it does provide a helpful overview regarding the amount of funding and other associated resources that are being invested in FRM in Greater Manchester.

The following map provides an overview of schemes across the City Region highlighting the number of properties that these are intended to protect. This clearly shows that current schemes in development intended to protect the largest number of properties are in Salford, Rochdale and Wigan - the previous Section identified these areas as being at high risk of flooding.

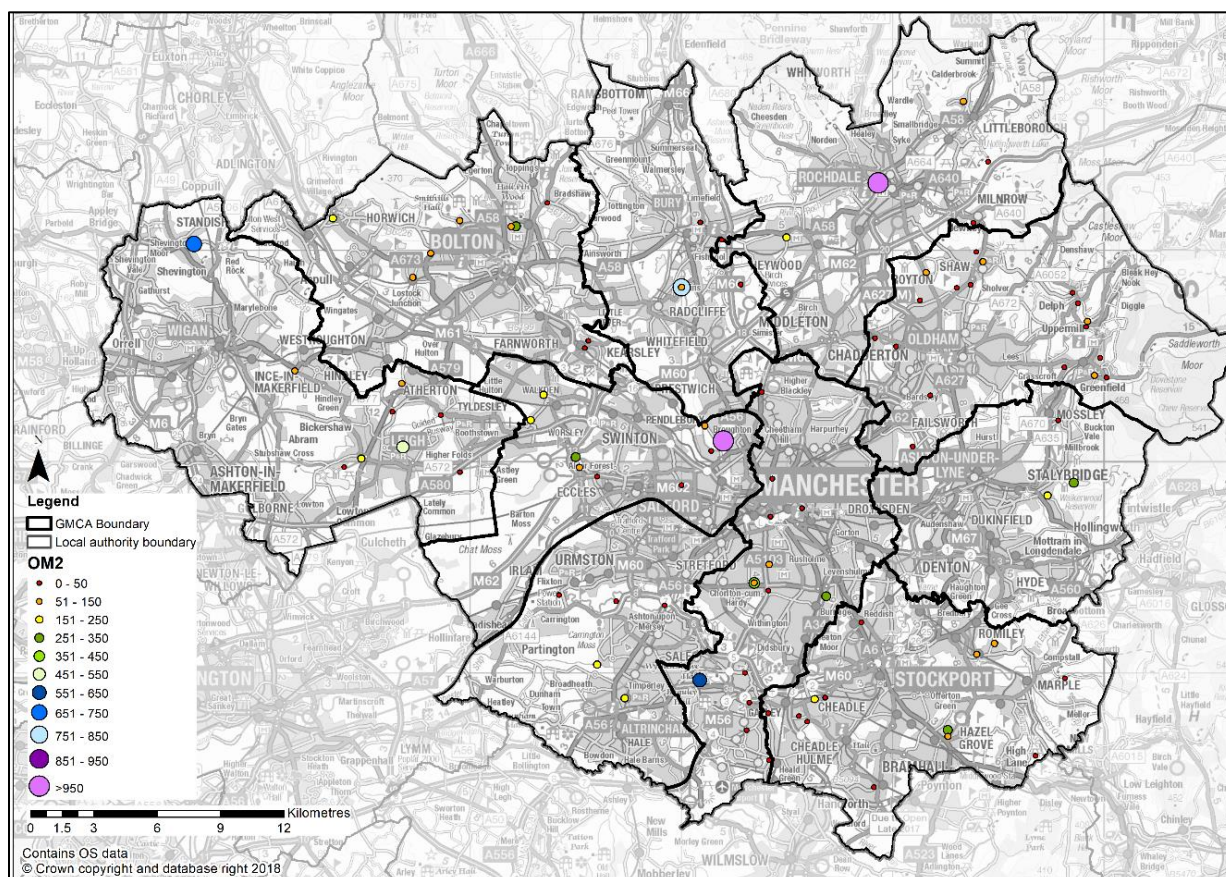


Figure 4-1: Distribution of Environment Agency Investment Programme schemes plus number of properties protected

The Environment Agency Investment Programme provides Government funded Grant in Aid that has to be supplemented by external funding sources to achieve a sufficient Partnership Funding score to secure funding. Analysis of the existing programme revealed that across Greater Manchester total public sector funding of almost £10m is sourced from Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Stockport and Tameside LLFAs and Water Framework Directive funding and total private sector funding of £245k has been sourced from the Brookhouse Group plc, New Charter Housing and United Utilities.

Sourcing external funding contributions is a constant challenge for LLFAs and the Environment Agency to enable the funding of schemes. Strategic, catchment wide approaches to the management of flood risk that bring in multiple partners including infrastructure organisations and business can foster more sustainable and holistic solutions as well as maximising opportunities for investment. Additional sources of funding that may be worth investigating include LEP funding such as the Single Growth Fund and ERDF funding via the European Strategic Investment Fund (although this has been largely earmarked), the National Lottery (BIG Lottery Fund and dependent on assets being protected, Heritage Lottery Fund), section 106 contributions and Community Infrastructure Levy from development opportunities, infrastructure organisations, charitable trusts and foundations and private companies.

The SFRMF is not making recommendations for specific interventions as it is based on a Level 1 SFRA rather than a more detailed understanding of flood risk for individual sites that would require a more Level 2 type approach. However, a clear recommendation can be made that GMCA should continue to work with the LLFAs to develop and implement a Greater Manchester package of schemes that address strategic risk across the City Region. This is already in place with the Greater Manchester Flood and Water Management Board working with the Environment Agency to track the progress of schemes in the Investment Programme and work with individual LLFAs to ensure progress.

Recommendations:

- GMCA and its constituent LPAs should look to developing catchment based solutions with multiple partners from the outset to achieve integrated solutions and maximise funding opportunities.
- Potential surface water schemes could benefit from a packaged approach across Greater Manchester to maximise the achievement of Outcome Measures that will in turn influence the funding that can be secured. This should build on the current tracking and oversight provided by the Greater Manchester Flood and Water Management Board.

4.3.4 Surface water flood risk management

The SFRA has identified that surface water flood risk is a challenge across the whole of Greater Manchester and all of the proposed Strategic Locations. The SFRA has produced OAFCDMs and each Greater Manchester LPA is required to assess these areas with a view to extending current CDA policy into the OAFCDMs.

All of the LPA Local Plans and LFRMSs (Appendix B) promote the use of SuDS and it is important that in addition to the inclusion of SuDS on large development sites that the potential for cumulative development of small sites to contribute to increased surface water run-off and potential surface water flooding is considered. This could be achieved by requiring developers to provide detailed surface water strategies for packages of sites and avoid piecemeal infrastructure provision.

Opportunities to reduce the current and future levels of flood risk through the development of a coherent and integrated SuDS approach across the GMCA area will help provide an opportunity to both manage surface water flooding and improve water quality through mitigating the impacts of diffuse pollution. Appropriate SuDS techniques also provide the opportunity to provide local amenity and wider biodiversity benefits. Further consideration regarding SuDS adoption and maintenance at the GMCA level is recommended.

SuDS need to be integrated with redevelopment opportunities within future employment sites identified in the Employment Land Review and future development should incorporate appropriate SuDS measures to: reduce the flood risk to the development site associated with surface water runoff and reduce the offsite surface water flood and pollution impacts from the proposed development. In addition the use of SuDs should be considered an essential component of any streetscape or Area Action Plan.

The current SWMP should be updated in the basis of improved understanding of surface water flood risk including the 21st Century Drainage mapping for sewer flood risk and more detailed SuDS opportunity mapping being undertaken by United Utilities. This should be informed by an assessment of the degree to which the existing SWMP has been actioned and the results it has achieved.

Finally the dual use of local authority owned green space (and other available areas of land) should be encouraged for amenity/biodiversity and FRM benefits on a GMCA wide basis but also focused to urban/city areas where localised flood risk is a challenge. This could form part of a SWMP or Area Action Plan.

Recommendations:

- Integrate SuDS requirements with large development and redevelopment opportunities and through development strategies to avoid piecemeal development that could contribute to overall surface water flood risk.
- Develop integrated approach to SuDS in the GMSF to achieve flood risk and biodiversity benefits. This should include consideration of adoption and maintenance issues.
- Update the current SWMP with updated information on surface water flood risk and using 21st Century Drainage outputs, and ensure delivery is actioned and monitored.

- GMSF should encourage the use of local authority owned green space to achieve amenity/biodiversity and flood risk benefits.

4.3.5 Property flood resilience

Property flood resilience (PFR), previously known as Property Level Protection or Property Level Resilience, covers a range of measures that provide resistance (preventing flood waters entering properties) and resilience (minimising the damage that flooding may achieve by moving property, including waterproof finishes etc.) PFR is used to manage residual risk where flood depths are likely to be low and can be a particularly useful mechanism for the management of surface water risk. To date, PFR has largely been funded through Government funded grant schemes following major flood events, for example, Storms Desmond and Eva in December 2015. Individual households that have been affected are eligible to apply for grants, but the most success has been achieved where collective schemes have been developed covering groups of properties and run by LLFAs or other organisations. Rochdale has been particularly successful with a very high level of take up following the most recent grant scheme made available in 2016. This success can be attributed to a Council run scheme that has been proactively managed across various departments in the Council. The Environment Agency is in the process of establishing a PFR Framework to improve the quality of delivery and this framework along with available funding through the Environment Agency's Investment Programme means that there is more access to PFR finance on an ongoing basis rather than just following major flood events.

Recommendations:

- PFR schemes should be developed for groups of properties by LLFA where residual risk needs to be managed.

4.4 Catchment approach and natural flood management

The Catchment Based Approach³ (CaBA) embeds collaborative working at a river catchment scale to deliver cross cutting improvements to our water environments. This integrated and holistic approach helps achieve synergy through multiple organisations working together at a catchment scale to achieve multiple benefits. The approach has particular resonance at the strategic scale, such as across Greater Manchester, due to the benefits that can be achieved from addressing cumulative and cross-boundary flood risk. Adopting a more catchment based approach should mean that schemes upstream can be developed to achieve benefits downstream and use these benefits to secure Partnership Funding - such an approach can overcome the challenges of securing funding for NfM schemes due to the difficulty in achieving Outcome Measures.

Within Greater Manchester, there are three active catchment partnerships - Rivers Return: the Irwell Catchment Partnership; Upper Mersey Catchment Partnership and the Lower Mersey Catchment Partnership; hosted by the Healthy Waterways Trust. NfM approaches are supported at all levels from national policy (25 year Environment Plan) to the draft GMSF and individual LPA local plans and LFRMSs (see Appendix C).

Greater Manchester is one of the four three-year Defra Pioneer projects designed to support and inform the development of Government's approach in its 25 Year Environment Plan. Urban Pioneer is intended to support Greater Manchester in creating a natural liveable city region by reversing the decline in quantity and quality of its natural assets and the services they provide. It is intended to provide local and national government and other local stakeholders with the tools and evidence to appropriately identify and account for the true value of Greater Manchester's natural capital and integrate it into decisions. It will also seek to secure an increase in both the quantity and quality of natural capital assets whilst engaging with Greater Manchester's residents so that they can understand and access the natural environment and the benefits it provides.

The Natural Course initiative is an EU funded LIFE Integrated Project that will run for 10 years (subject to funding) intended to improve and protect the water quality of the North West. It will achieve this by:

- Using the North West River Basin as a flagship project and sharing best practice with the UK and Europe and;

³ <https://www.catchmentbasedapproach.org/>

- Making better use of resources, share ownership of complex issues, reduce barriers and maximise outcomes, through a collaborative approach of organisations from public, private and third sector.

Recent outputs from the project have included the Ecosystem Services Opportunity Mapping Assessment and the Natural Capital Account that focus on the Heavily Modified Waterbodies in the Irwell Management Catchment. The draft GMSF recognises the importance of green and blue infrastructure to natural capital and in enhancing and sustaining economic development, health and wellbeing. The mapping identifies those areas best suited for the implementation of NfM measures.

Key outcomes from the project will include an improved level of understanding of the scale and value of ecosystem services in the Irwell Management Catchment (IMC), opportunities to develop or improve ecosystem services for each of the river valley corridors for the IMC, capacity built within the Irwell Catchment Partnership supporting the development and prioritisation of projects to enhance ecosystem services benefits and investment opportunities identified that will maximise the value of ecosystem services in the IMC. The project has calculated the economic value of ecosystem services in the IMC and for each 28 waterbodies; for the IMC this value is over £500m per year with the largest source of value coming from recreational use and almost £60m from avoiding flood damages through flooding alleviation mechanisms. Findings to date have highlighted that as the expected costs of flooding are large, targeted investments in natural capital could exploit opportunities for reducing expected flood damages and increasing the provision of other ecosystem services.

Whilst the Urban Pioneer and Natural Course initiatives are focusing on research and demonstration projects, GMCA actively promotes NfM and is proposing measures within the uplands of Greater Manchester to manage fluvial water across the main river catchments, such as the Irwell. The Environment Agency is also exploring the use of upland reservoirs to store floodwater.

The ecosystem services mapping tool is being used to develop interactive maps to support the SFRA and once these have been analysed, recommendations will be provided regarding the spatial focus for NfM across Greater Manchester. In addition, GMCA is commissioning a project to deliver an ecosystem services assessment tool, analysis of all areas of Greater Manchester against the various ecosystem services and a GIS package for the production of illustrative maps on MappingGM. These outputs will provide a useful source to better identify the best opportunity areas across Greater Manchester to develop and delivery NfM/other Natural Capital schemes.

4.4.1 SFRA Working with Natural Processes (WwNP) and Irwell Catchment Partnership screening

The EA's WwNP datasets and the Irwell catchment NfM work (see Sections 6.8.5.2 and 6.8.5.3 of the SFRA) have been screened against GMCA's proposed development sites to provide a high level indication of those sites that may be appropriate to leave undeveloped and use for flood alleviation. However, much more detailed investigation is required before making decisions on sites that may have potential for WwNP.

Using the Development Sites Assessment spreadsheets in Appendix B of the SFRA, GMCA and each LPA are able to filter the sites that have large enough areas within the WwNP datasets and that are large enough in total area to be able to provide effective flood mitigation. These filtered sites could then be assessed further through more detailed site-specific investigations on whether it would be possible in reality to use these sites for flood alleviation and whether there would be any real benefits to surrounding areas and areas downstream.

Recommendations:

- NfM and wider Natural Capital measures should be promoted through GMSF and Local Plan policies focusing on implementation in the upper catchments to manage flood risk further downstream.
- A strategic, catchment approach to pursuing NfM/Natural Capital opportunities should be developed and implemented once mapping complete. This should consider wider benefits, such as for biodiversity, health and climate change and the benefits downstream in the more flood prone heavily urbanised areas

4.5 Collaborative working

FRM is delivered by multiple organisations operating at different spatial scales and with different overall objectives. FRM is best addressed on a systems basis, at the catchment scale and combining packages of measures that provide 'mosaic' solutions. The Pitt Review (2007) found that 17 different types of organisations were involved in flood incidents, often with little coordination, lacking even a common language. The situation has improved over the last 10 years, but there is still some way to go. In Greater Manchester, in addition to the different roles of RMAs, there are various coordinating bodies from catchment partnerships to LLFA and LPA officer groups to the Resilience Forum, Greater Manchester Flood and Water Management Board and Steering Groups for initiatives such as Natural Course.

As part of the Natural Course project, a water governance review has been commissioned that will consider roles and responsibilities in relation to FRM as well as other aspects of water resources. Weaknesses have been identified where organisations try to develop projects together. For example, one Greater Manchester scheme in the Environment Agency Investment Programme is funded from Grant in Aid and United Utilities' five-year plan, but there have been challenges in developing projects with joint surface water and sewer flood risk issues. It was highlighted that this is down to a lack of compatibility between the partnership funding approach used for Grant in Aid and the way that water companies justify investment.

However, the Boxing Day 2015 Report highlighted the effective cooperation and collaboration between GMCA, the ten LLFAs, Environment Agency, United Utilities and the Manchester Ship Canal company and stated that this is crucial to minimise the chance of such an event recurring and manage the impacts if it should.

Recommendations:

- Use the findings of the water governance review to establish a governance structure that maximises opportunities for collaborative and coordinated working at the catchment scale.

5 Recommendations

Below the SFRMF recommendations are set out in relation to each of the earlier identified strategic objectives:

- Develop and maintain a strategic flood risk evidence base across Greater Manchester and use this to inform FRM
 - including an understanding of the location of and potential impacts of FRM for the most vulnerable communities

Recommendations:

- Review data gaps identified from the SFRA and identify how best to address these
- Improve data sharing and access to data across GMCA and with local authorities and other stakeholders.
- Move towards and identify options for the development of a single data platform across Greater Manchester where all flood data is held.

- Avoid development in areas that are most at risk of flooding now and in the future
 - unless approaches can be identified that ensure the safety of communities and avoid flood risk elsewhere
- Adopting a catchment based approach to the development of FRM initiatives that focuses on working with natural processes
 - linking upstream processes with impacts downstream

Recommendations

- The GMSF should be updated with evidence from the SFRA and SFRMF to promote a catchment based approach to the management of flood risk. This should include dialogue with adjacent LPAs (within and outside Greater Manchester) to manage cumulative and cross-boundary flood risk.
- NfM and wider Natural Capital measures should be promoted through GMSF and Local Plan policies focusing on implementation in the upper catchments to manage flood risk further downstream.
- A strategic, catchment approach to pursuing NfM/Natural Capital opportunities should be developed and implemented once mapping complete. This should consider wider benefits, such as for biodiversity, health and climate change and the benefits downstream in the more flood prone heavily urbanised areas

- Focus interventions in the areas of GM that present the most significant risk now, and in the future
 - taking into account the ability of local communities to prepare for, respond to and recover from flooding and working with them to manage residual risk, and;
 - considering adaptive approaches that facilitate changes in approach over time as climate change impacts become more apparent/understood.

Recommendations:

- GMCA and its constituent LPAs should look to developing catchment based solutions with multiple partners from the outset to achieve integrated solutions and maximise funding opportunities.
- Potential surface water schemes could benefit from a packaged approach across Greater Manchester to maximise the achievement of Outcome Measures that will in turn influence the funding that can be secured. This should build on the current tracking and oversight provided by the Greater Manchester Flood and Water Management Board.
- PFR schemes should be considered for groups of properties by LLFAs where residual risk needs to be managed.
- Development in areas at flood risk needs to include resilient design and consider the development of long term climate adaptation strategies for areas where flood risk is likely to increase in the future.

- Develop a consistent approach to the management of surface water flood risk
 - including Critical Drainage Area management, the development and delivery of SuDS and asset management and maintenance

Recommendation:

- Integrate SuDS requirements with large development and redevelopment opportunities and through development strategies to avoid piecemeal development that could contribute to overall surface water flood risk.
- Develop integrated approach to SuDS in the GMSF to achieve flood risk and biodiversity benefits. This should include consideration of adoption and maintenance issues.
- Update the current SWMP with updated information on surface water flood risk and using 21st Century Drainage outputs, and ensure delivery is actioned and monitored.
- As detailed in the SFRA, all LLFAs should assess the structures and features on their FRM Asset Registers to inform the capital programme and prioritise maintenance work.
- Asset management should be prioritised based on condition, capacity and resultant damages to manage liability and the risk of flooding from LLFA assets.
- Consider opportunities for asset data sharing between RMAs

- Working in partnership across local authorities, with the Environment Agency and other stakeholders
 - to maximise resources and achieve synergy through approaches that address multiple objectives and achieve multiple benefits

Recommendations:

- Use the findings of the water governance review to establish a governance structure that maximises opportunities for collaborative and coordinated working at the catchment scale.

References

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Association of Greater Manchester Authorities, 2012, Flood & Water Management: Partnership Arrangements in Greater Manchester, 14/09/2018, (http://www.ciria.com/landform/pdf/2012/e12501_agma.pdf);

Catchment Based Approach, 2018, Catchment Based Approach, 14/09/2018 (<https://www.catchmentbasedapproach.org/>).

A Greater Manchester LFRMSs

LLFA	Status	Key risks	Measures
Bolton	Adopted, 2013	Primary focus is to manage surface water flooding	Management of surface water through SuDS, improved asset management and maintenance, close working with Environment Agency and United Utilities, minimise flood risk impacts of new development.
Bury	Adopted, 2017	Fluvial flooding from watercourses (River Irwell and tributaries) that originate outside of Bury, surface water flooding due to steep topography	Incident management, asset management and maintenance, surface water management through SuDS cross boundary working, flood defence schemes in Radcliffe, NfM, minimise flood risk impacts of new development.
Manchester	Adopted, 2014	Surface water, ordinary watercourses and groundwater flood risk. River Irwell and Mersey and relationship with adjacent LLFAs.	Develop partnership arrangements incl. neighbouring LLFAs, flood incident management, asset management and maintenance, establish Critical Drainage Area, develop programme of interventions, development and flood risk, minimise flood risk impacts of new development.
Oldham	Adopted, 2014	Fluvial and surface water risk. Priority areas: Shaw/Royton, Saddleworth, Oldham/Medlock, Chadderton/North Failsworth, Failsworth/South Oldham	Asset management and maintenance, upland management, SuDS, minimise flood risk impacts of new development.
Rochdale	Adopted, 2014	Combination of fluvial flood risk (incl. flash floods) from the Roch and surface water plus groundwater	Whole catchment approach, SuDS, asset management and maintenance, community resilience, identifies FRM priorities for specific areas incl. schemes, NfM and upland management, minimise flood risk impacts of new development.
Salford	Adopted, 2015	Significant flood risk from the River Irwell and surface water, plus groundwater and canals, detailed consideration of climate change impacts	Second storage basin (Castle Irwell) recently constructed reducing overall flood risk, raising awareness, additional works to alleviate flood risk associated with Ship Canal, ordinary watercourses and surface water flooding, asset maintenance and management, minimise flood risk impacts of new development.
Stockport	Adopted, 2016	Surface water, groundwater and fluvial flooding (minimal risk) that are expected to increase with climate change	Asset management and maintenance, NfM, solutions that are resilient to climate change, ensure highways resilience, minimise flood risks of new development, innovative SuDS approaches through green infrastructure raising awareness.
Tameside	Adopted, 2016	Surface water flooding, groundwater flooding	Awareness, asset management and maintenance, promotion of SuDS,

LLFA	Status	Key risks	Measures
		and fluvial flooding from the River Tame	
Trafford	Adopted, 2014	Surface water and groundwater flooding, flooding from Manchester Ship Canal and Bridgewater Canal	More comprehensive assessment of flood risk from ordinary watercourses required, incident management, awareness, asset management and maintenance, NfM, minimise flood risks of new development.
Wigan	Adopted, 2014	Main sources are fluvial and surface water flooding, but risk also from groundwater, sewer and canals. Historic flood events have been very localised.	Awareness and understanding, incident management, cooperative working, asset management and maintenance, NfM, community resilience, minimise flood risks of new development.

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