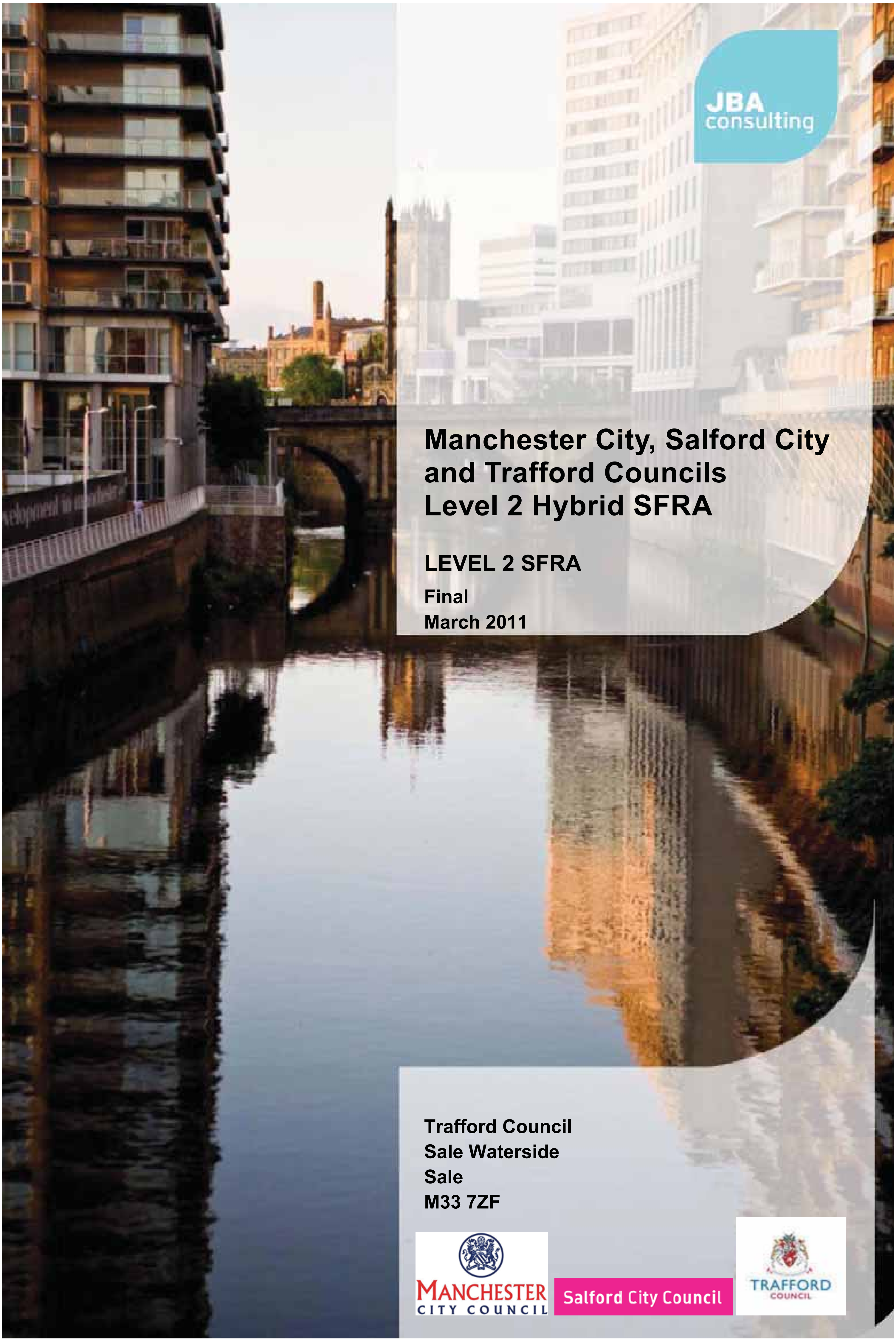

# Manchester City, Salford City and Trafford Councils Level 2 Hybrid SFRA

## LEVEL 2 SFRA

**Final**

**March 2011**

**Trafford Council**
**Sale Waterside**
**Sale**
**M33 7ZF**

Manchester City Council

Salford City Council

Trafford Council

## Structure of the Manchester, Salford and Trafford SFRA

The Manchester City, Salford City and Trafford Councils Level 2 Hybrid SFRA is supplied as four Volumes, described in the table below. Readers should refer to SFRA User Guide that is currently being developed for guidance on how to use the information provided in the SFRA.

| SFRA Volume | Contents |
|---|---|
| User Guide | This is currently being developed and will provide detailed guidance for Spatial Planners, Development Control Officers, developers and Emergency Planners on their responsibilities within regional and local flood risk management as defined within PPS25 and the use of the SFRA as a supporting tool. |
| Level 1 SFRA | The Level 1 SFRA has used mostly existing data to make an assessment of flood risk from all sources now and in the future and builds on the Association of Greater Manchester Authorities (AGMA) Sub-Regional SFRA. It looks at the risk of flooding from rivers, canals, reservoirs, groundwater and surface water and sewers. It provides evidence for LPA officers to apply the Sequential Test and identify the need to pass the Exception Test where required. |
| **Level 2 SFRA** | **The Level 2 SFRA provides more detailed information on flood risk from rivers (The Lower Irwell, Grey Irwell, Rivers Irk, Medlock and Mersey and the Corn Brook), canals (Manchester Ship Canal and the Bridgewater, Rochdale and Ashton Canals) and surface water and sewers.**<br>**It also looks at the impacts of development on flood risk and the interactions between different sources of flooding.**<br>**The additional detail can also inform a sequential approach to development allocation within flood risk areas, the likelihood of sites passing the Exception Test and mitigation options where appropriate.** |
| Maps | This volume collates the map outputs for the SFRA and provides a Maps Index. |

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# Revision History

| Revision Ref / Date Issued | Amendments | Issued to |
|---|---|---|
| Draft v1.0 (October 2009) | | Colin Moss (TBC), Fiona Fryer (SCC), Helen Best (MCC) and Helen Telfer (EA) |
| Draft v2.0 (February 2010) | EA and LPA comments | Colin Moss (TBC), Fiona Fryer (SCC), Helen Best (MCC) and Helen Telfer (EA) |
| Final (March 2010) | LPA and EA comments | Colin Moss (TBC), Fiona Fryer (SCC), Helen Best (MCC) and Helen Telfer (EA) |
| Final (April 2010) | Formatting amendments | Colin Moss (TBC), Fiona Fryer (SCC), Helen Best (MCC) and Helen Telfer (EA) |
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| Final (March 2011) | Canal map text amended and minor text amendments | Colin Moss (TBC), Fiona Fryer (SCC), Helen Best (MCC) and Helen Telfer (EA) |

# Contract

This report describes work commissioned by Trafford Council, on behalf of Manchester City, Salford City and Trafford Councils, by a letter dated 26 May 2009. Trafford's representative for the contract was Colin Moss. Hannah O'Callaghan and Christoff Power of JBA Consulting carried out this work.

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# Purpose

This document has been prepared as a Final Level 2 SFRA report for Manchester City, Salford City and Trafford Councils. JBA Consulting accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

The modelling undertaken for the SFRA is of a strategic nature and more detailed FRAs should seek to refine the understanding of flood risk from all sources to any particular site.

# Acknowledgments

JBA would like to acknowledge the support of the SFRA steering group Colin Moss, Steve Hark (Trafford BC), Fiona Fryer, Nigel Openshaw, Will Horsfall (Salford CC), Helen Best, Andrew Parkin (Manchester CC), Tilak Peiris, Helen Telfer and Chris Waring (Environment Agency).

We would also like to thank British Waterways and the Manchester Ship Canal Company.

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# Executive Summary

## Level 2 SFRA purpose and approach

Flood risk in Manchester, Salford and Trafford is a complex issue and arises from many potential sources. It is, rightly, a constraint to development and great care is needed over the type and form of new development in flood risk areas.

There is an intricate and well connected network of rivers, streams, sewers and canals within Greater Manchester. Flooding does not respect political boundaries and actions to manage flood risk and water from new development need to be carefully considered so that they do not increase risk downstream. Manchester City, Salford City and Trafford Councils and the Environment Agency should work together on flooding problems, particularly where actions could exacerbate flooding in downstream communities.

The Manchester, Salford and Trafford Level 2 Hybrid Strategic Flood Risk Assessment (SFRA) is presented across four separate report volumes:

- User Guide (this is currently being developed)
- Level 1 SFRA
- Level 2 SFRA
- Maps

The Level 2 SFRA (this volume) provides a detailed understanding of flood risk across Manchester, Salford and Trafford from all sources to help support the application of the Sequential Test and provide an assessment of the likelihood of a site passing the Exception Test. This document provides an understanding of actual risk (taking into account the presence of flood defences) and identifies residual risk. Residual risks are the risks that remain after all risk avoidance, substitution, control and mitigation measures have been taken into account. The residual risks in Manchester, Salford and Trafford are therefore related to the occurrence of events of low probability, such as extreme flood events greater than the design capacity of the constrained river system or failure of flood defences or other assets.

The Level 2 SFRA has considered flood risk from rivers, canals and surface water and sewers and the interactions between different sources of flood risk. The Level 1 SFRA has considered the risk of groundwater flooding. The risk of reservoir failure was not considered in the SFRA due to implications for national security.

The Level 2 SFRA has defined Critical Drainage Areas based on surface water flood risk data. It should be noted that these overlap into downstream and upstream local authority areas. This highlights that Manchester City, Salford City and Trafford Councils should work closely with neighbouring authorities to ensure that a consistent approach is taken to cross boundary drainage issues.

The cumulative impacts of development on flood risk have also been considered within the SFRA. The assessment highlights the need for floodplain storage when floodplain is lost to development through land raising or raised defences. It also shows that whilst development control policies to reduce surface water discharges from new development could have some benefit locally, development in the wider catchments has an important role to play in reducing flood risk in Manchester, Salford and Trafford. The adoption of the SFRA guidance on surface water drainage and the application of aspirational drainage standards upstream are essential and an AGMA wide drainage policy is required.

A summary of the key risks in each council district is provided below:

### Manchester

The River Irk, River Medlock, Corn Brook and surface water (including the risk of sewers and culverted ‘lost’ or ‘hidden’ watercourses surcharging) pose the highest risk of more frequent flooding. Surface water drainage from new developments is critical in reducing the risk of localised flooding. The SFRA has identified the Conurbation Core, Manchester and Trafford

South, Levenshulme and Fallowfield and Didsbury Critical Drainage Areas within the Manchester District.

There is a significant residual risk of flooding from defences overtopping or breaching on the Lower Irwell at Lower Broughton (originating in Salford district) and in extreme flood events from the Grey Irwell. The interactions between different sources of risk is complex, especially between the River Medlock and the Bridgewater Canal. Elsewhere canals are a secondary source of flooding, with the highest potential risk likely to be from a breach on the Ashton Canal.

### Salford

Worsley Brook, Ellen Brook and surface water (including the risk of sewers and culverted watercourses surcharging) pose the highest risk of more frequent flooding. There is a significant residual risk of flooding from defences overtopping or breaching on the Lower Irwell at Lower Broughton, Charlestown and Kersal and in extreme flood events from the Grey Irwell.

Surface water drainage from new developments is critical in reducing the risk of localised flooding. The SFRA has identified Salford North West and Conurbation Core Critical Drainage Areas within the Salford District.

In a 1 in 100 year flood event, there is a residual flood risk from the Manchester Ship Canal at Ordsall, Salford Quays, Media City and Barton. Considering the adopted residual risk scenario, flooding will become more extensive with climate change. There will be widespread flooding from the Manchester Ship Canal in an extreme 1 in 1000 year flood event. The Bridgewater Canal is a secondary source of potential flood risk.

### Trafford

Surface water (including the risk of sewers and culverted watercourses surcharging) poses the highest risk of more frequent flooding. Surface water drainage from new developments is critical in reducing the risk of localised flooding. The SFRA has identified the Conurbation Core and Manchester and Trafford South Critical Drainage Areas within the Trafford District.

Groundwater rebound poses a risk in the Trafford Core area. Pomona Island is at significant risk of flooding from both the Manchester Ship Canal and the Bridgewater Canal. The Bridgewater Canal is a potential source of flood risk, mainly from overtopping as a result of floodwaters from the River Medlock entering the canal. Flood risk from a breach of the canal is a lower secondary source but one that should be considered in any detail site assessment where indicated by the SFRA canal flood maps.

There could be widespread flooding from the River Mersey in a 1 in 100 year flood event, although this is mostly constrained to the undeveloped floodplain. Flooding is limited from other watercourses, with the exception of the Sinderland Brook. There is a significant residual risk of flooding from the Manchester Ship Canal in the Trafford Core area and at Carrington and Partington Canalside.

### Understanding flood risk from a planning perspective

This Level 2 SFRA provides an overview of flood risk from a planning perspective to aid councils when undertaking the Exception Test. The SFRA presents a summary of flood risk from all sources to groups of strategic sites, referred to as “Strategic Locations”, which has been summarised below. For each of these, a development strategy has been prepared, which provides advice on how development could proceed in flood risk areas and be compliant with the requirements of PPS25. The SFRA has assessed the likelihood of strategic development sites passing the Exception Test.

| SFRA Strategic Location | Strategic development sites | Flood risk | Planning conclusion |
|---|---|---|---|
| **Manchester** | | | |
| Regional Centre and Inner Areas West | Victoria (M0005)<br>Strangeways (M0004) | Primary risk from the Lower Irwell and Grey Irwell<br><br>Secondary risk from surface water, groundwater and lost watercourses | Development should be acceptable on flood risk grounds. Residual risk from these sources needs to be taken into account when planning developments, including the careful consideration of urban design at Strangeways |
| Regional Centre and Inner Areas North | Harpurhey/Moston (M0015-M0020)<br>Irk Valley (M0021)<br>Booth Hall (M0022)<br>Blackley Village (M0023)<br>Collyhurst (M0013)<br>Miles Platting (M0008)<br>Newton Heath (M0009)<br>Central Park (M0003) | Primary risk from the River Irk and Moston Brook<br><br>Secondary risk from canal breach and overtopping, surface water and lost watercourses | Areas of the highest risk within sites affected by flooding from the River Irk should be sequentially avoided<br><br>Development elsewhere should be acceptable on flood risk grounds. Residual risk from extreme events and other sources needs to be taken into account when planning developments |
| Regional Centre and Inner Areas South | Eastern Gateway (M0001)<br>Sport City (M0002)<br>Holt Town (M0024)<br>Chancellors Place (M0025)<br>Lower Medlock (M0026)<br>Oxford Road Corridor (M0042)<br>West Gorton (M0010)<br>Brunswick (M0011)<br>Coverdale Crescent/New Bank Street (M0012) | Primary risk from the River Medlock and Corn Brook<br><br>Secondary risk from canal breach and overtopping, surface water, groundwater and lost watercourses | Areas of the highest risk within sites affected by flooding from the River Medlock, Bridgewater Canal interactions and Corn Brook should be sequentially avoided<br><br>Development elsewhere should be acceptable on flood risk grounds. Residual risk from extreme events and other |

| SFRA Strategic Location | Strategic development sites | Flood risk | Planning conclusion |
|---|---|---|---|
| | | | sources needs to be taken into account when planning developments |
| Manchester South | Roundthorn (M0006)<br>Airport (M0007) | Primary risk from surface water<br><br>Secondary risk from the Timperley Brook and Fairywell Brook. | Careful management of surface water runoff and exceedence flows is the key issue |

| SFRA Strategic Location | Strategic development sites | Flood risk | Planning conclusion |
|---|---|---|---|
| **Salford** | | | |
| Lower Irwell | Salford Central (S0414)<br>Exchange Greengate (S0413)<br>Charlestown Riverside (S0002)<br>Lower Broughton (S0001)<br>Charlestown and Lower Kersal (S0405)<br>Cambridge Industrial Estate (S0399) | Primary risk from the Lower Irwell and Grey Irwell<br><br>Secondary risk from surface water and groundwater | Development needs to be carefully considered and planned for in areas at the highest risk of flooding should the defences on the Lower Irwell in Salford overtop or breach at Lower Kersal, Charlestown and Lower Broughton<br><br>Development elsewhere should be acceptable on flood risk grounds. Residual risk from extreme events and other sources needs to be taken into account when planning developments |
| Salford Quays and Ordsall | Media City UK (S0415) including Salford Quays (S0017) and Land at Erie Basin (S0014)<br>Ordsall Riverside (S0392) | Primary risk from the Manchester Ship Canal<br><br>Secondary risk from surface water and groundwater | Development needs to be carefully considered and planned for in areas at the highest residual risk of flooding from the Manchester Ship Canal.  Carefully considered urban design and the |

| SFRA Strategic Location | Strategic development sites | Flood risk | Planning conclusion |
|---|---|---|---|
| | | | layout of sites will be a key response to the level of flood risk |
| Salford North West | Linnyshaw (S0004)<br>Great Universal Stores (S0397, S0398)<br>Legh Street (S0395)<br>Cawdor Street (S0396) | Primary risk from the Whittle Brook<br><br>Secondary risk from canal breach, surface water and groundwater | Development should be acceptable on flood risk grounds. Residual risk from these sources needs to be taken into account when planning developments |
| Barton and Irlam | Barton (S0412)<br>Barton Stadium (S0011)<br>Irlam Wharf Road (S0009)<br>Irlam and Cadishead, Liverpool Road (S0408)<br>Irlam and Cadishead (S0404) | Primary risk from the Salteye Brook and Manchester Ship Canal.<br><br>Secondary risk from surface water and groundwater. | Development needs to be carefully considered and planned for in areas at the highest residual risk of flooding from the Manchester Ship Canal. Carefully considered urban design and the layout of sites will be a key response to the level of flood risk<br><br>Development elsewhere should be acceptable on flood risk grounds. Residual risk from extreme events and other sources needs to be taken into account when planning developments |

| SFRA Strategic Location | Strategic development sites | Flood risk | Planning conclusion |
|---|---|---|---|
| **Trafford**[1] | | | |
| Trafford Core | Pomona Island (T0467)<br>Old Trafford (T0468)<br>Wharfside (T0469)<br>Trafford Park Core (T0471)<br>Trafford Centre Rectangle (T0472), including Trafford Quays (T0463)<br>Victoria Warehouse (T0462) | Primary risk from the Manchester Ship Canal<br><br>Secondary risk from Bridgewater canal overtopping or breach, surface water and groundwater | Development needs to be carefully considered and planned for in areas at the highest residual risk of flooding from the Manchester Ship Canal. Carefully considered urban design and the layout of sites will be a key response to the level of flood risk<br><br>Development elsewhere should be acceptable on flood risk grounds. Residual risk from extreme events and other sources needs to be taken into account when planning developments<br><br>Flood risk is a key issue that may affect the delivery of development at Pomona |
| Trafford South and Central | Stretford Crossroads (T0473)<br>Sale Town Centre (T0479)<br>Woodfield Road (T0476)<br>Altrincham Town Centre (T0477), including Altair (T0466) | Primary risk from canal breach<br><br>Secondary risk groundwater and surface water | Development should be acceptable on flood risk grounds. Residual risk from these sources needs to be taken into account when planning developments |
| Carrington and Partington | Carrington (T0474)<br>Partington (T0475)<br>Partington Canalside (T0465) | Primary risk from the Manchester Ship Canal and River Mersey<br><br>Secondary risk from groundwater and surface water | Development needs to be carefully considered and planned for in areas at the highest residual risk of flooding from the Manchester Ship Canal at Carrington and Partington Canalside. The north of Carrington is also at high residual risk from overtopping or breach of the defences on the River Mersey. Carefully considered urban design and the layout of sites will be a key response to the level of flood risk<br><br>Development elsewhere should be acceptable on flood risk grounds. Residual risk from extreme events and other sources needs to be taken into account when planning developments |

[1] Note that there are three other locations identified in the emerging Trafford Core Strategy – Lancashire County Cricket Club Quarter (T0470), Sale West (T0478) and Stretford Meadows (T0470) – which fall into the 'Strategic Locations and other development areas' category but these have been scoped out of the Level 2 work given that the first two are not impacted by rivers and canals, with the third not being proposed for built development (this site is proposed as a woodland/ meadow recreation area).

### Recommendations for further work

The SFRA has made the following recommendations for further work:

1. Further work would improve the understanding of flood risk by undertaking a holistic review of flood risk from all watercourses, which would include linking the Lower Irwell, Grey Irwell, Manchester Ship Canal, Irk, Medlock, Corn Brook, Worsley Brook, Mersey and Sinderland Brook models.
2. Undertake an AGMA wide SWMP. The AGMA SWMP would take a consistent approach to the assessment of surface water flood risk across Greater Manchester, followed by more detailed investigations of Critical Drainage Areas targeted at those CDAs with the highest risk. The AGMA SWMP would extend to all ten authorities a consistent methodology to develop surface water risk maps and identify CDAs.

   The AGMA SWMP initiative should be supported. If, however, sufficient funding is not available to undertake an AGMA SWMP, Manchester City, Salford City and Trafford Councils should form a partnership with their neighbours, United Utilities and the Environment Agency to undertake SWMPs for:

   - Didsbury, Levenshulme and Fallowfield (including the Chorlton Platt Gore catchment)
   - Manchester and Trafford South (including the Sinderland and Longford Brook catchments)
   - Salford North West (including the Worsley and Ellen Brook catchments)
   - Conurbation Core (including river catchments in Central Manchester)
3. Undertake a Flood Risk Management Strategy to ensure that development needs and the different sources of flood risk are managed strategically for the:
   - Manchester and Salford City Centres, including Lower Kersal, Charlestown (Salford) and Lower Broughton
   - Worsley and Ellen Brook catchments
   - Areas at risk of flooding from the Manchester Ship Canal
   - River Mersey catchment
   - Sinderland Brook catchment

Local authorities should work closely with the Environment Agency through their emerging strategy work following on from the River Irwell and Upper Mersey Catchment Flood Management Plans to explore opportunities to reduce flood risk and deliver regeneration.

These recommendations were made whilst the report was being drafted. It is noted that the AGMA SWMP has received funding and is currently being undertaken.

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# Abbreviations

| | |
|---|---|
| ABD | Areas Benefiting from Defences |
| AEP | Annual Exceedance Probability |
| AGMA | Association of Greater Manchester Authorities |
| ASSWF | Areas Susceptible to Surface Water Flooding |
| CDA | Critical Drainage Area |
| CFMP | Catchment Flood Management Plans |
| EA | Environment Agency |
| FEH | Flood Estimation Handbook |
| FRA | Flood Risk Assessment |
| FRM | Flood Risk Management |
| GIS | Geographic Information Systems |
| LDDs | Local Development Documents |
| LDF | Local Development Framework |
| LIDAR | Light Detection and Ranging |
| LPAs | Local Planning Authorities |
| MSC | Manchester Ship Canal |
| MST | Manchester Salford Trafford |
| NFCDD | National Flood and Coastal Defence Database |
| OS | Ordnance Survey |
| PPS | Planning Policy Statement |
| RFRA | Regional Flood Risk Assessment |
| RSS | Regional Spatial Strategy |
| SA | Sustainability Appraisal |
| SFRA | Strategic Flood Risk Assessment |
| SHLAA | Strategic Housing Land Availability Assessment |
| SoP | Standard of Protection |
| SRF | Strategic Regeneration Framework |
| SUDS | Sustainable Drainage Systems |
| SWMP | Surface Water Management Plan |
| UKCIP | United Kingdom Climate Impacts Programme |
| UU | United Utilities |
| WCS | Water Cycle Study |
| WwTW | Wastewater Treatment Works |

# 1 Introduction

## 1.1 Background

JBA Consulting was commissioned in May 2009 by Manchester City, Salford City and Trafford Councils to undertake a Level 2 Hybrid Strategic Flood Risk Assessment (SFRA) following on from the Greater Manchester Sub-Regional SFRA completed in August 2008. This is a hybrid SFRA because it fills in the gaps from the sub regional Level 1 SFRA and also fulfils the criteria for a Level 2 SFRA. The Hybrid SFRA has been prepared in accordance with current best practice, including, Planning Policy Statement 25 Development and Flood Risk (PPS25)[2] and the PPS25 Practice Guide[3].

This document supports the application of the Sequential Test and an assessment of the likelihood of a site passing the Exception Test by providing an understanding of the variability of risk in flood risk areas. This builds on the data available in the Level 1 SFRA.

## 1.2 Level 2 SFRA scope and objectives

The Level 2 SFRA provides a detailed understanding of flood risk across Manchester, Salford and Trafford from all sources to help support the Sequential Test and provide an assessment of the likelihood of a site passing the Exception Test. This document provides an understanding of actual risk (taking into account the presence of flood defences) and identifies residual risk. Residual risks are the risks that remain after all risk avoidance, substitution, control and mitigation measures have been taken into account. The residual risks in Manchester, Salford and Trafford are therefore related to the occurrence of events of low probability, such as extreme flood events greater than the design capacity of the constrained river system or failure of flood defences or other assets.

It is the assessment of residual risk associated with low probability but high impact events that is central to the Level 2 SFRA work and the impacts they have on the spatial development in Manchester, Salford and Trafford. By facilitating the application of the Exception Test, the Level 2 SFRA technical work also provides evidence to support allocation of land for specific uses within individual developments in flood risk areas, including providing a range of possible mitigation measures that could enable development to proceed.

Whilst the application of the Exception Test may make it possible to strategically plan the type and form of the development, it must not be used as a tool to place inappropriate development in flood risk areas.

The Level 2 SFRA is structured as follows:

1. Introduction.
2. Flooding from rivers. Provides an assessment of the depth and hazard associated with a range of flood events from the Lower Irwell, Grey Irwell, Irk, Medlock, Mersey at Carrington and Corn Brook.
3. Flooding from canals. Provides an assessment of areas that could potentially be affected by overtopping or breach from the Rochdale, Ashton and Bridgewater Canals. This chapter also provides an assessment of the depth and hazard associated with a range of flood events from the Manchester Ship Canal.
4. Flooding from reservoirs. Due to implications for national security, the flood risk associated with reservoir failure has not been considered in the Level 2 SFRA.
5. Flooding from surface water and sewers. Contains a detailed assessment of flood risk from surface water (including hidden or 'lost' watercourses), which provides an indication of areas that may be affected by sewer flooding if the network were to surcharge. This chapter also introduces Critical Drainage Areas and provides recommendations for Surface Water Management Plans.

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[2] Communities and Local Government (2010) Planning Policy Statement 25: Development and Flood Risk
[3] Communities and Local Government (2009) Planning Policy Statement 25: Development and Flood Risk – Practice Guide

6. Cumulative Impacts. Provides an understanding of the impact that development within Manchester, Trafford and Salford and upstream could have on flood risk.
7. Hydraulic interactions. Understanding the potential interactions between different sources of flood risk in Greater Manchester is critical. These have been mapped and tabled for the Level 2 SFRA. The impact of these interactions will extend beyond the Manchester City, Salford City and Trafford Council areas.
8. Summary of flood risk. The risk of flooding from all sources has been summarised for collections of strategic sites in Manchester, Trafford and Salford.
9. Development strategy. This provides advice on how development could proceed in flood risk areas and be compliant with the requirements of PPS25.
10. Recommendations for further work. This includes Surface Water Management Plans and Flood Risk Management Strategies for new development.

# 2 Flooding from Rivers

**An assessment of the depth and hazard associated with flooding from rivers, including consideration of residual risk behind flood defences, has been undertaken where there is known high flood risk and where there is a focus for future development. This has been undertaken for the Rivers Irwell, Grey Irwell, Irk, Medlock, Mersey and the Corn Brook. For other rivers where there is lower risk, the Level 1 assessment will provide an adequate evidence base.**

## 2.1 Introduction

An assessment of the depth and hazard associated with flooding from rivers, including consideration of residual risk behind flood defences has been undertaken where there is known high flood risk and where there is a focus for future development.

The adopted Regional Spatial Strategy (RSS) for the North West sets out the broad scale and spatial distribution of development within the region up to 2021. The core of the Manchester City Region, identified as the Regional Centre and surrounding Inner Areas, is located within Manchester, Salford and Trafford. It is the primary focus of new development within the North West in terms of policy focus and scale of development. Across the three authorities there are considerable pressures for regeneration, as well as opportunities for inward investment to support economic and housing growth. Within the strategic context of the RSS the SFRA will help guide councils in the development of their Local Development Frameworks (LDFs) and other relevant strategies, policies and actions.

In line with the spatial focus of the RSS, the priority areas for housing and employment development within the three authorities are contained within the core of the conurbation, although some more peripheral areas also contain important development locations.

- Manchester's development is focused on 41 strategic sites within the Regional Centre and Inner Areas, as well as at Manchester Airport.
- Salford's development also has a strong focus on the Regional Centre and Inner Areas in Central Salford
- Trafford's development also has a strong focus on the Regional Centre / Inner Areas. There are 18 Strategic Locations and other development areas identified in the emerging Core Strategy.

To help determine the extent and severity of flood risk a number of linked 1D (river) and 2D (floodplain) models have been developed:

- River Irwell from downstream of the M60 to the River Irk confluence (Lower Kersal, Charlestown and Lower Broughton, including part of the Regional Centre in Salford and Manchester)
- Grey Irwell between the River Irk confluence and the River Medlock confluence (Regional Centre in Salford and Manchester)
- River Irk between the A6010 Queens Road and the confluence with the River Irwell (Regional Centre in Manchester)
- River Medlock from downstream of New Viaduct Street near the City of Manchester Stadium and the confluence with the Grey Irwell (Regional Centre in Manchester)
- Corn Brook (Regional Centre in Manchester and Trafford)
- River Mersey at Carrington in Trafford
- Manchester Ship Canal from Manchester city centre to Barton (this is discussed in Chapter 3)

The risk of flooding from the watercourses has been considered to strategic housing and employment sites in Manchester, Trafford and Salford. Sites beyond the extents of the modelling have been considered as part of the development strategy for flood risk areas in Chapter 9. The risk of flooding from 'hidden' watercourses is presented in more detail in Chapter 5 Flooding from Surface Water and Sewers.

## 2.2 Flood defences

The Environment Agency's National Flood and Coastal Defence Database and the River Irwell and Upper Mersey CFMPs were used to establish the presence of significant flood defences along the rivers. Assets are summarised in Table 2-1. The River Irwell and Upper Mersey CFMPs have set the long term policy direction for future flood risk management in Greater Manchester. It is important to consider flood defences in the context of the relevant CFMP policy for that area to understand the management of those defences over the lifetime of development. The performance of local authorities in delivering agreed actions in CFMPs is being monitored by National Indicator 189 - Flood and coastal erosion risk management.

However, it should be borne in mind that the CFMP is a strategic document that sets the direction of flood risk management for operating authorities over the next 50 to 100 years. Development in flood risk areas should always seek to reduce risk wherever possible; following the principles in PPS25 and the residual risk of flooding in an extreme flood event or from the failure of defences should always be carefully considered. The CFMP policy units for Manchester, Salford and Trafford are shown on Figure 2-1.

**Figure 2-1 CFMP policy units**

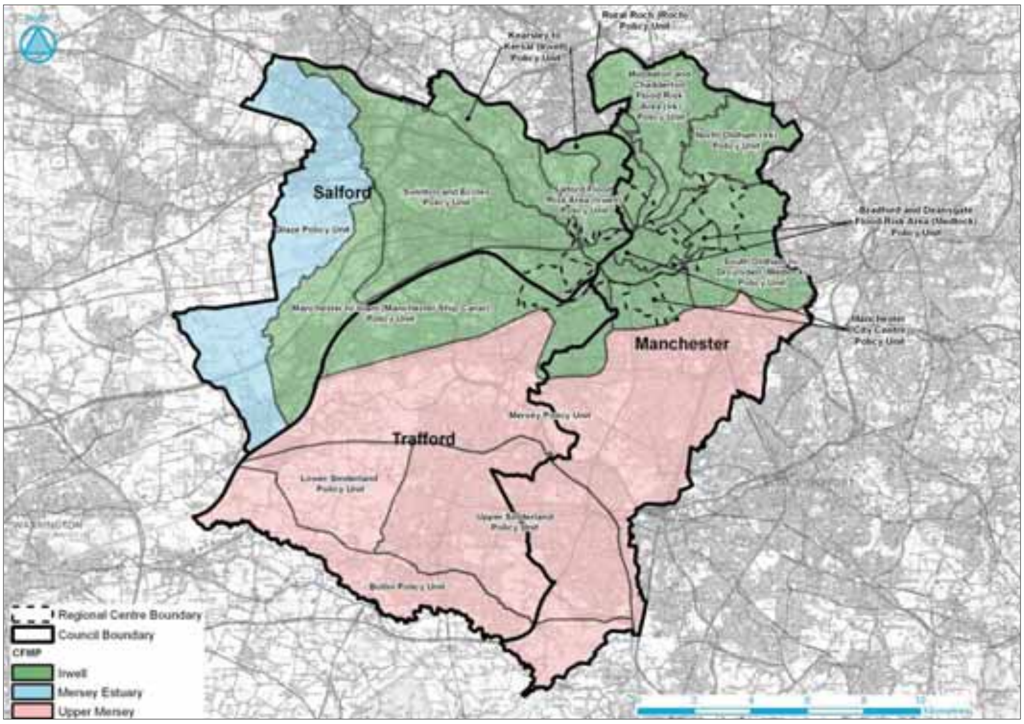


Table 2-1 Assets and CFMP policies

| CFMP | Policy unit | Assets | CFMP Policy |
|---|---|---|---|
| River Irwell | PU1* Manchester to Irlam (Manchester Ship Canal) | Sluices, retaining walls and other structures on the Manchester Ship Canal | P4 Take further action to sustain the current level of flood risk into the future |
| River Irwell | PU2 Manchester City Centre (Grey Irwell) | The Grey Irwell flows in a heavily modified channel that is up to 5m deep | P4 Take further action to sustain the current level of flood risk into the future |
| River Irwell | PU3 Salford (Lower Irwell) | Flood storage area and defences with a 1 in 75 year design standard of protection | P5 Take further action to reduce flood risk |
| River Irwell | PU4 Kearsley to Kersal | Localised defences | P6 Take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits, locally or elsewhere in the catchment - could help to reduce flood risk downstream in Salford |
| River Irwell | PU10 Swinton and Eccles (local watercourses draining to the Manchester Ship Canal) | Many local watercourses are culverted, which causes localised flooding problems | P5 Take further action to reduce flood risk |
| River Irwell | PU11 Bradford and Deansgate (Medlock) | The Medlock is heavily culverted, which encourages local sedimentation and increases flood risk | P5 Take further action to reduce flood risk |
| River Irwell | PU13 Middleton and Chadderton (Irk) | Raised defences and culverts. Defences at Vale Park Industrial Estate offer up to a 1 in 100 year standard of protection | P5 Take further action to reduce flood risk |
| Upper Mersey | PU4 Mersey | Flood storage areas at Didsbury and Northenden and Sales Ees and defences generally offer between 1 in 50 year and 1 in 75 year standard of protection | P5 Take further action to reduce flood risk |

| CFMP | Policy unit | Assets | CFMP Policy |
|---|---|---|---|
| Upper Mersey | PU5 Upper Sinderland (Sinderland Brook, Fairywell Brook and Timperley brook) | Many local watercourses are culverted, which causes localised flooding problems | P5 Take further action to reduce flood risk |
| Upper Mersey | PU8 Lower Sinderland | No significant defences and very low flood risk | P6 Take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits, locally or elsewhere in the catchment |

* The CFMP did not take the new information on the flood risk from the MSC into account.

Flood risk is modified by these defences, but they are finite in their ability to contain the full range of flows. Also these defences may under certain extreme conditions fail and cause rapid inundation. The SFRA has considered the residual risk associated with a breach in the flood defences on the Lower Irwell at Lower Kersal and Lower Broughton and the River Mersey at Carrington. The breach locations on the Lower Irwell were chosen to be consistent with the breach locations that were used during the previous Salford SFRA[4]. In this previous study the breaches were positioned at locations that were considered to result in the most extensive flooding. This is in line with a precautionary approach (as advocated by PPS25). The informal defences on the River Mersey at Carrington are limited in extent and in order to consider residual risk, a breach was modelled near the upstream end of the defended section. The resultant modelling shows the impact of breaching at Carrington to be small because the area behind the defences is affected by flood water that exits the channel upstream of the defences.

The Manchester Ship Canal reduces potential flood risk by the operation of sluices at locks. If water levels rise at Manchester city centre the sluices are progressively opened to allow water to pass down the system. The residual risk associated the operation of these sluices has been explored in Section 3.3.

## 2.3 Methodology and assumptions

The modelling that has been developed for the SFRA is of a strategic nature that has been developed to inform the application of the Sequential and Exception Test by the local planning authorities. Detailed studies should seek to refine the understanding of flood risk from all sources where a specific site risk assessment is being prepared.

Table 2-2 provides a summary of the nature of the SFRA river models including the key assumptions and limitations of each model.

[4] Jeremy Benn Associates Ltd (2005) City of Salford Strategic Flood Risk Assessment

Table 2-2 River modelling summary

| River | EA model | Comments |
|---|---|---|
| Lower Irwell | Faber Maunsell (2007) River Irwell Areas Benefiting from Defences (ABD) 1D/ 2D (ISIS-TUFLOW) | The final SFRA model is a 1D/ 2D linked ISIS-TUFLOW model with 10m grid size based on filtered LiDAR. It uses design flows from the recent EA Manchester Ship Canal study (2009) with a storm duration of 12.5 hours. This is the length of storm to which the watercourse is the most sensitive, in terms of the severity of flooding.<br><br>The 2D model domain extends from the M60 at Clifton to Manchester Victoria Station.<br><br>**Key Modelling Assumptions:**<br>The design flow estimate is valid for the upstream limit of the model and does not necessarily have to be matched at all locations within the study reach due to the attenuation that will occur in response to the sizeable floodplains at Lower Kersal and Lower Broughton.<br>Statutory water level on the Manchester Ship Canal at Mode Wheel Locks was used as the downstream limit. This is considered appropriate due to the distance downstream from the end of the 2D model at the River Irk confluence.<br>For the breach models, the breaches develop at the time of peak flood level and allowed to develop over a period of one hour.<br><br>**Key Model Limitations:**<br>The low topographic and urban definition of the Lower Irwell model will limit the modelled accuracy (especially with regard to urban flow routes).<br>The bank heights along both defended and undefended sections of the Lower Irwell model are in a simplistic form. A review of the accuracy of the bank heights would help validate (improve) the model predictions.<br>The ISIS component of the supplied model has key structures removed (reported to improve model stability). The removal of bridges could have an important influence on overtopping locations and subsequent flow routes. |
| Grey Irwell | JBA Consulting (2009) Irk to Medlock Flood Mapping Study 1D/ 2D link (ISIS-TUFLOW) | The final SFRA model is 1D/ 2D linked ISIS-TUFLOW model with 4m grid size (compared to 2m of the original) based on filtered LiDAR. It uses design flows from the recent EA Manchester Ship Canal study (2009) with a storm duration of 24.75 hours. The 2D model domain extends from Victoria |

| River | EA model | Comments |
|---|---|---|
| | | Station to Pomona Docks.<br><br>**Key Modelling Assumptions:**<br>The estimated design flow from the Manchester Ship Canal study is applicable to the inflow point at Victoria Station.<br>The water level predicted by the Manchester Ship Canal ISIS model (as run for the SFRA to give an indication of residual risk at Mode Wheel Locks) was used as the downstream boundary.<br><br>**Key Model Limitations:**<br>During an extreme event (greater than 0.1% AEP) the inflow into Grey Irwell at Victoria Station may be limited by attenuation along the Lower Irwell associated with the extensive floodplains at Lower Kersal and Lower Broughton. |
| River Irk | Faber Maunsell (2007)<br>River Irwell Areas Benefiting from Defences<br>1D (ISIS) | The final SFRA model is a 1D/ 2D linked ISIS-TUFLOW model with 4m grid size based on filtered LIDAR. It uses design flows outlined from the Faber Maunsell ABD study (2007). The 2D model domain extends from Queens Road to the River Irwell confluence.<br><br>**Key Modelling Assumptions:**<br>The supplied (ungauged) rating curve has been used to model flows from the River Irk into the River Irwell.<br><br>**Key Model Limitations:**<br>High water levels on the Grey Irwell could potentially limit outflow from the River Irk to the Grey Irwell. This may cause water levels to back up on the River Irk. |
| River Medlock | Atkins (2009)<br>River Medlock Flood Mapping Study<br>1D (ISIS) | The final SFRA model is a 1D/ 2D linked ISIS-TUFLOW model with 4m grid size based on filtered LIDAR using design flows from the Atkins FRM study. The 2D model domain extends from New Viaduct Street (Sport City) to the Grey Irwell confluence.<br><br>**Key Modelling Assumptions:**<br>The supplied normal flow boundary has been used to model flows from the River Medlock into the Grey Irwell.<br>The supplied design flows assume that flow will be not be impeded by the lengthy culverts beneath the Sport City site.<br><br>**Key Model Limitations:**<br>High water levels on the Grey Irwell could significantly limit flow from the Medlock into |

| River | EA model | Comments |
|---|---|---|
| | | the Grey Irwell. Under such circumstances there could be backing up of floodwater along the Medlock and more floodwater could flow into the Bridgewater Canal. This could in turn increase flood risk along the canal, especially to the south in Trafford. Again, this highlights the importance of considering flood risk on a cross boundary basis.<br><br>The River Medlock interacts with the Bridgewater Canal at Medlock Clows (where the Medlock goes into a shaft and culvert in Deansgate). This structure is prone to blockages with debris which could affect water levels upstream. The assumptions in the EA model were carried forward into the SFRA regarding flow between the River Medlock and Bridgewater Canal but further work should consider the variability of flows passing between the river and the canal. |
| Corn Brook | Atkins (2009) River Medlock and Corn Brook Flood Mapping Study<br>(2D Infoworks CS) | The Environment Agency Infoworks model was converted to Infoworks SD and run using the ground model in the existing model. This produces identical outlines to the Infoworks CS model.<br>The model extends from Railway Street, Gorton to its confluence with the Manchester Ship Canal at Pomona Docks.<br><br>**Key Modelling Assumptions:**<br>As in the supplied model, a free outfall to the Manchester Ship Canal is assumed for all events.<br><br>**Key Model Limitations:**<br>The sewer system has a finite capacity and hence combined sewer overflow inflows were not factored up for the climate change simulations. Natural catchments inflows were factored up in line with the guidance in PPS25.<br>Urban features (buildings, kerbs, roads etc) are not represented as 'break lines' in the 2D model. This tends to result in a flood outline which is wider spread but with lower depths and velocities than if these features were represented. |

| River | EA model | Comments |
|---|---|---|
| River Mersey | Halcrow (2008):<br>River Mersey remodel (ISIS) | The final SFRA model is a 1D/ 2D linked ISIS-TUFLOW model with 4m cell size based on filtered LiDAR. It uses design flows obtained from the supplied Halcrow model. The 2D model extent covers the Carrington site.<br><br>**Key Modelling Assumptions:**<br>The flood risk to Carrington is principally from flood events on the River Mersey and water flows into the Manchester Ship Canal at the rate calculated by the rating curve in the supplied Mersey model.<br>For the breach models, the breaches develop at the time of peak flood level and allowed to develop over a period of one hour.<br><br>**Key Model Limitations:**<br>Flooding directly from the Manchester Ship Canal or the impact of high levels on the Manchester Ship Canal on the Mersey is not considered by the model.<br>Interrogation of the Manchester Ship Canal model indicates that the Carrington site could be at direct risk of flooding from the Manchester Ship Canal during extreme events (1 in 1000 year flood event or greater). However, the area of the Carrington site at risk from the Manchester Ship Canal during an extreme event would be small and would probably not exceed the 1 in 1000 year plus climate change risk from the Mersey (for which outlines have been produced for this SFRA). |

| River | EA model | Comments |
|---|---|---|
| Manchester Ship Canal | JBA Consulting (2009) Manchester Ship Canal study (ISIS) | The final SFRA model is a 1D/ 2D linked ISIS-TUFLOW model with 10m grid size based on filtered LIDAR and NextMap. It uses design flows from the recent EA Manchester Ship Canal study (2009).<br><br>The 2D model domain extends from the River Medlock confluence around Woden Street footbridge to Woods End near Flixton.<br><br>**Key Modelling Assumptions:**<br>3 out of 4 gates are operational in an extreme flood event to give an indication of residual risk. Please see Chapter 3 for more detail.<br><br>**Key Model Limitations:**<br>Due to a LIDAR gap in Salford, the model topography could not be wholly based on LIDAR. Instead, the model topography was based on a composite LIDAR / NextMap grid.<br>The 1D model is based on cross section survey that dates from 1966 and a bathymetric survey of the canal in the Pomona Docks and Salford Quays areas (date unknown). |

There have been several assumptions made in the modelling of flood risk for this strategic study that should be borne in mind when using the outputs of the SFRA. These include:

- The SFRA river models are mostly linked 1D-2D (ISIS-TUFLOW) models. The accuracy of any ISIS-TUFLOW model depends on the accuracy of the ISIS component of the model. The Environment Agency's review process should provide a guarantee of model quality.
- The results of 1D-2D (ISIS-TUFLOW) models are very sensitive to the model bank elevations as it is these elevations that control the volume of overtopping between the 1D (channel) and 2D (floodplain) domains. Some bank elevation data was present in the supplied Lower Irwell and Grey Irwell (ISIS-TUFLOW) models, but elsewhere the bank heights in the other SFRA models had to be estimated from LIDAR and available river survey sections. This could impact on the accuracy of the model predictions.
- The urban density in key areas of Manchester, Trafford and Salford is high. There will always be uncertainties associated with trying to model floodplain areas with such high urban densities because of the difficulty involved in accurately modelling all potential flow routes along roads, around buildings etc. Furthermore, the supplied Lower Irwell model was based on a relatively coarse grid size which is unlikely to pick up all the flow paths in heavily urbanised areas.
- The inflows (hydrology) into the various models have been estimated and revised on a number of occasions and this has led to differences between the models. The best and most up-to-date information has been used in the SFRA modelling. This included rerunning the Lower Irwell and Grey Irwell models using the estimated peak flows from the recent Environment Agency Manchester Ship Canal Study (2009). This has contributed to some differences in the flood outlines, most notably in the extreme (1 in 1000 year flood event) when compared to other recent studies,

including site specific Flood Risk Assessments. The River Irwell has a large channel capacity and flows are broadly similar for more frequent flood events and so the change in extent from recent studies for these events is likely to be less significant.

- The flood risk situation in Greater Manchester is complex and includes interactions between many different open and culverted watercourses, canals, groundwater and surface water. The SFRA modelling is largely based on existing EA modelling and has carried the assumptions regarding the interactions between different sources forward into the SFRA modelling.
- Previously, the flood risks from each of the various watercourses (Lower Irwell, Grey Irwell, Manchester Ship Canal, Irk, Medlock, Mersey and Corn Brook) in Greater Manchester have been analysed to some extent in isolation from one another. The SFRA has considered the key interactions between some of the main watercourses by adjusting the relevant model boundaries to reflect the predictions of other models. There are many different factors that can affect the interaction between different watercourses in a flood event, including the location and duration of a rainstorm, the relative timing of peak flows along tributaries, the maintained water levels in canals, the operating rules of sluices and bypass structures and the nature of surface water inflows. A 'best judgement' has been made for the SFRA, based on the precautionary approach as advocated by PPS25.
- The supplied modelling reports for both the River Irk and River Medlock models indicate that these watercourses should not be overly sensitive to levels on the Grey Irwell. However, these tests were only carried out for the 1 in 100 year flood event flow. Consideration of potential flood levels on the Grey Irwell provided by the recently completed Manchester Ship Canal model suggest that, although this is still likely to hold for the 1 in 100 year flow, levels on the River Irk and River Medlock could be significantly affected by extreme (1 in 1000 year) levels on the Grey Irwell. The interaction between the River Irk and the Grey Irwell is complicated by the constrictions in the channel underneath Victoria Station and any more detailed studies would need to look into this further. There is an extensive area of the lower Medlock, as far upstream as the Medlock Tunnels at Deansgate that would be affected to a greater degree by the Grey Irwell in an extreme 1 in 1000 year flood event than the River Medlock itself. For this reason, the results presented in the SFRA for the lower Medlock area are based on the Grey Irwell model for the 1 in 1000 year flood event and the 1 in 1000 year climate change run.
- The SFRA models have been run to gain an understanding of risk from flooding associated with defence overtopping and breaching. When allocating or designing development in flood risk areas, freeboard should also be taken into account. Freeboard is a ‘safety margin’ and is the difference between the design level of interest (e.g. a defence crest level or property finished floor level) and the estimated flood level for the design flood event. It includes a safety margin for residual uncertainties in water level prediction and/or structural performance. The water level component of freeboard accounts for uncertainty in model inflows (hydrology), model accuracy, survey accuracy (including that of flood defence levels) and the quality of the digital elevation models upon which 2D models are based.
- The SFRA climate change modelling has used the recommended national precautionary sensitivity ranges for peak rainfall intensity and peak river flows set out in Table B.2 of PPS25. A new set of climate change projections (UKCP09) have been recently published; however, there is currently no Defra guidance on how to use the projections within flood and coastal flood risk management, including sensitivity ranges for flood risk modelling.

The modelling approach that has been undertaken is appropriate for a SFRA and informing strategic decisions regarding future development and has been discussed and agreed with the Environment Agency.

The modelling undertaken for the SFRA used the best available data at the time and has led to a number of recommendations regarding further work to the models in the Greater

Manchester area that are shown in Table 2-3. The SFRA has highlighted the need for a detailed holistic review of flood risk from all watercourses, which would include linking the Lower Irwell, Grey Irwell, Manchester Ship Canal, Irk, Medlock, Corn Brook, Worsley Brook, Mersey and Sinderland Brook models in order to gain an enhanced understanding of flood risk in Greater Manchester. Any future work should seek to use new information as it becomes available and the level of detail of modelling work should be suitable for the purpose of the study.

**Table 2-3 Recommendations for further modelling work**

| Model | Recommendation |
|---|---|
| Lower Irwell | The Lower Irwell Flood Hazard study (commissioned by the Environment Agency in 2009) should produce a more accurate existing risk (defended) model with updated hydrology, key structures (bridges) re-inserted into the model and the current defence heights accurately depicted. Removing the defences from the hazard model would enable the flood zones to be updated. |
| Irk | Assess impact of higher water levels at the downstream limit on the Grey Irwell from the Grey Irwell model run with the Manchester Ship Canal study hydrology. |
| Medlock | Assess impact of higher water levels at the downstream limit on the Grey Irwell from the Grey Irwell model run with the Manchester Ship Canal study hydrology. |
| Grey Irwell | The Grey Irwell model would benefit from being rerun using the Manchester Ship Canal study hydrology and extending the 2D domain upstream into the Lower Irwell. |
| Manchester Ship Canal | Any future 2 dimensional modelling study would benefit from using LIDAR data throughout the model domain (this was not available for the entire model domain at the time the SFRA modelling was undertaken). Also a new survey should be undertaken for bank and quay heights and a finer resolution grid size could be used. Calibration of the hydraulic performance of the sluices and debris booms is essential. |
| Mersey | Assess impact of water levels at the downstream limit on the Manchester Ship Canal using the recent Manchester Ship Canal study. |

## 2.4 River modelling scenarios

To provide the outputs required by PPS25, and considering the presence of defences, the scenarios defined in Table 2-4 below were modelled. 'Overtopping' is defined in this table as floodwaters overtopping either or both river banks or defences.

**Table 2-4 River modelling scenarios**

| River | Event probability | Scenario |
|---|---|---|
| Lower Irwell | 1 in 25 | Overtopping |
| Lower Irwell | 1 in 100 | Overtopping |
| Lower Irwell | 1 in 100 with climate change | Overtopping |
| Lower Irwell | 1 in 1000 | Overtopping |
| Lower Irwell | 1 in 1000 with climate change | Overtopping |
| Lower Irwell | 1 in 100 | Breach |

| River | Event probability | Scenario |
|---|---|---|
| Lower Irwell | 1 in 100 with climate change | Breach |
| Grey Irwell | 1 in 25 | Overtopping |
| Grey Irwell | 1 in 100 | Overtopping |
| Grey Irwell | 1 in 100 with climate change | Overtopping |
| Grey Irwell | 1 in 1000 | Overtopping |
| Grey Irwell | 1 in 1000 with climate change | Overtopping |
| Irk | 1 in 25 | Overtopping |
| Irk | 1 in 100 | Overtopping |
| Irk | 1 in 100 with climate change | Overtopping |
| Irk | 1 in 1000 | Overtopping |
| Irk | 1 in 1000 with climate change | Overtopping |
| Medlock | 1 in 25 | Overtopping |
| Medlock | 1 in 100 | Overtopping |
| Medlock | 1 in 100 with climate change | Overtopping |
| Medlock | 1 in 1000 | Overtopping |
| Medlock | 1 in 1000 with climate change | Overtopping |
| Corn Brook | 1 in 25 | Overtopping |
| Corn Brook | 1 in 100 | Overtopping |
| Corn Brook | 1 in 100 with climate change | Overtopping |
| Corn Brook | 1 in 1000 | Overtopping |
| Corn Brook | 1 in 1000 with climate change | Overtopping |
| Mersey | 1 in 100 | Overtopping |
| Mersey | 1 in 100 with climate change | Overtopping |
| Mersey | 1 in 1000 | Overtopping |
| Mersey | 1 in 1000 with climate change | Overtopping |
| Mersey | 1 in 100 | Breach |
| Mersey | 1 in 100 with climate change | Breach |
| Manchester Ship Canal | Please see Chapter 3 | |

In line with the requirements of the PPS25 Practice Guide, an extreme 1 in 1000 year flood event, considering climate change has been considered in the SFRA. It should be noted that there is considerable uncertainty associated with such an event, concerning the natural variability of climate over long timescales and hence the outputs from the modelling for such an event should be used to assess how robust design measures would be in an "extreme event" that exceeded the design event.

### 2.5 Model outputs

Flood extents, hazards and depths for each scenario have been provided on maps in the Maps Volume. Animations have also been produced for each of the 1 in 100 year with climate change and 1 in 1000 year events with the exception of the River Mersey at Carrington, where the extent of the flooding is comparatively small. The supplied animations (on DVD in the Maps Volume) can provide information on the time-varying nature of flooding such as the rate of onset of flooding, the duration of flooding and the development of key flow routes over time, all of which can be useful to planners and emergency planners.

Flood hazard is based on a multiplier of flood depth, flood velocity and a debris factor[5] and is presented on the following scale:

| Hazard to people | Hazard to people classification |
|---|---|
| No Hazard | |
| Very Low Hazard<br>“Flood zone with shallow flowing water or deep standing water” | Caution |
| Danger for some<br>“Danger: flood zone with deep or fast flowing water” | Includes children, the elderly and the infirm |
| Danger for most<br>“Danger: flood zone with deep fast flowing water” | Includes the general public |
| Danger for all<br>“Extreme danger: flood zone with deep fast flowing water” | Includes the emergency services |

The model outputs record the extent, depth and hazard associated with fluvial flooding. It should be recognised that fluvial flooding could have wider implications for both existing and new development and communities outside those areas shown immediately at risk. For example, there could be an impact on key transport routes and bridges (including those that provide access and egress during a flood event) and the sewer network (causing backing up and surface water and sewer flooding beyond the expected extent of fluvial flooding, including to basement properties).

### 2.6 Lower Irwell

The River Irwell enters Salford district near Clifton. The Environment Agency Flood Zones show that there is limited risk on the right (south) bank of the river in this area, with slightly more extensive flooding in a 1 in 1000 year event. The council district widens to cover both sides of the river at Kersal and the Flood Zones show extensive flooding through Lower Kersal. Flood Zone 3 shows flooding through Charlestown and Lower Broughton; however, it is Flood Zone 2 that shows widespread flooding in this area.

The Environment Agency maintains the River Irwell Flood Control Scheme which was designed to provide a 1 in 75 year Standard of Protection (SOP) through Kersal and Lower Broughton. The scheme includes raised flood defences and offline storage at Littleton Road flood storage area.

The Environment Agency’s normal policy is to add a “freeboard” element when constructing raised flood defences in order to compensate for local uncertainties in the hydrological and hydraulic modelling. At Kersal and Lower Broughton a freeboard of 600mm was added to the modelled 1 in 75 year flood level to define the design defence crest levels.

[5] Defra and Environment Agency (2006) The Flood Risks to People Methodology, Flood Risks to People Phase 2, FD2321 Technical Report 1, HR Wallingford et al. wrote the report for Defra/EA Flood and Coastal Defence R&D Programme, March 2006.

The model includes the defences and flood storage area as built and hence accounts for freeboard. This explains why the SFRA modelling shows that there is limited flooding in a 1 in 100 year event, which is greater than the design standard of the scheme.

The 1 in 25 year flood event is mostly in bank, except for the Lower Kersal flood storage area and around the meander to the east of Lower Kersal. During the 1 in 100 year defended scenario, the majority of developed areas behind flood defences remain protected, except around Lower Broughton Road upstream of Cromwell Bridge and the Heath Avenue and Riverside area at the neck of the eastern meander of the River Irwell.

In a 1 in 100 year event considering climate change, the defences would overtop, causing flood waters to cut across the floodplain at Castle Irwell in Charlestown and extensive flooding in Lower Broughton (affecting both Salford and Manchester districts). In a 1 in 1000 year event there is predicted to be extensive flooding across Lower Kersal, Charlestown and Lower Broughton, which would become more extensive when considering climate change.

The flood depth and hazard maps for all scenarios are presented in the Maps Volume. Approximate flood depths and hazards are presented below. These have been extracted over large areas and for more detailed flood information, the Level 2 SFRA maps should be referred to.

### 2.6.1 Lower Irwell summary

The existing risk from the Lower Irwell is summarised below, per strategic site.

#### Salford Strategic Housing Site S0002 - Charlestown Riverside

The SFRA modelling shows that the 1 in 100 year and the 1 in 100 year flood event with climate change will remain in bank. The extreme 1 in 1000 year flood event however is predicted to inundate large areas of the site. The residual risk associated with this event is significant and there would be deep flooding to the centre and east of the site. The predominant hazard categorisation for the flood risk areas for the 1 in 1000 year event is 'danger to most'.

#### Salford Strategic Employment Site S0405 - Charlestown and Lower Kersal

Flooding occurs at this site in 1 in 100 year plus climate change event and affects the works site located adjacent to the watercourse only. The increase in flood extent for the 1 in 1000 year and 1 in 1000 year event plus climate change is limited. Predicted flood depths at the site increase from less than 0.5m in the 1 in 100 year plus climate change event to 1 to 1.5m in the 1 in 1000 year plus climate change. The predominant hazard categorisations for these events are 'dangerous for some' and 'dangerous for most' respectively.

#### Salford Strategic Housing Site S0001 - Lower Broughton

The SFRA modelling shows that the 1 in 100 year flood event will remain largely in bank except to the north of the University where it is predicted to overtop the left bank. Flood depths in this event are up to 0.5m and the hazard categorisation ranges between 'very low' to 'danger for some'.

Flood extents in the 1 in 100 year event plus climate change increase dramatically with flooding affecting the majority of the site. Only the north, part of the west (around Myrtle Place) and the south end of the site (university playing fields) are outside the flood extents. Flooding depths across the site are generally between 0.5 and 1m with maximum depths of up to 1.5m predicted in the north east of the site. A hazard categorisation of 'danger for most' applies across most of the site.

There is significant residual risk to the site in the 1 in 1000 year and 1 in 1000 year plus climate change events. In both these events the majority of the site has flooding in excess of 2m deep and a hazard categorisation of 'danger for most'.

#### Salford Strategic Housing Site S0399 - Cambridge Industrial Estate - Lower Broughton

This site partially lies within the Salford Overall Growth Point Site S0001.

Flood banks are overtopped in the 1 in 100 year flood event plus climate change at this site with flood depths up to 0.5m across the majority of the site and depths up to 1m near the centre of the site. The predominant hazard categorisation is 'danger for most' centred around the area with the greatest flooding depth.

There is significant residual risk to the site in the 1 in 1000 year and 1 in 1000 year plus climate change events. In both these events the majority of the site has flooding in excess of 2m and a hazard categorisation of 'danger for most'.

### Salford Regionally Significant Site (mixed use) S0413 - Exchange Greengate

This site incorporates a number of smaller strategic sites. A breakdown of the sites and the sources of flood risk is as follows:

- S0417 Salford Approach - Grey Irwell
- S0418 Boond Street - Irwell/Grey Irwell
- S0419 Gorton Street - Irwell/Grey Irwell
- S0420 New Bridge Street - Irwell/Grey Irwell
- S0421 Collier Street - Irwell/Grey Irwell
- S0422 King Street - Irwell/Grey Irwell
- S0424 Greengate - Grey Irwell

Discussion of flood risk for each site is detailed below or in the relevant source flood risk section.

#### *Salford Regionally Significant Site S0418 - Exchange Greengate - Boond Street*

This site is at risk from flood waters from the Irwell upstream of the railway line and from the Grey Irwell downstream of the railway line via Greengate and Blackfriars Road.

The model results suggest flood waters do not exceed bank top in the 1 in 100 year and the 1 in 100 year plus climate change events at this site.

Flood risk at this site in the 1 in 1000 year and 1 in 1000 year plus climate change events is from the Irwell overtopping its banks to the south of Trinity Way. Inundation of the majority of the site occurs in the 1 in 1000 year event with flood depths of less than 0.5m predicted, increasing to between 0.5 and 1m to the eastern end of the site. Flood hazard categorisations range from 'very low' to 'dangerous for most' moving from west to east across the site.

The 1 in 1000 year plus climate change event inundates the entire site with flood depths increasing steadily from west to east from between 0.5 and 1m to in excess of 2m. The flood hazard categorisation is 'dangerous for all' across the whole site with the exception of the area around Caygill Street, which is categorised as 'dangerous for most'.

#### *Salford Regionally Significant Site S0419 - Exchange Greengate - Gorton Street*

This site is at risk from flood waters from the Irwell upstream of the railway line and from the Grey Irwell downstream of the railway line via Greengate and Blackfriars Road. The Gorton Street site is located immediately adjacent to the Irwell and as such is at risk of flooding as soon as flood waters exceed bank top.

The model results suggest flood waters do not exceed bank top in the 1 in 100 year and the 1 in 100 year plus climate change events. In the 1 in 1000 year and 1 in 1000 year plus climate change events however, flood waters are predicted to exceed bank top and maximum flooding depths in the site for both these events are in excess of 2m. The hazard categorisation associated with these flood depths is 'dangerous for all'.

#### *Salford Regionally Significant Site S0420 - Exchange Greengate - New Bridge Street*

This site is at risk from flood waters from the Irwell upstream of the railway line and from the Grey Irwell downstream of the railway line via Greengate and Blackfriars Road. The New Bridge Street site is again located immediately adjacent to the Irwell and as such is at risk of flooding as soon as flood waters exceed bank top.

The model results suggest flood waters do not exceed bank top in the 1 in 100 year and the 1 in 100 year plus climate change events.

In the 1 in 1000 year flooding is predicted across the whole site to a depth between 1.5 and 2m for the majority of the site. The flood hazard categorisation is 'dangerous for most' and 'dangerous for all' for the western and eastern halves of the site respectively.

Flood depths in the 1 in 1000 year plus climate change event are predicted to be in excess of 2m across the whole site with an associated hazard categorisation of 'dangerous for all'.

### *Salford Regionally Significant Site S0421 - Exchange Greengate - Collier Street*

This site is at risk from flood waters from the Irwell upstream of the railway line and from the Grey Irwell downstream of the railway line via Greengate and Blackfriars Road. There is no flood risk identified at this site in the 1 in 100 year, 1 in 100 year plus climate change and 1 in 1000 year events.

Model results predict flood depths of less than 0.5m across the whole site in the 1000 year plus climate change event. The hazard categorisation for the site for this event is 'very low'.

### *Salford Regionally Significant Site S0422 - Exchange Greengate - King Street*

This site is at risk from flood waters from the Irwell upstream of the railway line and from the Grey Irwell downstream of the railway line via Greengate and Blackfriars Road. There is no flood risk identified at this site in the 1 in 100 year and 1 in 100 year plus climate change events.

Flood depths in the 1 in 1000 year event are less than 0.5m and extend from the eastern edge of the site to Linsley Street. The hazard categorisation for this area increases gradually from 'very low' around Linsley Street to 'dangerous for all' around Gravel Lane.

Flooding in 1 in 1000 year plus climate change event is predicted to inundate the majority of the site. Flood depths increase across the site from west to east reflecting the local topography with a maximum flood depth in excess of 2m around Gravel Lane. The hazard categorisation for the site to the east of Linsley Street is 'dangerous for all'. To the west of Linsley Street the hazard associated with the flooding reduces to 'very low'.

### *Salford Regionally Significant Site S0423 - Exchange Greengate - Salford Approach Car Park*

The Salford Approach Car Park is significantly higher than local ground levels and so flooding is not predicted at this site in the 1 in 100 year, 1 in 100 year plus climate change events and 1 in 1000 year event.

When flooding is predicted in the 1 in 1000 year plus climate change event, flood waters are shown to come from water levels on the Irwell backing up and overtopping the railway line to the north of the site. Flooding in this event is limited to the north of the site. Modelled flood depths are less than 0.5m and the hazard categorisation is 'very low'.

### *Salford Regionally Significant Site S0424 - Exchange Greengate - Greengate*

The site is flooded from the Irwell and Grey Irwell and is discussed in full in Section 2.7.

### Salford Regionally Significant Site (mixed use) S0414 - Salford Central

This site incorporates a number of smaller strategic sites. A breakdown of the sites and the sources of flood risk is as follows:

- S0425 Upper Cleminson - Grey Irwell
- S0426 Hampson Street/Middlewood Street - Grey Irwell
- S0427 New Bailey Street/Gore Street - Grey Irwell
- S0428 James Street/Rodney Street - Grey Irwell
- S0429 Adelphi Street - Irwell

Discussion of flood risk for each site is detailed below or in the relevant source flood risk section.

#### *Salford Regionally Significant Site S0429 - Salford Central - Adelphi Street*

The model results suggest flood waters do not exceed bank top in the 1 in 100 year and the 1 in 100 year plus climate change events at this site.

Flooding is predicted in the 1 in 1000 year event but this is restricted to low lying land in the western and northern limits of the site. Flood depths at these locations are in excess of 2m and hence are attributed a hazard categorisation of 'dangerous for all'.

Flooding in the 1 in 1000 year plus climate change event is similar to that observed in the 1 in 1000 year event however, flooding is predicted on higher ground in the centre of the southern end of the site. Flood depths in this location range between 1 and 2m and the hazard categorisation is 'dangerous for all'.

#### Manchester Strategic Employment Site M0004 - Strangeways

The SFRA modelling shows that the 1 in 100 year flood event will remain in bank. Taking climate change into account, the defences will overtop in Lower Broughton, with flooding affecting the west of the site between Rugby Street and Irwell Street to a maximum depth of 1m in places.

There is significant residual risk to the site in the 1 in 1000 year and 1 in 1000 year plus climate change flood events. Flooding is predicted to affect around a quarter of the site in the west, bordering the prison and encroaching on the brewery. The majority of flooding is shown to be in excess of 2m in these events, resulting in hazards of 'danger for all'.

#### Manchester Strategic Employment Site M0005 - Victoria

This site is affected by flooding from the Irwell and the Grey Irwell. The River Irk is in culvert under the site. There is no flood risk identified at this site in the 1 in 100 year and 1 in 100 year plus climate change events.

Flooding at this site occurs in the 1 in 1000 year event and is predicted to affect the western border of the site only. Flooding from the Grey Irwell is predicted around Hunt's Bank and Victoria Street with depths in excess of 2m. Flooding from the Irwell is to the north of the railway and extends to the Arena. Flood depths are predicted to decrease towards the Arena to between 0.5 and 1m. The hazard categorisation associated with the majority of this flooding is 'dangerous to all'.

The 1 in 1000 year plus climate change event shows flooding reaching beyond Long Millgate from the Grey Irwell. Flood depths around Victoria Street, Walker's Croft and the Arena are all in excess of 2m but reduce to less than 0.5m towards the limit of the flood extent. The hazard categorisation reflects the flooding depths with the worst affected areas categorised as 'dangerous to all' and reducing to 'very low' around the periphery.

### 2.6.2 Sequence of flooding

In a 1 in 100 year flood event considering climate change, flooding starts within the eastern meander loop of the River Irwell and then fills the flood storage area at Lower Kersal. The River Irwell then overtops on the left bank upstream of Cromwell Bridge and short cuts the meander loop in the Heath Avenue and Riverside area of Lower Broughton. Flood waters then spread south east and north east into Lower Broughton. The River Irwell then overtops the right bank at Charlestown, causing flood waters to cut across the floodplain at Castle Irwell.

In a 1 in 1000 year flood event, flooding starts within the eastern meander loop of the River Irwell and then fills the flood storage area at Lower Kersal. The River Irwell then overtops in Charlestown and along the left bank at Lower Broughton before overtopping the left bank downstream of the flood storage area into Lower Kersal. Flooding then becomes deeper and more extensive in Lower Kersal, Charlestown and Lower Broughton.

### 2.6.3 Breach at Lower Kersal

In the event of a breach during a 1 in 100 year event on the left bank upstream of Littleton Bridge, flooding would be extensive within the River Irwell meander loop and extend north towards Castle Hill.

Considering climate change, flooding would be slightly more extensive. Flood depth and hazard increase under the breach scenario as floodwaters spill through the breach at higher velocities. In the 1 in 100 year flood event considering climate change, flood depths reach 2m deep across the majority of the Lower Kersal flood extent, and the flood hazard rating is extreme in most places, causing 'danger to all'.

The 1 in 1000 year considering climate change results are not significantly different from those for the 1 in 100 year flood event.

With regard to the sequence of flooding, in a 1 in 100 year considering climate change, the River Irwell would start to fill the flood storage area and spill from the north of the eastern meander loop before breaching the defences on the left bank upstream of Littleton Bridge. Flood waters would then extend north and eastwards into Lower Kersal. Areas immediately behind the defences are at the highest risk should the defence fail under load, with the possibility of sudden and deep floodwaters flowing at high velocities.

### 2.6.4 Breach at Lower Broughton

In the event of a breach during a 1 in 100 year event on the left bank south of Cromwell Bridge, flooding would be extensive and extend east along Broughton Lane into Manchester district, although the largest risk of flooding is in Salford district. This again highlights the importance of considering flood risk on a cross-boundary basis. Considering climate change, flooding would be significantly more extensive. If the defences at Lower Broughton breached, this could reduce the amount of water passing downstream and reduce flood risk from the Grey Irwell, lower Irk, lower Medlock and Manchester Ship Canal.

Flood depth and hazard increase slightly under the breach scenario from overtopping as floodwaters spill through the breach at higher velocities. In the 1 in 100 year plus climate change event flood depths reach 1-2m in isolated spots, including 'The Ave' to the west, and Milton Street and Broughton Lane to the east. The majority of the flood depths are shallow, between 0.25-0.5m. The flood hazard rating is increased in places, causing 'danger to most/ some' for most of the extent, with 'very low hazard' at the periphery.

With regard to the sequence of flooding, in a 1 in 100 year considering climate change, the River Irwell would overtop on the left bank in the meander loop in the Heath Avenue and Riverside area and further down on the left bank just before the river breached. When the river breaches defences on the left bank south of Cromwell Bridge, floodwaters would extend rapidly south east and north east into Lower Broughton. Areas immediately behind the defences are at the highest risk should the defence fail under load, with the possibility of sudden and deep floodwaters flowing at high velocities.

Breach or overtopping of the Lower Irwell will also cause the public sewerage system to back up causing sewer flooding.

## 2.7 Grey Irwell

The River Irwell is known as the 'Grey Irwell' between the confluences of the Rivers Irk and Medlock. The Grey Irwell flows through (and separates) the city centres of Manchester and Salford. The Grey Irwell drains into the Manchester Ship Canal, which is the canalised lower section of the River Irwell. There are no formal flood defences on the Grey Irwell.

The Grey Irwell has a large channel capacity and in a 1 in 25 year and a 1 in 100 year event the SFRA modelling shows that there is only limited flooding in low spots close to the channel. Taking into account the impact of climate change, flooding becomes more extensive on the right (north) bank close to the cathedral (Salford), around Quay Street (Salford), Stanley Street (Salford), Water Street (Manchester), Regent Bridge (Manchester) and Egerton Street Bridge (Manchester). In an extreme 1 in 1000 year event, flooding becomes extensive from both the Lower and Grey Irwell in Salford and Manchester. Water is likely to overtop the Lower Irwell upstream of the railway bridge crossing near Victoria Station and flow overland in a south westerly direction, passing underneath various railway crossings. There will be extensive flooding in Salford between the Grey Irwell and the railway line to the north from Chapel Street in the east to Princes Bridge in the south west. On the left (south) bank in Manchester there will be some flooding around Victoria Street and Hunts Bank. Water will overtop the channel around Bridge Street and flow along Water Street in a south westerly direction towards the Potato Wharf area, where there will be extensive flooding on the lower section of the River Medlock upstream to the Bridgewater Viaduct. There will be flooding around Dawson Street and Water Street, with flood waters passing into the Bridgewater Canal. In a 1 in 1000 year event considering climate change, flooding will extend into Salford, affecting the Town Hall area and the Trading Estate between the railway lines and into Manchester, affecting the courts.

The flood depth and hazard maps for all scenarios are presented in the Maps Volume. Approximate flood depths and hazards are presented below. These have been extracted over large areas and for more detailed flood information, the Level 2 SFRA maps should be referred to.

### 2.7.1 Grey Irwell summary

#### Salford Regionally Significant Site (mixed use) S0413 - Exchange Greengate

#### *Salford Regionally Significant Site S0417 - Exchange Greengate - Salford Approach*

There is no flood risk identified at this site in the 1 in 100 year event. Flood risk in the 1 in 100 year plus climate change event is limited to the south of Salford Approach and is not predicted to exceed 0.5m in depth. The hazard categorisation ranges from 'very low' to 'dangerous for some'.

Flooding in the 1 in 1000 year and 1 in 1000 year plus climate change events is again restricted to the south of Salford Approach but flooding depths in both cases is in excess of 2m. The associated hazard categorisation in these events is 'dangerous for all'.

#### *Salford Regionally Significant Site S0418 - Exchange Greengate - Boond Street*

The site is flooded from the Irwell and Grey Irwell and is discussed in full in Section 2.6.

#### *Salford Regionally Significant Site S0419 - Exchange Greengate - Gorton Street*

The site is flooded from the Irwell and Grey Irwell and is discussed in full in Section 2.6.

#### *Salford Regionally Significant Site S0420 - Exchange Greengate - New Bridge Street*

The site is flooded from the Irwell and Grey Irwell and is discussed in full in Section 2.6.

#### *Salford Regionally Significant Site S0421 - Exchange Greengate - Collier Street*

The site is flooded from the Irwell and Grey Irwell and is discussed in full in Section 2.6.

#### *Salford Regionally Significant Site S0422 - Exchange Greengate - King Street*

The site is flooded from the Irwell and Grey Irwell and is discussed in full in Section 2.6.

#### *Salford Regionally Significant Site S0424 - Exchange Greengate - Greengate*

The Greengate site is located on the banks of the Grey Irwell at its eastern limit and extends along Greengate, passing beneath the railway line, and incorporating Gravel Lane and Norton Street at its western limit.

Flood waters are predicted to exceed bank top in the 1 in 100 year plus climate change and inundate the site south of the railway. Flood depths in this event increase towards the Grey Irwell and are up to 1.5m. Similarly the hazard categorisations increase towards the Grey Irwell from 'very low' to 'dangerous for all'.

The entire site is inundated in the 1 in 1000 year and 1 in 1000 year plus climate change events with predicted flood depths in general in excess of 2m. In this event flooding to the western limit of the site is at risk from flood waters from the Irwell. The hazard categorisation across the site for both events is 'dangerous for all'.

### Salford Regionally Significant Site (mixed use) S0414 - Salford Central

#### *Salford Regionally Significant Sites S0425 - Salford Central - Upper Cleminson Street/Chapel Street*

There is no flood risk identified at this site in the 1 in 100 year, the 1 in 100 year plus climate change and the 1 in 1000 year events.

Flooding in the 1 in 1000 year plus climate change event is restricted to east of East Market Street with flooding depths in general predicted to be less than 0.5m. Flooding up to 2m in depth is predicted adjacent to East Market Street where the topography appears to show a low spot. The flood hazard categorisation across the site ranges between 'very low' and 'dangerous for most' with this around the location with the deepest flooding.

#### *Salford Regionally Significant Sites S0426 - Salford Central - Hampson Street/Middlewood Street*

There is no flood risk identified at this site in the 1 in 100 year and the 1 in 100 year plus climate change events. Flooding in the 1 in 1000 year event is negligible and occurs at the Prices Bridge roundabout only.

Flooding in the 1 in 1000 year plus climate change event is more extensive with flooding across most of the eastern half of the site. Flood depths north of Hampson Street are 1.5 to 2m and the flood hazard categorisation across the majority of the flood risk area is 'dangerous for most'.

#### *Salford Regionally Significant Sites S0427 - Salford Central - New Bailey Street/Gore Street*

SFRA model results shows that the 1 in 100 year flood event will remain largely in bank. Flooding in the 1 in 100 year plus climate change event is limited but will affect properties around Stanley Street and Quay Street with predicted flood depths of less than 0.5m and 0.5 to 1m for each site respectively. The predominant hazard categorisation at Stanley Street is 'very low' and at Quay Street 'dangerous for most'.

Flooding in the 1 in 1000 year event increases significantly with the majority of the site inundated. Flood depths in the centre of the site between Irwell Street and New Bailey Street are predicted to be 1 to 1.5m. At the eastern end of the site around Quay Street and at the southern end of the site around Princes Bridge flood depths are predicted to exceed 2m. The hazard categorisation across the majority of the site is 'dangerous for all'.

In the 1 in 1000 year plus climate change event the flood depths are in excess of 2m and the hazard categorisation is 'dangerous for all' across the majority of the site.

#### *Salford Regionally Significant Sites S0428 - Salford Central - James Street/Rodney Street*

There is no flood risk identified at this site in the 1 in 100 year and the 1 in 100 year plus climate change events. Flooding in the 1 in 1000 year event is limited occurring around East Ordsall Lane and Egerton Street with a predicted flood depth of less than 0.5m. The hazard categorisation for this site ranges between 'very low' up to 'dangerous for most' adjacent to the railway.

Flooding in the 1 in 1000 year plus climate change event is more extensive with flooding reaching as far north as Chapel Street but restricted to the eastern end of the site. Predicted flood depths gradually increase from less than 0.5m around Chapel Street to greater than 2m by the railway. The flood hazard categorisation across the majority of the flood risk area is 'dangerous for most'.

### Manchester Strategic Employment Site - Victoria M0005

The site is flooded from the Irwell and Grey Irwell and is discussed in full in Section 2.6.

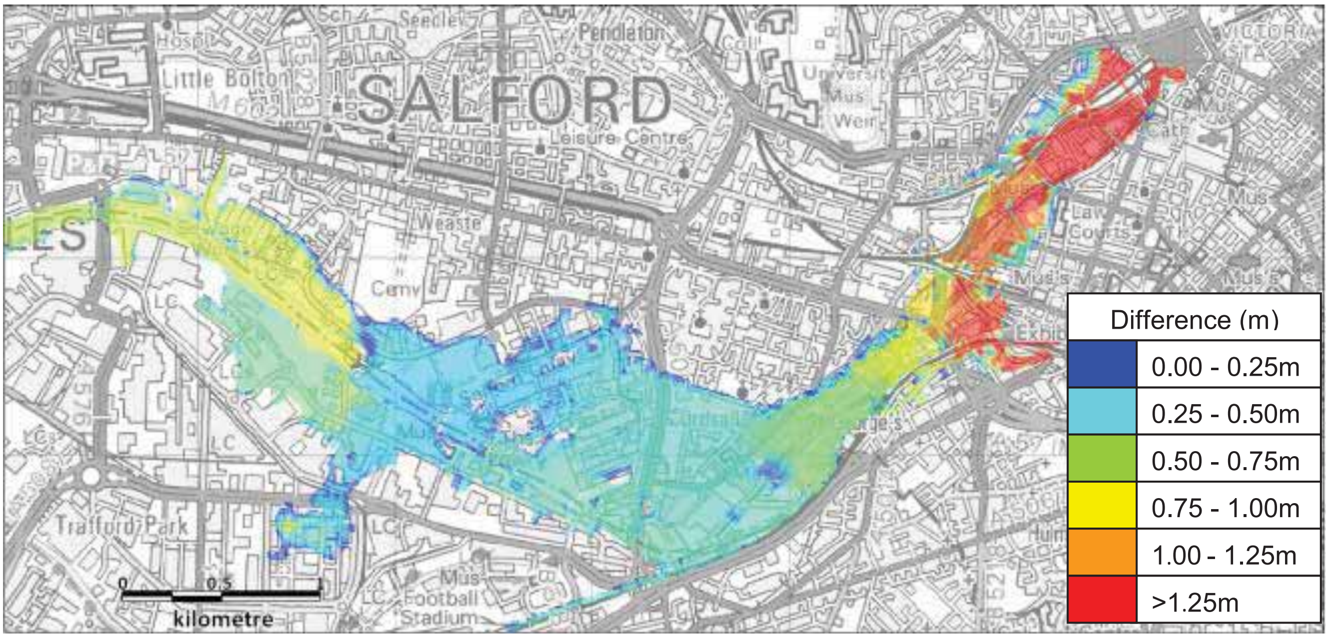
### 2.7.2 Sequence of flooding

In a 1 in 100 year flood event considering climate change, flooding starts in low spots on the right bank (Salford) before affecting lower lying areas on the right bank around Water Street (Manchester). Flooding becomes deeper and more extensive as the flood event progresses. In a 1 in 1000 year flood event, at the start of the event flooding follows a similar pattern, with flooding propagating further east into Salford and west into Manchester. Water overtops the River Irwell from upstream of the constriction in the channel around Victoria Station and flows overland in a south westerly direction before passing under railway crossings and adding to the flooding between the right bank of the Grey Irwell and the railway line (Salford).

### 2.7.3 Sensitivity testing

The Lower Irwell (Lower Broughton reach) modelling results indicate that during an extreme 1 in 1000 year event there would be significant flow attenuation due to extensive flood storage within the floodplain at Lower Kersal and Lower Broughton. For example, when the 1 in 1000 year flood event flow of 1170m$^3$/s is put into the upstream end of the Lower Irwell model, the peak outflow at Victoria Station is restricted to 899m$^3$/s. Consequently, two additional model runs (one for the Grey Irwell and one for the Manchester Ship Canal residual risk scenario) were carried out to determine the impact of attenuation during a 1 in 1000 year flood event in the floodplain at Lower Kersal and Lower Broughton on flood risk on the Grey Irwell and Manchester Ship Canal. Figure 2-2 shows the modelled difference in flood levels (and depths) that this attenuation would cause between Victoria Station and Centenary Bridge. The difference scale on the map reflects the decrease in flood level predicted by the attenuated flow model compared to the SFRA model runs. This illustrates that flood levels in the upstream part of the Grey Irwell could be reduced the most (in excess of 1m), considering the impact of floodplain storage upstream. The impact of the attenuation on flood risk decreases with distance downstream, especially once the floodplain widens at Salford Quays. It is a recommendation of the SFRA that further studies should consider this effect.

**Figure 2-2: Flood level difference map for attenuated (1 in 1000 year) flow along the Grey Irwell and Manchester Ship Canal**




NB The difference scale reflects the decrease in flood level predicted by the attenuated flow model compared to the SFRA model runs

### 2.7.4 Sensitivity testing: downstream water levels

Current modelling uncertainties result in a large variation in predicted water levels on the Manchester Ship Canal, into which the Grey Irwell outfalls. This is explored more fully in Chapter 3, which clearly demonstrates the significant impact of the operation of water control structures (sluices at locks) in reducing flood risk. To understand the implications of this for flood risk from the Grey Irwell, the Grey Irwell model was rerun for a range of events with downstream water levels from the "defended" Manchester Ship Canal model. The defended model presents a probable best case scenario with optimum operation of water control structures. The differences in water levels between the models at key locations during a 1 in 100 year with climate change and an extreme 1 in 1000 year event are shown on Table 2-5.

The results demonstrate that flood levels on the Grey Irwell are sensitive to water levels on the Manchester Ship Canal upstream of Mode Wheel Sluices. This sensitivity to levels on the Manchester Ship Canal is more evident during 1 in 100 year and 1 in 100 year with climate change events than during an extreme 1 in 1000 year event. A high sensitivity to levels on the Manchester Ship Canal is to be expected since the defended Manchester Ship Canal model presents a probable best case scenario with limited flood risk for a 1 in 100 year flood event.

The SFRA model for the Grey Irwell was configured using the water levels predicted by the SFRA Manchester Ship Canal model (which presents an indication of residual risk - i.e. an indication of what might happen should not all the sluices operate or sluice efficiency is reduced below the adopted optimum) rather than the defended Manchester Ship Canal model. The uncertainties in the current Manchester Ship Canal modelling and the need to take a precautionary approach as outlined in PPS25 mean that it is essential that residual risk is considered in the SFRA. The "residual risk" model predicts higher water levels on the Manchester Ship Canal and upstream on the Grey Irwell than the "defended" model. However, the large channel capacity of Grey Irwell would result in limited additional flooding during the residual risk scenario, even during a 1 in 100 year with climate change event.

For extreme 1 in 1000 year and 1 in 1000 year with climate change events the differences in water levels (and therefore flood extents) on the Grey Irwell are less marked. This is because the water control structures exert less control on flood levels along the Manchester Ship Canal during events of this magnitude.

**Table 2-5 Difference in water levels on the Grey Irwell relative to downstream water levels on the Manchester Ship Canal (m)**

| Event: | 1 in 100 year + climate change | | | 1 in 1000 year | | |
|---|---|---|---|---|---|---|
| Downstream water levels derived from: | MSC residual risk (SFRA) model | MSC defended model | Difference | MSC residual risk (SFRA) model | MSC defended model | Difference |
| Victoria Station | 27.78 | 27.21 | -0.56 | 32.15 | 32.10 | -0.05 |
| Blackfriars Bridge | 26.78 | 26.13 | -0.65 | 30.40 | 30.29 | -0.11 |
| Irwell Street Bridge | 26.11 | 25.34 | -0.77 | 28.77 | 28.60 | -0.18 |
| Castlefield Bridge | 25.89 | 24.90 | -0.99 | 27.95 | 27.85 | -0.10 |
| Medlock Confluence | 25.56 | 24.39 | -1.16 | 27.26 | 27.18 | -0.08 |

## 2.8 River Irk

The River Irk rises near Shaw in Oldham. It passes through Oldham and Rochdale Councils before flowing southwards towards Manchester City Centre, where it joins the River Irwell. The main tributaries of the Irk include Boggart Hole Brook and Moston Brook.

The Irk is relatively constrained to the channel until the floodplain widens between Crumpsall and Harpurhey in Manchester City Council district. Raised defences protect Vale Park Industrial Estate to a 1 in 50 year standard. The floodplain extends again as the Irk reaches the city centre, upstream of Victoria Station.

The SFRA modelling shows that there will be limited flooding in a 1 in 25 year event downstream of the confluence with the Moston (Moss) brook and on Collyhurst Road. In a 1 in 100 year event, there will be flooding close to the channel downstream of the confluence of Moston Brook and along Collyhurst Road and Roger Street. Taking into account the impact of climate change, flooding will become slightly more extensive. In an extreme 1 in 1000 year event, flooding will become significantly more extensive around and downstream of the confluence with Moston Brook, along Collyhurst Road and in the Roger Street area. In a 1 in 1000 year event considering climate change, flooding will become slightly more extensive than the current 1 in 1000 year flood extent.

The flood depth and hazard maps for all scenarios are presented in the Maps Volume. Approximate flood depths and hazards are presented below. These have been extracted over large areas and for more detailed flood information, the Level 2 SFRA maps should be referred to.

### 2.8.1 River Irk summary

#### Manchester Strategic Employment Site - Victoria M0005

The River Irk is culverted under this site and modelling shows that a weir upstream exerts most influence over water levels. Therefore there is limited flood risk associated with this culvert surcharging, except in the event of blockage. The site is subject to flood risk from the Irwell and Grey Irwell and is discussed in full in Section 2.6.

#### Manchester Strategic Housing Site - Collyhurst M0013

The Irk and Moston Brook flow through this site. Moston Brook is in culvert for the reach through this site. The Flood Zone maps show that there is limited flood risk associated with this culvert at the site, but the risk of blockage would need to be explored in more detailed studies.

Flood waters are predicted to remain in bank for the 1 in 100 year and 1 in 100 year plus climate change event. River waters exceed bank top in the 1 in 1000 year event but the flood extent is minimal with the effect restricted to a localised area around the Irk.

The 1 in 1000 year plus climate change event affects areas of Irkdale Street, Batty Street and Nasmyth Street. Flooding around these areas is predicted to be up to 1m and the associated hazard categorisation ranges between 'very low' and 'dangerous for most' reflecting the depths of flooding expected.

#### Manchester Strategic Housing Site - Irk Valley M0021

The River Irk runs the length of this site and Moston Brook outfalls into the Irk to the south of Fitzgeorge Street. Moston Brook is in culvert for the majority of the reach through this site. The Flood Zone maps show that there is limited flood risk associated with this culvert at the site, but the risk of blockage would need to be explored in more detailed studies.

Flood waters are predicted to exceed bank top in the 1 in 100 year event around the weir in the centre of the site, the southern end of Collyhurst Road and on Dantzic Street at the south end of the site. Flooding depths are generally predicted to be less than 0.5m with the exception of along Collyhurst Road where they could be up to 1m in depth. Hazard categorisations are between 'very low' and 'dangerous for most' for the weir and Dantzic Street sites and 'dangerous for all' at the Collyhurst Site.

The 1 in 100 year plus climate change flood event affects the same areas with a limited increase in flood extents and depths. Maximum flood depths are up to 1m for the weir and Dantzic Street areas and 1.5m for the Collyhurst area. Hazard categorisations remain similar with an increase in the area categorised as 'dangerous for most' for the weir and Dantzic Street sites.

Flooding is more widespread in the 1 in 1000 year event with both banks affected around the weir and the Dantzic Street areas and flood waters exceeding the left bank for the reach between the Collyhurst Road and Dantzic Street sites. Flooding depths are less than 0.5m for the majority of the flood extent with depths at the three critical sites increasing to in excess of 1.5m. The hazard categorisation at the three sites is 'dangerous for all' with the categorisation reducing to 'very low' towards the limits of the flood extent.

Flood extents in the 1 in 1000 year plus climate change event do not change dramatically from the 1 in 1000 year event with the main change in flood risk associated with increasing depths. Depths at the three critical sites are in excess of 2m and a greater proportion of the site is categorised as 'dangerous for all'.

### 2.8.2 Sequence of flooding

In a 1 in 100 year flood event considering climate change, flooding starts at Collyhurst Road, followed by the river overtopping its left bank downstream of the confluence with Moston Brook and opposite Hargreave's Street. Flooding becomes more extensive in these areas before the river overtops its right bank onto Roger Street. In a 1 in 1000 year event, the sequence of flooding follows a similar pattern with the flow path from Roger Street extending north and westwards, affecting the Chase Street and Scotland Bridge areas.

## 2.9 River Medlock

The River Medlock rises in the hills to the east of Oldham. It flows through Oldham and Tameside before reaching Clayton in Manchester City Council. The Medlock has a wide floodplain through Clayton Vale. The Medlock is culverted north of the City of Manchester Stadium and continues to meander in and out of culvert through the city centre. Flood Zones 2 and 3 are relatively wide through the urban landscape.

The SFRA modelling shows that the 1 in 25 year event comes out of bank alongside the open channel downstream of the culverted sections west of the A665 Pin Mill Brow. Downstream of the university the river comes out of bank west of the A34 and affects the York Street area. Development should be avoided if possible in areas at risk of frequent flooding. Flooding will mostly be constrained to a narrow floodplain for a 1 in 100 year event, with more extensive flooding at Holt Town upstream of the A662 Merill Street, Palmerston Street and Limekiln Lane, Hoyle Street Industrial Estate and downstream of the university affecting Charles Street and York Street. Taking into account the impact of climate change, flooding will become more extensive, particularly at Holt Town, Palmerston Street, Hoyle Street Industrial Park, downstream of the university around Charles Street and the Hulme Street area.

In an extreme 1 in 1000 year event, flooding will become significantly more extensive with flooding affecting Holt Town, Gurney Street, Palmerston Street and Limekiln Lane and crossing the A665 Pin Mill Brow and affecting the downstream Industrial Park and Fairfield Street. There will be extensive flooding at Hoyle Street Industrial Estate before the channel goes into culvert under the university. Flooding will affect the western side of the university and extend downstream to the Cambridge Street area. Downstream of Medlock Bridge flooding will be extensive down to the Bridgewater Viaduct, affecting Corn Street and Deansgate. In a 1 in 1000 year event considering climate change, flooding will become significantly more extensive than the current 1 in 1000 year flood extent at the Industrial Park downstream of the A665 Pin Mill Brow affecting North Western Street and Temperance Street and at the university. Downstream of Bridgewater Viaduct and the Medlock Tunnels flooding on the Lower Medlock is more extensive from the Grey Irwell in a 1 in 1000 year and greater flood events.

The flood depth and hazard maps for all scenarios are presented in the Maps Volume Approximate flood depths and hazards are presented below. These have been extracted over large areas and for more detailed flood information, the Level 2 SFRA maps should be referred to.

### 2.9.1 Medlock summary

#### Manchester Strategic Employment Site - Eastern Gateway M0001

There will be localised flooding on the site in the 1 in 25 and 1 in 100 year events, mostly affecting the Hoyle Street Industrial Estate. Flood depths at this site are predicted to be less than 0.5m and the hazard categorisation is generally 'very low'.

In the 1 in 100 year event plus climate change, there will be more significant flooding to the Hoyle Street Industrial Estate, with flood depths up to 2m in places and a hazard categorisation of 'danger for most'.

There is a significant increase in the predicted flood extent during an extreme 1 in 1000 year flood event, with flooding affecting Helmet Street and the B6469 to the east of the site and Baring Street to the west of the site. Flood depths are predicted to be in excess of 2 m at the Hoyle Industrial Estate, the end of Raven Street and the eastern end of Helmet Street, up to 2m at the southern end of Baring Street and less than 0.5m across the remainder of the flood affected area. The hazard categorisation is 'dangerous for all' at sites where flooding is predicted in excess of 2m reducing to 'very low' at other sites.

The 1 in 1000 year plus climate change event shows a consistent flood extent along the length of the Medlock across the site with flood waters overtopping railway in the centre of the site and inundating the Industrial Park north of Raven Street. The worst affected areas are those highlighted for the 1 in 1000 year event with the extents of flood depths in excess of 2m increasing. Flooding depths across the railway line and at the Raven Street Industrial Estate are less than 0.5m. The hazard categorisations are 'dangerous for all' where depths are in excess of 2m and generally 'dangerous for most' at remaining sites.

#### Strategic Housing Site - Holt Town M0024

Flooding occurs in the 1 in 100 year event and affects an limited open area to the south of the Holt Town road. Flooding depths are less than 0.5m close to the Holt Town road and increase to up to 2m closer to the Medlock. The hazard categorisations in this event mirror the predicted flood depths with a categorisation of 'very low' adjacent to the Holt Town road and 'dangerous for all' immediately adjacent to the Medlock.

The 1 in 100 year plus climate change event shows a similar flooding mechanism to the 1 in 100 year event with a limited increase in the predicted flood extents.

The 1 in 1000 year and 1 in 1000 year plus climate change events predict flood waters inundating the Holt Town road. Flooding depths increase progressively with the lower probability events such that in the 1 in 1000 year plus climate change event, the majority of the open area is predicted to be flooded to depths in excess of 2m. In both these events the predominant hazard categorisation is 'dangerous for all'; the hazard categorisation on the Holt Town road in the 1 in 1000 year event is 'dangerous for most'.

#### Manchester Strategic Housing Site - Chancellors Place M0025

The area of this site predicted to flood is a small area between North Western Street and Crane Street. This area is also incorporated within Strategic Site M0001 detailed above. Flood waters are predicted to remain in bank for the 1 in 100 year and 1 in 100 year plus climate change event.

Minor flooding to the road between North Western Road and Fairfield Street up to a depth of 1m is predicted in the 1 in 1000 year event with an associated hazard categorisation of between 'very low' and 'dangerous for most'.

Flooding of the entire site to the west of the Medlock is predicted in the 1 in 1000 year plus climate change event. Flood depths are generally less than 0.5m but increase to up to 1.5m on the link road between North Western Road and Fairfield Street. The hazard categorisation across the majority of the site for this event is 'dangerous for most'.

### Manchester Strategic Housing Site - Lower Medlock M0026

Flooding remains in bank for the majority of the site in the 1 in 100 year event with the exception of a reach adjacent to Palmerston Street on the western bank of the Medlock and at Limekiln Lane. A number of properties are affected at the Palmerston Street site. Flooding depths at Palmerston Street are predicted to be less than 0.5m with the exception of an area opposite Ancoats Grove where depths could be up to 1m. Flood hazard categorisations reflect the predicted flood depths with a categorisation of 'dangerous for most' around the area with the greatest flooding and 'very low' towards the flood extent limits. At Limekiln Lane depths are predicted in excess of 2m in some locations and the hazard categorisation at these sites is 'dangerous for all'.

Flood extents in the 1 in 100 year plus climate change event are predicted to reach beyond Palmerston Street and affect properties in Ancoats Grove. Flooding depths opposite Ancoats Grove are generally between 1 and 1.5m with lower depths around the edges of the flood extents. At Limekiln Lane flood depths are predominantly in excess of 2m. A hazard categorisation of 'dangerous to all' is applied along Palmerston Street north of Ancoats Grove and at Limekiln Lane. The remainder of the flood risk area is generally categorised 'dangerous for most'.

The 1 in 1000 year and 1 in 1000 year plus climate change events show a gradual increase the flood extent with properties along Tutbury Street also being affected. Flood depths in the previously highlighted areas are consistently in excess of 2m. There is some additional flooding around Gurney Street and Palmerston Street on the east bank. The hazard categorisation across the site is 'dangerous for all' with the exception of the two additional flood sites which have generally been categorised 'dangerous for most'.

### Manchester Strategic Employment Site - Oxford Road Corridor M0042

The Oxford Road Corridor Site is at risk from flooding from both the Medlock and from Corn Brook. The areas of flood risk do not overlap and as such have been discussed independently. Flood risk for this site from Corn Brook is detailed in Section 2.10.

Flood waters in the 1 in 100 year event overtop the left bank of the Medlock around York Street to the north of the railway line. Depths are predicted in excess of 2m to the north end of York Street reducing to less than 0.5m at Charles Street. Flood depths of up to 1m are also predicted on the right bank downstream of Oxford Road. The hazard categorisation at these sites reflect the flooding depths and ranges from 'dangerous to all' to 'very low'.

Flooding in the 100 year plus climate change event shows a significantly larger extent than that for the 1 in 100 year event. Flood waters are predicted to cover much of area around the Charles Street/Princess Street junction. Flood depths decease gradually from in excess of 2m to the north of the railway to less than 0.5m to the east of Princess Street. To the west of Oxford Street, flood waters reach as far as Cambridge Street with flood depths generally predicted to be less than 0.5m on the right bank of the Medlock and between 0.5 in excess of 2m on the left bank. Flood hazard categorisations are 'dangerous to all' at sites where flooding is in excess of 2m, reducing to 'very low' at sites with the shallowest depth of flooding.

Flooding in the 1 in 1000 year event shows another significant increase. Flooding extends south to Sackville Street, north to Whitworth Street and west beyond Hulme Street and Cambridge Street with predicted flood depths at these sites between 0 and 1m, Flood depths around Charles Street and Cambridge Street could be in excess of 2m and hence the hazard categorisation is 'dangerous for all' around these sites. Downstream of Albion Street flood depths of up to 1m are predicted to affect Deansgate and Commercial Street with an associated hazard categorisation of 'dangerous for most'.

The 1 in 1000 year plus climate change event extent is similar to the 1 in 1000 year event except flood waters are predicted to overtop London Road to the east of the site and inundate the university. Flood depths vary across the university site but are shown to be in excess of 2m in some locations. Hazard categorisations are 'danger for all' where flood depths are predicted in excess of 2m and 'danger for most' at remaining flood risk sites.

### 2.9.2 Sequence of flooding

In a 1 in 100 year flood event considering climate change, flooding starts at Holt Town and Charles Street, before affecting Palmerston Street and the Hoyle Street Industrial Estate. Flooding would follow a similar pattern in a 1 in 1000 year flood event, but would be more extensive, with flooding overtopping the A665 Pin Mill Brow. Depending on the timing of flood peaks on the different rivers, areas downstream of the Medlock Tunnels may flood first from the Grey Irwell or the River Medlock and may suffer from two flood peaks, one from each watercourse. In such an extreme event, flooding from the Grey Irwell would be deeper and more extensive and cause the River Medlock to back up, resulting in higher flood levels upstream.

Collyhurst Road, followed by the river overtopping its left bank downstream of the confluence with Moston Brook and opposite Hargreave's Street. Flooding becomes more extensive in these areas before the river overtops its right bank onto Roger Street. In a 1 in 1000 year event, the sequence of flooding follows a similar pattern with the flow path from Roger Street extending north and westwards, affecting the Chase Street and Scotland Bridge areas.

## 2.10 Corn Brook

The Corn Brook drains the urban area south of the River Medlock. The brook is largely culverted and flows from Openshaw in a westerly direction, discharging into the Manchester Ship Canal at Pomona Docks. There are open lengths at the upstream reach (around 750m) and upstream of the siphon under the Bridgewater Canal (around 20m).

The Environment Agency have undertaken a recent detailed flood risk mapping study for the Corn Brook, using the Infoworks software, which is most suitable for heavily culverted watercourses and can route flow overland over a digital elevation model. The modelling shows that the following areas are at risk from flooding (reproduced from the River Medlock SFRM Report[6]):

- A small area around Thorpness Street to the south of Openshaw is at risk of flooding from a 1 in 200 year flood event;
- The depot and industrial estate near to the open channel section along Ambrose Street is at risk in an extreme 1 in 1000 year flood event;
- A depot in West Gorton and housing to the south and east of the railway lines off Bennett Street are at risk during a 1 in 20 year flood event and a school in this area is at risk in an extreme 1 in 1000 year flood event;
- Housing off Kincardine Road and to the east of the University of Manchester is at risk of flooding in a 1 in 25 year flood event. and a school in this area is at risk in a 1 in 100 year flood event;
- Housing in Hulme off Boundary Lane is at risk during a 1 in 50 year flood event; and
- In Moss Side properties to the south of Moss Lane West and to the north of Alexandra Park are at risk in an extreme 1 in 1000 year flood event.

The Infoworks model has been run for the SFRA in order to present flood depths and hazards. The flood depth and hazard maps for all scenarios are presented in the Maps Volume. Approximate flood depths and hazards are presented below. These have been extracted over large areas and for more detailed flood information, the Level 2 SFRA maps should be referred to.

[6] Environment Agency (2009) River Medlock and Corn Brook Strategic Flood Risk Mapping Study

### 2.10.1 Corn Brook summary

#### Manchester Strategic Housing Site - West Gorton M0010

Corn Brook is culverted under the site. There will be localised flooding on the site in the 1 in 25 and 1 in 100 year events, mostly affecting Bennett Street and the depot upstream of the railway viaduct. In the 1 in 100 year flood event water will pond up to 1m deep in the Bennett Street area, with localised areas around the depot that will see flooding up to 2m deep. This will result in hazards of 'danger for most' in places. The 1 in 100 year flood event, considering climate change is significantly more extensive in this area. Flood depths will increase and the area of 'danger for most' will be more widespread.

There is significant residual risk to the site during an extreme 1 in 1000 year flood event, with extensive and deep flooding of over 2m in places in the Bennett Street area, including the depot. There will be widespread 'danger for most' in the Bennett Street area, with patches of 'danger for all', around the depot upstream of the viaduct and Vaughan Street. Climate change will increase the extent, depth and hazard associated with flooding in an extreme 1 in 1000 year flood event.

#### Manchester Strategic Housing Site - Brunswick M0011

Corn Brook is in culvert under this site. Localised flooding is predicted in a 1 in 25 year event between Whitekirk Close and Brunswick Street and Glenbarry Close.

Flooding becomes more widespread in the 1 in 100 year flood event incorporating areas off Wadeson Road. Flooding depths are generally less than 0.5m with localised depths in excess of 2m in the vicinity of Whitekirk Close to the east of Kincardine Road.

Flooding in the 1 in 100 year plus climate change is similar to the 1 in 100 year event with the general hazard categorisation in both events 'very low' increasing to 'dangerous for most' around Whitekirk Close,

There is some residual risk to the site during an extreme 1 in 1000 year and 1 in 100 year plus climate change event. In these events flooding extends north along Kincardine Road and eastwards towards Wadeson Road. Flooding across the majority of the site in less than 0.5m with Whitekirk Close the exception as discussed above, Flood hazard is hence categorised as 'very low' or 'dangerous for some' in the areas where flooding is shallower increasing to 'dangerous for most' for the Whitekirk Close area.

#### Manchester Strategic Employment Site - Oxford Road Corridor M0042

The Oxford Road Corridor Site is at risk from flooding from both the Medlock and from Corn Brook. The areas of flood risk do not overlap and as such have been discussed independently. Flood risk for this site from the Medlock is detailed in Section 2.9.

Flooding occurs in the 1 in 100 year event with the majority of flooding predicted around Cambridge Street and Coupland Street to a depth of less than 0.5m and a hazard categorisation of 'very low'. Some localised flooding to the west of Oxford Street is to a depth of up to 1.5m and categorised as 'dangerous for most'.

Flooding in the 1 in 100 year plus climate change event is similar to the 1 in 100 year event with some additional flooding around the dental hospital.

The 1 in 1000 year event flood event shows no significant changes to the west of the site from the 1 in 100 year plus climate change event. The flood extent does increase along Upper Brook Street, Booth Street East and Grosvenor Street. In these locations flood depths are predicted to be less than 0.5m with some localised depths up to 1.5m. Hazard categorisations reflect the flood depths ranging from 'very low' to dangerous for most'.

The 1 in 1000 year flood plus climate change event is similar to the 1 in 1000 year event with some additional flooding predicted south of Dover Street to a depth of less than 0.5m.

### Trafford Strategic Location (mixed use) T0468 - Old Trafford

There is limited residual risk to the site during an extreme 1 in 1000 year flood event, with localised flooding at Maher Gardens and Moss Lane West in the south of the site. In such an event there will be mostly shallow flooding up to 0.5m, with a localised patch on Maher Gardens up to 1.5m deep. Flood hazards are very localised, with 'danger for most' at Maher Gardens.

Climate change will slightly increase the extent, depth and hazard associated with flooding in an extreme 1 in 1000 year flood event.

### 2.10.2 Sequence of flooding

#### West Gorton Area

In a 1 in 100 year flood event, considering climate change flooding starts at Wigley Street and to the north of Bennett Street. Flooding becomes more extensive in these areas and flows down Bennett Street to Rostron and Ercall Avenues and the rail depot. The depth of flooding increases at the depot with water backing up behind the railway embankment to the west. Further flooding occurs upstream at Vaughan Street. In a 1 in 1000 year event, the sequence of flooding follows a similar pattern with the flooding at Vaughan Street extending to the south-west and higher water levels at the rail depot. There is additional flooding of the depot from the north after the initial inundation from Bennett Street. Additional flooding also occurs after the flooding at Bennett Street along the open section of the brook to the west of Ambrose Street, with the right bank of the brook overtopping and water flowing between the channel and the railway embankment towards Pottery Lane.

#### Hulme / Ardwick Area

In a 1 in 100 year flood event considering climate change, flooding starts at three locations; Kincardine Road, Oxford Road at the University and Charles Halle Road at the Brewery. Flooding from Kincardine Road affects residential streets as it flows north-westwards. Flooding from Oxford Road flows westwards along the Booth Street West towards Princes Road, where it is retained, and to the south affecting residential properties along Epping Street and Eden Close. Flooding from Charles Halle Road flows south and has little impact on residential properties. In a 1 in 1000 year flood event, flooding follows a similar sequence however; there is additional flooding at St Mary’s Street to the southwest, along Charles Halle Road, Kincardine Road and Oxford Road.

## 2.11 River Mersey

The River Mersey is formed from three tributaries: the Rivers Etherow, Goyt and Tame. The generally accepted start of the Mersey is at the confluence of the Tame and Goyt, in central Stockport. From Stockport it flows near Didsbury, Northenden, Stretford, Urmston and Flixton. At Carrington the Mersey flows into the Manchester Ship Canal. The other main tributaries of the River Mersey are Chorlton Platt Gore, Barrow Brook, Stromford Brook, Carrington Moss Brook, Old Eea Brook and Carrs Ditch.

The Mersey meanders through Manchester and Trafford with an extensive floodplain reaching 1km wide in places. There are two flood storage areas along the Mersey at Didsbury and Sale Ees Water Park, which benefit downstream urban areas with up to a 50 year standard of protection.

An assessment of flood risk associated with overtopping or breach of defences at Carrington, on the left bank upstream of the confluence with the Manchester Ship Canal, has been undertaken for the SFRA. The SFRA modelling results show that an area of land to the north of the site is affected by flooding from the Mersey, with higher risk in an extreme 1 in 1000 year flood event or a breach scenario. In an extreme flood event (1 in 1000 year) flood risk would be accentuated by water backing up at the confluence with the Manchester Ship Canal, which would further increase water levels on the Mersey.

The flood depth and hazard maps for all scenarios with the exception of breach are presented in the Maps Volume of the SFRA. Approximate flood depths and hazards are presented below. These have been extracted over large areas and for more detailed flood information, the Level 2 SFRA maps should be referred to.

### 2.11.1 Mersey summary

#### Trafford Mixed Use Site T0474 - Carrington

This site is predicted to flood from the Mersey and the Manchester Ship Canal. Flood risk from the Manchester Ship Canal is explored in Chapter 3.

The northern part of the site is on lower lying land, which fills with floodwater when the Mersey overtops. Flooding is relatively limited for the 1 in 100 year event, although freeboard should be taken into account when making planning decisions. There is significant residual risk from overtopping during a 1 in 100 year flood event considering climate change and in an extreme 1 in 1000 year flood event, with flooding up to 2m deep, resulting in hazards of 'danger to most'.

### 2.11.2 Breach at Carrington

A raised defence extends along both banks of the Mersey for 500m upstream of the confluence with the Manchester Ship Canal. The condition and standard of protection is unknown but the Environment Agency River Mersey model indicates that it offers an SOP above the 1 in 100 year event. Figure 2-3 and Figure 2-4 show the depth and hazard that could be expected following a breach in the defences on the River Mersey during a 1 in 100 year flood event, respectively.

**Figure 2-3: Depth of flooding in a 1 in 100 year event breach scenario at Carrington**

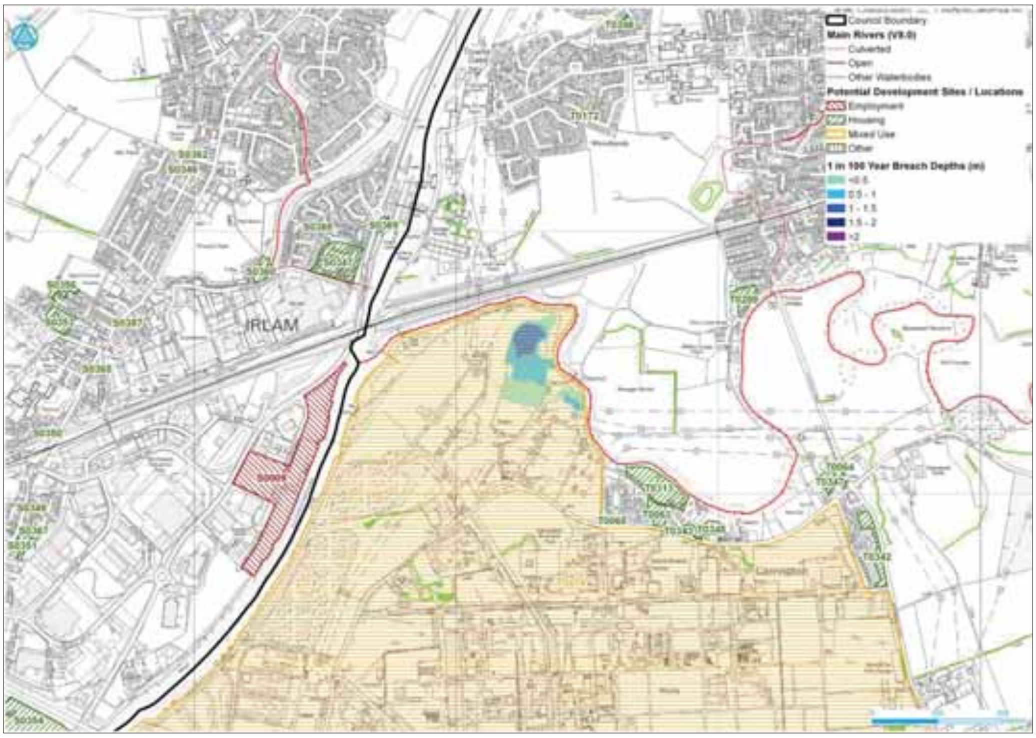
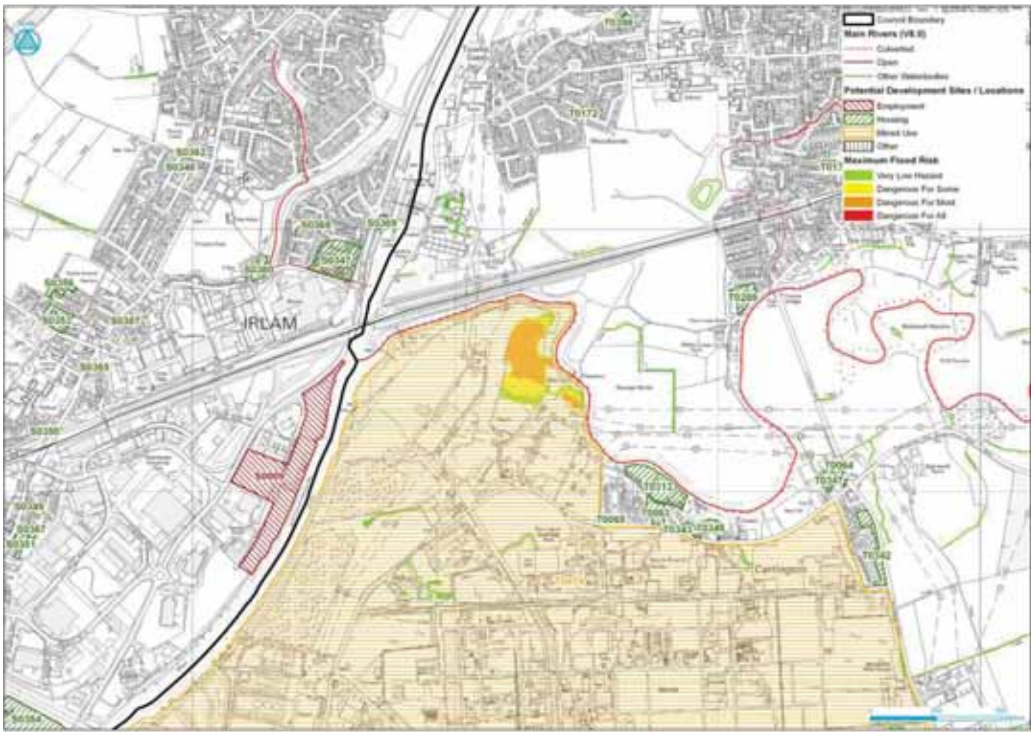


**Figure 2-4: Hazards from flooding in a 1 in 100 year event breach scenario at Carrington**






If the defence was to breach, there would be a local increase in flood extent for the 1 in 100 year and 1 in 100 year plus climate change events. Flood depth and hazard increase under the breach scenario as floodwaters spill through the breach at higher velocities. In the 1 in 100 year plus climate change event, flood depths locally reach 2m and the flood hazard rating is extreme within parts of the breach extent, causing 'danger to all'.

## 2.12 Developed scenarios and impact of loss of floodplain storage

In addition to the overtopping and breach scenarios, an additional ‘developed’ scenario was individually created for each of the linked ISIS-TUFLOW models (i.e. Lower Irwell, Grey Irwell, Irk, Medlock and Manchester Ship Canal) by raising the development sites across Manchester, Salford and Trafford above flood levels (to represent a site being fully defended). The models were run for a 1 in 100 year event with climate change since this is the principal event around which planning decisions would normally be based. However, it should be noted that the cumulative impacts of development would be much greater during an extreme 1 in 1000 year event and residual risk during such events should always be considered when designing developments in flood risk areas.

### 2.12.1 Results

#### Lower Irwell

The results of the developed Lower Irwell model imply that, whilst extensive raised development would prevent the flooding of Lower Broughton during a 1 in 100 with climate change event, the resulting flood levels along the Lower Irwell in this area would be raised by up to 0.17 metres. Although the channel has a relatively large capacity and this scenario may not result in a large increase in flood extent, the depth of flooding may increase locally. Any increase would be unacceptable according to PPS25. Any development in Flood Zone 3 would reduce the floodplain storage volume and therefore compensatory storage would be required.

### Grey Irwell

The results of the developed Grey Irwell model imply that the impact of development alongside the Grey Irwell would cause a negligible rise in flood levels and that no adverse impact would be passed into the Manchester Ship Canal. This is principally due to the fact that the 1 in 100 year with climate change event is modelled to cause little flooding under existing conditions along the Grey Irwell due to its large local channel capacity.

### River Irk

Due to the high density of potential development sites adjacent to the River Irk, the fully developed scenario predicts that there would be limited direct flooding associated with the River Irk between Queens Road and the River Irwell confluence (all sites would effectively be defended). However, the model results imply that flood levels due to development would be raised along much of this reach of the River Irk, with the largest increase of nearly 0.3m. At the confluence with the Grey Irwell peak flood levels are modelled to be raised by 0.06 metres and peak flows by approximately $2m^3/s$. Although these are likely to only have a small effect on water levels in the Grey Irwell, compensatory flood storage would be requested for any proposals that raise levels.

### River Medlock

Due to the high density of potential development sites adjacent to the River Medlock, the developed model predicts that there would be limited direct flooding associated with the Medlock between Sport City and the Grey Irwell confluence (all sites would effectively be defended). The model results imply that flood levels would be raised along much of the Medlock within Central Manchester but that the largest increase of nearly 0.3m would be limited to upstream of Charles Street close to the University. Flows from the River Medlock under this scenario are likely to have a negligible effect on water levels in the Grey Irwell and Bridgewater Canal.

### Manchester Ship Canal

Considering the defended scenario for the Manchester Ship Canal there is limited flood risk in a 1 in 100 year event, considering climate change and hence development would be likely to have a negligible impact on flood risk in general, although this could be locally significant, when considering locations such as Pomona Island.

However, as explained in Chapter 3, it is essential that the residual risk scenario is considered. Due to the high density of potential development sites alongside the Manchester Ship Canal, the developed residual risk scenario predicts that flooding from the Manchester Ship Canal during a 100yr with climate change event would be limited to the right bank around Pomona Docks and the Waste Water Treatment works at Peel Green but that the depth of flooding at these locations would increase by nearly 0.5m.

This scenario also shows that mitigating for the residual risk from failure of assets on the Manchester Ship Canal to sites by land raising or building defences in the Salford Quays area could cause a significant rise in flood levels along the Grey Irwell.

### Summary

The main conclusions arising from the modelling work are:

1. There are significant existing and future flood risk challenges that will impinge upon development proposals
2. Mitigation based around defending or raising land at development sites presents problems:
   A. Increases flood risk elsewhere, particularly on tributaries to the major watercourses
   
   B. In the case of defending, this introduces enhanced residual risk associated with breach or overtopping

3. Mitigation for development in flood risk areas by either retaining as much floodplain within the development or providing flood storage / upstream attenuation are the most sustainable solutions. This is subject to acceptable urban design solutions being available.
4. Water levels on the Grey Irwell would be relatively unaffected by loss of adjacent or upstream floodplain due to the large channel capacity of the watercourse. It may be possible here to use mitigation approaches such as land raising or flood defences where it would not affect flood flow conveyance and subject to further discussions at the Planning Application stage.

The impact of surface water runoff from development on flood risk has been investigated in Chapter 6.

# 3 Flooding from Canals

**The industrial revolution has left a legacy of inland waterways in Greater Manchester, from which flood risk is relatively unknown. The SFRA has undertaken a strategic assessment of the risk of overtopping and breaching of the Ashton, Rochdale and Bridgewater Broad Canals. The SFRA has also undertaken an assessment of the depth and hazard associated with the residual risk of flooding from the Manchester Ship Canal.**

## 3.1 Canal type

There are two types of canal in the study area

1. **Broad canal**. The Bridgewater, Ashton, Manchester, Bury and Bolton and Rochdale Canals are broad canals that were initially built to serve the growing industrial centres of the North West during the Industrial Revolution. These are fairly shallow canals that are embanked in places and mainly used today for tourism, carrying narrow boats and other small boats.
2. **Ship Canal**. The Manchester Ship Canal was built by canalising sections of the lower River Irwell and River Mersey in the late nineteenth century to allow large ships to dock in Manchester City Centre. The Manchester Ship Canal is managed by the Manchester Ship Canal Company and water levels in the canal are carefully monitored and controlled by a system of sluices. Although technically a canal, the Ship Canal is a canalised watercourse and hence its flooding mechanisms have more in common with a watercourse than a typical canal.

Both British Waterways and the Manchester Ship Canal Company are key stakeholders in the management of canals and have been consulted as part of the SFRA process.

The interaction between these canals and the main rivers, particularly in Manchester City Centre, are integral to the understanding of flood risk. The Level 1 SFRA (Section 2.7) has introduced the potential flooding mechanisms from the Bridgewater, Ashton and Rochdale Canals and the Manchester Ship Canal.

## 3.2 Broad Canals

The broad canals do not generally pose a direct flood risk as they are a controlled water body. Therefore the residual risk of canal flooding is usually associated with lower probability events such as overtopping and/or the breaching of embankments.

The residual risk associated with canals is more difficult to determine than from natural watercourses because it depends on a number of factors which include the source and flow of surface water runoff into the canal, materials used within the canal embankments and the condition of those embankments. If sufficient data were available then these factors could be combined to provide a spatially varying assessment of the probability of a breach, likely breach characteristics and a consequential flood extent. Potential flood extent is generally limited by the maximum volume of water within a pound length (a stretch of a canal between two locks).

The probability of a breach is managed by continued maintenance by the respective canal owners. No attempt is made in this SFRA to assess this probability, other than noting that such events are rare. However, if a breach event were to occur the consequences can be high, especially if people and/or properties are situated directly below the breached length.

Two "Canal Hazard Zones" have been created for the Bridgewater, Ashton and Rochdale Canals to show areas that could potentially be affected by flooding in the event of:

- overtopping of canal embankments and
- full breach of raised canal embankments (this zone is further sub-divided as set out below).

These are based on broad scale modelling techniques and should only be taken as an indication of areas that might be at risk. The methodologies used to derive the hazard zones are described below.

Developers should be aware that any site that is at or below canal level may be subject to canal flooding and this should be taken into account when building resilience into low level properties.

There are a number of uncertainties associated with the simulation of flooding from canals in either overtopping or breach conditions. Because of a number of complex factors during extreme flood events it is difficult to predict exactly inflows and outflows into the canal system. The assumptions behind the modelling should be considered when using and reviewing the hazard zones that have been produced.

### 3.2.1 Manchester, Bury and Bolton Canal

The Manchester, Bury and Bolton canal is largely derelict and in filled throughout much of Salford. There are plans by British Waterways to restore the canal by 2020 and the path of the canal is protected from development. The exact location, capacity and structures needed to fully restore the canal are unknown. However, a stretch of the disused Manchester, Bolton and Bury canal was reopened in 2008 at Middlewood between Oldfield Road and Princes Bridge. The 0.5km length of restored canal is filled by pumping from the Manchester Ship Canal. Since it is filled by pumping with a pumped control on the inflow this stretch of canal is considered to be low risk of overtopping or breach and therefore to present low flood risk. The short pound length also limits potential flood risk

Salford City Council should work closely with British Waterways during further restoration to minimise flood risk from the canal to local communities. If restored there will be a greater volume of water in the canal in one continuous length, which would increase residual flood risk to the surrounding area.

### 3.2.2 Bridgewater Canal methodology

#### Overtopping hazard zone

In locations where surrounding ground levels are the same as or lower than canal level water levels, flooding from canal overtopping was considered to be possible. For this study comprehensive canal bank height data was not available. Instead, a canal and ground level screening exercise was carried out that was used as the basis for canal overtopping risk. This was based on a number of assumptions and used LIDAR data (although the reader should note that LIDAR data has an accuracy of ±150mm and therefore could not be relied on to provide accurate bank height information).

The risk of flooding from the Bridgewater Canal is higher than that from the Ashton and Rochdale Canals, since it receives natural inflows from the River Medlock. There is hydraulic connection between the River Medlock and the Bridgewater Canal. The connecting weir structure between the River Medlock and the Bridgewater Canal at Medlock Clows is prone to blockage which would limit inflows into the Bridgewater Canal. Moreover, the susceptibility to blockage will be particularly acute in flood conditions and access to clear blockages during flood conditions is difficult. Minimisation of the flood risk from the last reach of the River Medlock is dependent on permitting flows into the Bridgewater Canal. However, the Bridgewater Canal does not have the capacity to carry all the River Medlock excess flow under certain extreme flood conditions as described below.

An estimation of the potential flow along the canal is relevant when estimating the overtopping risk from the Bridgewater Canal. The greater the potential flow, the greater is the potential for overtopping and consequent flood risk. For the Bridgewater Canal some estimation of flood conditions can be made because of the influence of the River Medlock. The upstream part of the canal is likely to be the most heavily affected by the River Medlock; however, after the canal splits at Stretford the impact will be rapidly reduced as the flood wave dissipates in two directions. For extreme flood events water levels in the Manchester Ship Canal may also have some impact on water levels in the Bridgewater Canal.

The Environment Agency River Medlock model (2009) was used to provide flow inputs to the Bridgewater Canal. The model includes details of the interaction between the River Medlock, the Manchester Ship Canal and the Bridgewater Canal at Giant's Basin in Manchester. The model shows that a peak inflow to the canal was 34 $m^3/s$ for the 1 in 100 year with climate change event. A sensitivity analysis was also applied to the River Medlock model to examine whether water levels in the Bridgewater Canal would significantly affect the inflows from the River Medlock in storm conditions. It was concluded that the water levels would only have a minor effect on the inflows to the canal.

The River Medlock model was also run using the SFRA Manchester Ship Canal model water levels at the downstream limit to determine whether water levels in the Ship Canal would affect those in the Bridgewater Canal. It was concluded that the Ship Canal water levels are unlikely to affect the River Medlock levels for the 1 in 100 year and 1 in 100 year with climate change events.

The 1 in 100 year with climate change flow hydrograph from the Medlock model was fed into a one dimensional model representing the canal using HEC-RAS software. At the start of the storm the available freeboard in the canal was set at 200mm. Two spill overflow hydrographs were measured at the two extreme ends of the canal model in order to represent the potential overtopping in the two sections of the canal, i.e. the upstream section which is immediately fed by the River Medlock and the sections downstream of the split at Stretford. Peaks of 1.3$m^3/s$ and 0.03$m^3/s$ per 100m of canal were measured for the up and downstream spills respectively.

Only the upstream section of the canal, where the overflow was significant, was then modelled using two dimensional hydraulic software. The "representative" overflow was fed into a JFLOW model with inflow points with a 100m interval to assess potential flood inundation extents. To provide a precautionary approach, this was completed anywhere along the canal section where ground levels are similar or lower than canal bank levels. This broad assessment was made using LIDAR data. The modelled extents from the individual inflows were combined with a small horizontal buffer zone (5m - to allow for some uncertainty) to provide a canal overtopping hazard zone for the upstream section of the Bridgewater Canal. It should be noted that the Canal Hazard zones are in addition to the Flood Zones arising from the Irwell, Medlock or Ship Canal.

The low flows recorded at the downstream end of the model confirm that the flood wave from the River Medlock would be expected to dissipate and that, although overtopping in this section of the canal is possible, the risk is likely to be much lower. The reduced hydrograph yields a flood volume that would be small compared to likely surface water run-off volumes in an actual storm event. Hence, for this section of the canal, the refined surface water maps (see Maps SS_4.1 and SS_4.2) are perhaps the best indicator of the locations of low embankments and where flood water could overtop the canal bank.

Those considering development in the vicinity of canals should refer to this zone in the first instance in order to assess whether flood risk from canal overtopping should be included within a FRA. If the development is within the zone, then the developer will need to quantify this risk. In some cases this may simply mean that some topographic survey of the local area is required, which may indicate that overtopping at the specific site under consideration is highly unlikely.

### Breach hazard zone

Canal breaches can be caused by overtopping of the canal embankments and erosion of the embankment face. In general, they are more commonly caused by failure of the canal lining and erosion within the embankment slope until failure occurs.

Flooding from a breach of a canal embankment is largely dictated by canal and ground levels, canal embankment construction, breach characteristics and the volume of water within the canal that can discharge into the lower lying areas behind any breach. British Waterways have considerable experience of breach modelling on canals and, based on this, a three stage breach mechanism was identified as being the most appropriate approach.

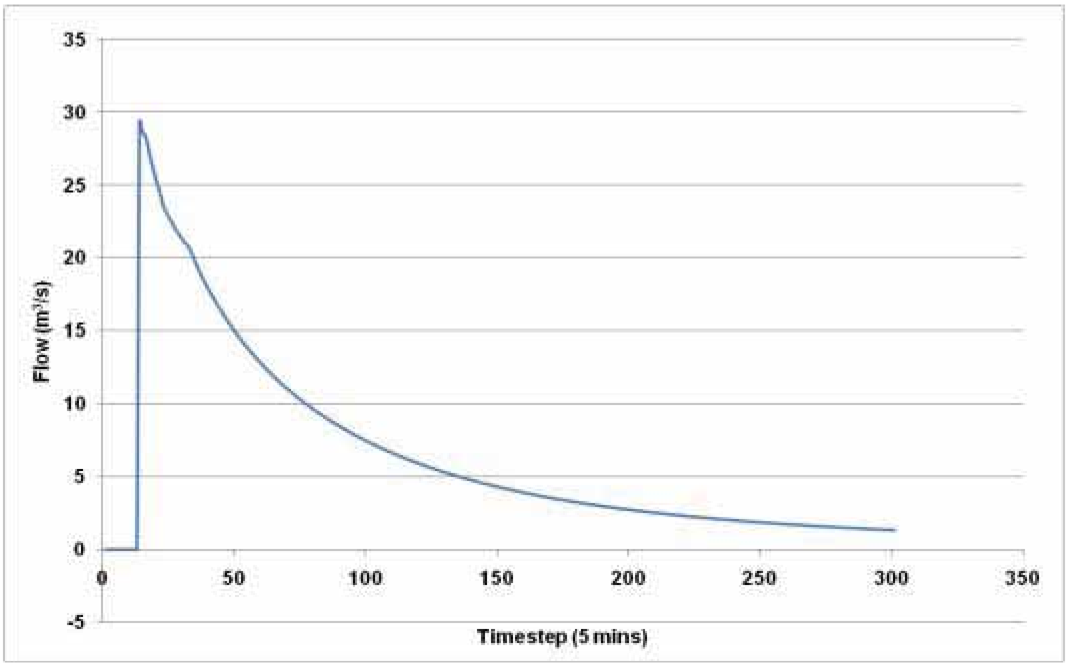
1. Continuous erosion of the embankment (e.g. via overtopping),

2. Slip of the raised embankment which would allow an approximately semi-circular breach, parallel to the canal, to bed level, then
3. Progressive erosion of the bed of the canal in two directions away from the breach location along the canal.

The potential breach outflow volume is either dictated by canal pound length or, for long pound lengths, as in the case of the Bridgewater Canal, how quickly the operating authorities can react to prevent further water loss. It was thought that the breach flow could be stopped within 24 hours, based on the assumption that the canal operator would install stop-logs as part of an emergency response, as was seen in the Dunham Massey breach in 1971. Experience from that event suggests that stop-logs can only be placed at a distance from the breach where velocities are sufficiently low. In that event a considerable length of canal was drained.

A breach hydrograph was developed using a 1-D HECRAS model to represent the three stage mechanism with the starting water level as bank full.

**Figure 3-1: Sample Breach Hydrograph for the Bridgewater Canal**




Possible breach locations were identified using a conservative approach. Areas in the vicinity of the canal that are more than approximately 0.3m lower than the estimated canal water level were assumed to be at potential risk from a canal breach. Canal water levels and hinterland levels were determined using LIDAR data. There are some areas where spill overtopping is possible, but given the assumptions used, a breach is unlikely.

A breach hydrograph (represented as a spill hydrograph) was fed into the two dimensional JFLOW model to assess flood inundation extents along the length of the canal. Inflows were included in the JFLOW model at 100m intervals along the canal at potential breach locations. The modelled extents from the individual inflows were combined, with a small buffer zone, to provide a canal breach hazard zone for the Bridgewater Canal.

The potential breach locations / areas were then sub-divided into two Canal Breach Zones:

A. A walkover survey of the canal was undertaken to identify the embankments more likely to breach, based on their height and width. This zone shows those areas that would be affected by a breach of one of these embankments. In this zone a detailed examination of canal breach flood risks are required.

B. Less likely breach locations, such as at wide, low or very low embankments, were identified by a walkover survey of the canal. At such locations it is more likely that this source of risk could be scoped out within any site specific FRA.

### 3.2.3 Rochdale and Ashton Canals methodology

#### Overtopping hazard zone

As was the case with the Bridgewater Canal, an assessment of the potential inflows to the Rochdale and Ashton Canals was, ideally, needed. Unfortunately, for the majority of the canals' length no information regarding the bank sides, bywashes or discharge rate down the canal in flood conditions in the study area was available.

The Rochdale and Ashton Canal are controlled water bodies and generally the overtopping risk was considered to be low. However, historic canal bank overtopping has been recorded on the Rochdale Canal at Holland Street and it was considered that this area warranted a more detailed assessment. British Waterways were able to advise that the overtopping in the area was caused by lowered freeboards from mining subsidence along the pound stretching, approximately, from Butler Street to Great Ancoats Street. A theoretical assessment of the flood risk was also completed as described below.

An estimation of the potential peak flow along the canal was obtained based on the pound lock gate dimensions and the rainfall-runoff into the canal was estimated. Higher inflows increase the potential for overtopping and associated flood risk. An estimation of flood conditions was generated by modelling the single pound at Holland Street in the one dimensional modelling package HEC-RAS.

The model predicted a small amount of overtopping at Holland Street. This implies that, although the hydraulics of the canal system largely regulate the maximum inflow to the canal during a storm event, the unusually low freeboard at Holland Street makes this area more susceptible to canal flooding.

The flow hydrograph output was distributed for spill locations at Holland Street in a two dimensional JFLOW model where ground levels are lower than the canal water level. The resultant flood extents were combined with a 5m buffer zone to produce an Overtopping Hazard Zone for the Rochdale Canal at Holland Street.

#### Breach hazard zone

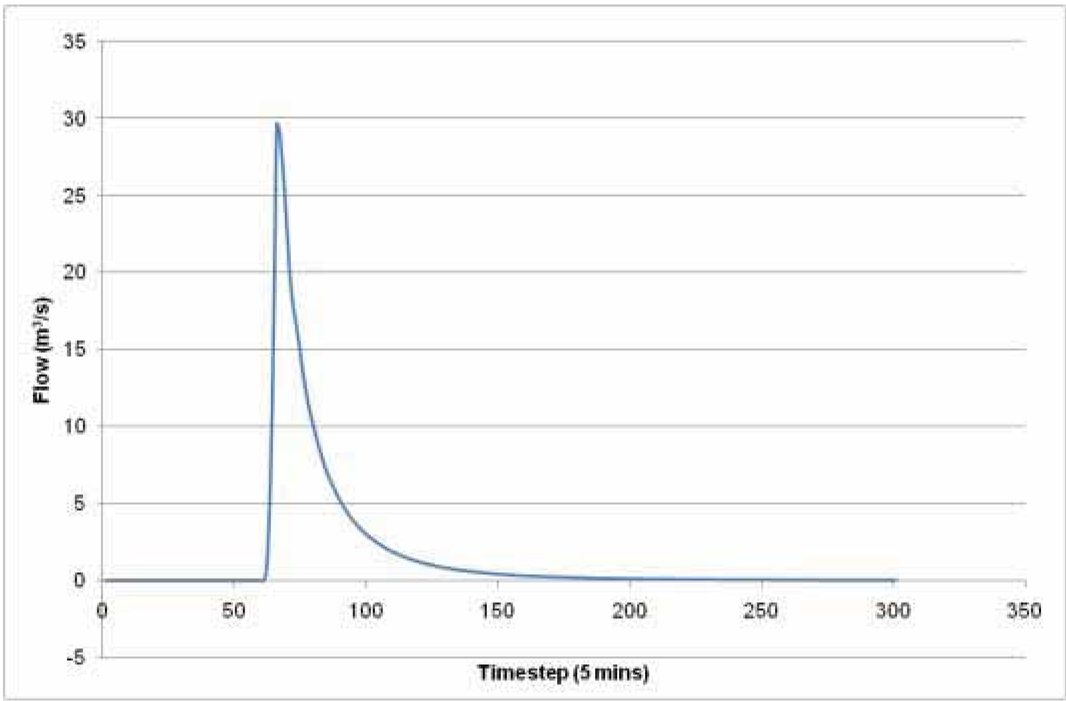
A similar method for breach analysis was developed for the Ashton and Rochdale Canals to that which was used for the Bridgewater Canal.

The main difference in this case is that the pound lengths are much shorter and therefore the available flood volume is much smaller. In breach conditions it was considered likely that only a single pound length would be likely to drain. For each of the canals the average pound length was estimated to be 1.3 km. The actual volume of water leaving a canal after a breach has occurred would in practice be dependent on the local pound length, which varies throughout the canal network within the study area.

A breach hydrograph was developed using a one dimensional HECRAS model to represent the three stage mechanism with the starting water level as bank full. The average 1.3 km pound length was applied to the model.

Breach hydrographs (see Figure 3-2) were fed into a two dimensional JFLOW model to assess potential flood inundation extents as per the Bridgewater Canal method.

**Figure 3-2: Sample Breach Hydrograph for the Rochdale and Ashton Canals**




### Flooding from a breach of the Rochdale Canal in Oldham

In addition to the Canal Hazard Zones produced for this SFRA, the risk of canal flooding following a breach from the Rochdale Canal in Oldham Council area has been included in the mapping for this SFRA. A similar methodology was used for devising the area at risk of breach for the Oldham SFRA (Oldham Council, 2010). This highlights the importance of considering flood risk on a cross-boundary basis.

## 3.2.4 Flooding from the Bridgewater Canal

### Trafford

Water entering the Bridgewater Canal from the River Medlock is estimated to overtop at Pomona Island T0467 within the upstream reach of the Bridgewater Canal. Overtopping water here is likely to flow overland into the Manchester Ship Canal.

There is a limited likelihood of canal overtopping elsewhere in Trafford. If it does occur, it is unlikely to affect areas beyond the canal towpath. The risk of canal flooding from breach is summarised below:

- The majority of the Pomona Island T0467 is within the Canal Breach Zone A. This does not take into account any joint probability event from the Manchester Ship Canal, which would further increase the risk at Pomona Island. Trafford Centre Rectangle T0472 is also within Canal Breach Zone A. These sites are also within the Canal Breach Zone B.
- Trafford Quays T0463, Stretford Crossroads T0473 and Woodfield Road T0476 are within Canal Breach Zone B.

### Salford

There is a limited likelihood of canal overtopping in Salford. If it does occur, it is unlikely to affect areas beyond the canal towpath. It should be noted that the risk of canal flooding is complicated in Salford with interactions between the Worsley Brook and Bridgewater Canal. This is explored further in Chapter 7.

The risk of canal flooding from breach is summarised below:

- In a breach scenario, the extents of flooding could spread a significant distance away from the canal. The areas which are most vulnerable to a breach include aqueducts and where watercourses pass under canals. This coincides with areas of lower topography and a higher probability of breach.
- There are no strategic sites within Canal Breach Zone A in Salford.
- Legh Street S0395 and Cawdor Street S0396 are within Canal Breach Zone B.

#### Manchester

There is a limited likelihood of canal overtopping in Manchester. If it does occur, it is unlikely to affect areas beyond the canal towpath.

The strategic sites that could be affected by breaching from the Ashton and Rochdale canals are discussed in sections 3.2.5 and 3.2.6 respectively.

### 3.2.5 Flooding from the Ashton Canal

#### Manchester

There is a limited likelihood of canal overtopping in Manchester. If it does occur, it is unlikely to affect areas beyond the canal towpath. The risk of canal flooding from breach is summarised below:

Breach:

- In a breach scenario, flooding could spread to areas a significant distance away from the canal. The areas which are most vulnerable to a breach include aqueducts and where watercourses pass under canals. This coincides with areas of lower topography and a higher probability of breach.
- The strategic sites within Canal Breach Zone A are Sport City M0002, Eastern Gateway M0001, Holt Town M0024 and Lower Medlock M0026.
- These sites are also within Canal Breach Zone B.
- A very small area of Miles Platting M0008 is also within Canal Breach Zone A to the south of the site.

### 3.2.6 Flooding from the Rochdale Canal

#### Manchester

There is a limited likelihood of canal overtopping in Manchester. If it does occur, it is unlikely to affect areas beyond the canal towpath. Areas around Holland Street are an exception where canal overtopping has historically been related to low bank levels. This may affect a small area of Miles Platting M0008.

The risk of canal flooding from breach is summarised below:

- Central Park M0003, Miles Platting M0008 and Oxford Road Corridor M0042 are within Canal Breach Zone B.

## 3.3 Manchester Ship Canal

The Manchester Ship Canal was built by canalising sections of the lower River Irwell and River Mersey in the late nineteenth century to allow large ships to dock in Manchester city centre. The Manchester Ship Canal is managed by the Manchester Ship Canal Company and water levels in the canal are carefully monitored and controlled by a system of water control structures (sluices at locks).

Although named as a canal, the Manchester Ship Canal is a canalised watercourse and hence its flooding mechanisms have more in common with a watercourse than a typical canal. The Manchester Ship Canal drains the catchments of the River Irwell and Mersey and hence in a flood event could receive significant inflows from these systems, potentially causing overtopping.

Flood risk along the Manchester Ship Canal is managed by the operation of sluices within the study area at:

- Mode Wheel Locks
- Barton Locks
- Irlam Locks

If water levels rise at Manchester city centre the sluices are progressively opened to allow water to pass down the system.

### 3.3.1 Modelling flood risk from the Manchester Ship Canal

A number of relevant hydraulic models have been reviewed, including:

- **The Areas Benefiting from Defences model (1D ISIS).** This model represents a best case flood risk scenario out of the three models, with all sluices operational at Mode Wheel Locks but with one closed at all other locks. It also models efficient operation of the sluices. This model has been used to provide the Areas Benefitting from Defences (ABD) and was supplied to the councils to inform the SFRA. The location of the locks and the Area Benefitting from Defences can be seen on Map FL_1.1 in the Maps Volume.
- **The Flood Zones model (1D ISIS).** This model represents what might be considered to be a worst case scenario for Manchester, where all the sluice gates are shut and do not operate in flood conditions. This model has been used to provide the Flood Zones and was supplied to the councils to inform the SFRA. The Flood Zones are shown on Map FL_1.2 in the Maps Volume.
- **The SFRA linked 1D-2D ISIS-TUFLOW model (see Section 3.3.2).** This model is considered to provide a reasonable representation of residual risk (in the event of human or mechanical failure and reduced efficiency of the sluices). In this model, only 3 out of the 4 sluices are operational at Mode Wheel Locks and the sluices do not operate as efficiently as in the "defended model". The outputs from the SFRA model are shown on Map FL_1.3 to FL_1.10 in the Maps Volume.

### 3.3.2 Level 2 SFRA linked 1D-2D model

For the SFRA, the Environment Agency's Manchester Ship Canal 1D (ISIS) model has been linked with a 2D TUFLOW model to provide an understanding of flood depths and hazards. The 2D model extends from the River Medlock confluence around Woden Street footbridge to Woods End near Flixton. For practical reasons the 2D model grid was created with a cell size of 10m based on filtered LIDAR where available. This is sufficient to model the broad scale pattern of flooding but will lack accuracy within dense urban areas.

There are no raised flood defences on the Manchester Ship Canal and the canal is in cut in the study area and so a breach scenario was not considered. Quay walls are represented in the modelling where these have been picked up on LIDAR and in cross section survey. In this model, only 3 out of the 4 sluices are operational at Mode Wheel Locks and the sluices do not operate as efficiently as in the "defended model". A summary of the modelling is provided in Table 2-2 and the assumptions and limitations listed in section 2.3 are also applicable to the Manchester Ship Canal model results.

The following events were run for the Manchester Ship Canal:

- 1 in 100 year event
- 1 in 100 year event, considering climate change
- 1 in 1000 year event
- 1 in 1000 year event, considering climate change

The model results are sensitive to the hydrology (model inflows) and the results of the 1 in 1000 year flow sensitivity test for the Manchester Ship Canal (considering the impact of attenuation on the Lower Irwell) are reproduced alongside those of the Grey Irwell in Figure 2-2. This illustrates that flood levels in the Salford Quays area during such a scenario could be on average around 0.35m lower than those depicted in the main SFRA output maps.

### 3.3.3 Variations in estimated water levels

A review of the modelling undertaken for the Manchester Ship Canal shows that there are uncertainties in the estimation of water levels in the Manchester Ship Canal at this time that should be considered in any future flood risk assessments. These arise from:

- The efficiency of the sluices. The sluices are large structures and pass a considerable quantity of flow. The flow paths are highly complex with the approach to the gates affected by debris booms and the access platforms. It is usual in these situations for the hydraulic performance to be confirmed by physical modelling as the coefficients in the ISIS software are not that sophisticated. In the absence of this model data, water level monitoring data could be collected that would provide a better idea of the overall efficiency of these structures.
- Operational availability, including the potential for sluice gates not operating (due to human or mechanical failure) or blockage.
- Model parameters. Any model needs to adopt a set of codes which the program uses in any given situation. The river modelling software can be left to find its own decisions from a defined suite or the user decides in advance. The model solution is often dependant on these parameters, and should be tested to understand the uncertainties within the model output. There is never one absolute flood level, but a range. In the case of the Manchester Ship Canal model the sensitivity testing revealed that depending how the model calculates the flow states through or over the sluice has a big impact on model stability and calculated water level.

To demonstrate the effect that these have on estimated water levels a series of models were run to investigate the sensitivity of flood levels to the operation and efficiency of the sluices during a flood event. The results of the sensitivity testing are shown in Figure 3-3 to Figure 3-6 and show the importance of the water control structures in reducing flood risk along the Manchester Ship Canal.

Figure 3-3 and Figure 3-4 show the impact that sluice operation at Mode Wheel Locks can have on estimated water levels in the Manchester Ship Canal. The figures compare the water levels in the 1D ISIS models for the 1 in 100 year and 1 in 1000 year events respectively for the Manchester Ship Canal between the defended ABD model, undefended Flood Zone model, a model with 3 out of 4 sluices open at Model Wheel Locks with optimum efficiency and the SFRA residual risk scenario.

Figure 3-3 shows that even with one sluice at Model Wheel Locks not opening, water levels are still over 2m lower (at Ordsall Riverside S0392 and upstream of Barton Sluices at Trafford Park Core T0471, Trafford Centre Rectangle T0472, Trafford Quays T0463, Barton S0412 and Barton Stadium S0011) in a 1 in 100 year event than they would be if none of the structures operated. There is less difference in an extreme 1 in 1000 year event as seen in Figure 3-4, but the operation of the sluices still reduces water levels by over 1m upstream of Mode Wheel Locks at Media City S0415, Trafford Wharfside T0469 and Trafford Park Core T0471.

The analysis shows that the operation of the fourth gate at Mode Wheel Locks has a significant impact on water levels in the Manchester Ship Canal in a 1 in 100 year event. This is most notable upstream of Mode Wheel Locks in the vicinity of Ordsall Riverside S0392, Media City S0415, Trafford Wharfside T0469 and Trafford Park Core T0471, with increases in water level of over 1m with the gate not operating when compared to the fully operational scenario, as shown on Figure 3-3. Figure 3-4 shows that for an extreme 1 in 1000 year event there would be a less obvious increase in water levels. This is since the water control structures exert less control on flood levels along the Manchester Ship Canal during events of this magnitude.

Figure 3-5 and Figure 3-6 show the impact of how sluice efficiency is estimated in the model on estimated water levels in the Manchester Ship Canal (assuming that all the sluice gates are open at Mode Wheel Locks). The figures compare the water levels between different model runs.

This analysis shows that if the sluices were not operating in the efficient hydraulic regime suggested by the Manchester Ship Canal Company, or the choice of coefficients is not borne out in reality, this could have a significant impact on water levels in the Manchester Ship Canal in a 1 in 100 year event. This is most notable upstream of Mode Wheel Locks in the vicinity of Ordsall Riverside S0392, Media City S0415, Trafford Wharfside T0469 and Trafford Park Core T0471, with increases in water level of nearly 1.5m when the sluices are not operating with high efficiency.

For an extreme 1 in 1000 year event the efficiency of the sluices would have less of an impact on water levels, with the largest increase when comparing reduced to higher efficiency of around 0.3m occurring upstream of Barton and Irlam Locks at Trafford Park Core T0471, Trafford Centre Rectangle T0472, Trafford Quays T0463, Barton S0412 and Barton Stadium S0011. This reduced impact is because the sluices exert less control on flood levels along the Manchester Ship Canal during extreme events.

Figure 3-3 to Figure 3-6 compare the water levels from the 1D ISIS model upon which the linked 1D-2D SFRA model was based to those from the defended and undefended models and the model runs that were undertaken to test sensitivity to sluice operation and efficiency. This shows the SFRA model provides a measure of risk that falls between the potentially best case (defended) and worst case (undefended) scenarios. The differences in water levels in an extreme 1 in 1000 year flood event are less than in a 1 in 100 year event for all the scenarios modelled.

**Figure 3-3 Differences in water levels - operation of sluice gates 1 in 100 year**

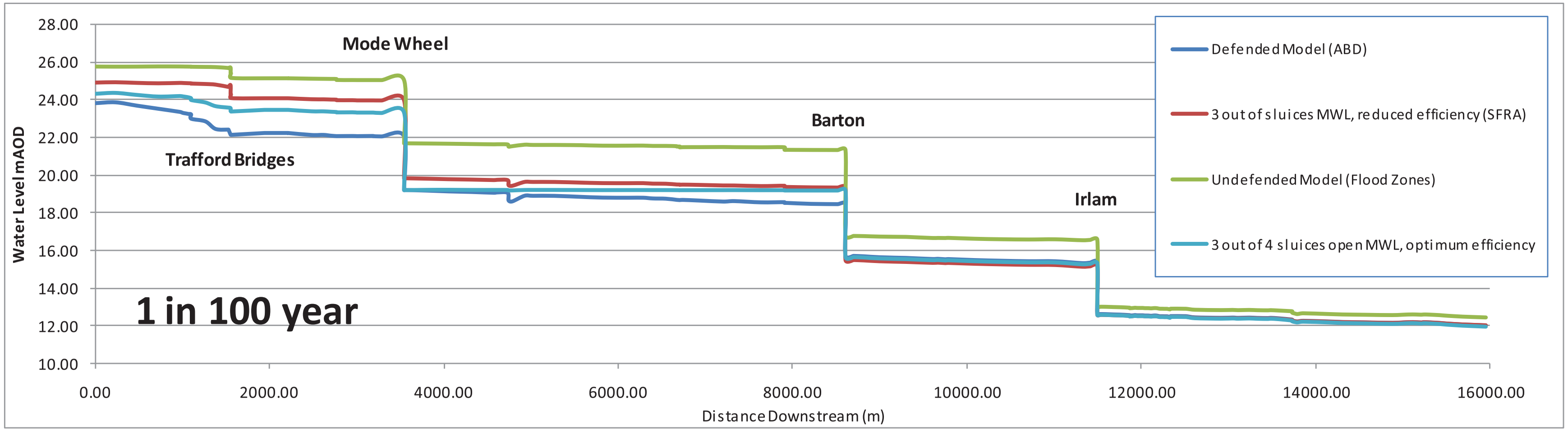



**Figure 3-4 Differences in water levels - operation of sluice gates 1 in 1000 year**

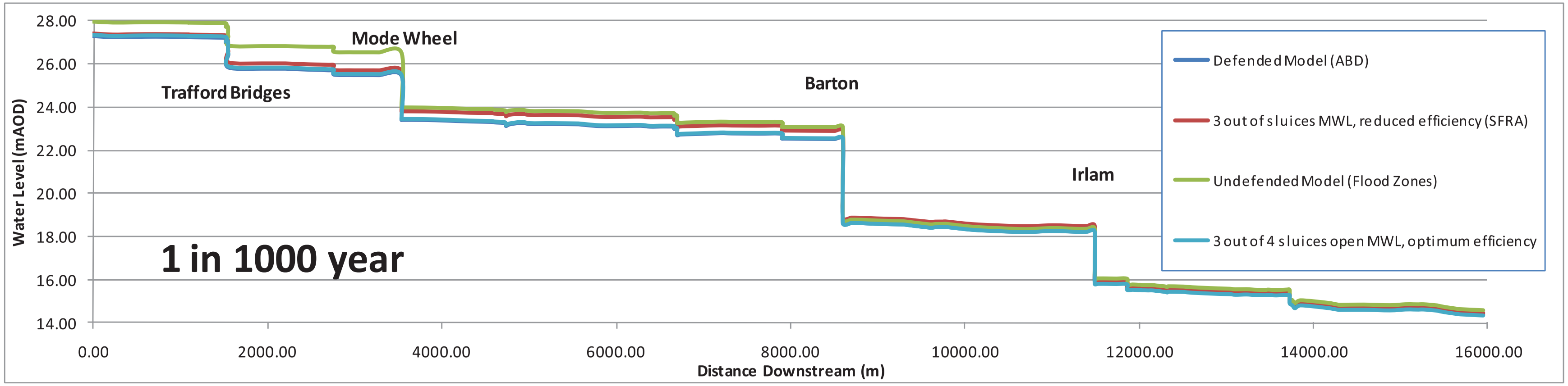


Figure 3-5 Differences in water levels - efficiency of sluice gates 1 in 100 year

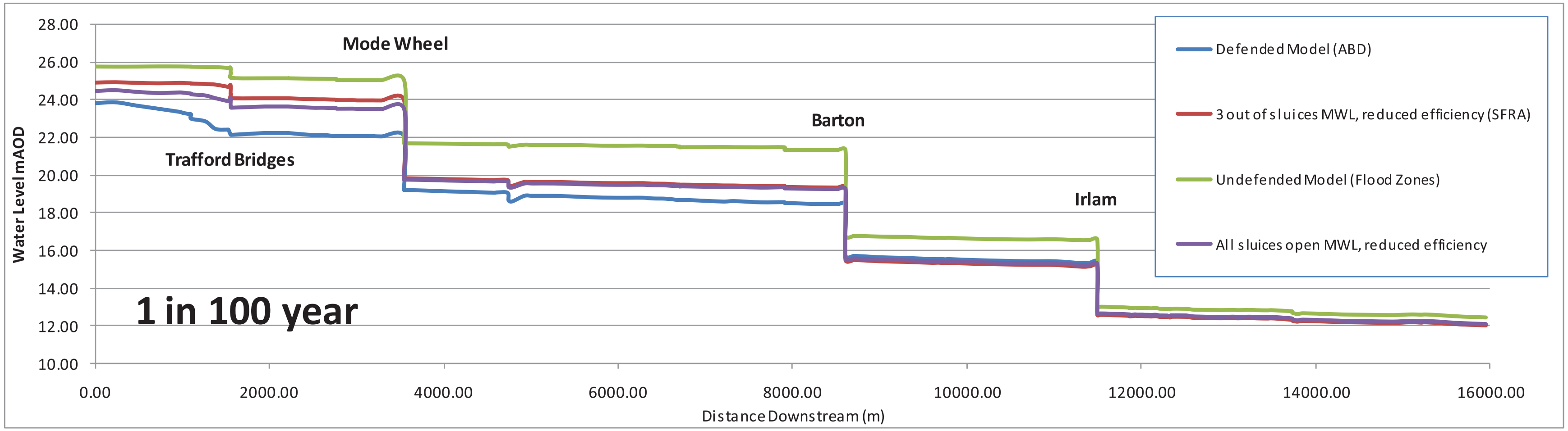
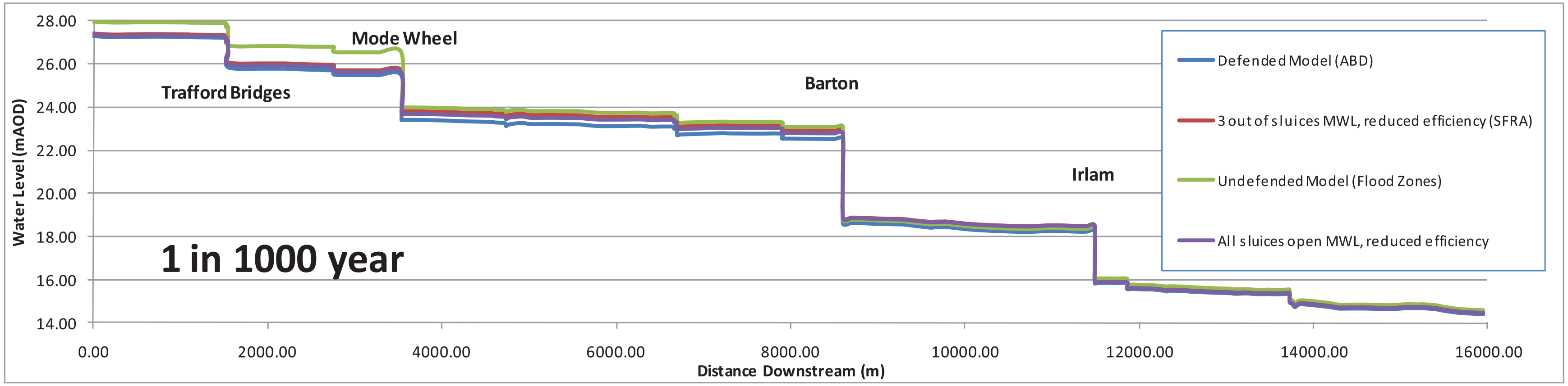



Figure 3-6 Differences in water levels - efficiency of sluice gates 1 in 1000 year



### 3.3.4 Considering residual risk in the SFRA

Flood risk is managed by the Manchester Ship Canal Company through a series of sluice gates at locks and recent modelling work has shown that when all gates can be opened and the optimum model and coefficients are used, the actual risk can be managed up to the 1 in 100 year event. However, even with optimum operation of the sluices, there is still a risk of flooding when considering climate change for a 1 in 100 year flood event and even more so for an extreme 1 in 1000 year event, for which the modelling predicts significant depths of water on the floodplain.

Residual risk in such a system where human and mechanical failure is a real threat to the operation of these key structures will always be present and the undefended Flood Zone map demonstrates the extent of flooding that could occur in a catastrophic failure (see Map FL_1.2).

**It is essential that the residual risk from both human and mechanical failure and in extreme events is taken into account when making planning decisions to ensure that development is only exposed to an appropriate level of flood risk.**

The analysis of the sensitivity of water levels above shows that changes in the modelled operation of the sluices (how many sluice gates open) and the efficiency of the sluices can both have significant impacts on estimated water levels, especially for a 1 in 100 year flood event. This implies that there is currently uncertainty around the modelled risk posed by any real flood event on the Manchester Ship Canal (which the model is attempting to replicate).

The modelling uncertainties (including those associated with the operation of the sluice gates) could be reduced in future if more data for model calibration (e.g. records of the operation of the sluices) become available, especially during flood conditions. A physical model may also help to refine the understanding of the complete hydraulics within the Manchester Ship Canal and provide confidence in the hydraulic model.

Given the uncertainties in the model discussed above and taking a precautionary approach to understanding flood risk as outlined in PPS25, the outputs of the linked 1D-2D ISIS-TUFLOW model have been presented in the SFRA to provide an indication of residual risk. Downstream of the 2D model extent in Irlam, Cadishead, Carrington and Partington, 1D model results have been used to produce outlines and depth maps. These are from the same 1D model that was used to base the 1D-2D linked SFRA model on.

The SFRA has taken into account a wide range of conditions, events and the sensitivity of key parameters to provide the fullest understanding of residual risks. The model outputs are available for a continuum of risk through to extreme events, considering climate change. They provide a strategic base on which to make decisions for strategic planning and development management, which will support the application of the Exception Test.

For comparison purposes and to aid the understanding of the variability of water level estimates from the different Manchester Ship Canal models, the depth of flooding that may be expected in a 1 in 100 year flood event in the defended and undefended scenarios has also been mapped for the length of the Manchester Ship Canal in Salford and Trafford.

All of the maps that have been produced for the SFRA can be found in the Maps Volume.

## 3.4 Review of flood risk from the Manchester Ship Canal to sites in Salford and Trafford

It is recognised that there is limited flood risk from the Manchester Ship Canal to development sites in Salford and Trafford in the adopted defended scenario for a 1 in 100 year event. However, due to the reasons explored in section 3.3, residual risk is an essential consideration to ensure that future development can be made safe from flooding. Hence this section explores residual flood risk to sites, providing an indication of how residual risk could be managed within new development. This is an appropriate approach described more fully in the PPS25 Practice Guide. Sluice gate operation and any model uncertainty has been found from the sensitivity testing to be the key residual risk scenario upon which any future Flood Risk Assessments will need to base a design response for managing residual flood risk.

### 3.4.1 Salford

#### Ordsall Riverside S0392

Considering the adopted residual risk scenario, the 1 in 100 year event floods the majority of this site, from Worrall Street, along the warehouses bordering the Manchester Ship Canal, through the rest of the site down to the A5063. Flood depths reach 1m around Modwen and Hagley Road works and near Exchange Quay in the 100 year event, with flood hazards of 'danger for some/ most'. The north-eastern end tends to be shallower in depth of less than 0.5m. The 1 in 100 year flood event, considering climate change is more extensive and flood depth and hazard will increase.

There is significant residual risk to the site during an extreme 1 in 1000 year flood event, with flooding nearly inundating the entire site to depths of 2m, resulting in hazards of 'danger for all/ most'. Climate change will increase the extent, depth and hazard associated with flooding in an extreme 1 in 1000 year flood event.

#### Media City UK and Salford Quays S0415, including Salford Quays S0017 and Land at Erie Basin S0014

Considering the adopted residual risk scenario, the 1 in 100 year event floods the south and south-eastern edge of the larger site around Broadway and around the wharfs up to Enterprise Park and the eastern boundary with Trafford Road. Flood depths in the 1 in 100 year event could be up to 2m around Custom House and Enterprise Park, presenting hazards of 'danger for all'. The remaining flooding is much shallower (up to 0.5m), with areas of lower hazard. Considering climate change, a 1 in 100 year flood event will be much more extensive to the north west of Huron Basin and flood depth and hazard will increase.

There is significant residual risk to the larger site during an extreme 1 in 1000 year flood event, with flooding inundating half the site from Enterprise Park, all the way down the quay sides and across to south of the cemetery. Flooding becomes deeper in the 1000 year event, with flooding 2m deep along Trafford Road. These areas have high hazard ratings of 'danger for all'. More of the site is at risk from flood depths of 1m, to the east and middle of the site. Depths decrease around Ohio Avenue and the periphery of the flood extent with lower hazard ratings. Climate change will increase the extent, depth and hazard associated with flooding in an extreme 1 in 1000 year flood event.

#### Barton Stadium S0011

Considering the adopted residual risk scenario, the 1 in 100 year event encroaches only slightly onto the south end of the site from the canal. There is also flooding to the north-east of the site, but this is from the canal further east, which then follows the lower lying ground of the Salteye Brook along the north edge of the site. The flood depths in the 1 in 100 year event are between 1m and 0.5m to the north-east of the site (mostly hazards of 'danger to most/ some' on site). Flooding is much more extensive in a 1 in 100 year flood event, considering climate change, with hazards of 'danger for all'.

There is significant residual risk to the site during an extreme 1 in 1000 year flood event, with flooding inundating the majority of the site; the water floods the site from up and downstream, not from the adjacent stretch of canal. Flooding could be around 2m deep across the northern and western sides of the site, covering half of the site area with a hazard of 'danger for all'. Flooding at the middle of the site would be shallower (up to 0.5m deep), resulting in hazards of 'danger for some/ very low hazard'. Climate change will increase the extent, depth and hazard associated with flooding in an extreme 1 in 1000 year flood event.

#### Barton S0412

Considering the adopted residual risk scenario, flooding from the 1 in 100 year event affects a small area of the site to the north, and follows the channel of the Salteye Brook through the site. Flooding will be relatively shallow on the site itself, except in the north, where flooding could be 1-2m deep locally, resulting in flood hazards of 'danger for most'. Flooding in a 1 in 100 year flood event, considering climate change is more extensive, affecting an additional area to the west of the site, with localised depths of 1-2m and hazard of 'danger to most'.

There is significant residual risk to the site during an extreme 1 in 1000 year flood event, with flooding inundating most of the site from both the east and from the canal adjacent to the site. There are a few patches unaffected on site, around the depot to the north-west, the middle, and south east of the site at the dismantled railway. Much of the site could be flooded up to 2m deep in the 1 in 1000 year event, presenting hazards of 'danger for all'. The peripheries of the flood extents are less significant, with 0.25-0.5m depths of flooding and lower levels of hazard. Climate change will increase the extent, depth and hazard associated with flooding in an extreme 1 in 1000 year flood event.

### Irlam Wharf Road S0009

Considering the adopted residual risk scenario, flood waters are predicted to remain in bank for the 1 in 100 year and 1 in 100 year plus climate change event.

There is significant residual risk to the site during an extreme 1 in 1000 year flood event when due to its proximity to the Manchester Ship Canal the site is inundated in this event. Flood depths vary with the topography across the site with the majority of the site affected by depths between 1m and 2m. At some locations adjacent to the Manchester Ship Canal depths are predicted in excess of 2m. The 1 in 1000 year plus climate change event shows flood depths across the whole site in excess of 2m.

Northbank Wastewater Treatment Works (WwTW) is located here and there will be additional foul flooding due to backing up of the sewer network.

### Irlam and Cadishead S0404

Considering the adopted residual risk scenario, flooding in the 1 in 100 year event affects a small area immediately adjacent to the Manchester Ship Canal with depths of up to 1m predicted. In the 1 in 100 year plus climate change event the flood extent incorporates a wide channel running parallel to the Manchester Ship Canal. Flood depths are generally between 0 and 2m with depths in excess of 2m at the western limit of the site.

There is significant residual risk to the site during an extreme 1 in 1000 year flood event with an increase in the flood extent from the 1 in 100 year plus climate change event to include the majority of the site except the northern corner. Flood depths in the channel parallel to the Manchester Ship Canal are predicted to be in excess of 2m with the remaining flooding depths generally less than 0.5m.

The 1 in 1000 year plus climate change event shows inundation of the entire site. Flooding depths gradually decrease from in excess of 2m in the south western corner to less than 0.5m towards the north eastern corner of the site.

### Irlam and Cadishead - Liverpool Road S0408

Considering the adopted residual risk scenario, there is no flood risk identified at this site in the 1 in 100 year and the 1 in 100 year plus climate change events.

There is some residual risk to the site during an extreme 1 in 1000 year flood event when flood waters are shown to have overtopped the banks of the Manchester Ship Canal to the north of the site but actual flooding on the site is minimal. Flooding is predicted around the periphery of the site adjacent to the Manchester Ship Canal with maximum depths of 2m.

Flooding affects the majority of the site in the 1 in 1000 year plus climate change event reaching as far as Green Lane to the north of the site. Again the greatest flooding depths are adjacent to the Manchester Ship Canal with depths in excess of 2m. Flooding across the remainder of the site is predicted to be less than 0.5m.

### 3.4.2 Trafford

#### Pomona Island T0467

Considering the adopted residual risk scenario, the 1 in 100 year flood event fully inundates Pomona Island. The 1 in 1000 year outline is similar to the 1 in 100 year plus climate change flood extent.

Flood depths range from 0.25 to 1.0m during the 1 in 100 year event but can reach 2m across the southern parts of the Pomona Island during the 1 in 100 year plus climate change event. Therefore the flood hazard is significant to extreme resulting in 'danger to all' for the 1 in 100 year plus climate change event.

#### Wharfside T0469

Considering the adopted residual risk scenario, the northwest corner of the site is affected by the 1 in 100 year plus climate change event. Here, flood depths reach 1m and the flood hazard is significant causing 'danger to most' for the 1 in 100 year plus climate change event.

During extreme flood events (1 in 1000 year) floodwaters overtop the Manchester Ship Canal and enter the northern boundary of the site. Trafford Wharf Road, which runs almost parallel to the Manchester Ship Canal, acts as a flow route; however, flood depths are shallower at 0.25m. Climate change will increase the extent, depth and hazard associated with flooding in an extreme 1 in 1000 year flood event.

#### Trafford Park Core T0471

Considering the adopted residual risk scenario, the 1 in 100 year event extends across the industrial estates and depots surrounding the Mode Wheel Locks. During the 1 in 100 year plus climate change event flood depths typically range between 1 and 2m. The flood hazard is extreme around Mode Wheel Locks and becomes significant causing 'danger to most' within 400m of the canal. Floodwaters also overtop the bank upstream of Centenary Bridge resulting in high depths of flooding for 250m southwards (1 in 100 year plus climate change event).

There is significant residual risk to the site during an extreme 1 in 1000 year flood event, with floodwaters flowing southwards for approximately 900m through Mosley village in the centre of Trafford Park Core. Climate change will increase the extent, depth and hazard associated with flooding in an extreme 1 in 1000 year flood event.

#### Trafford Quays T0463

This site lies within the Trafford Centre Rectangle site T0472.

Considering the adopted residual risk scenario, downstream of Barton Swing Bridge, at Old Barrow Road, floodwaters overtop the canal and flow into Trafford Quays for approximately 400m under the 1 in 100 year event. Flood depths and hazard are again significant here resulting in 'danger to most' within the 1 in 100 year plus climate change flood extent and place Bromyhurst Farm at risk.

There is significant residual risk to the site during an extreme 1 in 1000 year flood event, with flooding to the western side of the site. Flood depths are typically 2m and hazard rating is 'dangerous for all'. Climate change will increase the extent, depth and hazard associated with flooding in an extreme 1 in 1000 year flood event.

#### Trafford Centre Rectangle T0472

Considering the adopted residual risk scenario, floodwaters flow through Trafford Quays and enter a small part of the site under the 1 in 100 year plus climate change event.

There is significant residual risk to the site during an extreme 1 in 1000 year flood event, with flooding to the western side of the site around the Sports Centre. Flood depths are typically 0.5-1.0m and hazard rating is 'dangerous for most'. Climate change will increase the extent, depth and hazard associated with flooding in an extreme 1 in 1000 year flood event.

### Carrington T0474

This site is predicted to flood from the Mersey and the Manchester Ship Canal. Flood risk from the River Mersey is explored in Section 2.11.

Considering the adopted residual risk scenario, flood waters exceed bank top in the 1 in 100 year event in the north western corner of the site affecting a small area to a depth in excess of 2m. The 1 in 100 year plus climate change event shows flood waters exceeding bank top in the same location as the 1 in 100 year event. In this case however, water flows along a minor road and inundates a large area to the north of the site to a depth of less than 0.5m.

There is significant residual risk to the site during an extreme 1 in 1000 year flood event. The flooding mechanism from the Manchester Ship Canal is similar to that for the 1 in 100 year plus climate change but with a wider overtopping reach and flow route. Flooding is also supplemented from the Mersey. Large areas of the site are predicted to flood to depths in excess of 2m.

The 1 in 1000 year plus climate change event shows flooding in the north of the site to be widespread with a greater proportion of the site flooded to a depth in excess of 2m. In this event flood risk will be from both the Mersey and the Manchester Ship Canal.

### Partington Canalside T0465

This site lies within the Partington strategic site T0475.

Considering the adopted residual risk scenario, flooding in the 1 in 100 year event overtops the banks at a site opposite Forest Gardens affecting a small area to a depth of up to 1.5m. The 1 in 100 year plus climate change event flooding mechanism is as described for the 1 in 100 year event. There is a small increase in the flood extent with maximum flood depths predicted to be in excess of 2m.

There is significant residual risk to the site during an extreme 1 in 1000 year flood event with a further increase in flood extent at the western limit of the site. In addition to this flows are predicted to exceed bank top at a couple of locations towards the east of the site. Flooding depths shown are generally less than 0.5m but are up to 1.5m in some locations.

The 1 in 1000 year plus climate change event flood extent is similar to the 1 in 1000 year event. A greater proportion of the flooding to the west of the site is in excess of 2m. Flooding depths to the east of the site are generally between 1 and 1.5m but are up to 2m in some locations.

### Partington T0475

This site incorporates the Partington Canalside Strategic site T0465. The Partington Canal Strategic site runs the length of the site adjacent to the Manchester Ship Canal. Flooding in this area is discussed in detail above.

Considering the adopted residual risk scenario, there is no flooding of the site beyond the boundary of the Partington Canalside site in the 1 in 100 year and 1 in 100 year plus climate change events.

There is some residual risk to the site during an extreme 1 in 1000 year flood event when flood waters overtopping the banks to the north of the site inundate an area of low ground adjacent to the disused railway line following the alignment of properties in Orchard Avenue and Derwent Close. Predicted depths are in excess of 2m.

The 1 in 1000 year plus climate change event shows a similar flood extent and depths at the north of the site as the 1 in 1000 year event. In addition there is some flooding over Lock Lane towards the school and between Lock Lane and Thirlmere Road. Flooding at these locations is less than 0.5m and up to 1m respectively.

# 4 Flooding from Reservoirs

**Reservoir inundation mapping for reservoirs under the 1975 Reservoirs Act is covered by the Civil Contingencies Act and the information has a national security status. The National Protocol for the Handling, Transmission and Storage of Reservoir Inundation (Flood) Maps for England and Wales classifies reservoir inundation mapping according to map types and reservoir inundation mapping would not be available for public release. For this reason the SFRA has not taken the analysis of reservoir flood risk forward, including mapping the extent of inundation that may be expected following a reservoir breach.**

## 4.1 Reservoir locations

The Level 1 SFRA shows there a number of reservoirs within or upstream of Manchester, Salford and Trafford. Section 2.6 of the Level 1 SFRA identifies reservoirs and the main urban area at risk immediately downstream of them.

# 5 Flooding from Surface Water and Sewers

**The SFRA has refined the assessment of surface water flood risk shown on the national Environment Agency Areas Susceptible to Surface Water Flooding map for Manchester, Salford and Trafford. United Utilities flood risk data and sewer network models were not available in the timescales for this project. In the absence of this data this refined map also shows potential areas where water would flow and pond in the event that sewers surcharge. The method for producing this map picks up natural valley lines and has been used to identify the floodplains of lost watercourses.**

## 5.1 Introduction

This section presents information regarding flood risk from surface water and sewers within the SFRA area. Development has the potential to cause an increase in impermeable area, an associated increase in surface water runoff rates and volumes, and a consequent potential increase in downstream flood risk due to overloading of sewers, watercourses, culverts and other drainage infrastructure. This section presents the current issues and Chapter 6 goes on to examine what affect the design of drainage systems in new developments can have on flood risk.

It should be borne in mind that the sewer network in places across the Greater Manchester area was designed to drain less development than exists today. Development (both planned for and urban creep) has increased the coverage of impermeable surfaces and added flow over time and the network is known to be at capacity in many places. The frequent localised flooding experienced in many parts of Greater Manchester, and Salford in particular in this study area, is testament to this problem. During extreme flood conditions it is expected that all drainage systems will be overloaded and as result there will be additional foul flooding.

Managing surface water discharges from development is therefore crucial in managing and reducing flood risk to new and existing development downstream. Carefully planned development can also play a role in reducing the amount of properties that are directly at risk from surface water flooding.

The planning system has a key role to play in settings standards for sustainable drainage (SUDS) from new developments and ensuring that developments are designed to take account of the risk from surface water flooding. Sustainable drainage and the use of Sustainable Drainage Systems (SUDS) is supported by the policy direction in Future Water[7], Making Space for Water[8], the Pitt Review[9] and the Draft Flood and Water Management Bill[10] that provides for more sustainable management of the water cycle, working in partnership across different agencies and new responsibilities for local flood risk management. In particular, the Flood and Water Management Bill may require developers where practical, to include sustainable drainage in new developments to reduce flood risk and improve water quality. The Draft Bill included '*a requirement on developers to demonstrate that they have met national standards for the application of SUDS techniques before they can connect any residual surface water drainage to a public sewer (amending section 106 of the Water Industry Act 1991).*' As part of their new responsibility for local flood risk management, it is likely that local authorities will be responsible for approving SUDS for new developments and adopting and maintaining them.

Local flood risk management will be an important responsibility for local authorities in the future, which includes managing the risk of flooding from surface water, groundwater and ordinary watercourses. Many of the localised flooding problems in Greater Manchester can be related to local watercourses that have been culverted over as past development has

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[7] Defra (2008) *Future Water*

[8] Defra, Department for Transport, HM Treasury and Office of the Deputy Prime Minister (2005) *Making Space for water: Taking forward a new Government strategy for flood and coastal erosion risk management in England; First Government response to the autumn 2004 Making space for water consultation exercise*

[9] The Pitt Review (2008) *Learning lessons from the 2007 floods*

[10] Defra (2009) *Draft Flood and Water Management Bill* © Crown Copyright

taken place and many of these are now referred to as 'hidden' or 'lost'. The condition and standard of protection of these watercourses are unknown but they can be a significant source of flood risk. Flooding in the urban environment is difficult to separate into distinct sources and in reality surface water flooding will be from a combination of overland flows, sewers and highways gullies backing up and surcharging at manholes, local watercourses overtopping, culverts surcharging and potentially high groundwater levels. This is one reason why it is important for one body (the local authority, including the lead officer for drainage) to take the lead in local FRM delivery.

## 5.2 SFRA refined surface water mapping

The national Areas Susceptible to Surface Water Flooding map provides a useful reference in identifying areas that could be at risk from surface water flooding. To provide a refined surface water map reflecting local conditions, such as roads and buildings, the SFRA used the 2D modelling software JFLOW to route rainfall over an elevation map. This is the same base tool used for the national Areas Susceptible to Surface Water Flooding map. However, in this instance:

- The elevation model was modified to include roads and buildings to help define flow paths;
- The rainfall inputs were varied depending on whether an area was developed or green space to represent different runoff rates; and
- A 1 hour storm duration was used. This was based on experience in modelling urban catchments and is thought to best represent the impact that highly localised and intense rainfall would have in Manchester, Trafford and Salford.

An extreme 1 in 200 year rainfall event was chosen, as used for the National Surface Water Map. Under such extreme conditions it was assumed that the sewer network would be overwhelmed and so this was not taken into account. This is a relatively conservative approach that gives an indication of what might happen in such an extreme event.

A current and a future scenario were considered. The future scenario takes into account the increased intensity of extreme rainfall predicted by climate change models and increased runoff from new developments on green space. Hence the future scenario provides a conservative and worst case scenario which is considered appropriate for a strategic study.

Most new sewers are designed to a 1:30 year design standard and hence sewer flooding problems will often be associated with more frequent storm events when a sewer becomes blocked or fails. In the larger events that are less frequent but have a higher consequence, surface water will exceed the sewer system and culverted watercourses and flow across the surface of the land, picking up natural valley lines and hence the natural floodplains of 'hidden' or 'lost' watercourses. Hence the surface water modelling and mapping, which is based on an extreme scenario, picks up overland flow paths that would be expected should the sewers and/ or culverts surcharge (back up) in most locations. This is also the case for the more frequent storms when sewers could become blocked and flood at manholes, although flooding would be less extensive depending on the point in the sewer network where the blockage or failure has occurred.

Considering both sewer and surface water flooding together is considered to be appropriate when taking a strategic view of flood risk in an extreme event from both these sources. More detailed consideration of the mechanisms and locations of sewer flooding is beyond the scope of the SFRA. As a minimum a FRA should investigate the likely depths and extents of surface water flooding on a development site when the surface water mapping produced for the Level 2 SFRA indicates that there is a risk of surface water flooding. Master planning should ensure that existing overland flow paths are retained within the development

A GM WCS would consider water supply, waste water treatment and disposal, and any related flooding issues, within the current regulatory framework that exists and consequent funding availability, and would link to SFRAs and SWMPs, amongst other things.

The SFRA surface water flooding results are shown in Maps SS_4.1 and SS_4.2.

## 5.3 Critical Drainage Areas

The Town and Country Planning Order 2006[11] defines Critical Drainage Areas as "*an area within Flood Zone 1 which has critical drainage problems and which has been notified… [to]…the local planning authority by the Environment Agency*". However, the Environment Agency Standing Advice[12] also recognises the part that SFRAs play in identifying areas with drainage problems and in doing so highlighting areas that need a FRA to consider drainage in detail.

Certain locations are particularly sensitive to an increase in the rate of surface water runoff and/or volume from new development. There are generally known local flooding problems associated with these areas. These areas have been defined as CDAs in the SFRA. Specific drainage requirements are required in these areas to help reduce local flood risk. These are areas with complex surface water flooding problems that would benefit from a Surface Water Management Plan and subsequent drainage strategy.

The SFRA has developed Critical Drainage Areas where:

1. There is a high risk of localised flooding from ordinary watercourses, including culverts surcharging and overland surface water flows, including the potential for flooding from the sewer network due to failure/ blockage or exceedance events when the storm return period is greater than the sewer was designed for; or
2. Where there are areas of significant redevelopment planned that could have a significant impact on surface water runoff to local watercourses and the sewer network.

Screening for Critical Drainage Areas (CDAs) within the Manchester City, Salford City and Trafford Council areas was undertaken using data from the following sources:

- An understanding of areas where there is a focus for development, such as in the Conurbation Core
- Local authority incident records
- Discussions with Local Authority Drainage Engineers
- Refined surface water flood maps produced for the Level 2 SFRA.
- An assessment of properties at risk based on the SFRA surface water flood map
- United Utilities sewer records and drainage areas
- United Utilities DG5 register

United Utilities sewer flood risk data was not available in the timescales for this project. The Local Authorities should continue to work in partnership with United Utilities over the availability and use of sewer flood risk data. United Utilities flood risk data should be used in further work following on from this SFRA, including Surface Water Management Plan work.

The sewer network can have a significant impact on the location of surface water and sewer flooding for more frequent events. It can also affect the distribution of water throughout urban catchments during flood events, passing excess flows from the combined network into watercourses through combined sewer overflows. It was agreed that without the detailed UU flood risk data, natural catchments would be combined with UU Drainage Areas (showing where sewer systems are interconnected across the boundaries of natural catchments) to define CDA boundaries. It should be noted that only Drainage Areas that intersect the boundaries of Manchester City, Salford City and Trafford Council areas were made available for this study. The sewered catchments of the CDAs may therefore be larger than those produced for this SFRA.

Using the available data, the following Critical Drainage Areas have been provided as part of the SFRA.

[11] HMSO (2006) The Town and Country Planning (General Development Procedure) (Amendment) (No. 2) (England) Order 2006

[12] Environment Agency. Flood Risk Standing Advice for England - PPS25 National Version 2.0. Can be accessed online at http://www.environment-agency.gov.uk/research/planning/82584.aspx

**Table 5-1: Critical Drainage Areas**

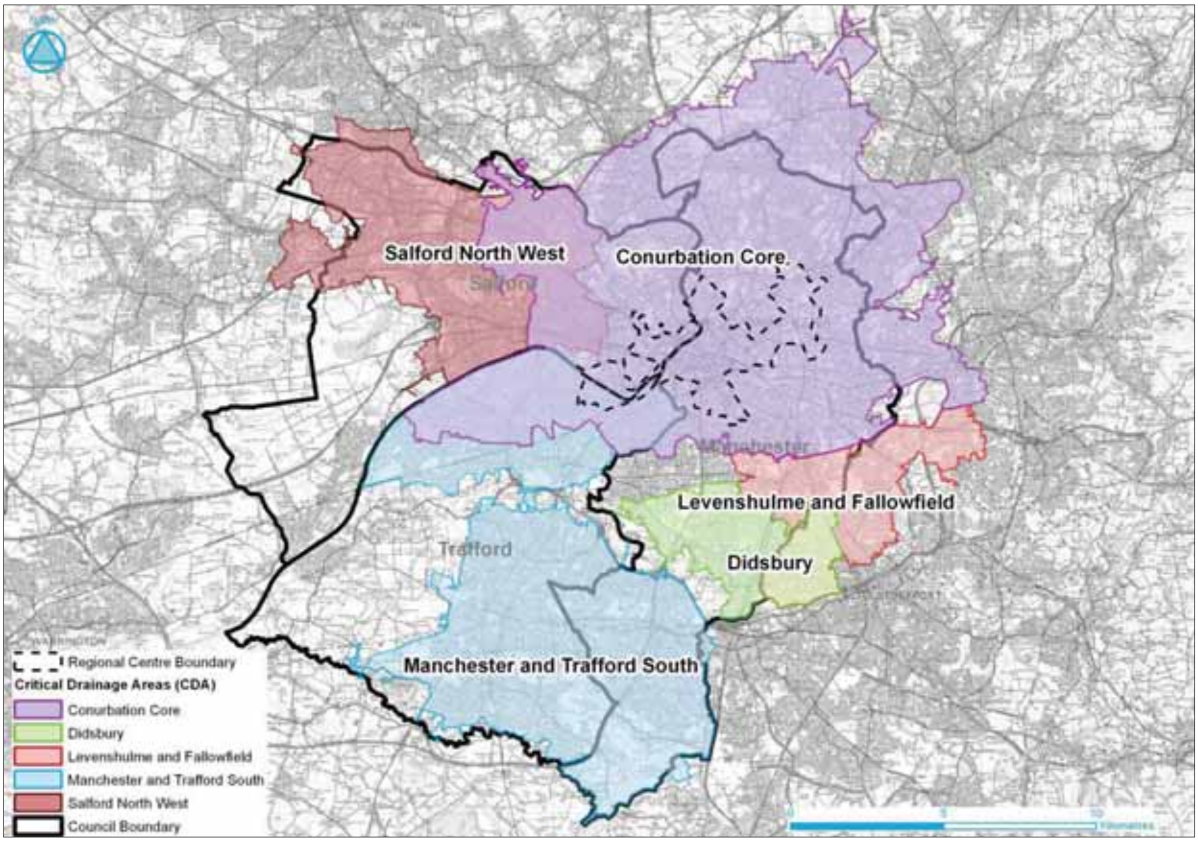
| CDA | Local Authority | Reason |
|---|---|---|
| Manchester and Trafford South | Manchester, Trafford, Stockport, Cheshire East | • Reported sewer and surface water flooding incidences (sub- regional SFRA).<br>• SFRA analysis shows significant surface water flooding hotspots at Stretford, Wythenshawe, Broadheath and Bowgreen<br>• 4 postcode areas with over 10 properties affected in the DG5 register. |
| Didsbury | Manchester, Stockport | • SFRA analysis shows significant surface water flooding hotspot between Didsbury and Heaton Mersey<br>• 3 postcode areas with over 10 properties affected in the DG5 register. |
| Levenshulme and Fallowfield | Manchester, Stockport, Tameside | • Historic flooding of properties and the railway at Fallowfield likely to be related to the local watercourses (including a lost watercourse at Levenshulme) and surface water.<br>• SFRA analysis shows significant surface water flooding hotspot in Levenshulme<br>• 4 postcode areas with over 10 properties affected in the DG5 register. |
| Conurbation Core | Manchester, Trafford, Salford, Tameside, Oldham, Rochdale, Bury, Bolton. | • Localised flooding problems in central Manchester and Salford.<br>• Includes Lower Broughton which was focus of Defra Making Space for Water IUD pilot.<br>• Focus of major regeneration and redevelopment that could have a significant impact on surface water runoff to local watercourses and the sewer network.<br>• Many lost watercourses that are interconnected with the sewers, canals and open channel watercourses that pose a significant risk.<br>• SFRA analysis shows significant surface water flooding hotspots between the Irk and Medlock and in Crumpsall, Cheetham Hill, Clifton Green, Newtown, Charlestown and Broughton.<br>• 5 postcode areas with over 10 properties affected in the DG5 register. |
| Salford North West | Salford, Bolton, Wigan, Bury | • Well known local flooding problems related to overland flow and surcharging culverts, many of which can be related to previous development within the catchment of the Worsley Brook. Around 60 |

| CDA | Local Authority | Reason |
|---|---|---|
| | | properties and roads have flooded in Walkden ward in the past.<br>• Linnyshaw and the Worsley Brook catchment is the focus of regeneration and redevelopment that could have a significant impact on surface water runoff to local watercourses and the sewer network.<br>• SFRA analysis shows significant surface water flooding hotspots at Monton, Ellen Brook and Little Hulton<br>• 3 postcode areas with over 10 properties affected in the DG5 register. |

The CDAs are shown in Figure 5.1 and Map SS_4.5 and it can be seen that without risk based information for the sewer network the Critical Drainage Areas are extensive and overlapping. The CDAs provided in the SFRA should be refined over time as more detailed information on flood risk and local flood management assets, including sewered catchments, becomes available. The CDAs identified here should therefore only be taken as a starting point in the identification of areas for which an SWMP would be beneficial.

It should be noted that CDAs overlap into downstream and upstream local authority areas. This highlights that Manchester City, Salford City and Trafford Councils should work closely with neighbouring authorities to ensure that a consistent approach is taken to cross boundary drainage issues.

**Figure 5-1 Manchester, Salford and Trafford CDAs overview**



## 5.4 Surface Water Flood Risk

The SFRA surface water maps were assessed against OS AddressPoint data to provide an assessment of flood risk to properties in the CDAs. This is provided in Table 5-2.

**Table 5-2: Flood risk in Critical Drainage Areas**

| CDA | Current properties | Future properties | Increase |
|---|---|---|---|
| Manchester and Trafford South | 146 | 286 | 140 |
| Didsbury | 40 | 91 | 51 |
| Levenshulme and Fallowfield | 26 | 35 | 9 |
| Conurbation Core | 601 | 797 | 196 |
| Salford North West | 146 | 286 | 140 |

Note that this table may count properties twice where CDAs are overlapping and should be used to provide an indication of the scale of flood risk only

### Manchester and Trafford South CDA

The Manchester and Trafford South Critical Drainage Area has a number of dispersed surface water hotspots. In general the hotspots reflect the drainage characteristics of the catchment. The largest of the surface water hotspots, and also the hotspot with the greatest density of properties at flood risk, is around Wythenshawe and Baguley. The flood risk in this location is closely linked to the flow route of the Baguley and Brownley Brooks. Other areas where surface water flooding is an issue are Stretford adjacent to Longford Brook, Broadheath adjacent to Timperley Brook and Bowgreen.

The density of properties at risk of surface water flooding at each of these sites is currently predicted to be between 5 and 20 per 0.25 $km^2$ with the exception of the site at the Baguley and Brownley Brooks confluence which shows a density of 37 per 0.25 $km^2$. Climate change shows a general increase in the number of properties at risk of surface water flooding; the site most sensitive to climate change is Broadheath.

### Conurbation Core CDA

Surface water flow paths in this CDA are largely linked to the natural floodplains of 'hidden' or 'lost' culverted watercourses that run through this area, particularly in Manchester city centre.

The most widespread surface water flooding is predicted in the city centre between the Irk and the Medlock with the density of properties at risk to surface water flooding in excess of 100 per 0.25 $km^2$. Other hotspots identified are Salford adjacent to Gilda Brook; Crumpsall and Cheetham Hill in Manchester adjacent to the Irk; Clifton Green; Newtown; Charlestown and Broughton. The worst of these is Crumpsall where in excess of 100 properties are predicted to be affected.

In the case of Lower Broughton and Charlestown in Salford, the problem is further exacerbated by the presence of river flood defences that would not allow excess surface water into the river system. In this case ponding would occur behind the defences, with the potential to form areas of deep and static water that would exacerbate any fluvial flooding that occurred at the same time.

Areas predicted to be most susceptible to climate change are the city centre and Cheetham Hill.

### Didsbury CDA[13]

Didsbury CDA is bounded by the Mersey to the south and Chorlton Platt Gore and Cringle Black Brook to the north. The natural drainage of the catchment between these two watercourses is generally via lost watercourses. The surface water flood hotspots identified in the Didsbury CDA are linked to these lost watercourses and the restricted nature of these channels would be expected to have a negative impact on flood risk. The railway runs parallel to the A34 and the flood maps show ponding of surface water against this structure in the worst affected areas. In addition an area to the north of Didsbury centre is also susceptible to surface water flooding.

The climate change assessment shows a general increase in flood risk across the Didsbury area with the worst affected area in central Didsbury.

### Levenshulme and Fallowfield CDA[14]

Surface water hotspots have been identified in Levenshulme along the alignment of the lost watercourses that run through this area with the greatest property density at risk of surface water flooding between 20 and 50 per 0.25 $km^2$.

Surface water hotspots to the west of Heaton Mersey within this CDA have been discussed as part of the Didsbury CDA.

### Salford North West CDA

Surface water flood risk areas within the Salford North West CDA are mainly associated with the valleys of local watercourses including Ellen Brook, Wardley Brook and Sindsley Brook. Hot spots have been identified at Monton, Ellen Brook and Little Hulton and the density of properties at risk from flooding for these locations varies between 2 and 20 per 0.25 $km^2$.

Climate change is not predicted to increase the effects of surface water flooding significantly.

Hotspots at Clifton Green, Newtown and adjacent to Gilda Brook in Salford have been discussed as part of the Conurbation Core CDA.

## 5.5 Recommendations for Surface Water Management

Local authorities and the Environment Agency should work closely with United Utilities, using the outputs from the SFRA as a starting point, to identify the potential locations of and priorities for SWMPs. The councils, as the lead for local flood risk management, should co-ordinate any future surface water management work. The recent Defra Surface Water Management Plan Guidance (2009) supports the use of SFRAs in providing the evidence base for where SWMPs are required. Background on SWMPs is provided in the Level 1 SFRA, but a brief summary is provided below.

Surface water management needs to take a holistic approach, taking into account all the sources of local flood risk, including from sewers, overland flow, culverted and open watercourses and groundwater. A suite of options are available for surface water management including source control, such as the implementation of SuDs, increasing the capacity of sewers or watercourses, storing excess water and managing exceedance flows through urban design and "Green Infrastructure". SWMPs should provide the opportunity to undertake detailed sewer modelling and pool together the knowledge and understanding from different organisations to help assess options to reduce surface water flood risk to new and existing development.

Options to reduce flood risk in one location should not increase risk upstream or downstream. SWMP areas may cross one or more local authority area and different local authorities, the Environment Agency and United Utilities can be brought together in a*n* SWMP partnership to develop sustainable options to manage surface water flood risk. Where there are possible interactions with canals, British Waterways and/ or the Manchester Ship Canal Company could also be involved.

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[13] This is more extensive than the Didsbury ward
[14] This is more extensive than the Levenshulme and Fallowfield wards

Recommendations for Surface Water Management Plans are provided in Table 5-3.

### 5.5.1 Taking Surface Water Management Plans forward

On the 18th August 2009, Defra announced that they were awarding £9.7m to 77 local authorities at the highest risk of surface water flooding to undertake surface water management. Other local authorities will be able to bid for a share of £5m to deal with known local surface water flooding issues.

The assessment and recommendations in the SFRA highlight that flood risk in Manchester, Salford and Trafford comes from many different, but inter-related sources. These should all be considered as part of an SWMP. The assessment also highlights the importance of partnership working and the access to United Utilities flood risk data, which would greatly enhance the definition of CDAs and recommendations for SWMPs.

There is a high risk from surface water flooding throughout Greater Manchester. Water (including United Utilities drainage infrastructure) does not respect administrative boundaries. Cross boundary and site specific issues already exist and future development in Manchester, Salford and Trafford has the potential to increase or decrease flood risk elsewhere and needs to be carefully managed.

Due to the large number of above and below ground hydraulic interactions between the ten local authorities of Greater Manchester, the Association of Greater Manchester Authorities (AGMA) is promoting the need for a Greater Manchester-wide SWMP and in November 2009 made an application to Defra for additional funding. A Greater Manchester wide and strategic SWMP would benefit from joint working and cost efficiencies and is consistent with emerging legislative requirements (Draft Flood and Water Management Bill (2009)). Manchester City Council and Rochdale Metropolitan Borough Council have agreed to pool the funding already assigned to them by Defra if the additional funding to undertake the AGMA SWMP is awarded.

The AGMA SWMP would take a consistent approach to the assessment of surface water flood risk across Greater Manchester, followed by more detailed investigations of Critical Drainage Areas targeted at those CDAs with the highest risk. The AGMA SWMP would extend to all ten authorities a consistent methodology to develop surface water risk maps and identify CDAs. United Utilities have agreed to make additional asset and flood risk data available, which would be used to refine CDAs as shown in Table 5-1. Such an SWMP would identify the most cost effective solutions (per property at risk) to enable a maximum reduction in surface water flood risk for minimum cost.

The AGMA SWMP initiative should be supported. If, however, sufficient funding is not available to undertake an AGMA SWMP, Manchester City, Salford City and Trafford Councils should form a partnership with their neighbours, United Utilities and the Environment Agency to undertake SWMPs as recommended in Table 5-3.

**Table 5-3: Recommendations for future surface water management**

| CDA | Local Authority | Recommendation |
|---|---|---|
| Manchester and Trafford South | Manchester, Trafford, Stockport, Cheshire East | An SWMP should be undertaken that will look in detail at drainage assets and local flood risk and assess feasible options for reducing risk. This should include a drainage strategy for development sites, to identify areas suitable for SUDS and how flood risk can be managed and reduced downstream.<br><br>This would be beneficial in understanding the nature of flood risk from open and culverted tributaries of the Sinderland and Longford Brooks and the impact that future development, including at the Airport, could have on local flood risk. |
| Didsbury | Manchester, Stockport | An SWMP should be undertaken that will look in detail at drainage assets and local flood risk and assess feasible options for reducing risk. This should include a drainage |

| CDA | Local Authority | Recommendation |
|---|---|---|
| | | strategy for development sites, to identify areas suitable for SUDS and how flood risk can be managed and reduced downstream.<br><br>This would be beneficial in understanding the nature of flood risk from open and culverted tributaries of the Chorlton Platt Gore (many of which are lost watercourses) and the impact that future development could have on local flood risk.<br><br>Due to the geographical proximity and shared area with the Levenshulme and Fallowfield CDA, it is recommended that these CDAs are taken forward for a joint SWMP. |
| Levenshulme and Fallowfield | Manchester, Stockport, Tameside | An SWMP should be undertaken that will look in detail at drainage assets and local flood risk and assess feasible options for reducing risk. This should include a drainage strategy for development sites, to identify areas suitable for SUDS and how flood risk can be managed and reduced downstream.<br><br>This would be beneficial in understanding the nature of flood risk from open and culverted tributaries of the Chorlton Platt Gore and Cringle Black Brook (many of which are lost watercourses) and the impact that future development could have on local flood risk.<br><br>Due to the geographical proximity and shared area with the Didsbury CDA, it is recommended that these CDAs are taken forward for a joint SWMP. |
| Conurbation Core | Manchester, Trafford, Salford, Tameside, Oldham, Rochdale, Bury, Bolton. | An SWMP should be undertaken that will look in detail at drainage assets and local flood risk and assess feasible options for reducing risk. This should include a drainage strategy for the collection of development sites to identify areas suitable for SUDS and how flood risk can be managed and reduced downstream.<br><br>There is a significant risk of localised flooding from many different but integrated sources, including hidden and culverted watercourses, open watercourses, sewers, canals and the major river network that should be investigated in detail for Greater Manchester. This assessment could be used to further inform future development on localised flood risk issues and should also feed into a strategy for runoff from new development that has the potential to reduce flood risk, both within the Regional Centre/ Inner Areas and downstream. |
| Salford North West | Salford, Bolton, Wigan, Bury | An SWMP should be undertaken that will look in detail at drainage assets and local flood risk and assess feasible options for reducing risk. This should include a drainage strategy for the collection of development sites, including at Linnyshaw, to identify areas suitable for SUDS and how flood risk can be managed and reduced downstream.<br><br>This would be beneficial in understanding the nature of flood risk from open and culverted tributaries of the Worsley Brook and Ellen Brook and the impact that future development, including at Linnyshaw, could have on local flood risk. |

There is the potential for groups of development sites coming forward to share a central and integrated solution for managing surface water runoff. This is best investigated further through an SWMP or a Drainage Strategy, which may or may not be undertaken at the same time as an SWMP. Such solutions can provide great benefits besides water management, including providing recreational facilities, improving biodiversity and making communities a better place to live. It should be recognised that a long term maintenance strategy is needed for such options. Where there are several sites that would share a communal facility, such sites may be funded through developer Section 106 or Community Infrastructure Levy payments. Drainage Strategies can be particularly useful for considering, recommending the implementation of, and long term management arrangements for, SUDS and setting appropriate runoff rates from new development.

These recommendations were made whilst the report was being drafted. It is noted that the AGMA SWMP has received funding and is currently being undertaken.

# 6 Cumulative impacts of future development and drainage design

**A strategic assessment of the impact of development within Manchester, Trafford and Salford and within the wider catchments of the River Irwell and Mersey on flood risk has been undertaken. The results of this can be used to inform policies on sustainable drainage for new developments.**

## 6.1 Introduction

Development has the potential to cause an increase in impermeable area, an associated increase in surface water runoff rates and volumes, and a consequent potential increase in downstream flood risk due to overloading of sewers, watercourses, culverts and other drainage infrastructure. Development (both planned for and urban creep) has increased the coverage of impermeable surfaces and added flow over time and the sewer network is known to be at capacity in many places. The frequent localised flooding experienced in many parts of Greater Manchester is testament to this problem.

**Managing surface water discharges from new development is therefore crucial in managing and reducing flood risk to new and existing development downstream.**

Carefully planned development can also play a role in reducing the amount of properties that are directly at risk from surface water flooding. The planning system has a key role to play in settings standards for sustainable drainage from new developments and ensuring that developments are designed to take account of the risk from surface water flooding.

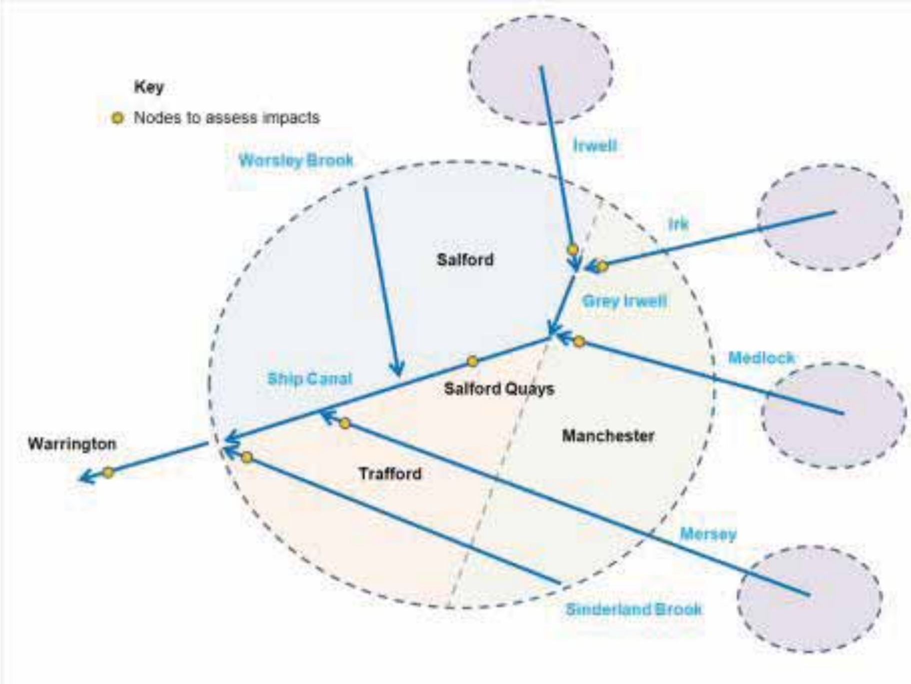
There is significant development planned for Manchester, Trafford and Salford which will take place on both previously developed and greenfield sites. The Regional Spatial Strategy sets out new housing provision and alongside this there will be land developed for commercial, industrial, public services and recreation use. Further information on the Regional Spatial Strategy is provided in Section 2.1. The Greater Manchester Sub-Regional SFRA identified hydrological links between the different local authorities within AGMA. A schematic of the river network in Manchester, Salford and Trafford is shown in Figure 6-1.

The councils fall within the River Irwell, Irk, Medlock and Mersey catchments and development within upstream local authorities has the potential to adversely affect flood risk within Manchester, Salford and Trafford. For example, unless drainage is appropriately designed development within Bury and Rochdale within the River Irwell catchment has the potential to affect flood risk in Salford. If site drainage is inappropriately designed, development within Manchester, Salford and Trafford itself also has the potential to affect flood risk locally and to Warrington downstream. This is especially the case for the smaller tributaries of the major rivers and the Manchester Ship Canal that are culverted in places and especially sensitive to runoff from developments. These include the Worsley Brook in Salford and the Sinderland Brook in Manchester and Trafford.

The SFRA has undertaken an assessment of the impacts of development within Manchester, Salford and Trafford on fluvial flood risk both locally and downstream in Warrington. The SFRA has also considered the additional impact of development in the upstream catchments of the River Irwell, Irk, Medlock and Mersey catchments on fluvial flood risk in Manchester, Salford and Trafford.

The management of surface water flooding in Greater Manchester and beyond is a cross boundary issue that is discussed in Chapter 5. Flooding from canals is also a cross boundary issue, where water overtopping or breaching from a canal in one local authority could lead to flooding in another. This is discussed in relation to the Rochdale Canal in Oldham in Chapter 3.

**Figure 6-1 River network in relation to Manchester City, Salford City and Trafford Councils**




## 6.2 Considering downstream impacts - scope and assessment methodology

As highlighted above, development has the potential to both increase and decrease surface water runoff and hence affect flood risk downstream. The SFRA has considered both of these scenarios.

The worst case scenario assumes that after development there would be no storage of surface water on the new development sites. This has the potential to both increase the rate and volume of surface water runoff into the sewer network and local watercourses, increasing flood risk downstream. In the current legislative and policy environment this scenario is unlikely.

The best case scenario assumes that after development surface water would be temporarily stored on the respective development sites in sustainable drainage systems. The introduction of such systems would attenuate the flows which would minimise flood risk. This is the most likely scenario under current legislation and Environment Agency policy.

As stated above, both the impact of planned development in Manchester, Salford and Trafford and of wider development in the catchments of River Irwell, Irk, Medlock and Mersey has been considered. The latter was based on development scenarios available from the Bury, Rochdale and Oldham SFRA analysis and extrapolated to other catchments based on the similarity of urbanisation to either the River Irwell or the River Irk catchments.

Combining the above, five cases were analysed:

- Current baseline.
- Worst case scenario, development in Manchester, Salford and Trafford.
- Worst case scenario, catchment-wide development (including development in Manchester, Salford and Trafford).
- Best case scenario, development in Manchester, Salford and Trafford.
- Best case scenario, catchment-wide development (including development in Manchester, Salford and Trafford).

The impact of the development on flood risk downstream was assessed by looking at the differences in flood levels from the current pre-development baseline to the future post-development situation. The methodology builds on the approach used in the River Irwell CFMP to assess future flood risk and is based on the impact on flood risk during a 1 in 100 year flood event, considering climate change.

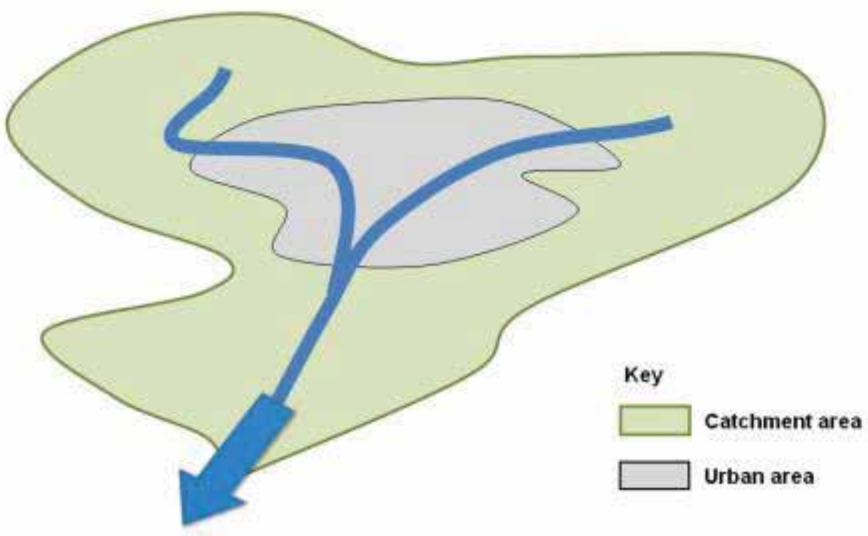
Impacts were assessed using 3 different models (refer to Chapter 2 for further information on the models):

- The Manchester Ship Canal model
- The Sinderland Brook model
- The River Mersey model

The impact of the development sites to flood risk downstream was assessed from the current pre-development baseline to the future post-development situation.

Flood Estimation Handbook (FEH) methods were used to calculated flood hydrographs and flows in river system. The FEH method takes into account the amount of urban area in a river catchment, as shown in Figure 6-2.

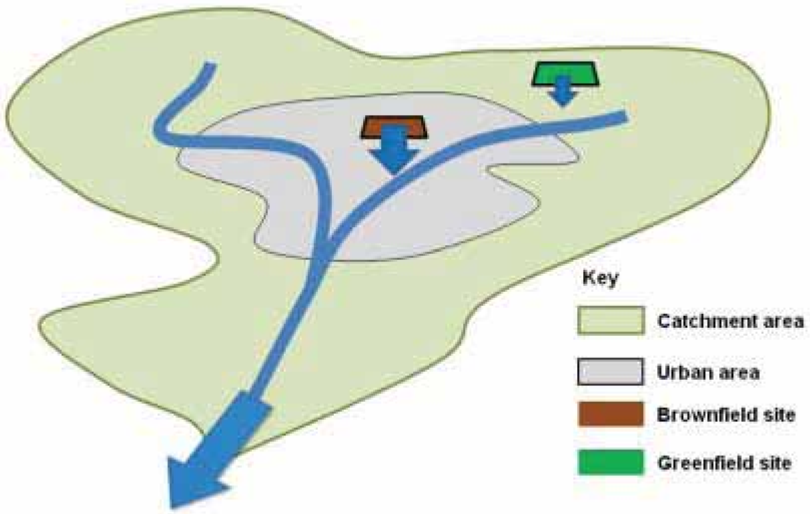
**Figure 6-2 FEH calculation of flood hydrology for baseline flow**




### 6.2.1 Current baseline case

Development sites inside urban areas were assumed to be previously developed and those outside of urban areas were assumed to be greenfield. The surface water runoff contribution from the brownfield and greenfield development sites was assumed to be included in FEH calculations for the models; hence there is a larger amount of runoff from previously developed sites in urban areas than from greenfield sites. This is shown in Figure 6-3.

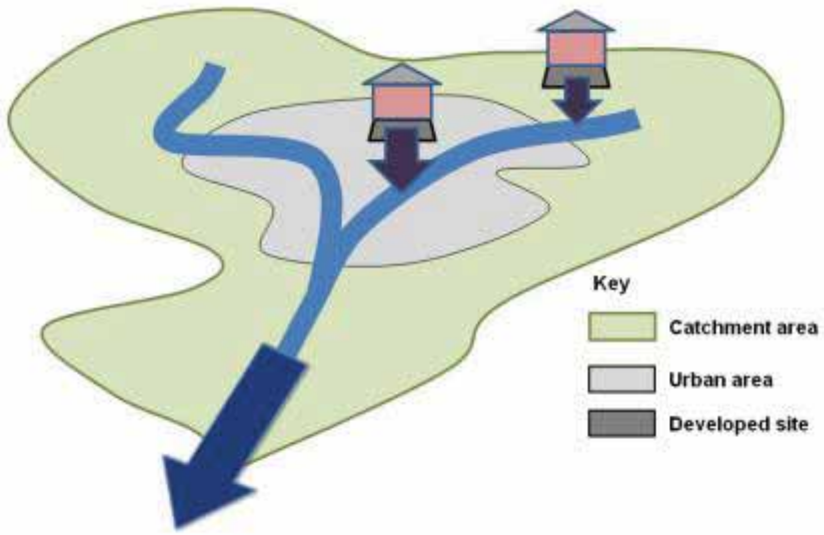
**Figure 6-3 Contribution of development sites to the current baseline flow**




### 6.2.2 Worst case

It was assumed that the development sites would be developed with impermeable areas and unattenuated drainage systems. In a storm event this would increase flood levels downstream, as shown in Figure 6-4.

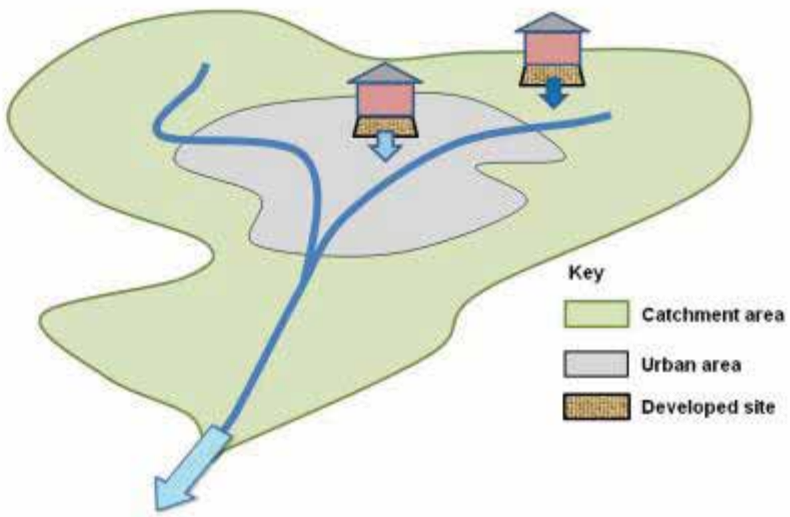
**Figure 6-4 Contribution of development sites to the current baseline flow**



### 6.2.3 Best case

It was assumed that the drainage from development sites would be reduced through the use of Sustainable Drainage Systems to mimic natural site drainage (this assumes greenfield rates). There would be less surface water runoff and this may help to reduce flood levels, as shown Figure 6-5.

**Figure 6-5 Contribution of development sites to the current baseline flow**




## 6.3 Results

Results are presented for the four cases that were discussed above.

The following four figures show changes in water level for the locations on Figure 6-1. These changes are indicative of changes that are expected in the river network under the different development cases. Figures and nodes shown in red are for the cases where there are water level increases. Figures and nodes shown in green are for the cases where there are water level reductions. All figures are in metres.

### 6.3.1 Worst case

Figure 6-6 shows the water level changes relative to the current base case for the worst case scenario for development in Manchester, Salford and Trafford. The largest increase in water levels would be at the downstream end of the River Irk.

**Figure 6-6 Change in water level (m): Worst case scenario, development in Manchester, Salford and Trafford**

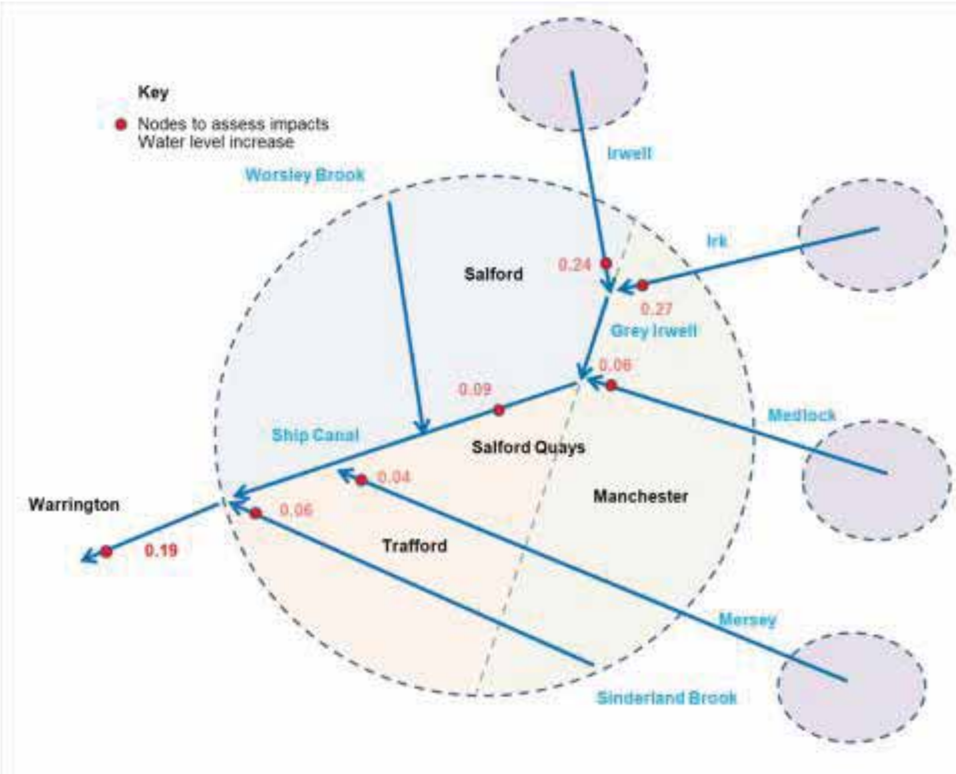
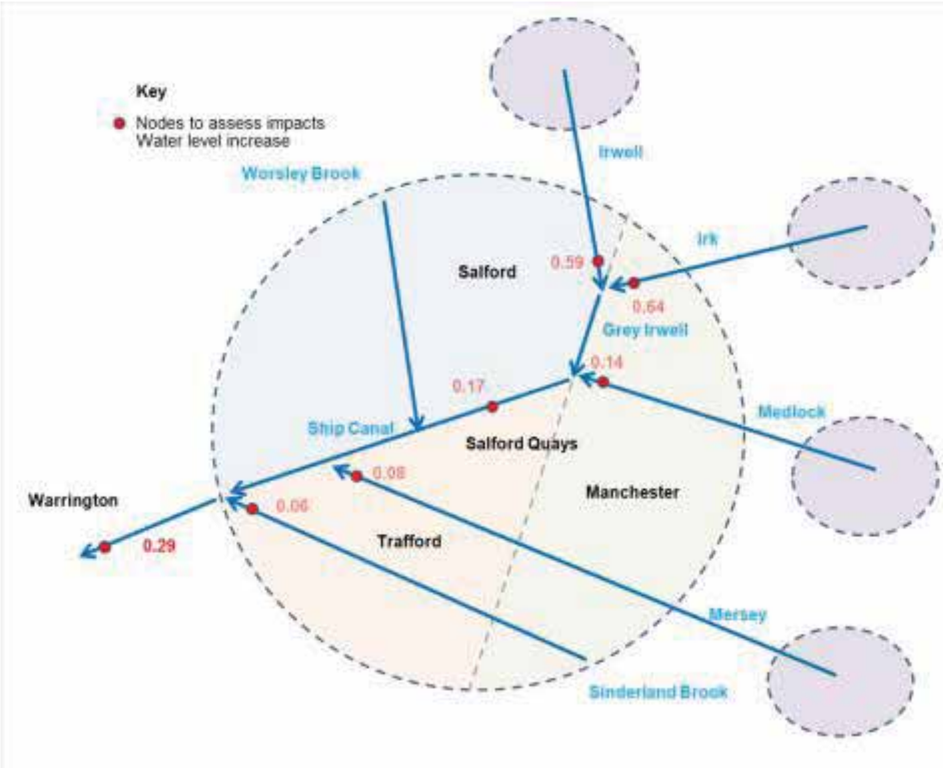


Figure 6-7 shows the water level changes for the worst case scenario for catchment-wide development. The largest increase in water levels would be at the downstream end of the River Irk.

**Figure 6-7 Change in water level (m): Worst case scenario, catchment-wide development (including development in Manchester, Salford and Trafford)**



### 6.3.2 Best case

Figure 6-8 shows the water level changes for the best case scenario for development in Manchester, Salford and Trafford. The largest decrease in water levels would be at the downstream end of the River Irk.

**Figure 6-8 Change in water level (m): Best case scenario, development in Manchester, Salford and Trafford**

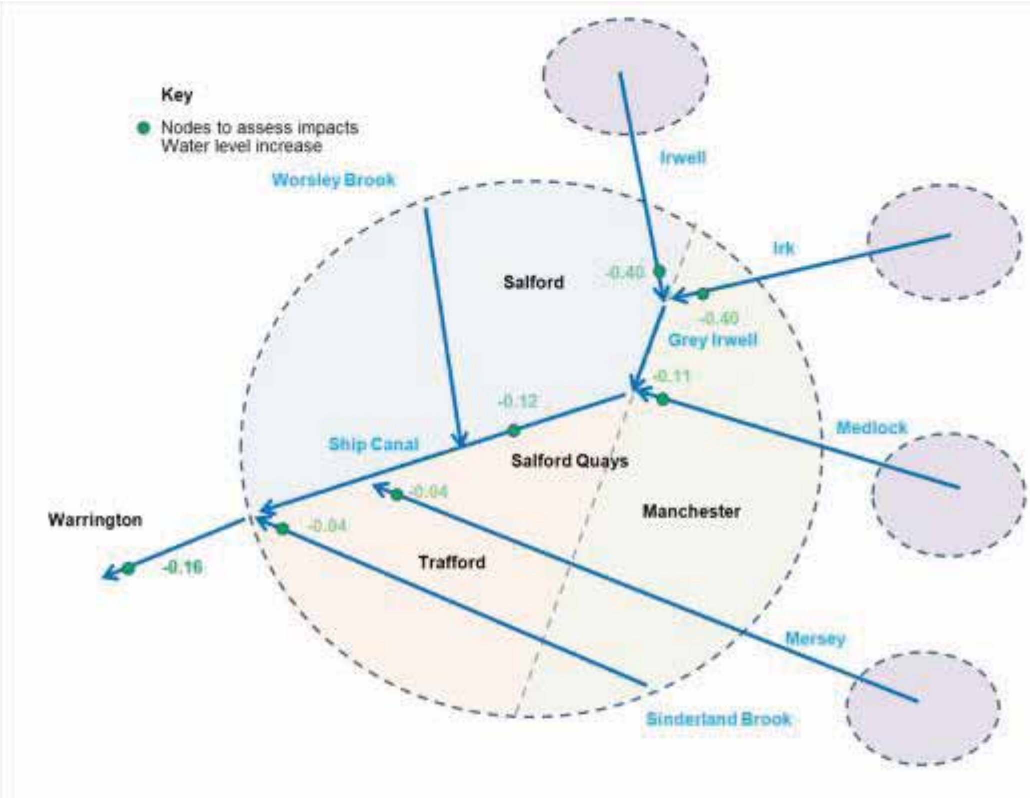
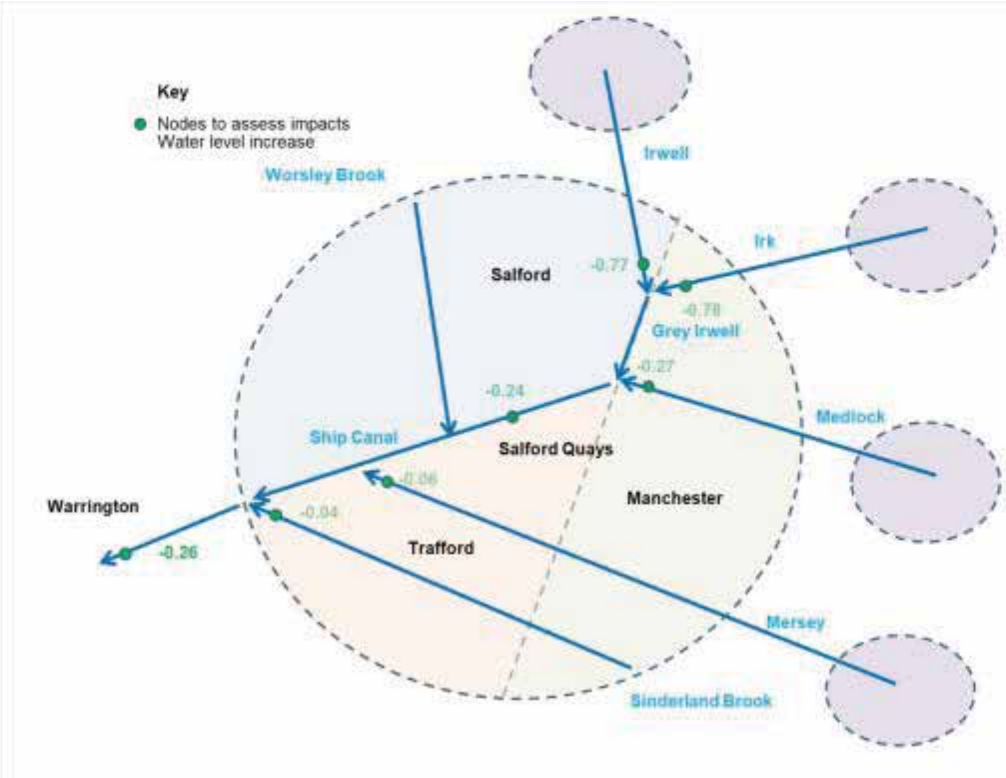


Figure 6-9 shows the water level changes for the best case scenario for catchment-wide development. The largest decrease in water levels would be at the downstream end of the River Irk.

**Figure 6-9 Change in water level (m): Best case scenario, catchment-wide development (including development in Manchester, Salford and Trafford)**




## 6.4 Discussion

The analysis undertaken for the SFRA shows developing sites with large impermeable areas and no attenuation will increase flood risk downstream. Unattenuated development upstream of the study area, and particularly in the Upper Irk and Irwell catchments, could have the largest impact on water levels in Manchester, Salford and Trafford. However, the results show by using SUDS to reduce surface water runoff from development sites to below existing levels there will be a beneficial impact on flood risk downstream. Attenuated development upstream of the study area, and particularly in the Upper Irk, Irwell and Medlock catchments, could have the largest benefit to water levels in Manchester, Salford and Trafford.

The analysis shows that whilst development control policies to reduce surface water discharges from new development could have some benefit locally, development in the wider catchments has an important role to play in reducing flood risk in Manchester, Salford and Trafford. This highlights the need for local authorities both within AGMA and in the wider River Irwell, Irk, Medlock and Mersey catchments to work together to reduce flood risk through the planning process.

# 7 Hydraulic linkages

**Flood risk across the three districts is present from a number of sources. The interactions between these different sources are fundamental to understanding the risk of flooding at a strategic level and recommending appropriate management measures. The SFRA has looked at the possible interactions between rivers, canals, reservoirs and surface water across Manchester, Salford and Trafford to prompt the appropriate consideration of these issues in site specific FRAs and further studies such as SWMPs and Drainage Strategies.**

## 7.1 Introduction

In this context, hydraulic interactions are considered as potential interactions between different sources of flooding; for example, fluvial flooding (from rivers), surface water flooding, and flooding from canals, drains and sewers. During a significant flood event hydraulic interactions between these systems can have an important, but often overlooked, impact on the distribution, magnitude and extent of flood risk.

Historically, flood risk management in the UK has concentrated on defining the flood extents from separate sources of flooding by treating them independently. Little consideration has been given to the fact that these flood outlines may overlap (representing a double counting of available storage) or to the fact that one system may provide a conduit for conveying water sourced from another. These effects may result in reduced flooding, where additional storage is available in another system (such as canals or sewers); or may increase the flood risk by transporting water out of previous flood extents. Critically, in urban areas where water is conveyed in many systems, often in close proximity, the traditional approach of considering flooding sources in isolation is not completely representative.

This strategic study has not concentrated on quantifying the effects of the hydraulic interactions which may occur in Greater Manchester, nor has it tried to assign a probability to them. Instead, a desk based study has been undertaken, pooling available resources to try to define where these interactions may occur. At each location, potential risks have been summarised, with the intention of providing a reference for flood risk managers, planners and developers in the future. Interactions are summarised on the table below and mapped on Map HI_5.1.

It is envisaged that improving understanding of how different sources of flooding interact during a flood event and the resulting impact on flood risk will be an important component of future studies in the city. Indeed until recently it has not really been possible to accurately model all these interactions. However, a number of software packages are now readily available (with others due to be released soon) which have been designed specifically to accommodate the complexities of integrated urban flood modelling. With these developments in modelling software capabilities it is likely that future studies will be better equipped to assess the relationships between drainage systems, surface water and fluvial flooding.

## 7.2 Canal and river interactions

Because of Manchester's industrial history the city is criss-crossed by a network of canals. Because of this, interactions between canals and other sources of flooding are likely to have a significant impact within the SFRA study area. Where canals pass close to rivers interactions between them are likely during large flood events. These interactions involve water either passing from the canal into the river or from the river into the canal. Situations where the former is possible are more frequent because typically canals occupy an elevated position compared to rivers. The potential impact of flood waters overtopping the canal and entering the river system are usually minor because the increased discharge is likely to be small compared to flow already being conveyed by the river. However, where a canal overtops during a flood event there is a risk of erosion of embankments, and therefore the possibility of this resulting in breach of the canal banks. Should this situation arise then the influx of flow into the river may very well result in a significant and sudden increase to flood risk downstream.

In the reverse situation, where floodwaters from a river enter the canal network, the effects are likely to be two-fold. Firstly, the canal may be able to convey the flood waters away from the interaction site and possibly outside of the expected fluvial flood extent. This excess flood water may then spill from the canal resulting in flood risk, possibly some distance from the river. Secondly, the canal may provide additional flood storage, as well as conveying some flow. The result may well be a reduced flood extent along the river downstream of the interaction.

For this study possible interaction locations between rivers and canals have been identified using a GIS desk-based approach. A combination of existing flood outlines and outlines produced for this study have been used. In both cases the largest outline available has been used. Initially fluvial outlines were plotted and locations where they crossed or abutted canals were recorded. Secondly, the reverse was done by plotting the canal breach and canal overtopping outlines produced for this study and noting where they may interact with watercourses. Although this visual assessment formed the basis of the study, local knowledge and data from OS mapping was used provide additional information where possible. It should be noted that the assumptions used in developing the canal outlines were conservative and so the assessment of the potential interactions will reflect this previous cautious approach.

Table 7-1 summarises locations within the study limits where canal and river interactions are considered possible (refer to Map HI_5.1). Any future studies in these areas should consider how these interactions may affect their objectives.

**Table 7-1: Canal River Interactions**

| Location ID | Summary | NGR |
|---|---|---|
| ASH_001 | It is possible that breach of the Ashton Canal at this location would result in additional water flowing into the River Medlock upstream of the culvert entrance. It is not considered possible for flow from the Medlock to enter the canal at this location because of the elevation difference between the two. | SJ870988 |
| ASH_002 | It is possible that breach of the Ashton Canal at this location would result in additional water flowing into the River Medlock downstream of the culvert exit. It is not considered possible for flow from the Medlock to enter the canal at this location because of the elevation difference between the two. | SJ864987 |
| ASH_003 | A breach along this section of canal may result in additional flow entering the River Medlock. This will not occur purely from overtopping. It is not considered possible for flow from the Medlock to enter the canal at this location because of the elevation difference between the two. | SJ855984 |
| RCH_002 | Breaching of the Rochdale Canal at this location may result in increased flow in the River Medlock. Flow from the Medlock into the canal is not considered possible because of the elevation difference. | SJ838975 |
| RCH_003 | The Rochdale Canal enters the Castlefield canal basin (Bridgewater Canal) via a downwards lock. During periods of high water level in the Rochdale Canal significant quantities of water may spill over the lock gates and into the canal. This additional inflow to the basin maybe stored in or conveyed along the canal but it may also flow into the River Medlock via BGW_001. | SJ831975 |
| MED_001 | The River Medlock is conveyed under the Castlefield canal basin through an inverted siphon. This is susceptible to blockage. When this is surcharged there some storage available in the channel upstream but if | SJ833974 |

| Location ID | Summary | NGR |
|---|---|---|
| | the water levels rise enough then the next available flow path is over a spill and into the canal basin. This in an engineered interaction and there is provision downstream for flow to return to the river downstream of the canal basin. | |
| BGW_001 | There are a number of engineered spills allowing water in the Bridgewater Canal to spill in to the River Medlock either into or downstream of the inverted siphon. The most significant of these is a large circular spill on the northern limit of the canal basin. This allows flow from the canal to enter the Medlock downstream of the siphon via a separate culvert. Evidently this is designed primarily to convey some of water entering the canal basin via MED_001back into the river; however, it will work just as effectively whatever the cause of high water levels in the Bridgewater Canal. | SJ829976 |
| BGW_003 | The Bridgewater Canal passes over the River Mersey in an aqueduct. Should this aqueduct breach along this reach then the water escaping from the canal would arrive almost directly in the River Mersey. This interaction is only likely to be significant in the event of a breach or failure of the aqueduct. Flow from the river into the canal is not considered possible. | SJ795933 |
| BGW_004 | The Bridgewater Canal passes over the Baguley Brook in an aqueduct. Should this aqueduct breach, along this reach then the water escaping from the canal would enter the watercourse. Flow from the river into the canal is not considered possible. | SJ778901 |
| BGW_005 | The Bridgewater Canal passes over the Timperley Brook in an aqueduct. Should this aqueduct breach along this reach then the water escaping from the canal would enter the watercourse. Flow from the river into the canal is not considered possible. | SJ771983 |
| BGW_006 | The Bridgewater Canal passes over the River Bollin in an aqueduct. Should this aqueduct breach along this reach then the water escaping from the canal would enter the watercourse. Flow from the river in to the canal is not considered possible. | SJ728874 |
| STB_001 | Salteye Brook discharges into the MSC at this location. High flows on the brook will result in an increased discharge to the canal; however, these flows are likely to be negligible compared to the flows already being conveyed in the MSC. Probably more significantly is that high water levels on the MSC will also result in increased water levels on the lower reaches of Salteye Brook. | SJ746965 |
| MER_001 | This is the location where the River Mersey discharges into the MSC. Before entering the canal the river flows over a weir. So long as this structure does not drown out then the upstream water levels in the Mersey will be independent of the water levels in the canal. However, the volume of water being delivered to the canal by the Mersey is likely to be an important influence on water levels in the canal. | SJ726934 |
| GLB_001 | At this location Glaze Brook discharges into the MSC. Both watercourses may be affected by high water levels on the other. | SJ702911 |

| Location ID | Summary | NGR |
|---|---|---|
| REB_001 | At this location Red Brook discharges into the MSC. Both watercourses may be affected by high water levels on the other. | SJ700908 |
| WAB_001 | Warburton Brook discharges into the MSC at this location. The volume of water delivered in the brook is unlikely to have a significant impact on water levels in the canal. However, high water levels in the canal may result in elevated water levels in on the lower reaches of the brook. | SJ697902 |
| BOL_001 | This is the location where the River Bollin discharges into the MSC. The volume of water being delivered to the canal by the Mersey is likely to be an important influence of water levels in the canal. Also, high water levels on the canal will result in elevated water levels on the lower reaches of the River Bollin (this effect is unlikely to extend upstream of the weir adjacent to the Warburton Bridge unless the structure becomes drowned out). | SJ683888 |
| BGW_008 | At this location the Folly Brook is culverted under the embankment supporting the Bridgewater Canal. Breach of the canal at (or near to) this location will result in an additional inflow of water to the Brook. Blockage of the culvert under the canal will cause water to pond upstream of the embankment but this is unlikely to reach a high enough elevation to enter the canal. In order to be confident in this prediction a detailed hydraulic model would be required. | SJ762995 |
| BGW_009 | At this location the Sindsley Brook is culverted under the embankment supporting the Bridgewater Canal. Breach of the canal at (or near to) this location will result in an additional inflow of water to the Brook. Blockage of the culvert under canal will cause water to pond upstream of the embankment but this is unlikely to reach a high enough elevation to enter the canal. In order to be confident in this prediction a detailed hydraulic model would be required. | SJ757999 |
| BGW_010 | At this location the Worsley Brook is culverted under the embankment supporting the Bridgewater Canal. Breach of the canal at (or near to) this location will result in an additional inflow of water to the Brook. Blockage or surcharge of the culvert under canal will cause water to pond upstream of the canal. It is likely that during a large flood event water from Worsley Brook will enter the Bridgewater Canal at this location. | SD748005 |
| BGW_011 | At this point the Bridgewater Canal crosses Shaw Brook; Breach of the canal banks along this section will result in additional flow being delivered to the brook. | SD731000 |

## 7.3 Hydraulic interactions resulting from reservoir breach

As outlined in Chapter 4, due to implications for national security reservoir breach modelling and mapping was not undertaken for the SFRA. In the event that a reservoir does breach it is likely that excess water will find its way into other water bodies, including rivers and canals, increasing flood extents and depths and enhancing the effects of the hydraulic interactions between the different sources as set out in this chapter.

## 7.4 Hydraulic interactions affecting surface water

Compared to other sources of flooding, surface water flooding is distributed much more evenly across the catchment. Because of this it is possible that interactions can occur with most other sources of flooding. For example, surface water flow routes may discharge into canals and exacerbate flooding from other areas within the same canal pound (section of canal between two locks). Conversely, if the canal is embanked then this may block potential surface water flow paths and result in ponding. Because of the highly distributed nature of surface water flooding it is not feasible to discuss specific locations in this strategic study; however, it is recommended that possible interactions are considered on a local basis during future studies (such as in SWMPs). These interactions highlight the importance of representing other hydraulic systems in pluvial modelling studies.

## 7.5 Canal interactions

There are a few locations in the study limits where it is conceivable that water from one canal could overtop its banks and enter another nearby canal. However, the only situation where this is likely to have a significant effect on flood risk is if the Manchester Ship Canal spills into the Bridgewater Canal along the reach between St Georges and Old Trafford (MSC_001); the other interactions are likely to involve such small volumes of water that they will have a negligible effect on flood risk.

**Table 7-2: Canal Interactions**

| Location ID | Summary | NGR |
|---|---|---|
| BGW_002 | During times of high water on the Bridgewater Canal it is possible that the lock gates to the Pomona Docks on the MSC could be overtopped, however the inflow of water to the ship canal is unlikely to be significant. | SJ820967 |
| MSC_001 | Overtopping from the Manchester Ship Canal (MSC) may enter the Bridgewater Canal anywhere along the reach between St Georges and Old Trafford. | SJ820967 |
| BGW_007 | At this location the Bridgewater Canal flows over the MSC in swinging aqueduct bridge. Failure or overtopping of this structure will result in additional flow entering the MSC. There is potentially a slightly increased chance of breach at this location given the complexity of the structure. Because of the elevation difference between the two canals there is no chance of water from the MSC entering the Bridgewater Canal. | SJ767976 |
| RCH_001 | It is possible for water breaching from the Rochdale Canal to enter the Ashton Canal; however, the effect is likely to be negligible because the two canals join shortly downstream. | SJ853987 |

## 7.6 Hydraulic interactions affecting the sewer network

Surcharging of the drainage and sewerage systems are often a cause of flooding in urban areas. The interaction between these systems and other sources of flooding such as fluvial and surface water is often highly complex. For example, increased water levels in river networks will result in reduced ability for them to convey water away from surface water drain outfalls and from combined sewer overflows. This will typically result in backing up of water levels in the pipe system until the pressure can be relieved by overflow from the lowest nearby manhole. Surcharging of this manhole will result in reduced ability to drain surface water as well as a source of flood water that may interact with surface water. Because of the highly distributed nature of sewer flooding it is not feasible to discuss specific locations in this strategic study; however, it is recommended that possible interactions are considered on a local basis during future studies (such as in SWMPs).

## 7.7 Hydraulic interactions resulting from high groundwater levels

High groundwater levels have the potential to infiltrate the sewer system causing local surcharging. They could also contribute to areas of and prolong fluvial, surface water or canal flooding.

# 8 Summary of risk

**A summary of flood risk issues for groups of development sites (Strategic Locations) is presented below. This should provide a useful evidence base for the application of the Exception Test. Chapter 9 then proposes a development strategy by highlighting the mitigation measures that should be considered in accordance with PPS25.**

## 8.1 Introduction

For each council, the development sites which have the greatest risk of flooding and may need to undergo the Exception Test have been grouped into 'Strategic Locations' and summarised in terms of flood risk. This will help provide an evidence base for the inclusion of sites within the Manchester, Salford and Trafford authorities Core Strategy where appropriate after applying the sequential approach as advocated in PPS25. Chapter 9 then proposes a development strategy by highlighting the mitigation measures that could be considered in accordance with PPS25.

This review of sites is based on a procedure developed to provide a greater appreciation of the actual and residual risks. The flood risk management (FRM) policy and strategy with respect to the protection of these communities is identified in the River Irwell CFMP, Upper Mersey CFMP and the emerging Environment Agency strategy documents. Evaluation of the implications of new development in the high and medium risk zones demands the responses to the level of protection and the commitment to "mitigation" within the relevant FRM documents to be considered alongside specific measures associated with the proposed new development.

The underlying objective is to identify whether there is a need for strategic flood risk mitigation measures or whether it is possible for new development to be permitted and provisions made on a piecemeal basis (it should be noted that this is not the preferred approach according to PPS 25). If it is identified that there is a requirement to provide strategic infrastructure then the requirements of PPS12 should also be addressed.

The flood risk to these key sites has been summarised by addressing the following range of relevant issues:

- Are the development sites in the area at significant risk during a 1 in 100 year event, considering climate change?
- Is there a consistent asset standard of protection? (assets include culverts and canals)
- Is there a consistent asset condition?
- Is there a significant possibility of assets breaching or failing?
- Could assets overtop during climate change or extreme events?
- Is overall residual risk significant in the area?
- Are there other sources of flooding? (besides fluvial flood risk)
- Is flood risk a significant environmental issue/constraint?
- Does development need to be considered strategically?
- If a strategic approach is not necessary, can development proceed in a piecemeal basis without considering adjacent areas in the floodplain?
- Does development need to be integrated into a flood risk management strategy?
- Is floodplain compensation required?
- Can the loss of floodplain be compensated within site?
- Will there be off site effects?
- Will flood risk be an urban design issue?
- Can residual risk be successfully managed?

- Could development reduce risk?

Preparing responses to these questions for each of the identified locations will generate a profile of:

- The implications of seeking to manage the risk to an acceptable level
- The effects of climate change on existing defences and the residual risk due to overtopping
- The consequences of the residual risk in the event that assets breach or fail

The summary tables below provide an overview of flood risks to the key sites across the Manchester, Salford and Trafford authorities. By providing yes/no answers to key questions they have highlighted the links between flood risk information provided here and recommended mitigation options going forward. The summary tables below will help to provide a greater evidence base for the Core Strategy and Sustainability Appraisal.

## 8.2 Sustainability Appraisal

Each Council's Sustainability Appraisals, land allocations and development control policies should be informed by the Manchester, Salford and Trafford Level 2 Hybrid SFRA and carried out in liaison with the Environment Agency.

Manchester City Council's and Trafford Council's Sustainability Appraisal have a flood risk objective to *'Reduce the impacts of climate change',* with the sub-objective to, '*Minimise risk of flooding and increase use of SUDS*'. There are two indicators for Manchester and Trafford:

- New developments incorporating SUDS
- New developments in Flood Zone 3

Salford City Council's Sustainability Appraisal has a flood risk objective "To minimise the risk and impacts of flooding". There is one Sustainability Appraisal indicator for Salford:

- Number of dwellings at risk of flooding more often than once every 100 years

The SFRA provides information (e.g. maps, Sequential Test spreadsheet) to measure these indicators and will provide the evidence base to help direct sustainable development.

## 8.3 Planning considerations

In the first instance the Sequential Test should be applied to all proposed development to confirm that there are no reasonable alternatives on land with a lower probability of flooding which deliver the same planning objectives. The results from the Level 2 SFRA have identified that there are significant areas of developed land in Manchester, Salford and Trafford where existing development has a high probability of flooding.

If, following the application of the Sequential Test, it is identified that there is a requirement to place additional development in areas with a high or medium probability of flooding then the following issues must be considered:

- The level of "actual" flood risk to the strategic sites should be evaluated
- The implications of climate change on the level of "actual" risk should be understood and
- The implications of residual risk, as a consequence of overtopping or breach of defences should be determined

This further review is needed to understand whether development can be made safe from flooding, including whether it has the potential to pass part (c) of the Exception Test if it is needed. In order to pass the Exception Test, the LPA must demonstrate that all of the three conditions must be passed (see paragraph D9 of PPS25):

a. *It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. If the LDD has reached the 'submission' stage (see Figure 4.1 of PPS12:*

*Local Development Frameworks) the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal;*

b. *The development should be on developable previously-developed land or, if it is not on previously-developed land, that there are no reasonable alternative sites on developable previously-developed land; and*

c. *A site-specific Flood Risk Assessment must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.*

Having followed this procedure it is then possible to consider the appropriate responses that will be required to protect the strategic sites/ locations in detail. It will be necessary to consider the full range of responses according to the type of risk being addressed and if new development is being proposed then this must be done in accordance with the guidance given in PPS25 and the associated Practice Guide.

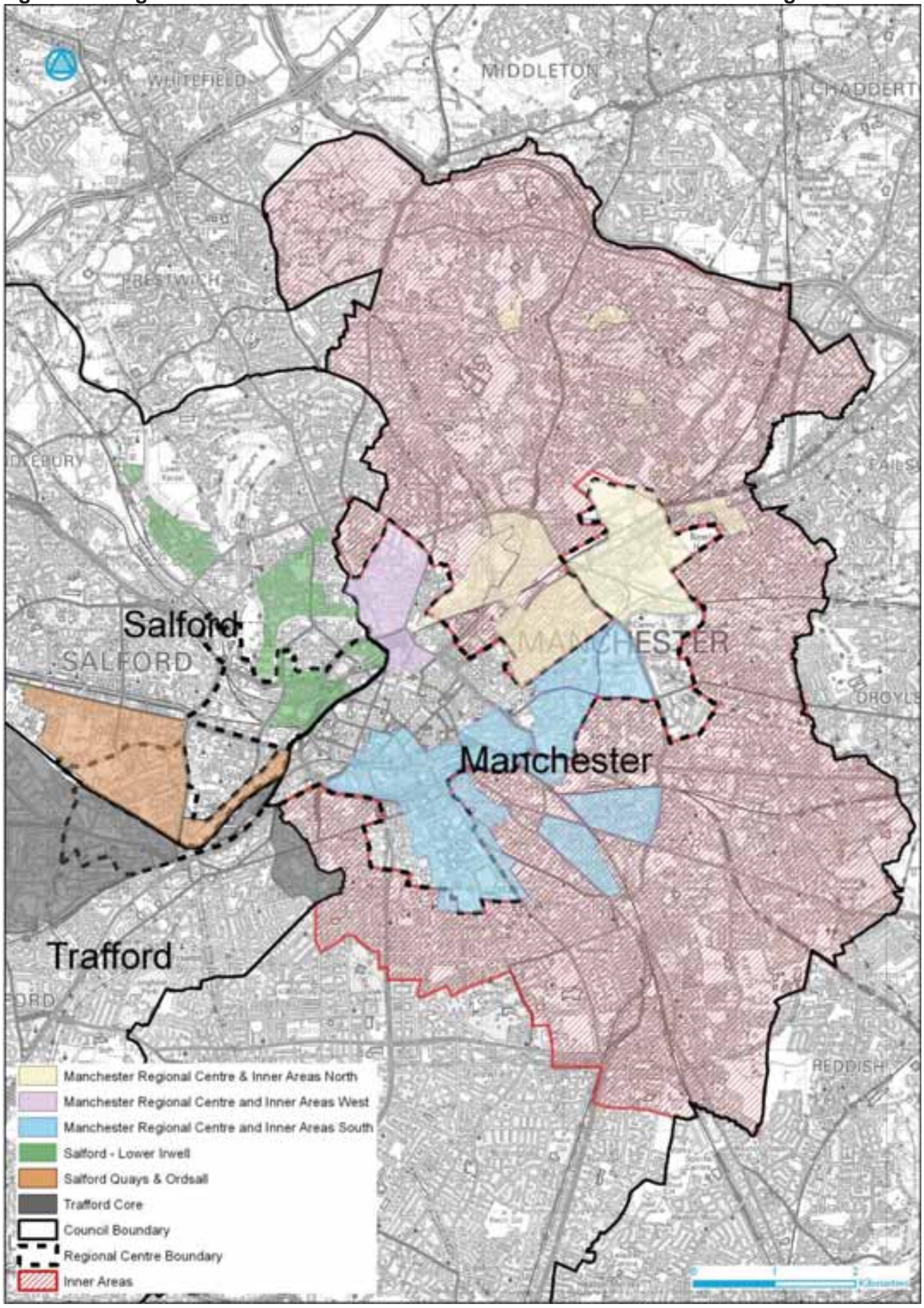
## 8.4 Regional Centre and Inner Areas

In line with the spatial focus of the RSS, the priority areas for housing and employment development within the three authorities are contained within the core of the conurbation, although some more peripheral areas also contain important development locations.

- Manchester's development is focused on 41 strategic sites within the Regional Centre and Inner Areas, as well as at Manchester Airport.
- Salford's development also has a strong focus on the Regional Centre and Inner Areas in Central Salford
- Trafford's development also has a strong focus on the Regional Centre / Inner Areas. There are 18 Strategic Locations and other development areas identified in the emerging Core Strategy.

An overview map, showing the coverage of the Regional Centre and Inner Areas in relation to the strategic locations within the Level 2 SFRA is shown on Figure 8-1.

**Figure 8-1 Regional Centre and Inner Areas in relation to Level 2 SFRA Strategic Locations**



## 8.5 Manchester City Council

The Strategic Locations assessed within Manchester City Council include:

1. **Regional Centre and Inner Areas West**

   This includes the following Strategic Employment Sites: Strangeways (M0004) and Victoria (M0005).

2. **Regional Centre and Inner Areas North**

   This includes the following Strategic Housing and Employment Sites: Central Park (M0003), Miles Platting (M0008), Newton Heath (M0009), Collyhurst (M0013), Harpurhey/Moston (M0015 to M0020), Irk Valley (M0021), Booth Hall (M0022) and Blackley Village (M0023).

3. **Regional Centre and Inner Areas South**

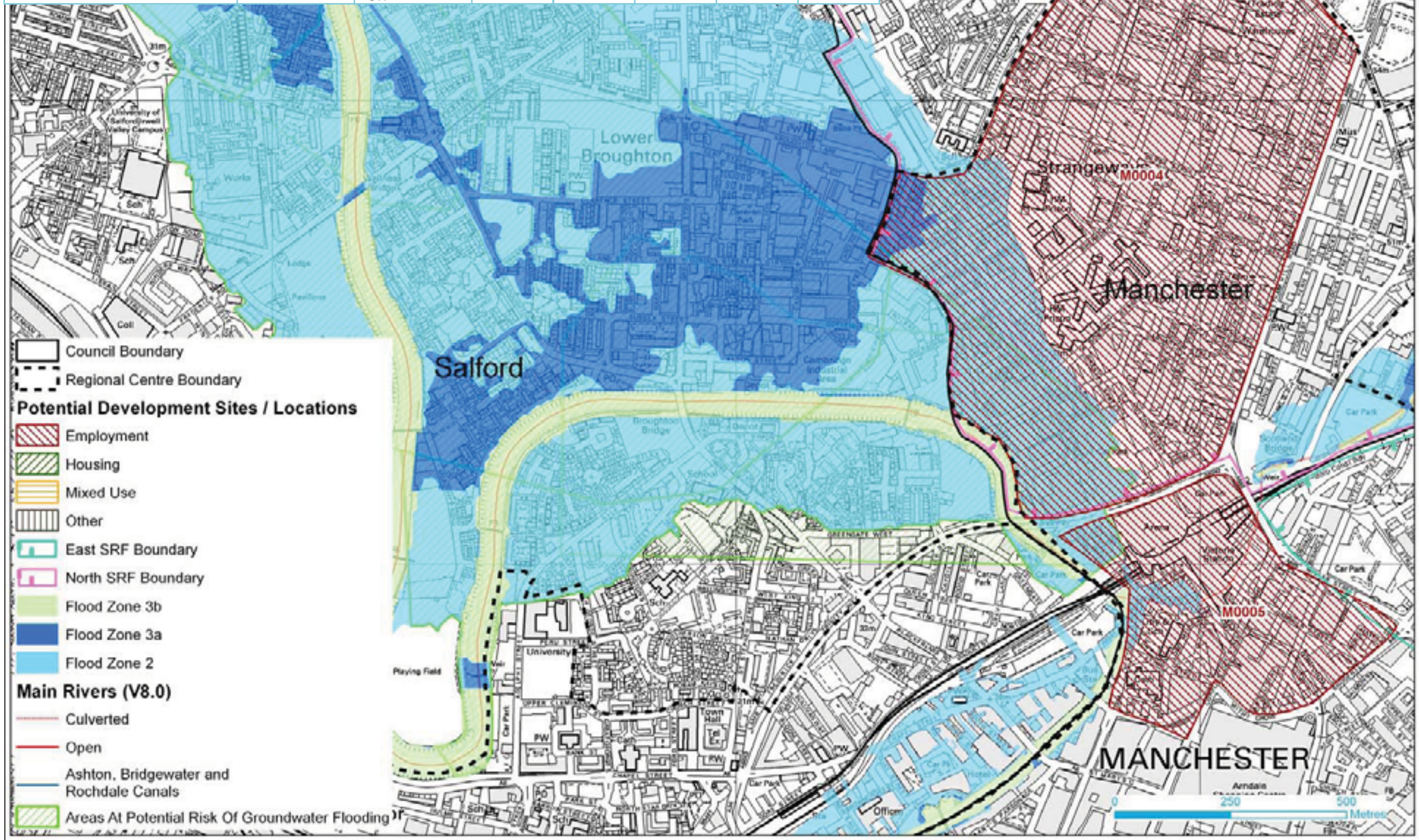
   This includes the following Strategic Housing and Employment Sites: Eastern Gateway (M0001), Sport City (M0002), West Gorton (M0010), Brunswick (M0011), Coverdale Crescent/New Bank Street (M0012), Holt Town (M0024), Chancellors Place (M0025), Lower Medlock (M0026) and Oxford Road Corridor (M0042).

4. **Manchester South**

   This includes the following Strategic Employment Sites: Roundthorn (M0006) and Airport (M0007).

The flood risk summary below will help to provide a greater evidence base for the Core Strategy and Sustainability Appraisal.

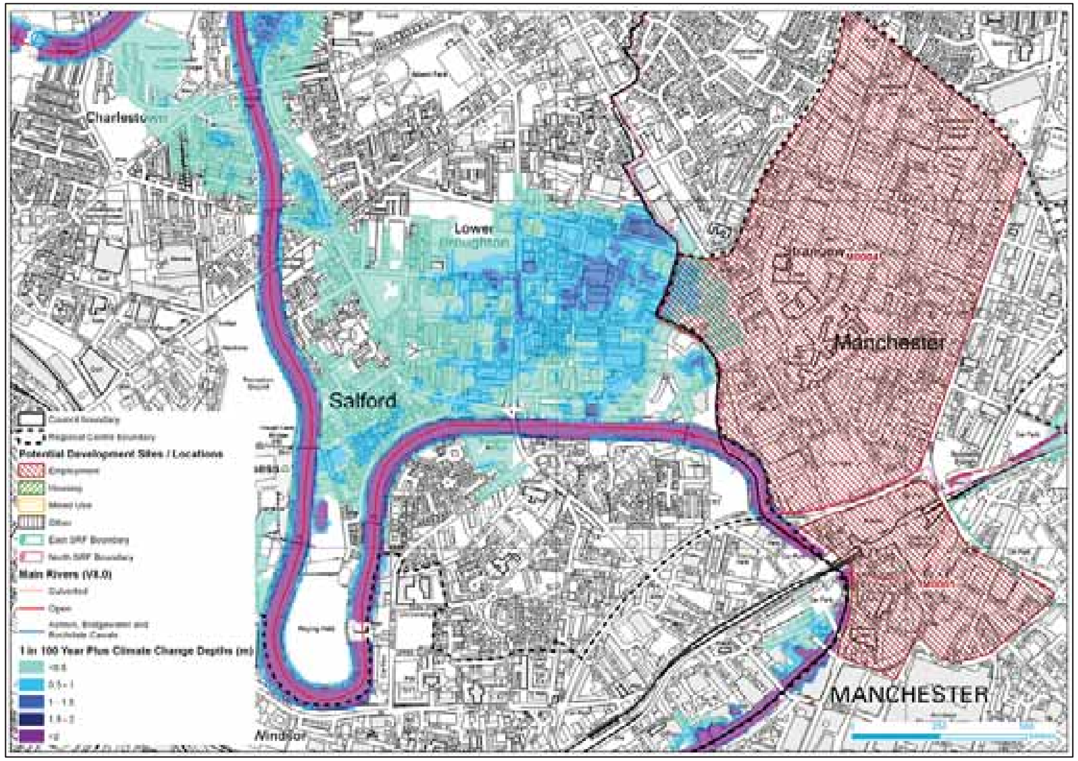
| Strategic Location | Regional Centre and Inner Areas West | | | | | | |
|---|---|---|---|---|---|---|---|
| Primary Source of Flood Risk | Irwell (Ir), Grey Irwell (GI) | | | | | | |
| Secondary Sources of Flood Risk | Surface water (SW), Lost watercourses (LW), Groundwater (GW) | | | | | | |
| Development Sites | | | Environment Agency Flood Maps | | | | |
| | Proposed Land Use | Sources of Flooding | Total area (km²) | Flood Zone 1 (%) | Flood Zone 2 (%) | Flood Zone 3a (%) | Flood Zone 3b (%) |
| Strangeways (M0004) | Employment | Ir, SW, LW, GW | 0.84 | 77.32 | 20.76 | 1.74 | 0.18 |
| Victoria (M0005) | Employment | Ir, GI, SW, LW, GW | 0.22 | 91.64 | 8.31 | 0.00 | 0.05 |



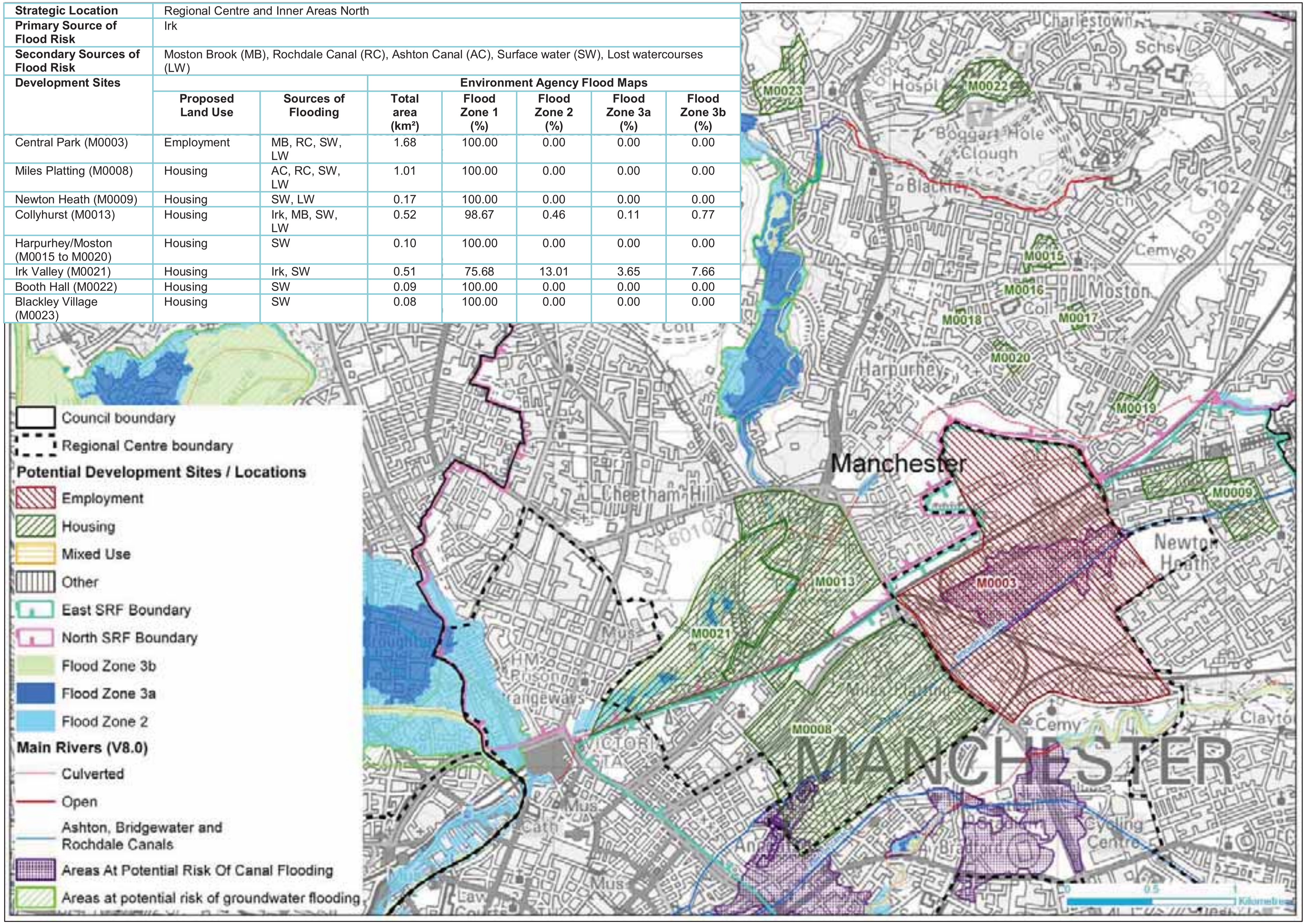
## Regional Centre and Inner Areas West

| **Understanding Flood Risk** | **Comment (Yes / No)** |
| --- | --- |
| Are the development sites in the area at significant risk during a 1 in 100 year event, considering climate change? | No, a limited area of Strangeways M0004 is affected in this event |
| Is there a consistent asset standard of protection? | Yes, provided by the Lower Kersal FSA and raised defences and the large channel capacity of the Grey Irwell |
| Is there a consistent asset condition? | Yes |
| Is there a significant possibility of assets breaching or failing? | Yes, defences on the Lower Irwell |
| Could assets overtop during climate change or extreme events? | Yes |
| Is overall residual risk significant in the area? | Yes |
| Are there other sources of flooding? | Yes, groundwater flood risk should be considered in the design of buildings to mitigate risk<br>Localised surface water flood risk, including that from 'lost watercourses' |
| Is flood risk a significant environmental issues/constraint? | Yes |
| Is the area at significant residual risk during a 1 in 1000 year event? | Yes |
| | |
| **Managing Flood Risk** | |
| Does development need to be considered strategically? | Yes |
| Can development proceed in a piecemeal basis? | No |
| Flood Risk Management Strategy required? | Yes |
| Is floodplain compensation required? | Yes, at Strangeways M0004 |
| Can storage be delivered within site? | Yes |
| | |
| **Likelihood of passing Exception Test** | |
| Will there be off site effects? | Potentially, in Conurbation Core CDA |
| Will flood risk be an urban design issue? | Yes |
| Can residual risk be successfully managed? | Yes |
| Could development reduce risk? | Yes, by considered reductions in surface water runoff and mitigation of flood risk |



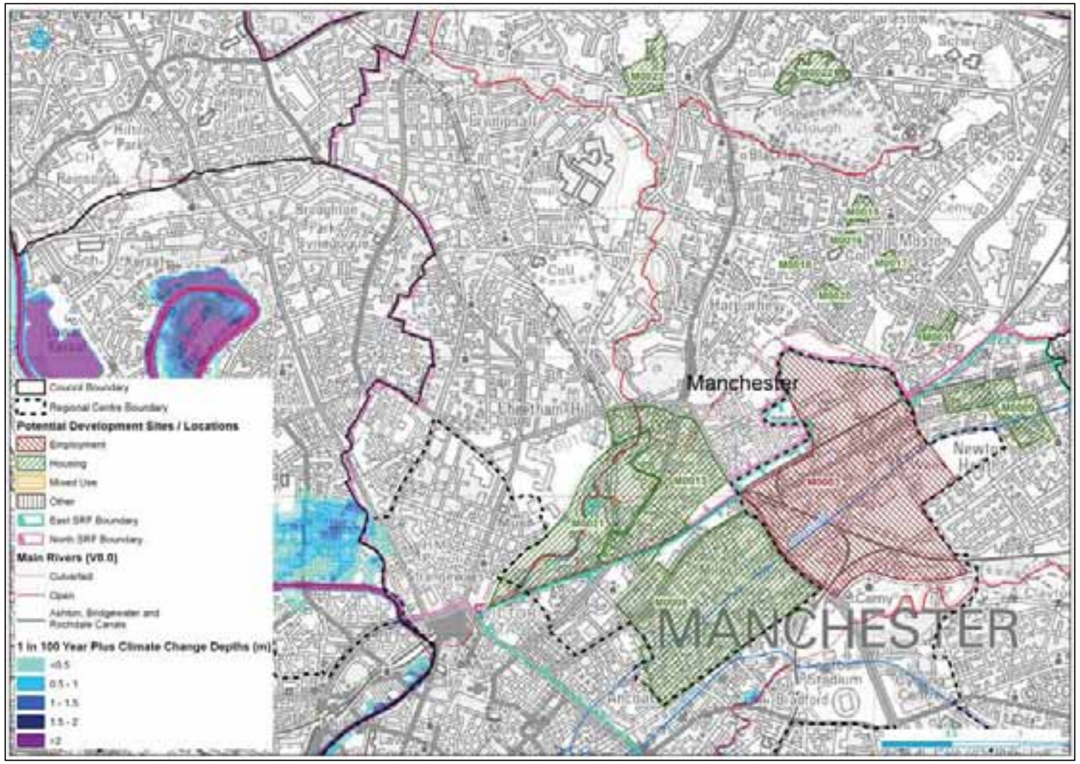

  

| Strategic Location | Regional Centre and Inner Areas North | | | | | | |
|---|---|---|---|---|---|---|---|
| Primary Source of Flood Risk | Irk | | | | | | |
| Secondary Sources of Flood Risk | Moston Brook (MB), Rochdale Canal (RC), Ashton Canal (AC), Surface water (SW), Lost watercourses (LW) | | | | | | |
| Development Sites | | | Environment Agency Flood Maps | | | | |
| | Proposed Land Use | Sources of Flooding | Total area (km²) | Flood Zone 1 (%) | Flood Zone 2 (%) | Flood Zone 3a (%) | Flood Zone 3b (%) |
| Central Park (M0003) | Employment | MB, RC, SW, LW | 1.68 | 100.00 | 0.00 | 0.00 | 0.00 |
| Miles Platting (M0008) | Housing | AC, RC, SW, LW | 1.01 | 100.00 | 0.00 | 0.00 | 0.00 |
| Newton Heath (M0009) | Housing | SW, LW | 0.17 | 100.00 | 0.00 | 0.00 | 0.00 |
| Collyhurst (M0013) | Housing | Irk, MB, SW, LW | 0.52 | 98.67 | 0.46 | 0.11 | 0.77 |
| Harpurhey/Moston (M0015 to M0020) | Housing | SW | 0.10 | 100.00 | 0.00 | 0.00 | 0.00 |
| Irk Valley (M0021) | Housing | Irk, SW | 0.51 | 75.68 | 13.01 | 3.65 | 7.66 |
| Booth Hall (M0022) | Housing | SW | 0.09 | 100.00 | 0.00 | 0.00 | 0.00 |
| Blackley Village (M0023) | Housing | SW | 0.08 | 100.00 | 0.00 | 0.00 | 0.00 |

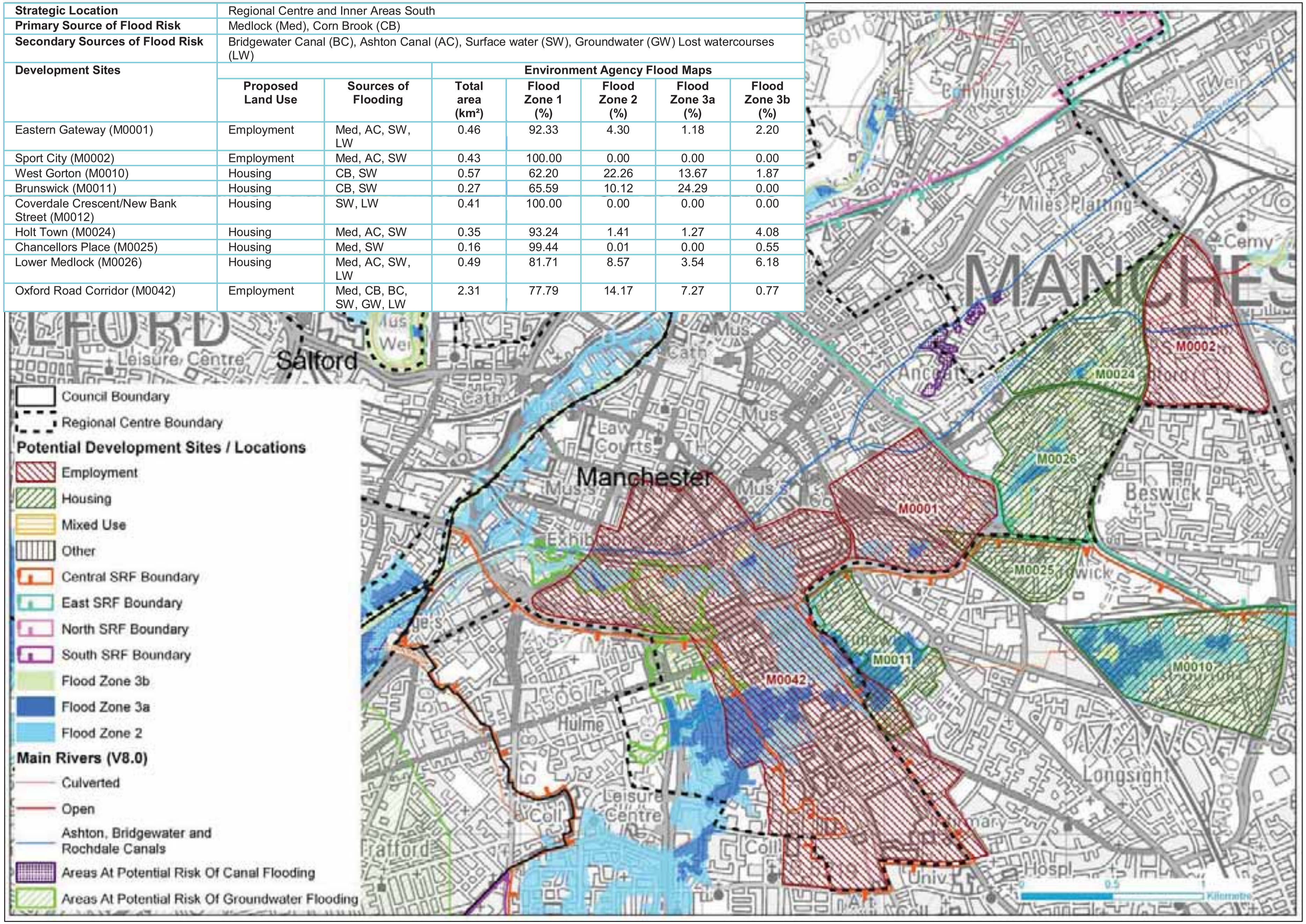


## Regional Centre and Inner Areas North

| Understanding Flood Risk | Comment (Yes / No) |
|---|---|
| Are the development sites in the area at significant risk during a 1 in 100 year event, considering climate change? | Yes, Irk Valley (M0021) |
| Is there a consistent asset standard of protection? | No |
| Is there a consistent asset condition? | No |
| Is there a significant possibility of assets breaching or failing? | Yes, culvert blockage or breach of the Rochdale Canal |
| Could assets overtop during climate change or extreme events? | Yes |
| Is overall residual risk significant in the area? | Yes, from culvert blockage or breach of the Rochdale Canal |
| Are there other sources of flooding? | Yes, both canal and groundwater flood risk should be considered in the design of buildings to mitigate risk<br>Localised surface water flood risk, including that from 'lost watercourses' |
| Is flood risk a significant environmental issues/constraint? | Yes |
| Is the area at significant residual risk during a 1 in 1000 year event? | Yes, Irk Valley (M0021) |
| | |
| **Managing Flood Risk** | |
| Does development need to be considered strategically? | Yes |
| Can development proceed in a piecemeal basis? | No |
| Flood Risk Management Strategy required? | No |
| Is floodplain compensation required? | Yes |
| Can storage be delivered within site? | Yes and key flow conveyance routes should be maintained |
| | |
| **Likelihood of passing Exception Test** | |
| Will there be off site effects? | Potentially, in Conurbation Core CDA |
| Will flood risk be an urban design issue? | Yes |
| Can residual risk be successfully managed? | Yes |
| Could development reduce risk? | Yes, by considered reductions in surface water runoff and mitigation of flood risk |

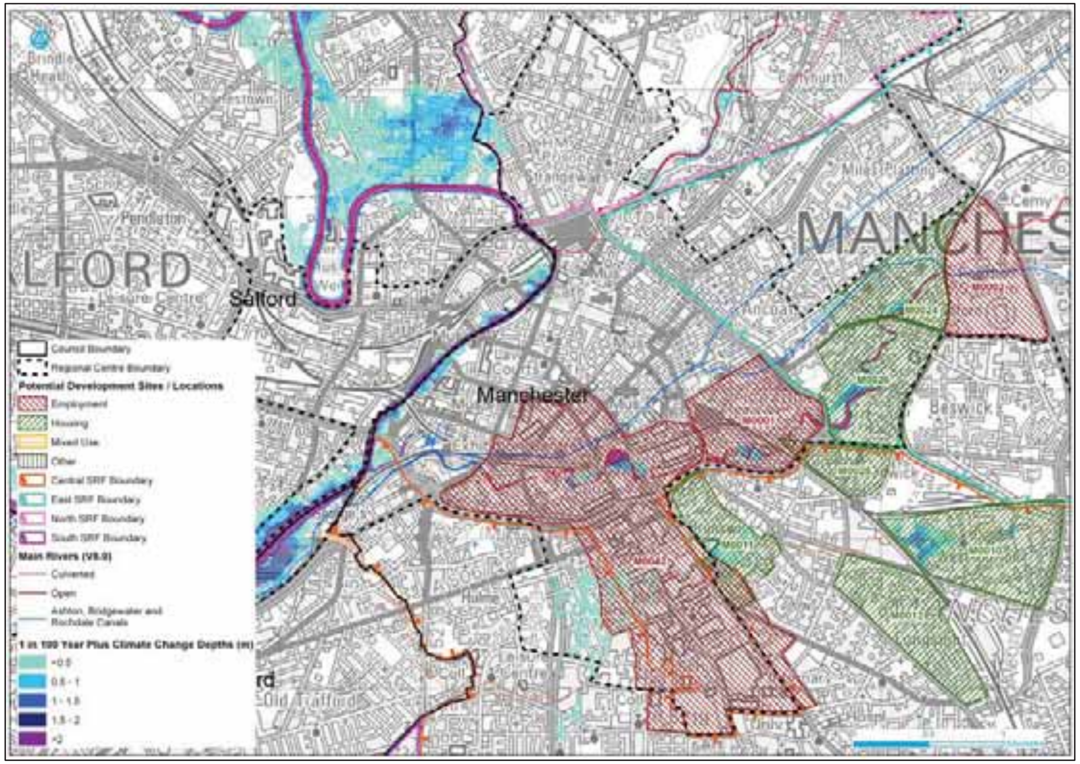


| Strategic Location | Regional Centre and Inner Areas South | | | | | | |
|---|---|---|---|---|---|---|---|
| Primary Source of Flood Risk | Medlock (Med), Corn Brook (CB) | | | | | | |
| Secondary Sources of Flood Risk | Bridgewater Canal (BC), Ashton Canal (AC), Surface water (SW), Groundwater (GW) Lost watercourses (LW) | | | | | | |
| Development Sites | | | Environment Agency Flood Maps | | | | |
| | Proposed Land Use | Sources of Flooding | Total area (km²) | Flood Zone 1 (%) | Flood Zone 2 (%) | Flood Zone 3a (%) | Flood Zone 3b (%) |
| Eastern Gateway (M0001) | Employment | Med, AC, SW, LW | 0.46 | 92.33 | 4.30 | 1.18 | 2.20 |
| Sport City (M0002) | Employment | Med, AC, SW | 0.43 | 100.00 | 0.00 | 0.00 | 0.00 |
| West Gorton (M0010) | Housing | CB, SW | 0.57 | 62.20 | 22.26 | 13.67 | 1.87 |
| Brunswick (M0011) | Housing | CB, SW | 0.27 | 65.59 | 10.12 | 24.29 | 0.00 |
| Coverdale Crescent/New Bank Street (M0012) | Housing | SW, LW | 0.41 | 100.00 | 0.00 | 0.00 | 0.00 |
| Holt Town (M0024) | Housing | Med, AC, SW | 0.35 | 93.24 | 1.41 | 1.27 | 4.08 |
| Chancellors Place (M0025) | Housing | Med, SW | 0.16 | 99.44 | 0.01 | 0.00 | 0.55 |
| Lower Medlock (M0026) | Housing | Med, AC, SW, LW | 0.49 | 81.71 | 8.57 | 3.54 | 6.18 |
| Oxford Road Corridor (M0042) | Employment | Med, CB, BC, SW, GW, LW | 2.31 | 77.79 | 14.17 | 7.27 | 0.77 |

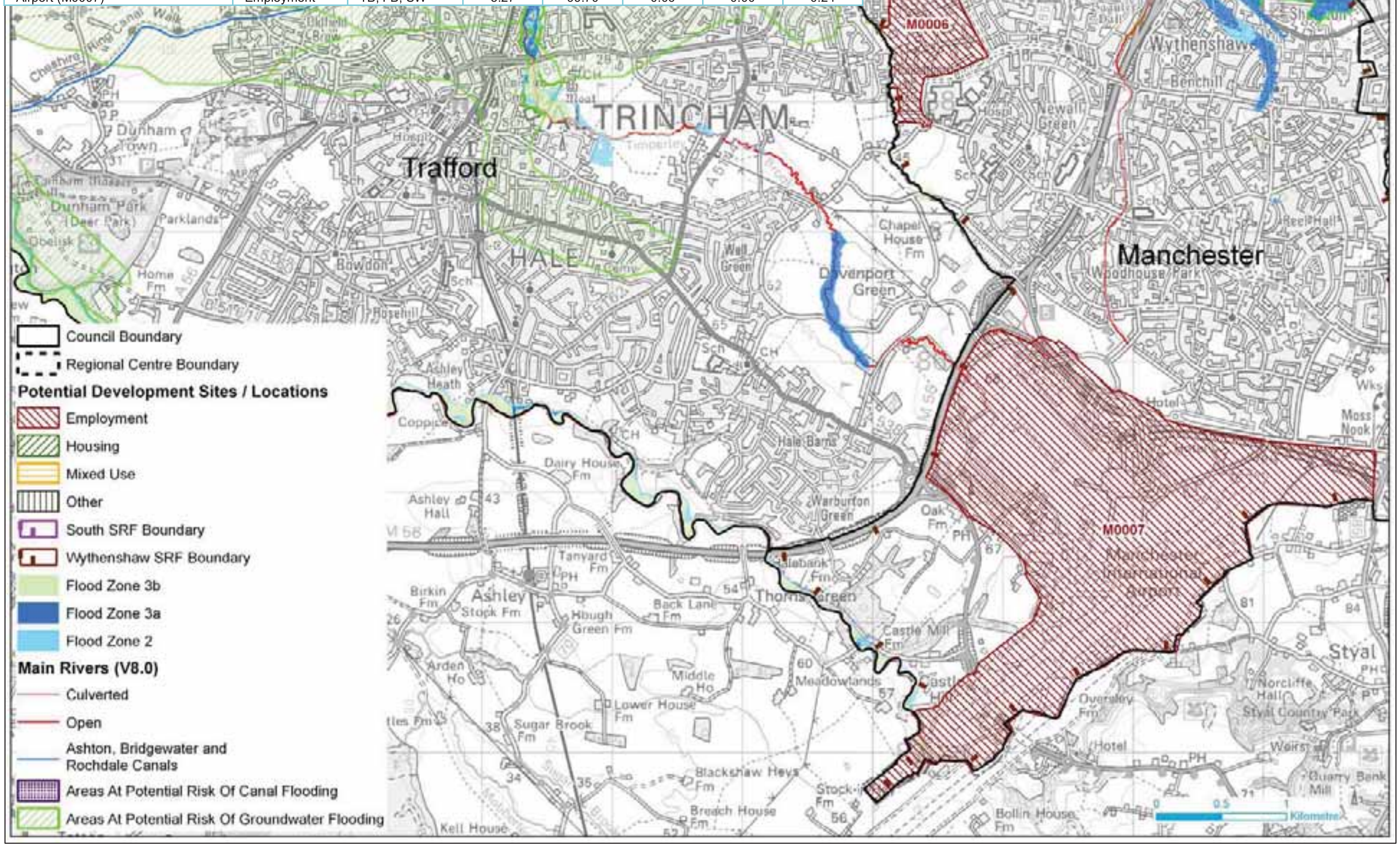


## Regional Centre and Inner Areas South

| Understanding Flood Risk | Comment (Yes / No) |
|---|---|
| Are the development sites in the area at significant risk during a 1 in 100 year event, considering climate change? | Yes, Holt Town M0024, Lower Medlock M0026, Chancellors Place M0025, Eastern Gateway M0001 and Oxford Road Corridor M0042 (River Medlock) West Gorton M0010 (Corn Brook) |
| Is there a consistent asset standard of protection? | No |
| Is there a consistent asset condition? | No |
| Is there a significant possibility of assets breaching or failing? | Yes, culvert blockage or breach of the Ashton Canal |
| Could assets overtop during climate change or extreme events? | Yes |
| Is overall residual risk significant in the area? | Yes, from culvert blockage or breach of the Ashton Canal |
| Are there other sources of flooding? | Yes, both canal and groundwater flood risk should be considered in the design of buildings to mitigate risk<br>Localised surface water flood risk, including that from 'lost watercourses' |
| Is flood risk a significant environmental issues/constraint? | Yes |
| Is the area at significant residual risk during a 1 in 1000 year event? | Yes, Holt Town M0024, Lower Medlock M0026, Chancellors Place M0025, Eastern Gateway M0001 and Oxford Road Corridor M0042 (River) Medlock) West Gorton M0010 (Corn Brook) |
| | |
| **Managing Flood Risk** | |
| Does development need to be considered strategically? | Yes |
| Can development proceed in a piecemeal basis? | No |
| Flood Risk Management Strategy required? | Yes |
| Is floodplain compensation required? | Yes |
| Can storage be delivered within site? | Yes and key flow conveyance routes should be maintained |
| | |
| **Likelihood of passing Exception Test** | |
| Will there be off site effects? | Potentially, in Conurbation Core CDA |
| Will flood risk be an urban design issue? | Yes |
| Can residual risk be successfully managed? | Yes |
| Could development reduce risk? | Yes, by considered reductions in surface water runoff and mitigation of flood risk |



| Strategic Location | Manchester South | | | | | | |
|---|---|---|---|---|---|---|---|
| **Primary Source of Flood Risk** | Timperley Brook (TB), Fairywell Brook (FB) | | | | | | |
| **Secondary Sources of Flood Risk** | Surface water (SW) | | | | | | |
| **Development Sites** | | | Environment Agency Flood Maps | | | | |
| | **Proposed Land Use** | **Sources of Flooding** | **Total area (km²)** | **Flood Zone 1 (%)** | **Flood Zone 2 (%)** | **Flood Zone 3a (%)** | **Flood Zone 3b (%)** |
| Roundthorn (M0006) | Employment | FB, SW | 0.67 | 99.79 | 0.00 | 0.00 | 0.21 |
| Airport (M0007) | Employment | TB, FB, SW | 5.27 | 99.70 | 0.06 | 0.00 | 0.24 |



## Manchester South

| **Understanding Flood Risk** | **Comment (Yes / No)** |
|---|---|
| Are the development sites in the area at significant risk during a 1 in 100 year event, considering climate change? | No |
| Is there a consistent asset standard of protection? | No |
| Is there a consistent asset condition? | No |
| Is there a significant possibility of assets breaching or failing? | No |
| Could assets overtop during climate change or extreme events? | No |
| Is overall residual risk significant in the area? | No |
| Are there other sources of flooding? | Significant risk of surface water flooding to Roundthorn M0006<br>Localised surface water flood risk elsewhere |
| Is flood risk a significant environmental issues/constraint? | No |
| Is the area at significant residual risk during a 1 in 1000 year event? | No |
| | |
| **Managing Flood Risk** | |
| Does development need to be considered strategically? | No |
| Can development proceed in a piecemeal basis? | Yes |
| Flood Risk Management Strategy required? | No |
| Is floodplain compensation required? | No |
| Can the loss of floodplain be compensated within site? | N/A |
| | |
| **Likelihood of passing Exception Test** | |
| Will there be off site effects? | Potentially, in Manchester and Trafford South CDA |
| Will flood risk be an urban design issue? | Yes |
| Can residual risk be successfully managed? | Yes |
| Could development reduce risk? | Yes, by considered reductions in surface water runoff and mitigation of flood risk |

## 8.6 Salford City Council

The Strategic Locations assessed within Salford City Council include:

1. **Lower Irwell**

   This includes the following Strategic Housing, Employment and Mixed Sites: Lower Broughton (S0001), Charlestown Riverside (S0002) including St George's Way (S0400) & Charlestown & Lower Kersal (S0401), Cambridge Industrial Estate (S0399), Charlestown and Lower Kersal (S0405), Exchange Greengate (S0417 to S0424), Salford Central (S0425 to S0429)

2. **Salford Quays and Ordsall**

   This includes the following Strategic Mixed Sites: Ordsall Riverside (S0392) and Media City UK (S0415) including Salford Quays (S0017) and Land at Erie Basin (S0014)

3. **Salford North West**

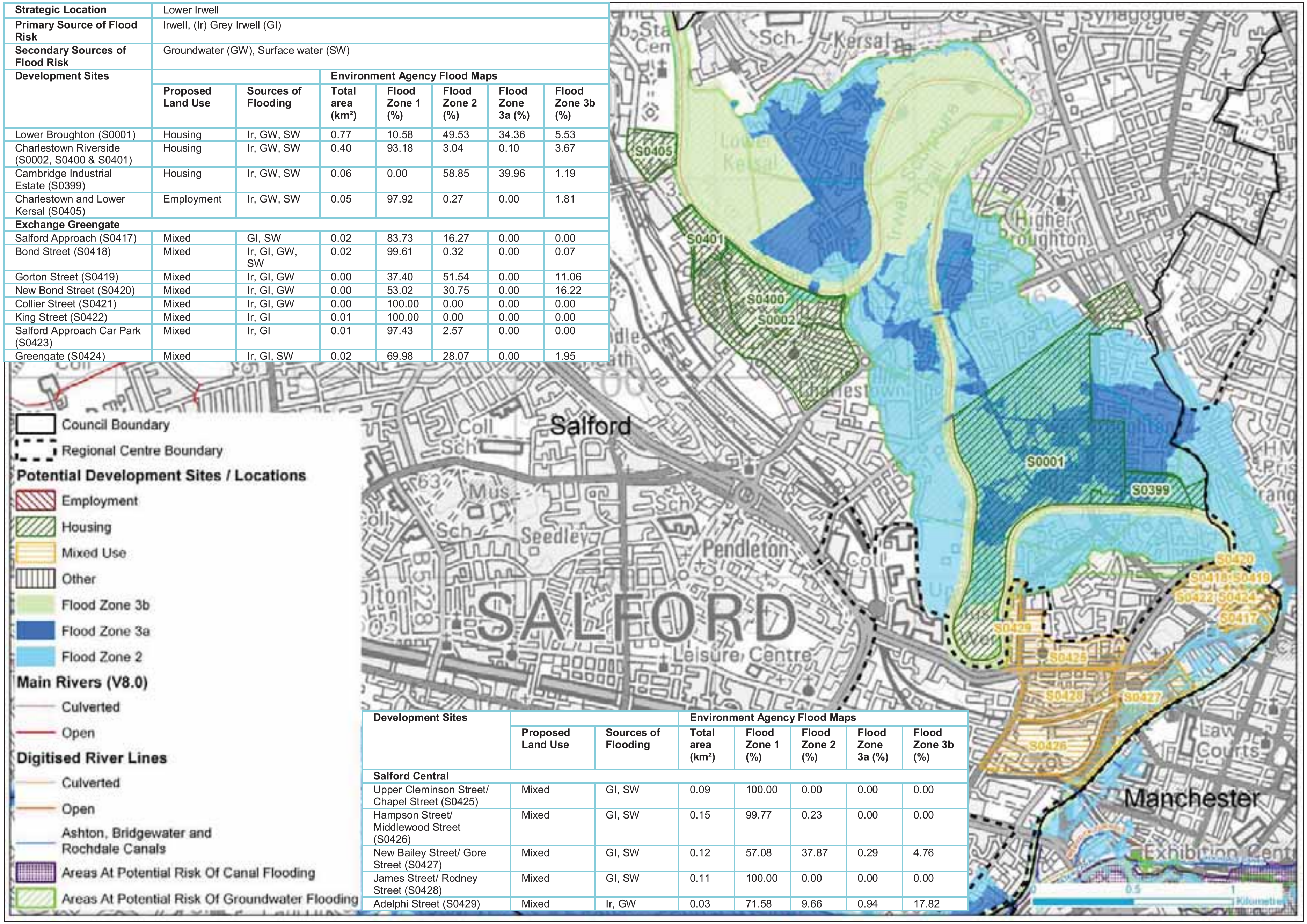
   This includes the following Strategic Housing Sites: Linnyshaw (S0004) Legh Street (S0395) Cawdor Street (S0396) Great Universal Stores (S0397, S0398)

4. **Barton and Irlam**

   This includes the following Strategic Housing and Employment Sites: Irlam Wharf Road (S0009), Barton Stadium (S0011), Irlam and Cadishead (S0404), Irlam and Cadishead, Liverpool Road (S0408), Barton (S0412)

The flood risk summaries below will help to provide a greater evidence base for the Core Strategy and Sustainability Appraisal.

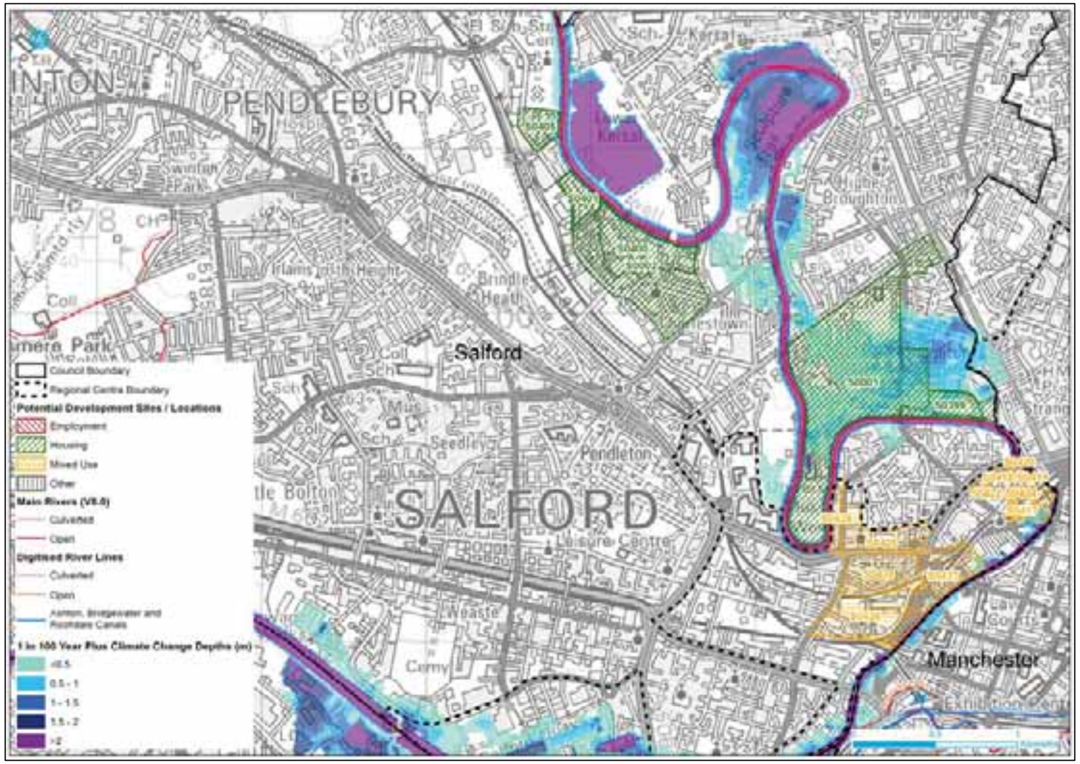
| Strategic Location | Lower Irwell | | | | | | |
|---|---|---|---|---|---|---|---|
| Primary Source of Flood Risk | Irwell, (Ir) Grey Irwell (GI) | | | | | | |
| Secondary Sources of Flood Risk | Groundwater (GW), Surface water (SW) | | | | | | |
| Development Sites | | | Environment Agency Flood Maps | | | | |
| | Proposed Land Use | Sources of Flooding | Total area (km²) | Flood Zone 1 (%) | Flood Zone 2 (%) | Flood Zone 3a (%) | Flood Zone 3b (%) |
| Lower Broughton (S0001) | Housing | Ir, GW, SW | 0.77 | 10.58 | 49.53 | 34.36 | 5.53 |
| Charlestown Riverside (S0002, S0400 & S0401) | Housing | Ir, GW, SW | 0.40 | 93.18 | 3.04 | 0.10 | 3.67 |
| Cambridge Industrial Estate (S0399) | Housing | Ir, GW, SW | 0.06 | 0.00 | 58.85 | 39.96 | 1.19 |
| Charlestown and Lower Kersal (S0405) | Employment | Ir, GW, SW | 0.05 | 97.92 | 0.27 | 0.00 | 1.81 |
| **Exchange Greengate** | | | | | | | |
| Salford Approach (S0417) | Mixed | GI, SW | 0.02 | 83.73 | 16.27 | 0.00 | 0.00 |
| Bond Street (S0418) | Mixed | Ir, GI, GW, SW | 0.02 | 99.61 | 0.32 | 0.00 | 0.07 |
| Gorton Street (S0419) | Mixed | Ir, GI, GW | 0.00 | 37.40 | 51.54 | 0.00 | 11.06 |
| New Bond Street (S0420) | Mixed | Ir, GI, GW | 0.00 | 53.02 | 30.75 | 0.00 | 16.22 |
| Collier Street (S0421) | Mixed | Ir, GI, GW | 0.00 | 100.00 | 0.00 | 0.00 | 0.00 |
| King Street (S0422) | Mixed | Ir, GI | 0.01 | 100.00 | 0.00 | 0.00 | 0.00 |
| Salford Approach Car Park (S0423) | Mixed | Ir, GI | 0.01 | 97.43 | 2.57 | 0.00 | 0.00 |
| Greengate (S0424) | Mixed | Ir, GI, SW | 0.02 | 69.98 | 28.07 | 0.00 | 1.95 |



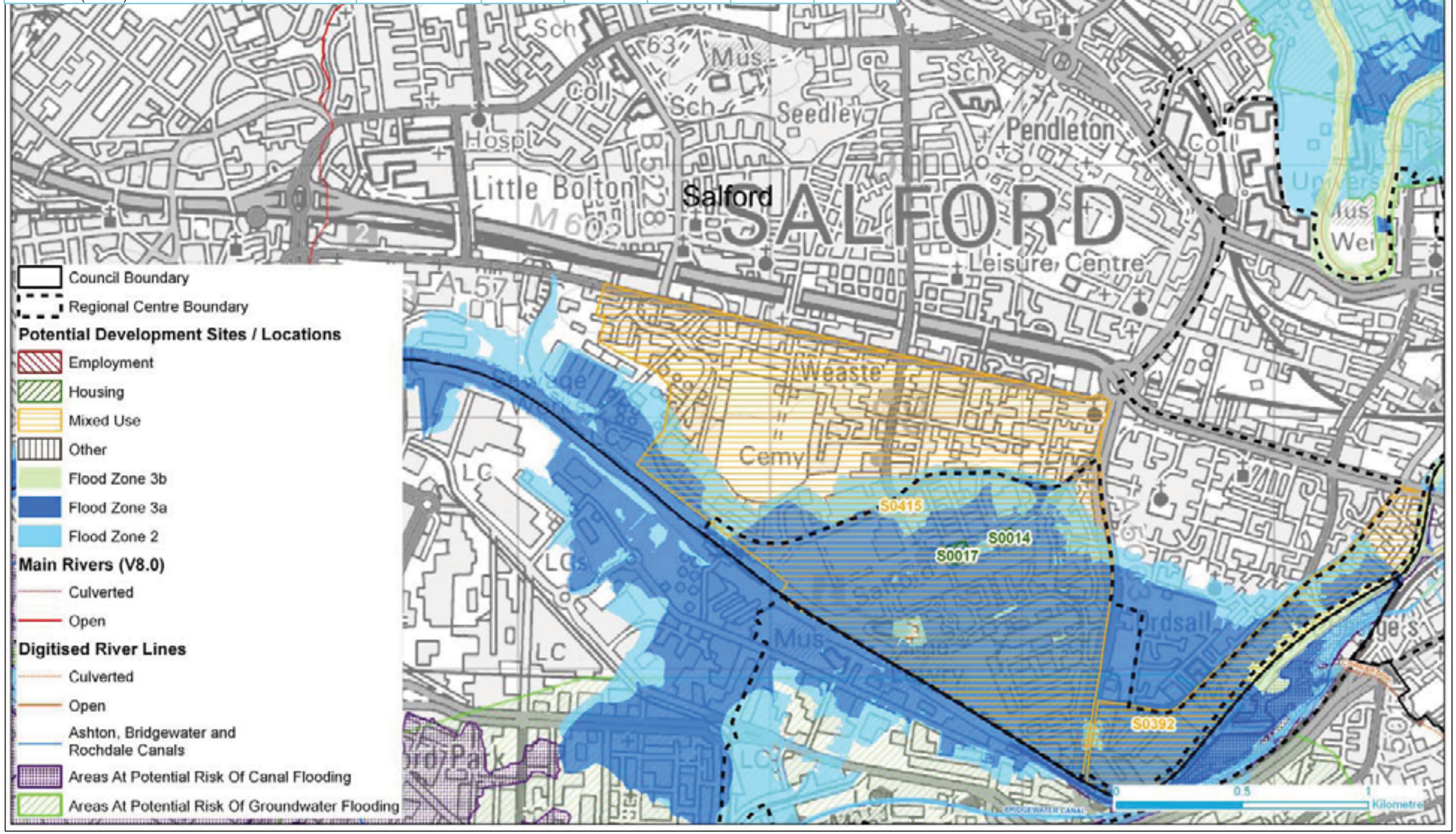

| Development Sites | Proposed Land Use | Sources of Flooding | Environment Agency Flood Maps | | | | |
|---|---|---|---|---|---|---|---|
| | | | Total area (km²) | Flood Zone 1 (%) | Flood Zone 2 (%) | Flood Zone 3a (%) | Flood Zone 3b (%) |
| **Salford Central** | | | | | | | |
| Upper Cleminson Street/ Chapel Street (S0425) | Mixed | GI, SW | 0.09 | 100.00 | 0.00 | 0.00 | 0.00 |
| Hampson Street/ Middlewood Street (S0426) | Mixed | GI, SW | 0.15 | 99.77 | 0.23 | 0.00 | 0.00 |
| New Bailey Street/ Gore Street (S0427) | Mixed | GI, SW | 0.12 | 57.08 | 37.87 | 0.29 | 4.76 |
| James Street/ Rodney Street (S0428) | Mixed | GI, SW | 0.11 | 100.00 | 0.00 | 0.00 | 0.00 |
| Adelphi Street (S0429) | Mixed | Ir, GW | 0.03 | 71.58 | 9.66 | 0.94 | 17.82 |

## Lower Irwell

| Understanding Flood Risk | Comment (Yes / No) |
|---|---|
| Are the development sites in the area at significant risk during a 1 in 100 year event, considering climate change? | Yes, from the Lower Irwell |
| Is there a consistent asset standard of protection? | Yes, provided by the Lower Kersal FSA and raised defences and the large channel capacity of the Grey Irwell |
| Is there a consistent asset condition? | Yes |
| Is there a significant possibility of assets breaching or failing? | Yes, defences on the Lower Irwell |
| Could assets overtop during climate change or extreme events? | Yes |
| Is overall residual risk significant in the area? | Yes |
| Are there other sources of flooding? | Yes, groundwater flood risk should be considered in the design of buildings to mitigate risk<br>Localised surface water flood risk |
| Is flood risk a significant environmental issues/constraint? | Yes |
| Is the area at significant residual risk during a 1 in 1000 year event? | Yes, from the Lower Irwell and Grey Irwell |
| | |
| **Managing Flood Risk** | |
| Does development need to be considered strategically? | Yes |
| Can development proceed in a piecemeal basis? | No |
| Flood Risk Management Strategy required? | Yes |
| Is floodplain compensation required? | Yes |
| Can the loss of floodplain be compensated within site? | Yes and key flow conveyance routes should be maintained |
| | |
| Likelihood of passing Exception Test | |
| Will there be off site effects? | Potentially, in Conurbation Core CDA |
| Will flood risk be an urban design issue? | Yes |
| Can residual risk be successfully managed? | Yes |
| Could development reduce risk? | Yes, by considered reductions in surface water runoff and mitigation of flood risk |



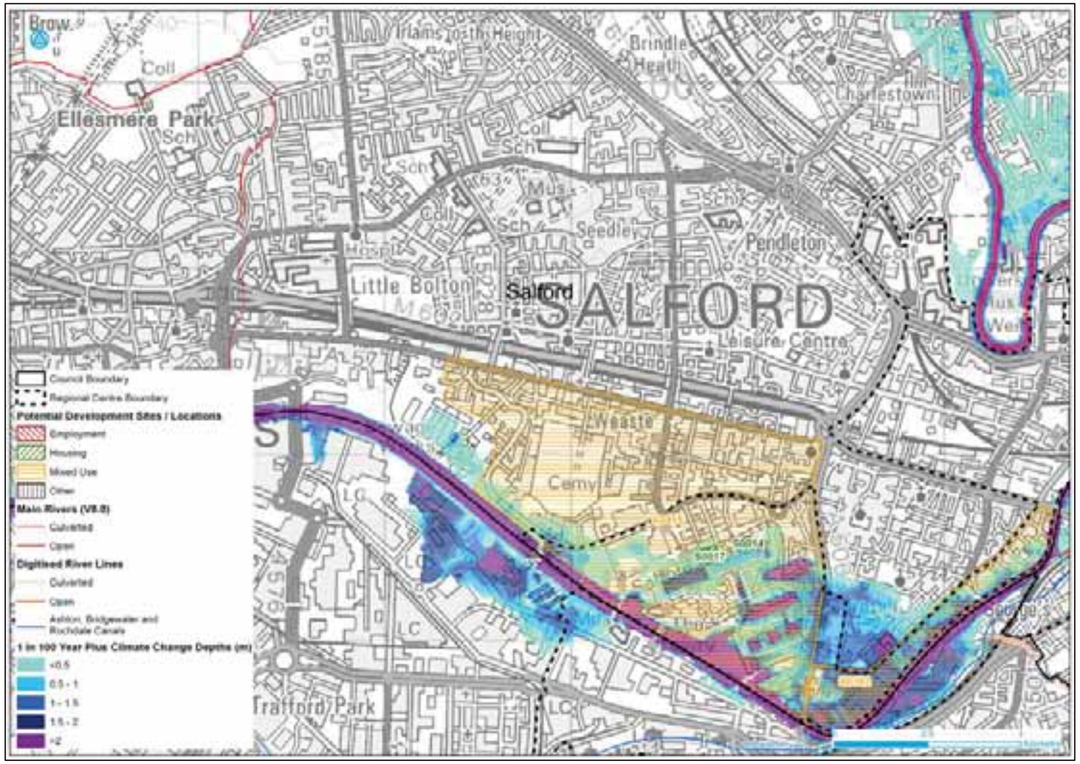
| Strategic Location | Salford Quays and Ordsall | | | | | | |
|---|---|---|---|---|---|---|---|
| **Primary Source of Flood Risk** | Manchester Ship Canal (MSC) | | | | | | |
| **Secondary Sources of Flood Risk** | Groundwater (GW), Surface water (SW) | | | | | | |
| **Development Sites** | | | **Environment Agency Flood Maps** | | | | |
| | **Proposed Land Use** | **Sources of Flooding** | **Total area (km²)** | **Flood Zone 1 (%)** | **Flood Zone 2 (%)** | **Flood Zone 3a (%)** | **Flood Zone 3b (%)** |
| Ordsall Riverside (S0392) | Mixed | MSC, GW, SW | 0.34 | 13.60 | 9.79 | 67.82 | 8.79 |
| Media City UK (S0415) including Salford Quays (S0017) and Land at Erie Basin (S0014) | Mixed | MSC, GW, SW | 2.14 | 44.23 | 12.84 | 42.93 | 0.00 |



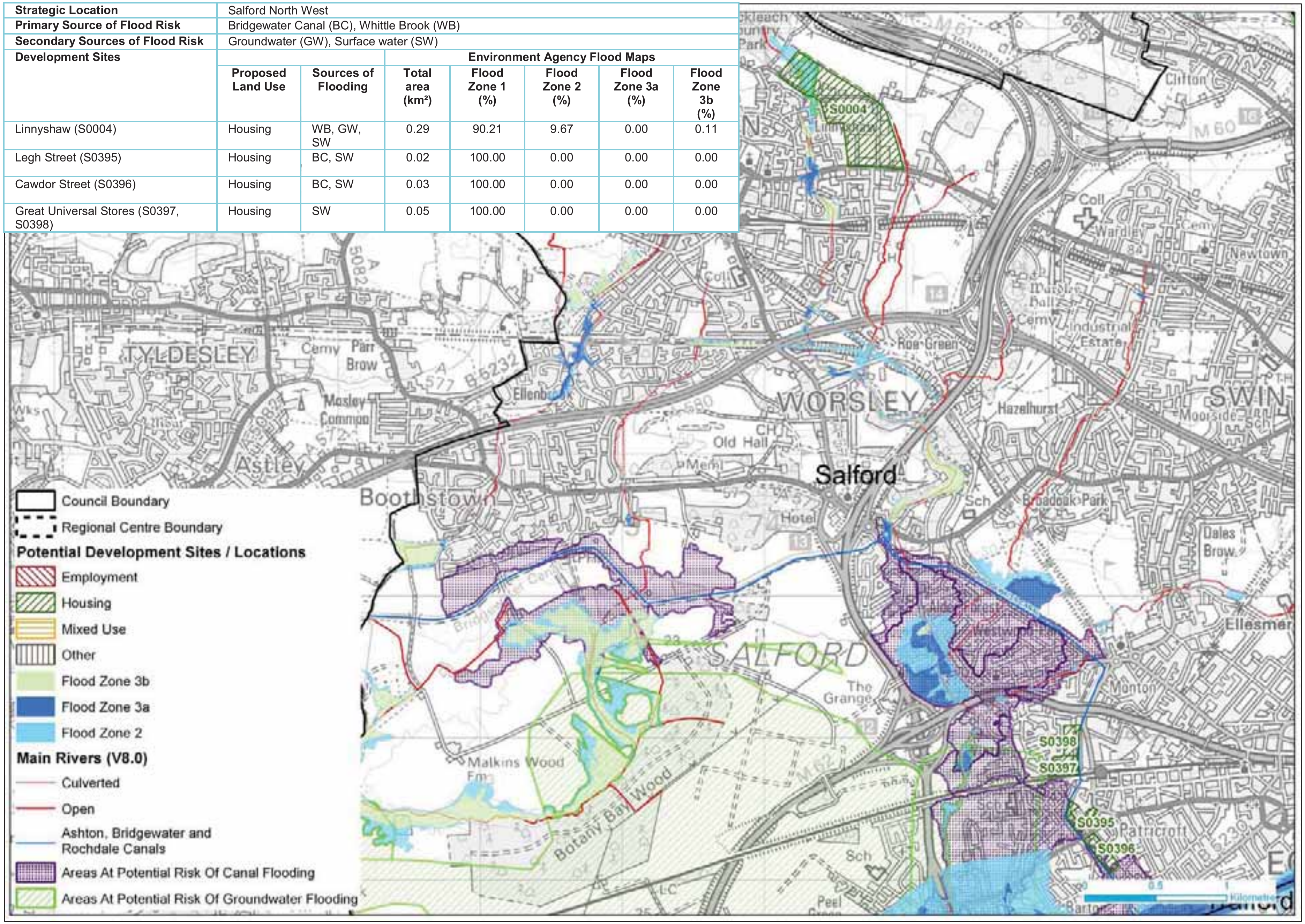
## Salford Quays and Ordsall

| **Understanding Flood Risk** | **Comment (Yes / No)** |
|---|---|
| Are the development sites in the area at significant risk during a 1 in 100 year event, considering climate change? | Yes, residual risk from the MSC |
| Is there a consistent asset standard of protection? | Yes, provided by the operation of sluices on the Manchester Ship Canal The boundary walls of sites do not act as flood defences |
| Is there a consistent asset condition? | Yes |
| Is there a significant possibility of assets breaching or failing? | Yes, due to operational or human error on MSC. |
| Could assets overtop during climate change or extreme events? | Yes |
| Is overall residual risk significant in the area? | Yes |
| Are there other sources of flooding? | Yes, groundwater flood risk should be considered in the design of buildings to mitigate risk<br>Localised surface water flood risk |
| Is flood risk a significant environmental issues/constraint? | Yes |
| Is the area at significant residual risk during a 1 in 1000 year event? | Yes |
| | |
| **Managing Flood Risk** | |
| Does development need to be considered strategically? | Yes |
| Can development proceed in a piecemeal basis? | No |
| Flood Risk Management Strategy required? | Yes |
| Is floodplain compensation required? | Yes |
| Can the loss of floodplain be compensated within site? | Yes, with the exception of Ordsall Riverside S0392 |
| | |
| Likelihood of passing Exception Test | |
| Will there be off site effects? | Potentially, in Conurbation Core and Salford North West CDAs |
| Will flood risk be an urban design issue? | Yes |
| Can residual risk be successfully managed? | Yes |
| Could development reduce risk? | Yes, by considered reductions in surface water runoff and mitigation of flood risk , with the exception of Ordsall Riverside S0392 |



| Strategic Location | Salford North West | | | | | | |
|---|---|---|---|---|---|---|---|
| Primary Source of Flood Risk | Bridgewater Canal (BC), Whittle Brook (WB) | | | | | | |
| Secondary Sources of Flood Risk | Groundwater (GW), Surface water (SW) | | | | | | |
| Development Sites | | | Environment Agency Flood Maps | | | | |
| | Proposed Land Use | Sources of Flooding | Total area (km²) | Flood Zone 1 (%) | Flood Zone 2 (%) | Flood Zone 3a (%) | Flood Zone 3b (%) |
| Linnyshaw (S0004) | Housing | WB, GW, SW | 0.29 | 90.21 | 9.67 | 0.00 | 0.11 |
| Legh Street (S0395) | Housing | BC, SW | 0.02 | 100.00 | 0.00 | 0.00 | 0.00 |
| Cawdor Street (S0396) | Housing | BC, SW | 0.03 | 100.00 | 0.00 | 0.00 | 0.00 |
| Great Universal Stores (S0397, S0398) | Housing | SW | 0.05 | 100.00 | 0.00 | 0.00 | 0.00 |

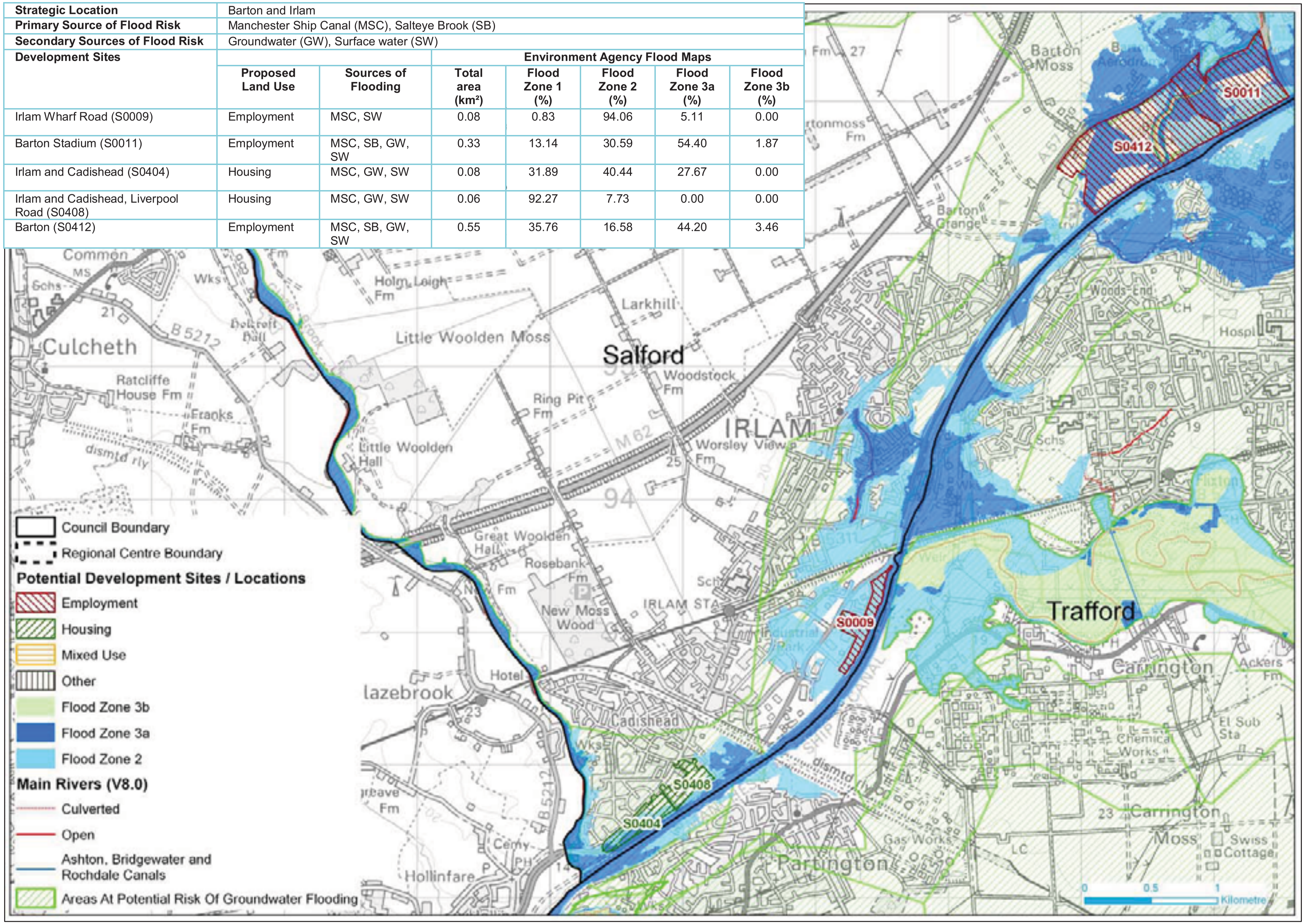


## Salford North West

| Understanding Flood Risk | Comment (Yes / No) |
|---|---|
| Are the development sites in the area at significant risk during a 1 in 100 year event, considering climate change? | No |
| Is there a consistent asset standard of protection? | No |
| Is there a consistent asset condition? | No |
| Is there a significant possibility of assets breaching or failing? | Yes, Risk of breach from Bridgewater Canal |
| Could assets overtop during climate change or extreme events? | No |
| Is overall residual risk significant in the area? | Yes, at Legh Street S0395 and Cawdor Street S0396 from the Bridgewater Canal |
| Are there other sources of flooding? | Yes, both canal and groundwater flood risk should be considered in the design of buildings to mitigate risk<br>Localised surface water flood risk |
| Is flood risk a significant environmental issues/constraint? | No |
| Is the area at significant residual risk during a 1 in 1000 year event? | No |
| | |
| **Managing Flood Risk** | |
| Does development need to be considered strategically? | No |
| Can development proceed in a piecemeal basis? | Yes |
| Flood Risk Management Strategy required? | No |
| Is floodplain compensation required? | No |
| Can the loss of floodplain be compensated within site? | Yes |
| | |
| **Likelihood of passing Exception Test** | |
| Will there be off site effects? | Potentially, in Salford North West CDA |
| Will flood risk be an urban design issue? | Yes |
| Can residual risk be successfully managed? | Yes |
| Could development reduce risk? | Yes, by considered reductions in surface water runoff and mitigation of flood risk |

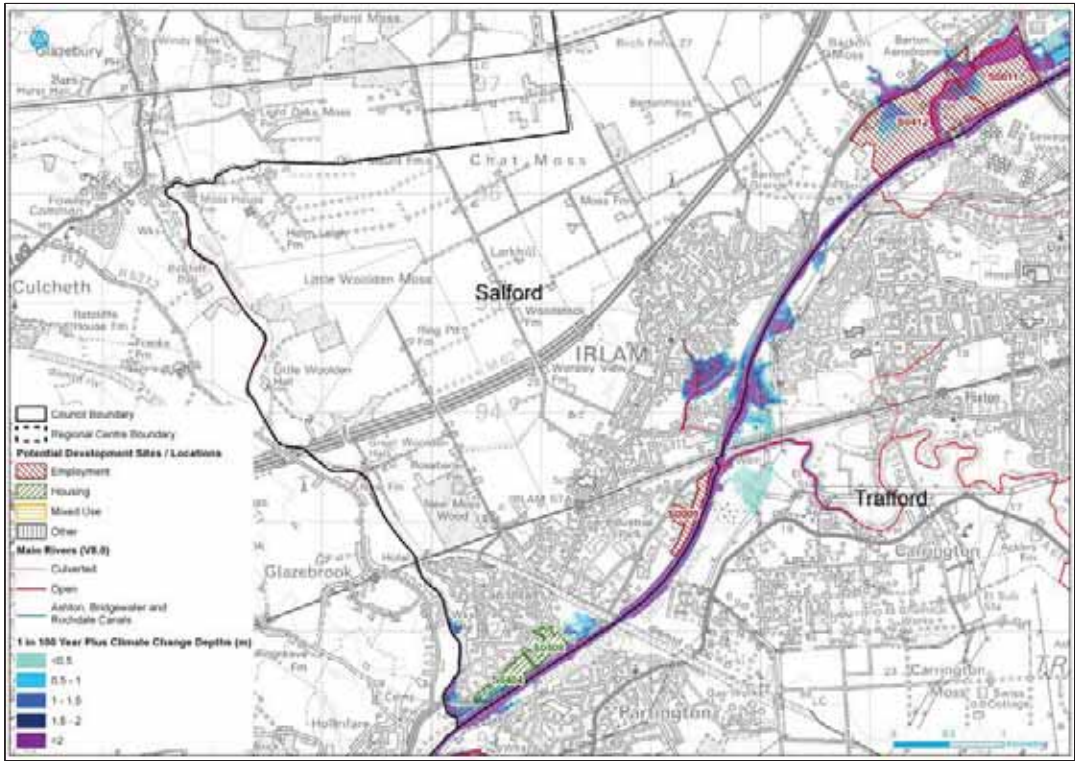
| Strategic Location | Barton and Irlam | | | | | | |
|---|---|---|---|---|---|---|---|
| Primary Source of Flood Risk | Manchester Ship Canal (MSC), Salteye Brook (SB) | | | | | | |
| Secondary Sources of Flood Risk | Groundwater (GW), Surface water (SW) | | | | | | |
| Development Sites | | | Environment Agency Flood Maps | | | | |
| | Proposed Land Use | Sources of Flooding | Total area (km²) | Flood Zone 1 (%) | Flood Zone 2 (%) | Flood Zone 3a (%) | Flood Zone 3b (%) |
| Irlam Wharf Road (S0009) | Employment | MSC, SW | 0.08 | 0.83 | 94.06 | 5.11 | 0.00 |
| Barton Stadium (S0011) | Employment | MSC, SB, GW, SW | 0.33 | 13.14 | 30.59 | 54.40 | 1.87 |
| Irlam and Cadishead (S0404) | Housing | MSC, GW, SW | 0.08 | 31.89 | 40.44 | 27.67 | 0.00 |
| Irlam and Cadishead, Liverpool Road (S0408) | Housing | MSC, GW, SW | 0.06 | 92.27 | 7.73 | 0.00 | 0.00 |
| Barton (S0412) | Employment | MSC, SB, GW, SW | 0.55 | 35.76 | 16.58 | 44.20 | 3.46 |



## Barton and Irlam

| Understanding Flood Risk | Comment (Yes / No) |
|---|---|
| Are the development sites in the area at significant risk during a 1 in 100 year event, considering climate change? | Yes, residual risk from the MSC |
| Is there a consistent asset standard of protection? | Yes, provided by the operation of sluices on the MSC |
| Is there a consistent asset condition? | Yes |
| Is there a significant possibility of assets breaching or failing? | Yes, due to operational or human error on MSC. |
| Could assets overtop during climate change or extreme events? | Yes |
| Is overall residual risk significant in the area? | Yes |
| Are there other sources of flooding? | Yes, groundwater flood risk should be considered in the design of buildings to mitigate risk<br>Localised surface water flood risk |
| Is flood risk a significant environmental issues/constraint? | Yes |
| Is the area at significant residual risk during a 1 in 1000 year event? | Yes |
| | |
| **Managing Flood Risk** | |
| Does development need to be considered strategically? | Yes |
| Can development proceed in a piecemeal basis? | No |
| Flood Risk Management Strategy required? | Yes |
| Is floodplain compensation required? | Yes |
| Can storage be delivered within site? | Yes |
| | |
| **Likelihood of passing Exception Test** | |
| Will there be off site effects? | Potentially, in Salford North West CDA |
| Will flood risk be an urban design issue? | Yes |
| Can residual risk be successfully managed? | Yes |
| Could development reduce risk? | Yes, by considered reductions in surface water runoff and mitigation of flood risk |



## 8.7 Trafford Council

The Strategic Locations assessed within Trafford Council include:

1. **Trafford Core**

   This includes the following Strategic Employment and Mixed Sites: Victoria Warehouse (T0462) Pomona Island (T0467) Old Trafford (T0468) Wharfside (T0469) Trafford Park Core (T0471) Trafford Centre Rectangle (T0472), including Trafford Quays (T0463)

2. **Trafford South and Central**

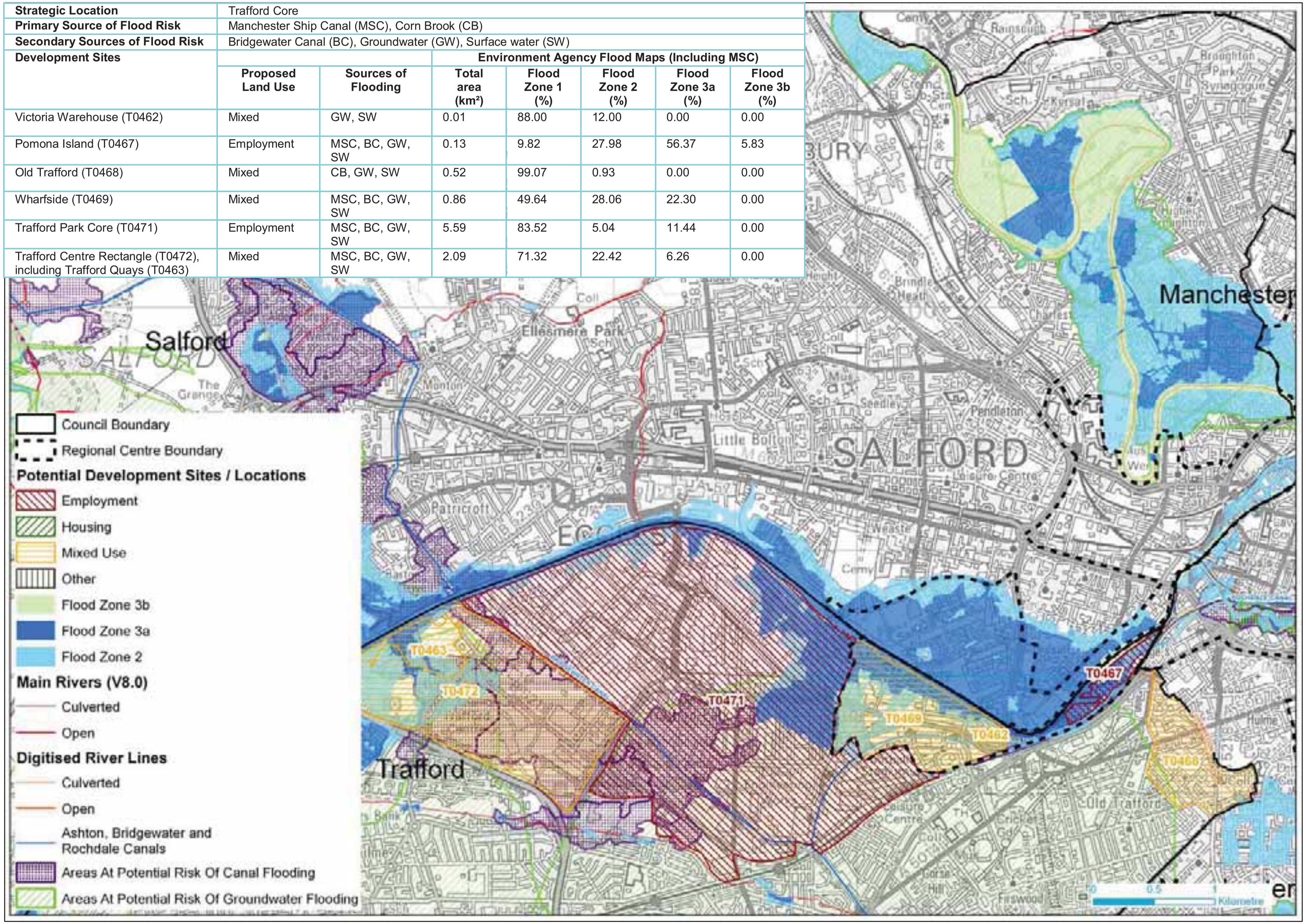
   This includes the following Strategic Mixed Sites: Stretford Crossroads (T0473) Sale Town Centre (T0479) Woodfield Road (T0476) Altrincham Town Centre (T0477), including Altair (T0466)

3. **Carrington and Partington**

   This includes the following Strategic Housing and Mixed Sites: Carrington (T0474) Partington (T0475) Partington Canalside (T0465)

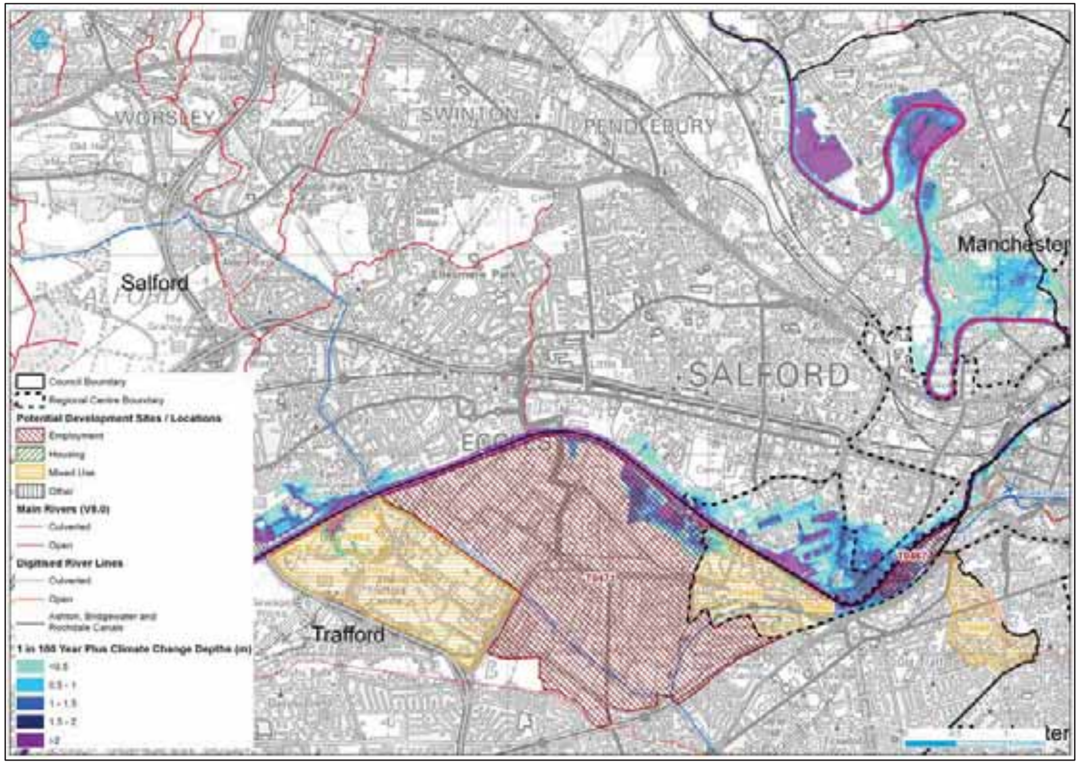
The flood risk summaries below will help to provide a greater evidence base for the Core Strategy and Sustainability Appraisal.

| Strategic Location | Trafford Core | | | | | | |
|---|---|---|---|---|---|---|---|
| Primary Source of Flood Risk | Manchester Ship Canal (MSC), Corn Brook (CB) | | | | | | |
| Secondary Sources of Flood Risk | Bridgewater Canal (BC), Groundwater (GW), Surface water (SW) | | | | | | |
| Development Sites | | | Environment Agency Flood Maps (Including MSC) | | | | |
| | Proposed Land Use | Sources of Flooding | Total area (km²) | Flood Zone 1 (%) | Flood Zone 2 (%) | Flood Zone 3a (%) | Flood Zone 3b (%) |
| Victoria Warehouse (T0462) | Mixed | GW, SW | 0.01 | 88.00 | 12.00 | 0.00 | 0.00 |
| Pomona Island (T0467) | Employment | MSC, BC, GW, SW | 0.13 | 9.82 | 27.98 | 56.37 | 5.83 |
| Old Trafford (T0468) | Mixed | CB, GW, SW | 0.52 | 99.07 | 0.93 | 0.00 | 0.00 |
| Wharfside (T0469) | Mixed | MSC, BC, GW, SW | 0.86 | 49.64 | 28.06 | 22.30 | 0.00 |
| Trafford Park Core (T0471) | Employment | MSC, BC, GW, SW | 5.59 | 83.52 | 5.04 | 11.44 | 0.00 |
| Trafford Centre Rectangle (T0472), including Trafford Quays (T0463) | Mixed | MSC, BC, GW, SW | 2.09 | 71.32 | 22.42 | 6.26 | 0.00 |

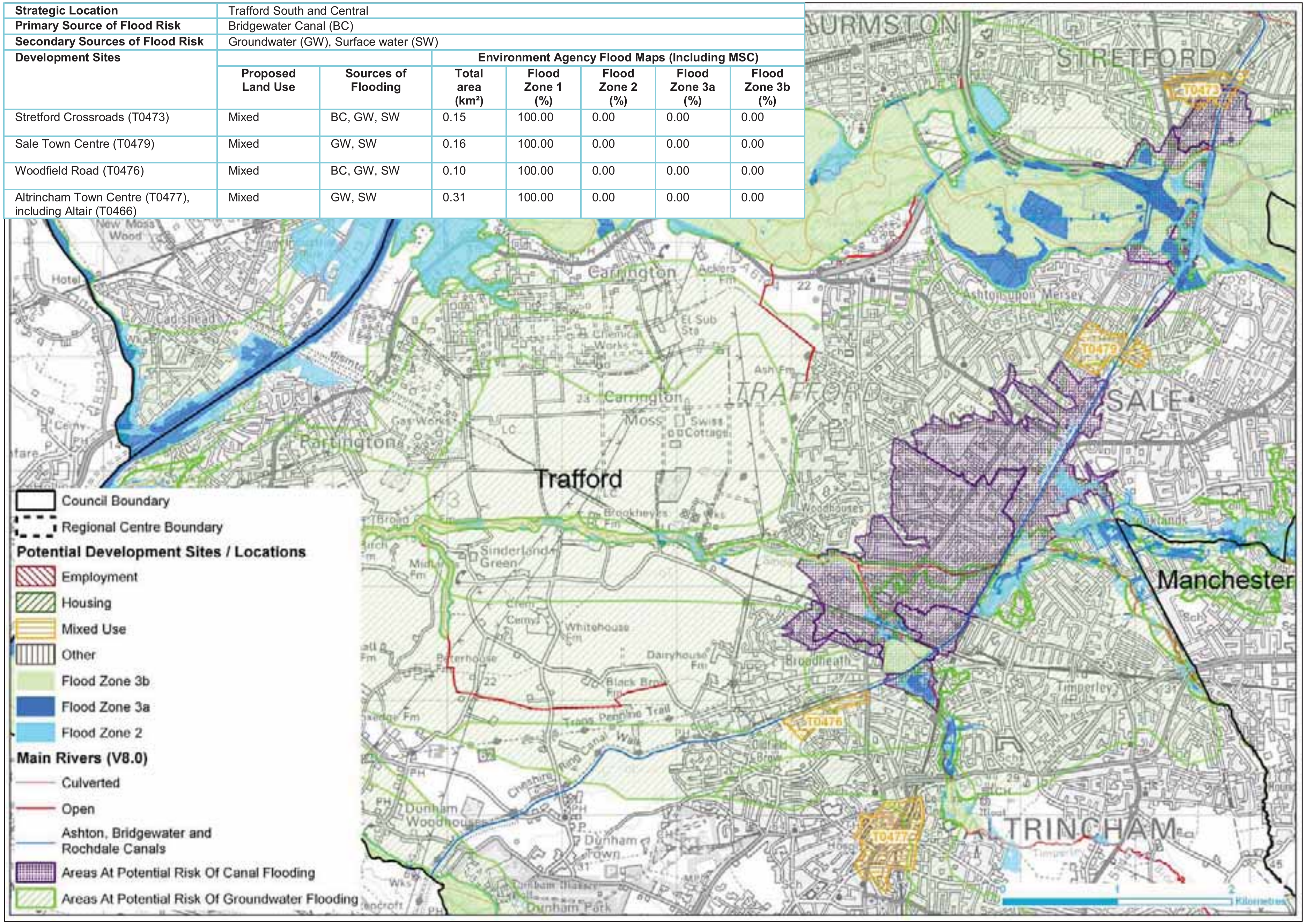


### Trafford Core

| Understanding Flood Risk | Comment (Yes / No) |
|---|---|
| Are the development sites in the area at significant risk during a 1 in 100 year event, considering climate change? | Yes, residual risk from the MSC to Pomona Island T0467, Trafford Park Core T0471 and Trafford Quays T0463 |
| Is there a consistent asset standard of protection? | Yes, provided by the operation of sluices on the MSC |
| Is there a consistent asset condition? | Yes |
| Is there a significant possibility of assets breaching or failing? | Yes, due to operational or human error on MSC. Risk of breach from Bridgewater Canal. |
| Could assets overtop during climate change or extreme events? | Yes |
| Is overall residual risk significant in the area? | Yes |
| Are there other sources of flooding? | Yes, both canal and groundwater flood risk should be considered in the design of buildings to mitigate risk<br>Localised surface water flood risk |
| Is flood risk a significant environmental issues/constraint? | Yes |
| Is the area at significant residual risk during a 1 in 1000 year event? | Yes, Pomona Island T0467, Trafford Park Core T0471, Trafford Centre Rectangle T0472 and Trafford Quays T0463 |
| | |
| **Managing Flood Risk** | |
| Does development need to be considered strategically? | Yes |
| Can development proceed in a piecemeal basis? | No |
| Flood Risk Management Strategy required? | Yes |
| Is floodplain compensation required? | Yes |
| Can the loss of floodplain be compensated within site? | Yes, with the exception of Pomona Island T0467 |
| | |
| **Likelihood of passing Exception Test** | |
| Will there be off site effects? | Potentially, in Conurbation Core and Manchester and Trafford South CDAs<br>Impact of development at Pomona Island on the passage of floodwaters from the Bridgewater Canal to the MSC |
| Will flood risk be an urban design issue? | Yes |
| Can residual risk be successfully managed? | Yes |
| Could development reduce risk? | Yes, by considered reductions in surface water runoff and mitigation of flood risk, with the exception of Pomona Island T0467 |



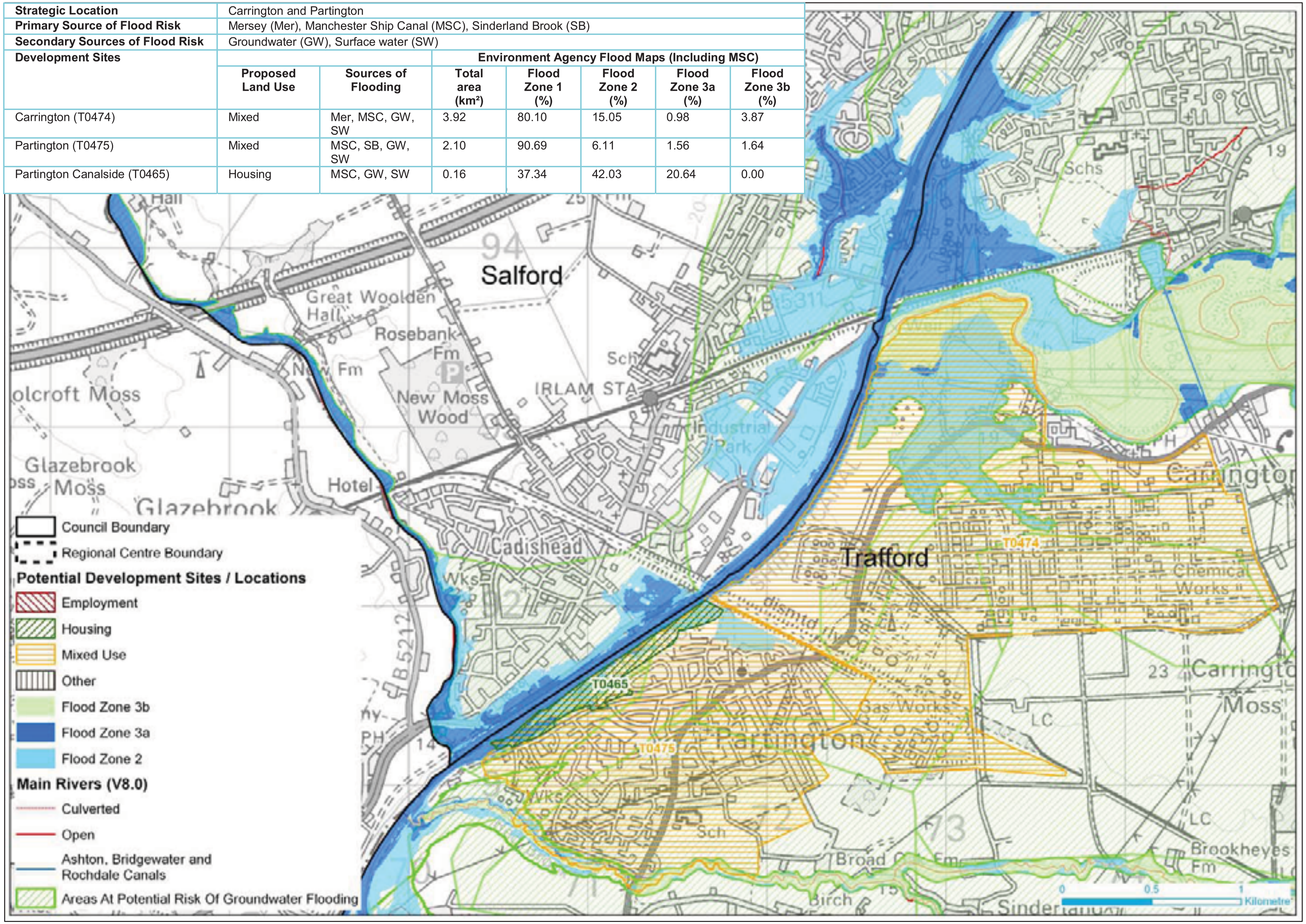
| Strategic Location | Trafford South and Central | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Primary Source of Flood Risk | Bridgewater Canal (BC) | | | | | | | |
| Secondary Sources of Flood Risk | Groundwater (GW), Surface water (SW) | | | | | | | |
| Development Sites | | | Environment Agency Flood Maps (Including MSC) | | | | | |
| | Proposed Land Use | Sources of Flooding | Total area (km²) | Flood Zone 1 (%) | Flood Zone 2 (%) | Flood Zone 3a (%) | Flood Zone 3b (%) | |
| Stretford Crossroads (T0473) | Mixed | BC, GW, SW | 0.15 | 100.00 | 0.00 | 0.00 | 0.00 | |
| Sale Town Centre (T0479) | Mixed | GW, SW | 0.16 | 100.00 | 0.00 | 0.00 | 0.00 | |
| Woodfield Road (T0476) | Mixed | BC, GW, SW | 0.10 | 100.00 | 0.00 | 0.00 | 0.00 | |
| Altrincham Town Centre (T0477), including Altair (T0466) | Mixed | GW, SW | 0.31 | 100.00 | 0.00 | 0.00 | 0.00 | |



## Trafford South and Central

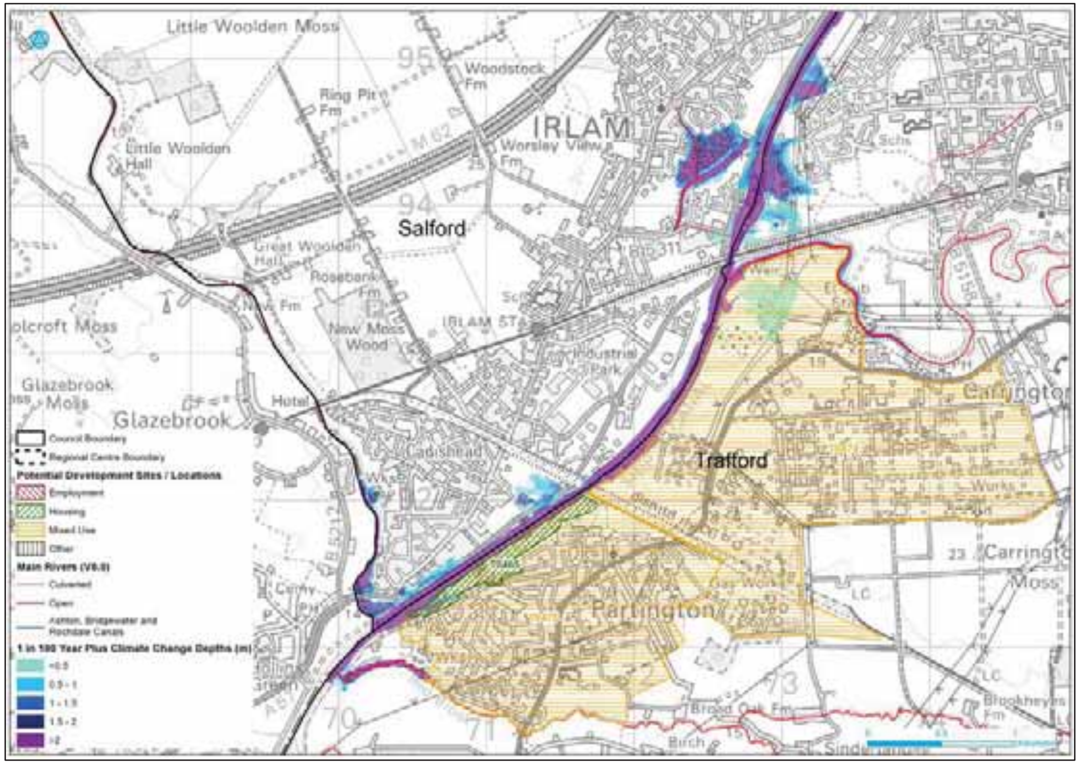
| **Understanding Flood Risk** | **Comment (Yes / No)** |
|---|---|
| Are the development sites in the area at significant risk during a 1 in 100 year event, considering climate change? | No |
| Is there a consistent asset standard of protection? | No |
| Is there a consistent asset condition? | No |
| Is there a significant possibility of assets breaching or failing? | Yes, risk of breach from Bridgewater Canal |
| Could assets overtop during climate change or extreme events? | No |
| Is overall residual risk significant in the area? | Yes, only at Stretford Crossroads T0473 from the Bridgewater Canal |
| Are there other sources of flooding? | Yes, both canal and groundwater flood risk should be considered in the design of buildings to mitigate risk<br>Localised surface water flood risk |
| Is flood risk a significant environmental issues/constraint? | No |
| Is the area at significant residual risk during a 1 in 1000 year event? | No |
| | |
| **Managing Flood Risk** | |
| Does development need to be considered strategically? | No |
| Can development proceed in a piecemeal basis? | Yes |
| Flood Risk Management Strategy required? | No |
| Is floodplain compensation required? | No |
| Can the loss of floodplain be compensated within site? | N/A |
| | |
| **Likelihood of passing Exception Test** | |
| Will there be off site effects? | Potentially, in Manchester and Trafford South CDA |
| Will flood risk be an urban design issue? | Yes |
| Can residual risk be successfully managed? | Yes |
| Could development reduce risk? | Yes, by considered reductions in surface water runoff and mitigation of flood risk |

| Strategic Location | Carrington and Partington | | | | | | |
|---|---|---|---|---|---|---|---|
| Primary Source of Flood Risk | Mersey (Mer), Manchester Ship Canal (MSC), Sinderland Brook (SB) | | | | | | |
| Secondary Sources of Flood Risk | Groundwater (GW), Surface water (SW) | | | | | | |
| Development Sites | | | Environment Agency Flood Maps (Including MSC) | | | | |
| | Proposed Land Use | Sources of Flooding | Total area (km²) | Flood Zone 1 (%) | Flood Zone 2 (%) | Flood Zone 3a (%) | Flood Zone 3b (%) |
| Carrington (T0474) | Mixed | Mer, MSC, GW, SW | 3.92 | 80.10 | 15.05 | 0.98 | 3.87 |
| Partington (T0475) | Mixed | MSC, SB, GW, SW | 2.10 | 90.69 | 6.11 | 1.56 | 1.64 |
| Partington Canalside (T0465) | Housing | MSC, GW, SW | 0.16 | 37.34 | 42.03 | 20.64 | 0.00 |



## Carrington and Partington

| Understanding Flood Risk | Comment (Yes / No) |
|---|---|
| Are the development sites in the area at significant risk during a 1 in 100 year event, considering climate change? | Yes, Carrington T0474 at residual risk from the MSC and Mersey |
| Is there a consistent asset standard of protection? | Yes, provided by the operation of sluices on the MSC but not on the Mersey at Carrington T0474 |
| Is there a consistent asset condition? | No |
| Is there a significant possibility of assets breaching or failing? | Yes, due to operational or human error on MSC. Yes - along lower Mersey |
| Could assets overtop during climate change or extreme events? | Yes |
| Is overall residual risk significant in the area? | Yes, from the MSC and Mersey at Carrington T0474 |
| Are there other sources of flooding? | Yes, groundwater flood risk should be considered in the design of buildings to mitigate risk<br>Localised surface water flood risk |
| Is flood risk a significant environmental issues/constraint? | Yes |
| Is the area at significant residual risk during a 1 in 1000 year event? | Yes, Carrington T0474 and Partington Canalside T0465 |
| | |
| **Managing Flood Risk** | |
| Does development need to be considered strategically? | Yes |
| Can development proceed in a piecemeal basis? | No |
| Flood Risk Management Strategy required? | Yes |
| Is floodplain compensation required? | Yes |
| Can the loss of floodplain be compensated within site? | Yes |
| | |
| Likelihood of passing Exception Test | |
| Will there be off site effects? | No, if compensatory storage is provided |
| Will flood risk be an urban design issue? | Yes |
| Can residual risk be successfully managed? | Yes |
| Could development reduce risk? | Yes, by considered reductions in surface water runoff and mitigation of flood risk |



# 9 Development strategy

## 9.1 Introduction

Throughout the risk based approach, the need to take a sequential approach when allocating land for development should always be kept in mind and opportunities taken to minimise flood risk at every stage of the planning process. Therefore **mitigation measures should be seen as a last resort to address flood risk issues.**

Mitigation measures must be designed to provide an appropriate level of protection to a site for the lifetime of the development. At many sites it may be technically feasible to mitigate or manage flood risk. **However**, the potential impacts of mitigation measures on flood risk to the surrounding community must always be considered and where the depth of flooding is substantial, these mitigation measures may result in practical constraints to development with significant financial implications.

The minimum acceptable standard of protection against flooding for new property within flood risk areas is the 1 in 100 year flood event for fluvial flooding, with an allowance for climate change over the lifetime of the development.

Mitigation measures should be considered on a strategic basis that avoids a piecemeal approach and advocates partnership between the LPA and the Environment Agency and integration with wider Environment Agency flood risk management works and strategies (e.g. River Irwell CFMP, Upper Mersey CFMP and the forthcoming Manchester Strategies).

The hydraulic linkages between the three authorities mean that development or defence works in one authority could have consequences in another authority. This applies not only to Manchester, Salford and Trafford but also in relation to other GM Districts and other neighbouring districts. Work to develop appropriate consultation and operational protocols between local authorities, and potentially between local authorities, the Environment Agency and other stakeholders for such development and works is needed to ensure effective flood risk management and sustainable development.

The SFRA has identified the need for a strategic vision when it comes to managing flood risk to new development in the majority of cases due to the cross boundary nature of flood risk issues with regards to both the site boundaries themselves and on a larger scale the boundaries of each local authority and the Greater Manchester sub-region.

As a summary, taking a strategic approach requires all that are involved in flood risk management to consider:

- Avoidance of development in flood risk areas;
- The sequential approach to site layout, substituting higher vulnerability development in lower flood risk areas and considering flooding from all sources;
- Wherever possible, using open land or green infrastructure to reduce risk, provide compensatory flood storage or serve a sustainable drainage function;
- **Adopting mitigation solutions that fit with the wider vision of the community in managing flood risk. In significant flood risk areas, developers should aim to reduce risk to the wider community;**
- Adopting SUDS;
- Preparing emergency flood plans.

Section 9.2 below describes the range of planning considerations and mitigation options available. Their suitability for the Strategic Locations in the SFRA has been summarised in Table 9-4. Linking to this, a mitigation approach for each of the Strategic Locations is presented for Manchester, Salford and Trafford. Recommendations and flood risk management requirements in line with PPS25 guidelines have been proposed and links with relevant CFMPs have been discussed. In addition, for each authority a "flood risk balance sheet" has been prepared, which is designed to facilitate the Exception Test and demonstrate the acceptability and soundness of the proposed development sites.

### 9.2 Planning considerations and mitigation options

#### 9.2.1 Site layout and design

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development.

The PPS25 Practice Guide states that a sequential, risk-based approach should be applied to try to locate more vulnerable land use to higher ground, while more flood-compatible development (e.g. vehicular parking, recreational space) can be located in higher risk areas.

Waterside areas, or areas along known flow routes, can be used for recreation, amenity and environmental purposes, allowing the preservation of flow routes and flood storage, and at the same time providing valuable social and environmental benefits contributing to other sustainability objectives. Landscaping should ensure safe access to higher ground from these areas, and avoid the creation of isolated islands as water levels rise.

#### 9.2.2 Modification of ground levels

Modifying ground levels to raise the land above the required flood level is a very effective way of reducing flood risk to the site in question.

In this event however, in most areas of fluvial flood risk, floodplain volume would be reduced by raising land above the floodplain, often adversely affecting flood risk in the vicinity and downstream. Compensatory flood storage must be provided, and should be on a level for level, volume for volume basis generally on land that does not currently flood but is adjacent to the floodplain (in order for it to fill and drain). It should be in the vicinity of the site and within the red line of the planning application boundary (unless the site is strategically allocated) and based on a level for level compensation for any loss of floodplain.

Where the site is entirely within the floodplain it is not often possible to provide compensatory storage up to the maximum flood level and this may not be a viable mitigation option. Compensation schemes must be environmentally sound.

#### 9.2.3 Local flood storage

Where development reduces the volume of floodplain storage it will be necessary to provide compensatory storage locally to avoid worsening flood risk. This could be an environmental wetland area, designated washland (designed to flood) or a flood basin. A long term maintenance strategy is needed for such options. This can also be considered within urban design if areas are designated to flood in a flood event (e.g. garaging of a development with residential on first floor).

On a strategic catchment-wide scale, appropriately located flood storage basins and washlands can not only provide a reduction in flood risk, but can also enhance and contribute to wetland restoration and habitat creation as well as potentially increasing the recreational value of many river corridors. For upstream flood storage schemes to maximise benefits downstream, they need to be located in suitable areas of the catchment. Locating flood storage basins too high in the catchment could mean that a large proportion of a flood event is still able to travel downstream from other areas in the catchment.

The need for compensatory storage is a strategic issue and must be addressed at the appropriate spatial scale – usually a catchment. It would be sensible to discuss this with all stakeholders, including developers, at an early stage, as this will be a major constraint since this requirement may have significant implications for the yields achieved for individual sites due to the associated land take this may require.

#### 9.2.4 Raised defences

Construction of raised floodwalls or embankments to protect new development is not a preferred option, as a residual risk of flooding will remain. Compensatory storage must be provided where raised defences remove storage from the floodplain to avoid there being an adverse impact on flood risk elsewhere. Temporary or demountable defences are generally not acceptable flood protection for a new development unless flood risk is residual only.

In some cases, it may be necessary for the developer to make a contribution to the improvement of flood defence provision that would benefit both the development in question and the local community.

### 9.2.5 Urban design

The raising of floor levels within a development avoids damage occurring to the interior, furnishings and electrics in times of flood. Making the ground floor use of a building water compatible (for example a car park), is an effective way of raising living space above flood levels.

Putting a building on stilts is not considered an acceptable means of flood mitigation for new development. However it may be allowed in special circumstances if it replaces an existing solid building, as it can improve flood flow routes. In these cases attention should always be paid to safe access and egress and legal protection should be given to ensure the ground floor use is not changed.

#### Resistance and resilience

There may be instances where flood risk remains to a development, such as residual risk from an extreme event or from the failure of flood defences. In these cases (and for existing development in the floodplain), additional measures can be put in place to reduce damage in a flood and increase the speed of recovery. These measures should not be relied on as the only mitigation method.

Resistance measures are those designed to exclude water from properties. These may include:

- Temporary barriers consisting of moveable flood defences which can be fitted into doorways and windows. The permanent fixings required to install these temporary defences should be discrete and keep architectural impact to a minimum. On a smaller scale temporary snap-on covers for airbricks and air vents can also be fitted to prevent the entrance of flood water and/or
- Permanent barriers including built up doorsteps, rendered brick walls and toughened glass barriers.

Resilience measures are those designed to reduce the impact of flooding and speed up recovery following a flood event. The 2007 document 'Improving the Flood Performance of New Buildings' provides further details on possible resistance and resilience measures[15].

This involves designing interiors to reduce damage caused by flooding, for example:

- Electrical circuitry installed at a higher level with power cables being carried down from the ceiling rather than up from the floor level
- Water-resistant materials for floors, walls and fixtures
- Resilience measures will be specific to the nature of flood risk, and as such will be informed and determined by the FRA.

Resilience and resistance measures will be specific to the nature of flood risk at a site, and as such should be informed and determined by a site specific FRA.

#### General urban design guidance

##### *Commercial*

Where it is appropriate to raise floor levels, they should be raised to an agreed freeboard (which may typically be 600mm) above the maximum water level during a 1 in 100 year flood event plus climate change. Resilience (of both the building and materials) is an appropriate response to residual risk and depending on the sensitivity of uses within commercial premises, this could be built in to manage the risk up the 1 in 1000 year flood level.

[15] Communities and Local Government (2007) Improving the Flood Performance of New Buildings – Flood Resilient Construction

*Residential*

The vulnerability of residential land uses is higher due to the increased risk to people. Therefore it is recommended that floor levels for habitable uses (defined as living rooms, dining rooms, kitchens depending on their use within the household and bedrooms) are raised to an agreed freeboard (which may typically be 600mm) above the maximum water level during a 1 in 100 year flood event plus climate change. The difference between this level and the 1 in 1000 year defended level should be considered. It may be practical to raise floor levels to the 1 in 1000 year level to account for residual risk in an extreme event. An alternative would be to set floor levels so that a low depth of flooding could be expected during a 1 in 1000 year event (up to 0.6m). The adopted floor levels should be considered on a location by location basis in a Flood Risk Assessment, which should consider the nature of the residual risk to the development. In all cases a safe place of refuge should be provided above the 1 in 1000 year defended flood level.

### Urban design in the Manchester Ship Canal and Grey Irwell corridor

Figure 9-1 and Figure 9-2 illustrate what the variation in estimated water levels from different modelled scenarios for the Manchester Ship Canal (explored in section 3.3) could mean at strategic development sites in Salford and Trafford. These have been prepared purely for illustration purposes with an indicative ground level presented. Ground levels on the sites themselves vary and the depth maps presented in the Maps Volume of the SFRA should be referred to for a wider representation of flood depth across the development sites.

Figure 9-1 Variations in estimated water levels and implications for urban design on the Manchester Ship canal in the vicinity of Ordsall Riverside and Pomona

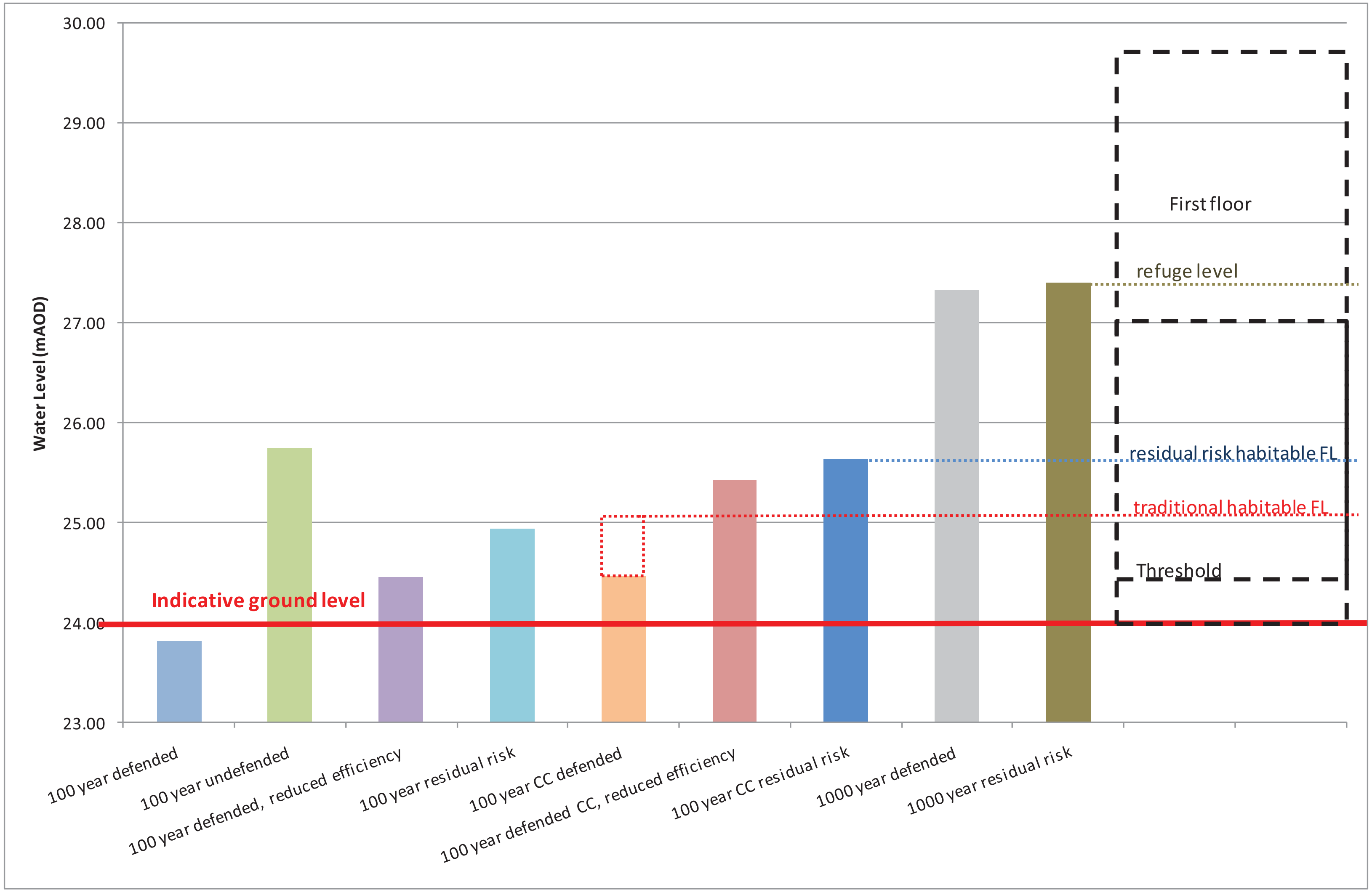


Figure 9-2 Variations in estimated water levels and implications for urban design on the Manchester Ship canal in the vicinity of Media City and Trafford Wharfside

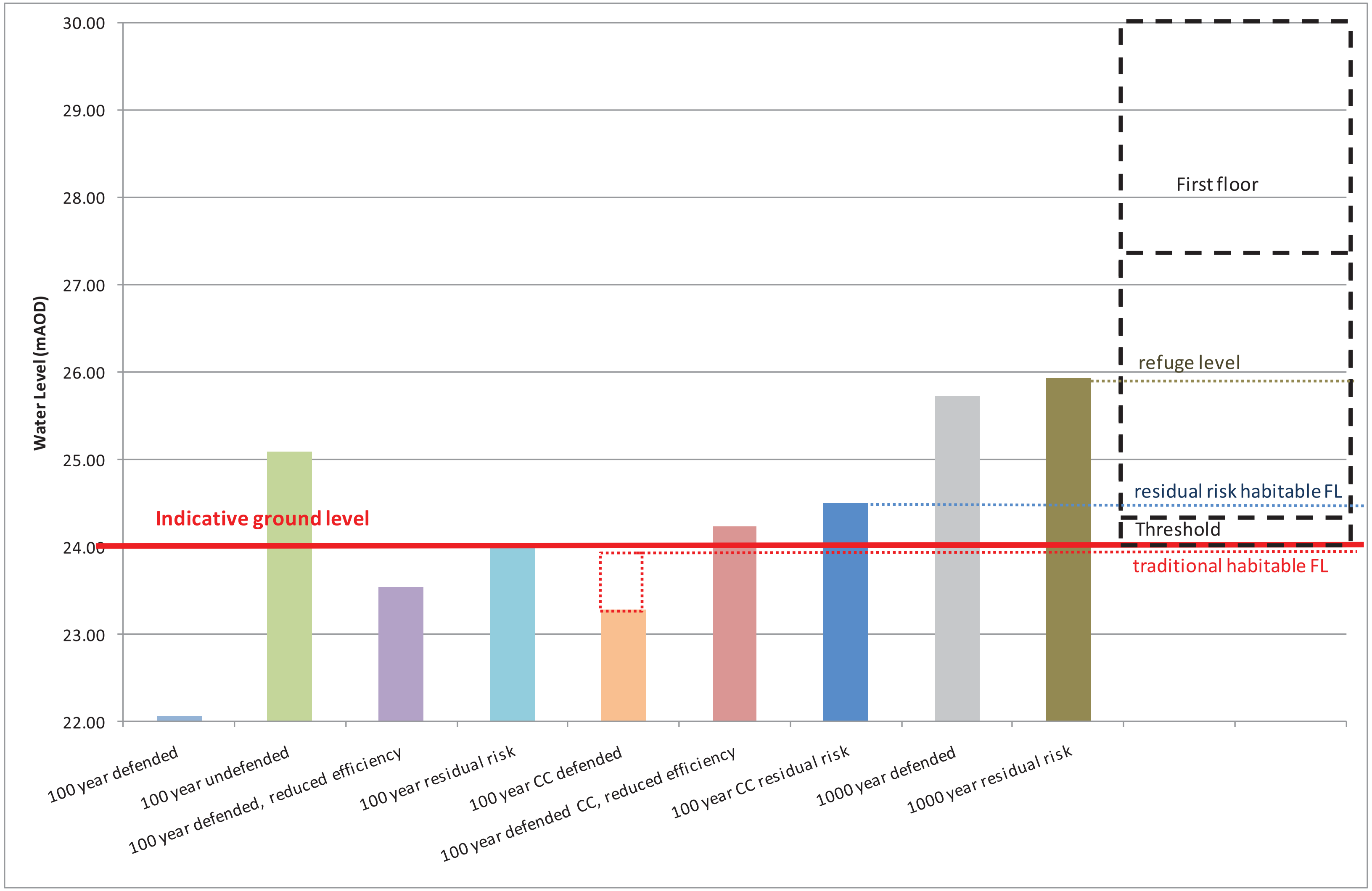


Figure 9-1 shows that the operation of the sluices can make the difference between developments flooding and not flooding in a 1 in 100 year event at Ordsall Riverside and Pomona. However, even with optimal operation and efficiency of the sluices, development would still be affected by flooding, potentially to first floor level in an extreme 1 in 1000 year event.

Using the model results here in a planning context and taking the precautionary approach to account for residual risk for this example would mean that floor levels would need to be set around 2.6m higher than ground level. Comparing this to a traditional approach to setting floor levels, where they are set at a 1 in 100 year flood event, considering climate change level, plus a typical allowance of 600mm for freeboard would result in floor level requirements being around 0.5m lower.

However as discussed in section 3.3, taking account of the residual risk on the Manchester Ship canal is critical and it can be argued that the freeboard allowance should be increased above a typical 600mm to cover the uncertainties regarding the current estimations of water levels on the Manchester Ship Canal. This is supported by the comparison of water levels in a 1 in 100 year, considering climate change event when the gates were operating at reduced efficiency (which as described in section 3.3, is possible based on the limited calibration data available in flood conditions to inform the modelling of the Manchester Ship Canal). Water levels in this scenario are actually higher than the 1 in 100 year, considering climate change event with optimal defence operation and freeboard. In any case, the graph illustrates that even when considering climate change for all scenarios, water levels are lower for the residual risk scenario than the worst case undefended scenario for a 1 in 100 year event without a consideration for climate change.

Table 9-1 shows a comparison of what traditional floor levels might be set at (1 in 100 year, considering climate change defended case, plus a typical freeboard allowance of 600mm) compared to the residual risk scenario for a 1 in 100 year event, considering climate change, that takes account of both operational failure and the potential for reduced efficiency of the sluice gates during flood conditions. This shows that whilst required floor levels might be lower based on a traditional approach in the vicinity of Salford Quays, Trafford Park and Barton, they would actually be higher downstream at Irlam, Cadishead, Carrington and Partington. This shows that optimising the control of water levels in one location could have a detrimental impact on flood risk downstream.

**For the reasons discussed in the previous two paragraphs the SFRA suggests that floor levels should be considered based on the residual risk scenario, rather than a traditional approach of adding freeboard to a determined event.**

The 1 in 1000 year event should be considered as set out on the following page.

Table 9-1 Comparison of floor levels for the Manchester Ship Canal

| Location | Nearby strategic sites (Salford) | Nearby strategic sites (Trafford) | Traditional habitable FL | Residual risk habitable FL | Difference |
|---|---|---|---|---|---|
| Woden Street Footbridge | Ordsall Riverside | Pomona | 25.06 | 25.64 | 0.57 |
| Trafford Bridges | Ordsall Riverside | | 24.14 | 25.51 | 1.37 |
| The Lowry Bridge | Salford Quays, Media City | Trafford Wharfside | 23.88 | 24.51 | 0.63 |
| Model Wheel | Media City | Trafford Park Core | 23.87 | 24.45 | 0.58 |
| Centenary Way Bridge | | Trafford Park Core | 20.41 | 20.83 | 0.42 |
| Barton Swing Bridge | | Trafford Centre Rectangle, Trafford Quays | 20.19 | 20.70 | 0.52 |
| Barton High Level Bridge | Barton Stadium | | 20.11 | 20.65 | 0.54 |
| Barton Sluices | Barton | | 19.96 | 20.47 | 0.51 |
| Irlam Viaduct | Irlam Wharf Road | Carrington | 13.93 | 13.29 | -0.64 |
| Cadishead Viaduct | Irlam and Cadishead | Partington, Partington Canalside | 13.70 | 13.08 | -0.62 |
| Hollins Green / Partington | | Partington | 13.22 | 12.64 | -0.58 |

Two conclusions can be drawn from Figure 9-1, when water levels are significant in a residual risk scenario for the 1 in 100 year flood event, considering climate change:

1. That locally land could be raised and ground floor levels could be provided at this level. This is potentially problematic, in that it may affect the conveyance of flood flows and increase risk elsewhere and for other planning considerations, such as disabled access.
2. That habitable uses (defined as living rooms, dining rooms, kitchens depending on their use within the household and bedrooms) should be provided on a first floor basis, with non habitable uses provided on the ground floor, with resilience built in to the 1 in 100 year, considering climate change event residual risk scenario water levels. Moving to first floor accommodation provides a robust approach, by raising habitable floor levels well above the 1 in 100 year event, plus climate change defended with freeboard and also residual risk scenario water levels. Where there could be significant depths, this can be considered practical in order to keep residents safe from flooding

In either case, and for residential uses, refuge should be provided above the extreme 1 in 1000 year flood level, considering the adopted residual risk scenario and the building should be structurally stable to this depth of flooding. This supports the provision of habitable accommodation on a first floor basis, especially when considering the needs of ground floor residents in apartment blocks having access to a place of refuge.

Figure 9-2 provides a good representation for where the depth of flooding is shallower in that using a traditional approach to set floor levels would not actually result in an impact on urban design. However, as set out in section 3.3, residual risk is an important design consideration for areas at risk of flooding from the Manchester Ship Canal and in this case would result in floor levels being set approximately 0.5m above ground level. This would involve a modest increase in ground floor level from a typical threshold level of 0.3m, although any land raising that might be needed must be proved to not have an impact on flood risk elsewhere. Again refuge would need to provided to give a safe haven for residents in the event of an extreme event. This would need to be provided at first floor level and as above may support the provision of habitable accommodation on a first floor basis, when considering the needs of ground floor residents in apartment blocks having access to a place of refuge.

Where habitable uses are accommodated on the first floor, it may be appropriate to permit lower vulnerability uses (such as car parking with appropriate warning in place) on the ground floor. Resilience would need to be built into the ground floor to the level predicted for a 1 in 100 year flood event, considering climate change residual risk scenario.

For commercial development, there is generally a greater acceptance of risk that will affect the type and use of these buildings. For such development, it may be practical to allow development at ground floor level where the depth of flooding in a 1 in 100 year flood event, considering climate change residual risk scenario would be shallow (up to around 0.6m). Resilience and resistance measures would need to be provided to this level. Evacuation upon receipt of a flood warning and the provision of safe access and egress would need to be provided for such development.

Where there would be significant depths of flooding (greater than 0.6m) then significant damage could be done to commercial premises and stock and it is recommended that first floor should be considered for more sensitive commercial uses, with lower vulnerability uses (such as car parking with appropriate warning in place) on the ground floor. Resilience would need to be built into the ground floor to the level predicted for a 1 in 100 year flood event, considering climate change residual risk scenario. The need for refuge should be considered when setting first floor levels in this instance.

Taking a risk based approach to setting floor levels for the Manchester Ship Canal and Grey Irwell (upon which levels in the Manchester Ship Canal have an influence) is considered appropriate in this high residual risk environment. Table 9-2 summarises the SFRA recommendations for urban design in areas at risk of flooding from the Manchester Ship Canal and Grey Irwell. It should be recognised that the sequential approach to flood risk should be considered at the master plan stage of any development, to avoid placing the most vulnerable land uses in the areas of highest risk. Overland flow routes (including those for surface water) should also be taken into account at this stage.

Urban design would also address the risks from other sources of flooding, such as surface water, groundwater or canals.

Map FL_1.15 provides a zonal indication regarding habitable floor levels for areas at risk of flooding from the Manchester Ship Canal and Grey Irwell and should be used in conjunction with this section of the report. Note that this is based on the strategic modelling undertaken for the SFRA and the recommendations should always be supported by more detailed investigations in a site specific flood risk assessment.

**Table 9-2 Recommendations for urban design in the Manchester Ship Canal and Grey Irwell Corridor**

| Event/ scenario | Depth of flooding | Residential | Commercial |
|---|---|---|---|
| 1 in 100 year flood event, considering climate change residual risk scenario | Water level less than 0.6m | Habitable floor levels above flood level. Resilience built into building design below this level. | Resilience and resistance provided to this level |
| | Water level greater than 0.6m | First floor accommodation for habitable uses Resilience built into lower floor non habitable uses to flood level. | First floor accommodation, with less vulnerable uses Resilience built into lower floor lower vulnerability uses to flood level. |
| 1 in 1000 year flood event, residual risk scenario | | Refuge to be provided on floor above Building to be structurally sound to this level | Where practical flood warning and evacuation should be in place Where there are significant depths, refuge to be provided on floor above Building to be structurally sound to this level. |

### 9.2.6 Making development safe

#### Safe access and egress

The developer must ensure that safe access and egress is provided to an appropriate level for the type of development. This may involve raising access routes to a suitable level. Environment Agency guidance suggests that all development should have a dry access and egress in the 1 in 100 year event.

As part of the FRA, the developer should review the acceptability of the proposed access in consultation with the Environment Agency. For the purpose of the SFRA it is considered appropriate to provide a low hazard environment in access and egress routes associated with new housing developments.

#### Flood warning and evacuation

Emergency/evacuation plans should be in place for all properties, large and small, at residual risk of flooding; those developments which house vulnerable people (i.e. care homes and schools) will require more detailed plans.

## 9.3 Summary

Table 9-4 presents a summary of some of the potential mitigation measures for the Strategic Locations. Further context on these in relation to the proposed strategic development sites is provided below.

### 9.3.1 Manchester City Council

#### Regional Centre and Inner Areas West

In the Regional Centre and Inner Areas West, one of the two development sites is partly within Flood Zone 3 (Sustainability Appraisal indicator) (the risk is from the Lower Irwell in Salford, since the Grey Irwell is likely to be in bank in a 1 in 100 year event). Although these employment sites do not need to undergo the Exception Test, the risk of flooding still needs to be managed and proved to be safe.

The SFRA modelling suggests that a limited area of Strangeways M0004 is at risk, except for extreme events that would overtop the defences on the Lower Irwell or a breach in the defences. Proceeding with development in flood risk areas would need careful consideration of urban design and the use of resistance and resilience measures, with appropriate low vulnerability uses in the highest risk areas. Modifying ground levels could have an impact on flood risk elsewhere during extreme events. Victoria M0005 is only at risk from an extreme 1 in 1000 year event on the Grey Irwell. Development in flood risk areas would need to ensure that residual risk was taken into account through resistance and resilience measures and with appropriate low vulnerability uses in the highest risk areas.

Flood warning and an emergency flood plan should be in place for both developments and safe access and egress in the event of a flood should be available.

There is a potential risk of flooding from lost watercourses and a site specific FRA should address mitigation for risk from surface water, culvert blockage and smaller watercourses where appropriate. The Environment Agency recommend that culverts are opened up (de-culverted), where possible (although this needs careful consideration due to potential future maintenance problems), to reduce the risk of flooding (due to blockages), for easy access and maintenance and to enhance the biodiversity value of the site.

For all sites, development proposals should look at opportunities to incorporate SUDS to reduce the risk of surface water flooding (Sustainability Appraisal indicator). Surface water run-off from these sites should not increase as a result of development (reduced run-off should be sought if possible in some areas) and not discharge into the combined sewer system. Many of these sites lie within the Conurbation Core Critical Drainage Area and managing surface water discharges from development and exceedance flows is critical. The risk of groundwater flooding should be considered when assessing suitable SUDS techniques at a strategic level and in the design of buildings.

The River Irwell CFMP recognises the need to reduce flood risk from the Lower Irwell in Salford (that affects Strangeways M0004) and manage the low level of risk (in a 1 in 100 year event) from the Grey Irwell into the future (that affects Victoria M0005). Actions on the Lower Irwell may include the provision of flood storage that will help reduce flows in the Grey Irwell or raised defences. Actions on the Grey Irwell will be investigated by the Environment Agency as part of the Central Manchester Flood Risk Management Strategy. The CFMP also recognises the opportunity to protect or restore river corridors linked to regeneration/redevelopment or specifically for reduction of flood risk in Central Manchester. Close consultation with the Environment Agency and other stakeholders, such as British Waterways, United Utilities and the Manchester Ship Canal Company will be required to develop a suitable Flood Risk Management Strategy to ensure the development needs and the different sources of flood risk are managed strategically in Central Manchester.

### Regional Centre and Inner Areas North

In the Regional Centre and Inner Areas North, two of the development sites are partly within Flood Zone 3 (Sustainability Appraisal indicator). Although employment sites do not need to undergo the Exception Test the risk of flooding still needs to be managed and proved to be safe. Irk Valley M0021 and Collyhurst M0013 are intended for housing use and therefore will need to undergo the Exception Test.

The risk of flooding is relatively low to **Harpurhey/ Moston M0015**-M0020**, Booth Hall M0022** and **Blackley Village M0023** and a site specific FRA should address mitigation for risk from surface water and smaller watercourses where appropriate.

The River Irk and its tributary, Moston Brook, flow through Irk Valley M0021 and Collyhurst M0013. Housing should be directed towards the lower flood risk area of these sites with open spaces designated along the riverside. Development should be sequentially avoided where there is significant risk in the floodplain of the River Irk in a 1 in 100 year event considering climate change in Irk Valley M0021. The Moston Brook is in culvert at Collyhurst, which should be taken into account in the planning process. Residual risk in an extreme event or from culvert blockage should be taken into account through resistance and resilience measures. Flood warning and an emergency flood plan should be in place for both developments and safe access and egress in the event of a flood should be available.

The Rochdale Canal passes through Newton Heath M0009, Central Park M003 and Miles Platting M0008 and these sites are at potential risk of canal flooding. Subject to the findings of a more detailed assessment in a site specific FRA, these development sites should manage this residual risk by appropriate access, egress, emergency planning procedures and finished floor levels which incorporate an agreed freeboard allowance for the risk from canal flooding. Miles Platting M0008 is also at potential risk of flooding from the Ashton Canal.

There is a potential risk of flooding from lost watercourses to Collyhurst M0013, Miles Platting M0008, Newton Heath M0009 and Central Park M0003 and a site specific FRA should address mitigation for risk from surface water, culvert blockage and smaller watercourses where appropriate. The Environment Agency recommend that culverts are opened up (de-culverted), where possible (although this needs careful consideration due to potential future maintenance problems), to reduce the risk of flooding (due to blockages), for easy access and maintenance and to enhance the biodiversity value of the site.

For all sites, development proposals should look at opportunities to incorporate SUDS to reduce the risk of surface water flooding (Sustainability Appraisal indicator). Surface water run-off from these sites should not increase as a result of development (reduced run-off should be sought if possible in some areas) and not discharge into the combined sewer system. Many of these sites lie within the Conurbation Core Critical Drainage Area and managing surface water discharges from development and exceedance flows is critical.

The River Irwell CFMP recognises the need to reduce flood risk from the River Irk. Actions on the River Irk will be investigated by the Environment Agency as part of the Central Manchester Flood Risk Management Strategy. The CFMP also recognises the opportunity to protect or restore river corridors linked to regeneration/redevelopment or specifically for reduction of flood risk in Central Manchester. Close consultation with the Environment Agency and other stakeholders, such as British Waterways and United Utilities will be required to develop a suitable Flood Risk Management Strategy to ensure the development needs and the different sources of flood risk are managed strategically in Central Manchester.

### Regional Centre and Inner Areas South

In the Regional Centre and Inner Areas South, six of the development sites are partly within Flood Zone 3 (Sustainability Appraisal indicator). Although employment sites do not need to undergo the Exception Test the risk of flooding still needs to be managed and proved to be safe. Holt Town M0024, Lower Medlock M0026, West Gorton M0010 and Brunswick M0011 are intended for housing use and therefore will need to undergo the Exception Test.

The River Medlock flows through Holt Town M0024, Chancellors Place M0025, Lower Medlock M0026, Eastern Gateway M0001 and Oxford Road Corridor M0042. Housing should be directed towards the lower flood risk areas of Holt Town M0024, Chancellors Place M0025 and Lower Medlock M0026 with open spaces designated along the riverside. Development should be sequentially avoided where there is significant risk in the floodplain of the River Medlock in a 1 in 100 year event considering climate change in Holt Town M0024, Chancellors Place M0025, Lower Medlock M0026, Eastern Gateway M0001 and Oxford Road Corridor M0042. The River Medlock is in culvert at Sport City (M0002), which should be taken into account in the planning process. Residual risk in an extreme event and though potential culvert blockage should be taken into account through resistance and resilience measures. Flood warning and an emergency flood plan should be in place for all developments and safe access and egress in the event of a flood should be available.

The Ashton Canal passes through Eastern Gateway M0001, Sport City M0002, Holt Town M0024 and Lower Medlock M0026 and the Bridgewater Canal passes through Oxford Road Corridor M0042 and these sites are at potential risk of canal flooding. Subject to the findings of a more detailed assessment in a site specific FRA, these development sites should manage this residual risk by appropriate access, egress, emergency planning procedures and finished floor levels which incorporate an agreed freeboard allowance for the risk of canal flooding.

The main source of flood risk to West Gorton M0010 and Brunswick M0011 is from Corn Brook culvert. The risk is higher at West Gorton where it is recommended that development should be sequentially avoided where there is significant risk in the floodplain of the Corn Brook in a 1 in 100 year event considering climate change. Residual risk in an extreme event or from potential culvert blockage should be taken into account through resistance and resilience measures. Flood warning and an emergency flood plan should be in place for both developments and safe access and egress in the event of a flood should be available.

There is a potential risk of flooding from lost watercourses to Eastern Gateway M0001, Lower Medlock M0026, Oxford Road Corridor M0042 and Coverdale Crescent M0012 and a site specific FRA should address mitigation for risk from surface water, culvert blockage and smaller watercourses where appropriate. The Environment Agency recommend that culverts are opened up (de-culverted), where possible (although this needs careful consideration due to potential future maintenance problems), to reduce the risk of flooding (due to blockages), for easy access and maintenance and to enhance the biodiversity value of the site.

For all sites, development proposals should look at opportunities to incorporate SUDS to reduce the risk of surface water flooding (Sustainability Appraisal indicator). Surface water run-off from these sites should not increase as a result of development (reduced run-off should be sought if possible in some areas) and not discharge into the combined sewer system. Many of these sites lie within the Conurbation Core Critical Drainage Area and managing surface water discharges from development and exceedance flows is critical. The risk of groundwater flooding should be considered when assessing suitable SUDS techniques at a strategic level and in the design of buildings.

The River Irwell CFMP recognises the need to reduce flood risk from the River Medlock. Actions on the River Medlock will be investigated by the Environment Agency as part of the Central Manchester Flood Risk Management Strategy. These may include upstream flood storage. The CFMP recognises the opportunity to protect or restore river corridors linked to regeneration/redevelopment or specifically for reduction of flood risk in Central Manchester. Close consultation with the Environment Agency and other stakeholders, such as British Waterways, United Utilities and the Manchester Ship Canal Company will be required to develop a suitable Flood Risk Management Strategy to ensure the development needs and the different sources of flood risk are managed strategically in Central Manchester.

### Manchester South

A limited area of both Roundthorn M0006 and the Airport M0007 is within Flood Zone 3. These sites are allocated for employment use and hence the Exception Test will not need to be applied.

There is a high susceptibility to surface water flooding at Roundthorn M0006, which should be taken into account when master-planning the development, considering resistance and resilience measures and for the management of exceedence flows. There is a low risk of localised surface water flooding to the Airport M0007 site.

For both sites, development proposals should look at opportunities to incorporate SUDS to reduce the risk of surface water flooding (Sustainability Appraisal indicator). Surface water run-off from these sites should not increase as a result of development (reduced run-off should be sought if possible in some areas) and not discharge into the combined sewer system. These sites lie within the Manchester and Trafford South Critical Drainage Areas and managing surface water discharges from development and exceedance flows is critical.

The Upper Mersey CFMP recognised the need for a flood risk management strategy to reduce flood risk on the Sinderland Brook network. Close consultation with the Environment Agency and other stakeholders, such as United Utilities and British Waterways will be required to develop a suitable Flood Risk Management Strategy to ensure the development needs and the different sources of flood risk are managed strategically in this area.

### 9.3.2 Salford City Council

#### Lower Irwell

Across the Lower Irwell strategic location, Lower Broughton S0001, Cambridge Industrial Estate S0399 and Salford Central S0414 (New Bailey Street/ Gore Street S0427) are partly within Flood Zone 3. Elsewhere the Lower Irwell and Grey Irwell are likely to stay in bank during a 1 in 100 year event. Housing is proposed at Lower Broughton and Cambridge Industrial Estate and therefore the Exception Test applies if housing is proposed in Flood Zone 3. It is unlikely that the Exception Test will need to be applied for Salford Central, unless housing in proposed in the area shown as Flood Zone 3.

Salford Central S1046 and Exchange Greengate S1045 are mostly at a residual risk of flooding in an extreme event. There is very limited flood risk within the Salford Central site to Upper Cleminson Street/ Chapel Street (S0425) and within the Exchange Greengate site at Collier Street S0421 and Salford Approach Car Park S0423, with residual risk in an extreme 1 in 1000 year event, considering climate change. Awareness of the potential risk of flooding should be raised here. Access and egress may need further consideration where it would be provided across nearby sites that are at higher flood risk.

There is a residual risk of flooding in an extreme 1 in 1000 year event within the Salford Central site to Hampson Street/ Middlewood Street S0426, James Street/ Rodney Street S0428, Adelphi Street S0429, Boond Street S0418, Gorton Street S0419, New Bond Street S0420 and King Street S0422. New Bailey Street/ Gore Street S0427, Salford Approach S0417 and Greengate S0424 are at some risk in a 1 in 100 year event, considering climate change and much greater risk in an extreme 1 in 1000 year event. Residual risk in an extreme event and where the depth of water is shallower in lesser events should be taken into account through resistance and resilience measures. Access and egress may need further consideration where it would be provided across other areas at flood risk.

The Lower Irwell SFRA model predicts that approximately 13% of the Lower Broughton Growth Point site is within the 1 in 100 year flood extent, placing a high number of homes at risk of flooding (Sustainability Appraisal indicator). Only the riverside boundaries of the other sites would flood during the 1 in 100 year event. The risk increases significantly at Lower Broughton for the 1 in 100 year event plus climate change scenario. There is significant residual risk from the 1 in 1000 year event with flood hazard causing 'danger to most'.

Planning Permission has already been granted for some areas of the Lower Broughton site with the intention to manage the risk by the following measures:

- Influencing and informing the public (good awareness of risk)
- Maintaining the flood flow route along Lower Broughton Road through the site
- Cut and fill across the site to maintain flood storage
- Sequentially locating housing to lower hazard areas (e.g. Spike Island to the south)
- Residential development on the first floor (above flood level)
- Raised road levels for safe access and egress for emergency vehicles
- 'Shelter in place' as a last resort

Flood warning and an emergency flood plan should be in place for all developments and safe access and egress in the event of a flood should be available. Any development in areas of high flood risk would reduce the floodplain storage volume and therefore compensatory storage would be required. Urban design issues should be considered, so that the impact of residential development on the first floor and leaving the ground floor for parking are fully integrated in the place making needs of the area.

For all sites, development proposals should look at opportunities to incorporate SUDS to reduce the risk of surface water flooding. Surface water run-off from these sites should not increase as a result of development (reduced run-off should be sought if possible in some areas) and not discharge into the combined sewer system. Many of these sites lie within the Conurbation Core Critical Drainage Area and managing surface water discharges from development and exceedance flows is critical. The risk of groundwater flooding should be considered when assessing suitable SUDS techniques at a strategic level and in the design of buildings.

The River Irwell CFMP recognises the need for a future flood risk management strategy to investigate how flood risk can be reduced on the Lower Irwell at Salford where there is high flood risk. This could be through upstream or local flood storage or through raised defences. Actions on the Grey Irwell will be investigated by the Environment Agency as part of the Central Manchester Flood Risk Management Strategy. These may include upstream flood storage. The CFMP recognises the opportunity to protect or restore river corridors linked to regeneration/redevelopment or specifically for reduction of flood risk in this area of Salford. Close consultation with the Environment Agency and other stakeholders, such as United Utilities and the Manchester Ship Canal Company will be required to develop a suitable Flood Risk Management Strategy to ensure the development needs and the different sources of flood risk are managed strategically in Salford City Centre.

### Salford Quays and Ordsall

Media City S0415 (including Salford Quays S0017 and Land at Erie Basin S0014) and Ordsall Sub Regional Significant sites S0392 are intended for mixed uses and fall within Flood Zone 3 (undefended). The sequential approach should be applied so that any housing is located towards the lower risk areas. The Exception Test will need to be applied if housing is proposed in Flood Zone 3. Given the significant residual risk across the Ordsall Riverside site, housing should be avoided or substituted with less vulnerable uses unless there is no other way of regenerating the local area and the Exception Test can be passed. In addition, any development in high flood risk areas would reduce the floodplain storage volume and therefore compensatory storage would be required. Urban design issues should be considered, so that the impact of residential development on the first floor and leaving the ground floor for parking are fully integrated in the place making needs of the area. A site specific FRA would consider the risks to these sites in greater detail including the residual risk from the Manchester Ship Canal.

Flood warning and an emergency flood plan should be in place for all developments and safe access and egress in the event of a flood should be available.

For all sites, development proposals should look at opportunities to incorporate SUDS to reduce the risk of surface water flooding. Surface water run-off from these sites should not increase as a result of development and not discharge into the combined sewer system. Many of these sites lie within the Conurbation Core Critical Drainage Area and managing surface water discharges from development and exceedance flows is critical. The risk of groundwater flooding should be considered when assessing suitable SUDS techniques at a strategic level.

The River Irwell CFMP recognised the need for further investigations into flood risk from the Manchester Ship Canal and how this can be managed to the assumed current low level in the future (note that the CFMP did not undertake any modelling of the risk from the Manchester Ship Canal and hence better data is now available). Close consultation with the Environment Agency and the Manchester Ship Canal Company will be required to develop a suitable Flood Risk Management Strategy to ensure the development needs and the different sources of flood risk are managed strategically in areas associated with the Manchester Ship Canal Flood Zones.

### Salford North West

A very limited area of Linnyshaw is in Flood 3. Housing is proposed and hence the Exception Test applies. There are residual flood risks which need to be managed appropriately and a FRA will be required to further consider all sources of flooding for proposed development sites.

In the Worsley Brook and Ellen Brook catchments there are well known local flooding problems related to overland flow and surcharging culverts, many of which can be related to previous development. Around 60 properties and roads have flooded in Walkden ward in the past. Regeneration and redevelopment in the catchments could have a significant impact on surface water runoff to local watercourses and the sewer network.

Where development is proposed over or next to a culverted watercourse, Culverts on this site will require further consideration and the Environment Agency recommend that culverts are opened up (de-culverted), where possible (although this needs careful consideration due to potential future maintenance problems), to reduce the risk of flooding (due to blockages), for easy access and maintenance and to enhance the biodiversity value of the site. If de-culverting is not practicable a full 8 metre easement is required on either side (where watercourses are Main River) to allow access for maintenance or repair.

Whittle Brook flows (partly in culvert) through the north part of the Linnyshaw S0004. In an extreme event the site is at risk of flooding, although flood depths are expected to be shallow. If the culvert were to block this would also increase flood risk. Surface water flooding incidents have occurred in the site and a small watercourse, How Clough, flows along the eastern boundary of Linnyshaw. Resistance and resilience measures should account for residual risk, a flood warning and an emergency flood plan should be in place and safe access and egress in the event of a flood should be available.

Legh Street S0395 and Cawdor Street 0396 are situated adjacent to the Bridgewater Canal and are at potential risk of canal flooding. A FRA should demonstrate that development is safe from canal flooding by appropriate access, egress and emergency planning procedures. Finished floor levels should incorporate an appropriate freeboard allowance given the residual risk from the Bridgewater Canal.

The risk of flooding is relatively low to Great Universal Stores S0397, S0398 and a site specific FRA should address mitigation for risk from surface water flooding.

For all sites, development proposals should look at opportunities to incorporate SUDS to reduce the risk of surface water flooding. Surface water run-off from these sites should not increase as a result of development (reduced run-off should be sought if possible in some areas) and not discharge into the combined sewer system. Many of these sites lie within the Salford North West Critical Drainage Area and managing surface water discharges from development and exceedance flows is critical. The risk of groundwater flooding should be considered when assessing suitable SUDS techniques at a strategic level and in the design of buildings.

The River Irwell CFMP recognises the need for a future flood risk management strategy to investigate how flood risk can be reduced in this area, including by long term asset management on the Worsley Brook. Close consultation with the Environment Agency and other stakeholders, such as United Utilities will be required to develop a suitable Flood Risk Management Strategy to ensure the development needs and the different sources of flood risk are managed strategically for potential development sites in this area of Salford.

### Barton and Irlam

Three of the five development sites in this strategic location are within Flood Zone 3 (Barton Regionally Significant Site S0412, Barton Stadium S0011 and Irlam and Cadishead S0404). Irlam and Cadishead S0404 is intended for housing use and therefore will need to undergo the Exception Test. In addition, although the other Core Strategy site at Irlam and Cadishead S0408 is proposed for housing use, since it falls outside of Flood Zone 3 the Exception Test is not required. Nevertheless, it is important that the actual and residual risks are managed to ensure that development is sustainable.

Salteye Brook flows through Barton Stadium S0011 and Barton S0412 and discharges into the Manchester Ship Canal. Flooding could come from either source, and in the case of the Salteye Brook is largely related to the Manchester Ship Canal backing up the watercourse, resulting in depths of flooding up to 2m adjacent to Salteye Brook and the existing football ground, when considering the adopted residual risk scenario. The 1 in 1000 year flood event covers the majority of the Barton Stadium S0011 and Barton S0412 sites. Residual risk from the Manchester Ship Canal should be taken into account when master planning the sites, setting appropriate floor levels and providing access and egress.

The Irlam Wharf Road S0009 allocation, which is adjacent to the Manchester Ship Canal, is entirely within Flood Zone 2 (the Manchester Ship Canal is likely to be in bank in a 1 in 100 year event here) . Although less vulnerable development is compatible with this flood zone, the potential flood hazards are likely to be significant. In the event of an extreme flood event (1 in 1000 year) safe access and egress to the site would be difficult as the surrounding area is also at risk. Land raising should be considered across the site and for any access roads to ensure dry access and egress is provided, subject to an assessment proving that it will not have an adverse effect on flood risk elsewhere. Residual risk from the Manchester Ship Canal should be taken into account when master planning the sites, setting appropriate floor levels and providing access and egress.

Taking into account residual risk, during the 1 in 100 year event flood water will stay in bank along the Manchester Ship Canal at the Irlam and Cadishead S0408 Core Strategy site but overtop the Manchester Ship Canal across part of the Irlam and Cadishead S0404 Core Strategy site. There is residual risk from the extreme event with flood depths over 2m adjacent to the Manchester Ship Canal. As more vulnerable development (housing) has been proposed for these sites appropriate access, egress, emergency planning procedures and finished floor levels which take account of residual risk will be essential.

Flood warning and an emergency flood plan should be in place for all developments and safe access and egress in the event of a flood should be available.

For all sites, development proposals should look at opportunities to incorporate SUDS to reduce the risk of surface water flooding. Surface water run-off from these sites should not increase as a result of development (reduced run-off should be sought if possible in some areas) and not discharge into the combined sewer system. Barton Stadium S0011 lies partly within the Salford North West Critical Drainage Area and managing surface water discharges from development and exceedance flows is critical. The risk of groundwater flooding should be considered when assessing suitable SUDS techniques at a strategic level and in the design of buildings.

The River Irwell CFMP recognised the need for further investigations into flood risk from the Manchester Ship Canal and how this can be managed to the assumed current low level in the future (note that the CFMP did not undertake any modelling of the risk from the Manchester Ship Canal and hence better data is now available). Close consultation with the Environment Agency and other stakeholders, such as United Utilities and the Manchester Ship Canal Company will be required to develop a suitable Flood Risk Management Strategy to ensure the development needs and the different sources of flood risk are managed strategically in areas associated with the Manchester Ship Canal Flood Zones.

### 9.3.3 Trafford Council

#### Trafford Core

In Trafford Core, five of the seven development sites (Pomona Island T0467, Trafford Wharfside T0469, Trafford Park Core T0471, Trafford Quays T0463 and Trafford Centre Rectangle T0472) are partly within Flood Zone 3 (Sustainability Appraisal indicator). It needs to be proved that the risk of flooding to these sites can be managed and made safe for the Exception Test to be passed where housing is proposed.

When considering the adopted residual risk scenario, T0471 Trafford Park Core, T0463 Trafford Quays and Pomona T0467 are exposed to significant flood depths (up to 2m) and hazard ('danger to all') from the Manchester Ship Canal in a 1 in 100 year flood event, considering climate change. Residual risk will increase in a 1 in 1000 year flood event, with deeper and more extensive flooding. In addition, there is a potential risk of flooding from the Bridgewater Canal, affecting Pomona T0467, Trafford Quays T0463 and Trafford Centre Rectangle T0472.

At these sites appropriate land uses should be designated that reflect the scale of flood risk. The sequential approach should be applied within each site so that water compatible development, such as open space, is located in the high hazard canal side areas, where there is a significant risk to life and there are high flood depths.

Where flood depths are up to 0.6m, this risk can be managed by appropriate access, egress, flood warning, emergency planning procedures and finished floor levels which take account of both residual risk from the Manchester Ship Canal and Bridgewater Canal. Urban design issues should be considered, so that the impact of residential development on the first floor and leaving the ground floor for parking are fully integrated in the place making needs of the area.

Pomona T0467 has the most challenging planning constraints. The site is at significant risk of flooding and serves a function in allowing excess water to pass from the Bridgewater Canal to the Manchester Ship Canal, thereby reducing risk to sites next to the Bridgewater Canal to the south in Trafford. More vulnerable land uses will be difficult to deliver given the high risk of flooding from the Manchester Ship Canal and Bridgewater Canal. Finished floor levels would need to be equivalent to the 1 in 100 year plus climate change event, taking into account residual risk. In addition, any development in such a high flood risk area would reduce floodplain storage volume and therefore compensatory storage would be required, which would be problematic to deliver on site. Providing access and egress in a flood event could be challenging.

For all sites, development proposals should look at opportunities to incorporate SUDS to reduce the risk of surface water flooding (Sustainability Appraisal indicator). Surface water run-off from these sites should not increase as a result of development (reduced run-off should be sought if possible in some areas) and not discharge into the combined sewer system. Many of these sites lie within the Conurbation Core and Manchester and Trafford South Critical Drainage Areas and managing surface water discharges from development and exceedance flows is critical. The risk of groundwater flooding should be considered when assessing suitable SUDS techniques at a strategic level and in the design of buildings.

The River Irwell CFMP recognised the need for further investigations into flood risk from the Manchester Ship Canal and how this can be managed to the assumed current low level in the future (note that the CFMP did not undertake any modelling of the risk from the Manchester Ship Canal and hence better data is now available). Close consultation with the Environment Agency and the Manchester Ship Canal Company will be required to develop a suitable Flood Risk Management Strategy to ensure the development needs and the different sources of flood risk are managed strategically in areas associated with the Manchester Ship Canal Flood Zones.

### Trafford South and Central

None of the development sites along the Bridgewater Canal fall within Flood Zone 3 (Sustainability Appraisal Indicator). Therefore the actual risk from rivers is relatively low to these sites. The Exception Test is not required and the development sites should be taken forward provided a site specific FRA is undertaken that considers all sources of flooding.

Stretford Crossroads T0470 and Woodfield Road T0476 are at potential risk of canal flooding. A FRA should demonstrate that development is safe from canal flooding by appropriate access, egress and emergency planning procedures. Finished floor levels should incorporate an appropriate freeboard allowance given the residual risk from the Bridgewater Canal.

The risk of flooding is relatively low to Sale Town Centre T0479 and Altrincham Town Centre T0477, including Altair (T0466) and a site specific FRA should address mitigation for risk from surface water flooding.

For all sites, development proposals should look at opportunities to incorporate SUDS to reduce the risk of surface water flooding (Sustainability Appraisal indicator). Surface water run-off from these sites should not increase as a result of development (reduced run-off should be sought if possible in some areas) and not discharge into the combined sewer system. Many of these sites lie within the Manchester and Trafford South Critical Drainage Area and managing surface water discharges from development and exceedance flows is critical. The risk of groundwater flooding should be considered when assessing suitable SUDS techniques at a strategic level and in the design of buildings.

### Carrington and Partington

The Partington T0475, Partington Canalside T0465 and Carrington T0474 sites partly fall within Flood Zone 3 (Sustainability Appraisal Indicator). The sites are intended for housing and mixed use and if housing is proposed in Flood Zone 3, the Exception Test will need to be applied.

The southern section of the Partington Canalside T0465 is at risk of flooding from the Manchester Ship Canal. Therefore, an appropriate land use should be considered, with provision for open spaces in the highest flood risk areas.

Residential development is suitable for the Partington T0475 (excluding Partington Canalside T0465) as the majority of the site falls in Flood Zone 1 and only a small area is at risk from the Manchester Ship Canal in an extreme event and the Red Brook.

The risk of flooding is relatively low to the majority of Carrington T0474. To the north of the site on the lower lying areas there is residual risk in the event of the defences overtopping or breaching on the River Mersey and from the Manchester Ship Canal. Lower vulnerability uses should be allocated to these areas of the sites, with appropriate consideration of access, egress, flood warning, emergency planning procedures and finished floor levels. The areas of highest flood risk at Carrington should be sequentially avoided and set aside as open space.

For all sites, development proposals should look at opportunities to incorporate SUDS to reduce the risk of surface water flooding (Sustainability Appraisal indicator). Surface water run-off from these sites should not increase as a result of development (reduced run-off should be sought if possible in some areas) and not discharge into the combined sewer system. The risk of groundwater flooding should be considered when assessing suitable SUDS techniques at a strategic level and in the design of buildings.

The River Irwell CFMP recognised the need for further investigations into flood risk from the Manchester Ship Canal and how this can be managed to the assumed current low level in the future (note that the CFMP did not undertake any modelling of the risk from the Manchester Ship Canal and hence better data is now available). The Upper Mersey recognised the need for a flood risk management strategy to reduce flood risk on the River Mersey, which may include the provision of upstream storage and a strategy for flood risk management on the Sinderland Brook network. Close consultation with the Environment Agency and other stakeholders, such as United Utilities and the Manchester Ship Canal Company will be required to develop a suitable Flood Risk Management Strategy to ensure the development needs and the different sources of flood risk are managed strategically in areas associated with the Manchester Ship Canal Flood Zones.

## 9.4 Flood Risk Balance Sheets

In any assessment of an environmental risk a transparent record of how the risk was assessed and is to be managed is essential. The Flood Risk Balance Sheets provide a short summary of the risk assessment and the characteristics of that risk and its likely mitigation. It is intended to help planning authorities facilitate the Exception Test and demonstrate the acceptability and soundness of the proposed development sites.

To provide this longer-term view to spatial planning in flood-risk areas, a number of indicators have been developed to understand the nature of flood risk to a site and whether that site could be delivered in a way that would ensure the development would be safe from flooding and that there would be no increase in flood risk elsewhere. These indicators are shown in Table 9-3.

**Table 9-3 Flood Risk Balance Sheet indicators**

| Indicator | Description |
|---|---|
| Is the development within existing flood-risk area? | Existing flood warning and evacuation is in place. Importantly how easily will the area recover following an event? New development may lose local services for 12 months if an event occurs. |
| What are the scale and nature of flood risks? | The Level 2 SFRA maps in the Maps Volume provide an indication of the likely depth and hazard from fluvial flooding and areas at risk from canal and surface water flooding. |

| Indicator | Description |
| --- | --- |
| What scale of residual risk measures will be required? | Low depths of flooding can be easily designed out by modest alteration of ground or floor levels. First floor accommodation has implications for the urban design and place setting of the development. |
| How will egress and access be assured?<br>What will be the emergency planning impact? | Impact on emergency planning provision and whether risks to development would be acceptable. Access routes need to be accessible in a flood to the emergency services. |
| Will there be a change in number of people at risk? | Introduction of more people will put a greater strain on the emergency services in an event. Whilst they may be accommodated at high elevation they will require support very quickly even after the inundation has stopped. |
| Will there be a change in number of properties at risk? | Assumes mitigation measures put in place – From an economic viewpoint development can replace existing property with lower vulnerability land uses and also development that is designed to be flood-resistant or resilient. A reduction in economic risk can be achieved. |
| Will mitigation measures have an impact on other areas downstream or adjacent? | How wide-ranging would mitigation measures need to be to take account of the effects of significant land raising or alteration or blockage of flow routes. |

These indicators have been used to qualitatively assess flood risk to produce one of five possible outcomes on the acceptability of strategic development sites in terms of flood risk i.e. can the development be made safe from flood risk and not have an adverse impact on flood risk elsewhere? This can be used to inform the Exception Test where this applies.

The five outcomes are:

- Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas
- Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development
- A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)
- Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas
- Acceptable subject to FRA

**Table 9-4: Suitability of Mitigation Measures**

| Mitigation measure | Suitability | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Manchester | | | | Salford | | | | Trafford | | |
| | **Regional centre and Inner Areas** West | **Regional Centre and Inner Areas** North | **Regional centre and Inner Areas** South | **Manchester South** | **Lower Irwell** | **Salford Quays and Ordsall** | **Salford North West** | **Barton and Irlam** | **Trafford Core** | **Trafford South and Central** | **Partington and Carrington** |
| Site layout and design | Likely | Likely | Likely | Likely | Likely | Likely | Likely | Likely | Likely | Likely | Likely |
| Modification of Ground Levels | Unlikely | Possible | Possible | Possible | Possible | Unlikely | Possible | Possible | Possible (with the exception of Pomona T0476) | Unlikely | Possible |
| Raised Defences | Potential | Unlikely | Unlikely | Unlikely | Potential | Unlikely | Unlikely | Unlikely | Unlikely | Unlikely | Possible |
| Urban Design (including resistance and resilience) | Likely – see guidance for MSC and Grey Irwell Corridor (Victoria M0005) and general guidance (Strangeways M0004) | Likely – see general guidance | Likely – see general guidance | Likely – see general guidance | Likely – see general guidance | Likely – see guidance for MSC and Grey Irwell corridor | Likely – see general guidance | Likely – see guidance for MSC and Grey Irwell corridor | Likely – see guidance for MSC and Grey Irwell corridor | Likely – for other sources of flooding | Likely – see guidance for MSC and Grey Irwell corridor |
| Local flood storage | Potential | Possible | Possible | Unlikely | Potential | Unlikely | Possible | Unlikely | Unlikely | Unlikely | Unlikely |

The information is this table is provided to inform future work

**Table 9-5: Flood Risk Balance Sheets**

| Indicator | | | | | | |
|---|---|---|---|---|---|---|
| A | B | C | D | E | F | G |
| Is the development within existing flood-risk area? | What are the scale and nature of flood risks? | What scale of residual risk measures will be required? | How will egress and access be assured? What will be the emergency planning impact? | Will there be a change in number of people at risk? | Will there be a change in number of properties at risk? | Will mitigation measures have an impact on other areas downstream or adjacent? |
| +<br>No risk<br><br>-<br>Risk area within resilient communities<br><br>- -<br>Vulnerable community, which would struggle to recover | + +<br>Benign, and understood<br><br>-<br>Risk is significant but understood<br><br>- -<br>Difficult to warn, unpredictable, may result in operational failure of defences, from multiple sources | ++<br>None required<br><br>+<br>Measures could reduce risk to existing development<br><br>-<br>Standard, no major alteration to layout and form<br><br>- -<br>Flood resistance is dominant in design | +<br>No special provisions, safe<br><br>-<br>Needs to be managed, should be safe, must be proven in FRA<br><br>- -<br>Special provision, natural response will not be obvious. Safety not guaranteed, and may not convince LPA/EA when examined in detail | +<br>Reduction<br><br>=<br>Neutral impact<br><br>-<br>Increase | +<br>Reduction (preferable outcome in PPS25)<br><br>=<br>Neutral impact<br><br>-<br>Increase | +<br>Reduction<br><br>=<br>Neutral impact<br><br>-<br>Increase in flood risk elsewhere (Exception test requires no impact) |

| | | Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | Recommendation | Commentary |
| Strategic Location/ development site | Proposed land use | Is the development within existing flood-risk area? | What are the scale and nature of flood risks? | What scale of residual risk measures will be required? | How will egress and access be assured? What will be the emergency planning impact? | Will there be a change in number of people at risk? | Will there be a change in number of properties at risk? | Will mitigation measures have an impact on other areas downstream or adjacent? | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas<br>Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development<br>A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)<br>Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas<br>Acceptable subject to FRA | |
| **Regional Centre and Inner Areas West** | | | | | | | | | | |
| Strangeways (M0004) | Employment | - | - - | - - | - | = | + | - | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary) | Most at risk from breach or overtopping in an extreme 1 in 1000 year event. May be difficult to warn for breach. Significant residual risk in extreme event affecting around 25% of site would need to be carefully planned for. In flow path so any mitigation measures, such as land raising would need careful consideration. Proceeding with development here would need careful consideration of urban form, with appropriate low vulnerability uses in the highest risk areas.<br>Surface water flood risk associated with 'lost watercourses' needs further consideration in a FRA. |
| Victoria (M0005) | Employment | - - | - | - | - | = | + | = | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | The west central part of the site is at residual risk in an extreme 1 in 1000 year event. Proceeding with development here would need careful consideration of urban form, with appropriate low vulnerability uses in the highest risk areas.<br>Surface water flood risk associated with a 'lost watercourse' to the |

| Strategic Location/ development site | Proposed land use | A<br>Is the development within existing flood-risk area? | B<br>What are the scale and nature of flood risks? | C<br>What scale of residual risk measures will be required? | D<br>How will egress and access be assured? What will be the emergency planning impact? | E<br>Will there be a change in number of people at risk? | F<br>Will there be a change in number of properties at risk? | G<br>Will mitigation measures have an impact on other areas downstream or adjacent? | Recommendation | Commentary |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | south needs further consideration in a FRA. | |
| **Regional Centre and Inner Areas North** | | | | | | | | | | |
| Harpurhey/ Moston (M0015 to M0020) | Housing | - | ++ | ++ | + | = | + | = | Acceptable subject to FRA | Limited surface water flood risk should be explored further in a FRA. |
| Irk Valley (M0021) | Housing | - | - | - - | - | - | + | - | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary) | Riverside areas next to the River Irk are at risk in 1 in 100 year event and considering climate change. There is residual risk in riverside areas in extreme events, with larger areas of significant depths and hazards. In flow path so any mitigation measures, such as land raising would need careful consideration. Proceeding with development here would need careful consideration of urban form and should be sequentially avoided in the areas of highest risk in a 1 in 100 year event, considering climate change. |
| Booth Hall (M0022) | Housing | - | ++ | ++ | + | = | + | = | Acceptable subject to FRA | Limited surface water flood risk should be explored further in a FRA. |

Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators)

Recommendation key:
- Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas
- Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development
- A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)
- Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas
- Acceptable subject to FRA

| | | Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | Recommendation | Commentary |
| Strategic Location/ development site | Proposed land use | Is the development within existing flood-risk area? | What are the scale and nature of flood risks? | What scale of residual risk measures will be required? | How will egress and access be assured? What will be the emergency planning impact? | Will there be a change in number of people at risk? | Will there be a change in number of properties at risk? | Will mitigation measures have an impact on other areas downstream or adjacent? | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas<br>Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development<br>A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)<br>Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas<br>Acceptable subject to FRA | |
| Blackley Village (M0023) | Housing | - | ++ | ++ | + | = | + | = | Acceptable subject to FRA | Limited flood risk from surface water and a minor tributary of the River Irk should be explored further in a FRA. |
| Collyhurst (M0013) | Housing | - | - | - | - | = | + | = | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | Extreme events give rise to limited residual risk on the site from the River Irk and Moston Brook. Development here would need careful consideration of urban form to account for this residual risk. Surface water flood risk associated with a 'lost watercourse' needs further consideration in a FRA. |
| Miles Platting (M0008) | Housing | - - | - - | + | - | - | + | = | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | Development on the south west of the site would need to take account of the risk from a breach on the Rochdale or Ashton Canals and overtopping from the Rochdale Canal in urban design. It would be difficult to provide flood warning for such an occurrence. Surface water flood risk associated with 'lost watercourses' needs further consideration in a FRA. |
| Newton Heath (M0009) | Housing | - | ++ | ++ | + | = | + | = | Acceptable subject to FRA | Surface water flood risk, including that associated with a 'lost watercourse' needs further consideration in a FRA. |
| Central Park (M0003) | Employment | - - | - - | + | - | - | + | = | Acceptable with some detailed consideration of | Development on the centre of the site would need to take account of |

| | | Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | Recommendation | Commentary |
| Strategic Location/ development site | Proposed land use | Is the development within existing flood-risk area? | What are the scale and nature of flood risks? | What scale of residual risk measures will be required? | How will egress and access be assured? What will be the emergency planning impact? | Will there be a change in number of people at risk? | Will there be a change in number of properties at risk? | Will mitigation measures have an impact on other areas downstream or adjacent? | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas<br>Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development<br>A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)<br>Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas<br>Acceptable subject to FRA | |
| | | | | | | | | | flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | the risk from a breach on the Rochdale Canal in urban design. It would be difficult to provide flood warning for such an occurrence. Surface water flood risk associated with 'lost watercourses' needs further consideration in a FRA. |
| **Regional Centre and Inner Areas South** | | | | | | | | | | |
| Eastern Gateway (M0001) | Employment | -- | -- | - - | - | = | + | - | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary) | Riverside areas next to the River Medlock to the north of the site are at risk in 1 in 100 year event and considering climate change. There is residual risk in riverside areas in extreme events, with larger areas of significant depths and hazards.<br>In flow path so any mitigation measures, such as land raising would need careful consideration. Development on the north of the site would need to take account of the risk from a breach on the Ashton Canal. It would be difficult to provide flood warning for such an occurrence.<br>Proceeding with development here would need careful consideration of urban form, with appropriate low vulnerability uses in the higher risk areas and should be sequentially |

| Strategic Location/ development site | Proposed land use | A<br>Is the development within existing flood-risk area? | B<br>What are the scale and nature of flood risks? | C<br>What scale of residual risk measures will be required? | D<br>How will egress and access be assured? What will be the emergency planning impact? | E<br>Will there be a change in number of people at risk? | F<br>Will there be a change in number of properties at risk? | G<br>Will mitigation measures have an impact on other areas downstream or adjacent? | Recommendation | Commentary |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | avoided in the areas of highest risk from the River Medlock in a 1 in 100 year event, considering climate change.<br>Surface water flood risk associated with a 'lost watercourse' to the north of the site needs further consideration in a FRA. |
| Sport City Visitor Destination (M0002) | Mixed | - - | - - | + | - | - | + | = | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | Development on the south of the site would need to take account of the risk from a breach on the Ashton Canal in urban design. It would be difficult to provide flood warning for such an occurrence.<br>Flood risk associated with the River Medlock culvert needs further consideration in a FRA. |
| Holt Town (M0024) | Housing | - - | - - | - - | - | - | + | = | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor | Highest risk is to riverside areas in the south of the site with significant depths and hazards expected locally to the river.<br>Development on the centre of the site would need to take account of the risk from a breach on the Ashton Canal in urban design. It would be difficult to provide flood warning for such an occurrence.<br>Proceeding with development here |

Flood risk indicators adopted as measure of Acceptability
(-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators)

Key (Recommendation / Commentary):
- Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas
- Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development
- A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)
- Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas
- Acceptable subject to FRA

| | | Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | Recommendation | Commentary |
| Strategic Location/ development site | Proposed land use | Is the development within existing flood-risk area? | What are the scale and nature of flood risks? | What scale of residual risk measures will be required? | How will egress and access be assured? What will be the emergency planning impact? | Will there be a change in number of people at risk? | Will there be a change in number of properties at risk? | Will mitigation measures have an impact on other areas downstream or adjacent? | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas<br>Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development<br>A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)<br>Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas<br>Acceptable subject to FRA | |
| | | | | | | | | | accommodation may be necessary) | would need careful consideration of urban form and should be sequentially avoided in the areas of highest risk from the River Medlock in a 1 in 100 year event, considering climate change. |
| Chancellors Place (M0025) (including area within Eastern Gateway at risk from the River Medlock) | Housing | - | - | + | - | - | + | - | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | There is generally low risk to the site with the exception of residual risk to a limited area in the north west corner of the site from the River Medlock, with significant localised depths and hazards in an extreme 1 in 1000 year event. In flow path so any mitigation measures, such as land raising would need careful consideration. Proceeding with development here would need careful consideration of urban form and should be sequentially avoided in the areas of highest risk from the River Medlock in a 1 in 100 year event, considering climate change. |
| Lower Medlock (M0026) | Housing | - - | - - | - - | - | - | + | - | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important | Highest risk is to riverside areas in the south of the site with significant depths and hazards expected. Development on the west of the site would need to take account of the risk from a breach on the Ashton Canal in urban design. It would be |

| Strategic Location/ development site | Proposed land use | Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) A | B | C | D | E | F | G | Recommendation | Commentary |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Is the development within existing flood-risk area? | What are the scale and nature of flood risks? | What scale of residual risk measures will be required? | How will egress and access be assured? What will be the emergency planning impact? | Will there be a change in number of people at risk? | Will there be a change in number of properties at risk? | Will mitigation measures have an impact on other areas downstream or adjacent? | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas<br>Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development<br>A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)<br>Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas<br>Acceptable subject to FRA | |
| | | | | | | | | | influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary) | difficult to provide flood warning for such an occurrence.<br>In flow path so any mitigation measures, such as land raising would need careful consideration.<br>Proceeding with development here would need careful consideration of urban form and should be sequentially avoided in the areas of highest risk from the River Medlock in a 1 in 100 year event, considering climate change.<br>Surface water flood risk associated with a 'lost watercourse' needs further consideration in a FRA. |
| Oxford Road Corridor (M0042) | Employment | - - | - - | - - | - | = | + | - | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary) | Riverside areas next to the River Medlock to the north of the site are at risk in 1 in 100 year event and considering climate change. There is residual risk in riverside areas in extreme events, with larger areas of significant depths and hazards.<br>In flow path so any mitigation measures, such as land raising would need careful consideration.<br>There is also a risk of flooding from the Corn Brook, which is expected to be shallow, becoming more widespread for extreme events.<br>Development on the west of the site |

| | | Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | Recommendation | Commentary |
| Strategic Location/ development site | Proposed land use | Is the development within existing flood-risk area? | What are the scale and nature of flood risks? | What scale of residual risk measures will be required? | How will egress and access be assured? What will be the emergency planning impact? | Will there be a change in number of people at risk? | Will there be a change in number of properties at risk? | Will mitigation measures have an impact on other areas downstream or adjacent? | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas<br>Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development<br>A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)<br>Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas<br>Acceptable subject to FRA | |
| | | | | | | | | | | would need to take account of the risk from a breach on the Bridgewater Canal and it would be difficult to provide flood warning for such an occurrence.<br>Surface water flood risk associated with 'lost watercourses' needs further consideration in a FRA.<br>Proceeding with development here would need careful consideration of urban form, with appropriate low vulnerability uses in the higher risk areas and should be sequentially avoided in the areas of highest risk from the River Medlock in a 1 in 100 year event, considering climate change. |
| West Gorton (M0010) | Housing | - | - - | - - | - | - | + | = | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary) | Areas to the west of the site are at significant risk from the Corn Brook in a 1 in 100 year event, with increasing risk for extreme events. Proceeding with development here would need careful consideration of urban form and should be sequentially avoided in the areas of highest risk in a 1 in 100 year event, considering climate change. |

| | | Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | Recommendation | Commentary |
| Strategic Location/ development site | Proposed land use | Is the development within existing flood-risk area? | What are the scale and nature of flood risks? | What scale of residual risk measures will be required? | How will egress and access be assured? What will be the emergency planning impact? | Will there be a change in number of people at risk? | Will there be a change in number of properties at risk? | Will mitigation measures have an impact on other areas downstream or adjacent? | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas<br>Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development<br>A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)<br>Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas<br>Acceptable subject to FRA | |
| Brunswick (M0011) | Housing | - | -- | - | - | = | + | = | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | Areas to the west of the site are at some risk from the Corn Brook in a 1 in 100 year event and with climate change. There is residual risk associated with localised significant depths and hazards in an extreme 1 in 1000 year event. Development here would need careful consideration of urban form to account for residual risk. |
| Coverdale Crescent (M0012) | Housing | - | ++ | ++ | + | = | + | = | Acceptable subject to FRA | Surface water flood risk, including that associated with 'lost watercourses' needs further consideration in a FRA. |
| **Manchester South** | | | | | | | | | | |
| Roundthorn (M0006) | Employment | -- | - | + | - | = | + | = | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | High susceptibility to surface water flooding with need for careful consideration of urban form and management of exceedence flows. Limited risk from the Fairywell Brook. |
| Airport (M0007) | Employment | - | ++ | ++ | + | = | + | = | Acceptable subject to FRA | Limited flood risk from surface water and the Fairywell and Timperley Brooks should be explored further in a FRA. |

| | | Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | Recommendation | Commentary |
| Strategic Location/ development site | Proposed land use | Is the development within existing flood-risk area? | What are the scale and nature of flood risks? | What scale of residual risk measures will be required? | How will egress and access be assured? What will be the emergency planning impact? | Will there be a change in number of people at risk? | Will there be a change in number of properties at risk? | Will mitigation measures have an impact on other areas downstream or adjacent? | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas<br>Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development<br>A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)<br>Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas<br>Acceptable subject to FRA | |
| **Lower Irwell** | | | | | | | | | | |
| Salford Central - Upper Cleminson Street/ Chapel Street (S0425) | Mixed | -- | - | - | - | = | + | = | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | Limited residual risk, with exception of an extreme 1 in 1000 year event with climate change from the Grey Irwell. Awareness of this potential risk of flooding should be raised. |
| Salford Central - Hampson Street/ Middlewood Street (S0426) | Mixed | -- | - | - | - | - | + | = | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | Limited residual risk, with exception of an extreme 1 in 1000 year event from the Grey Irwell. Development here would need careful consideration of urban form to account for this residual risk. |
| Salford Central - New Bailey Street/ Gore Street (S0427) | Mixed | - - | - | - - | - - | - | + | - | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be | Riverside areas are at localised residual risk from the Grey Irwell in a 1 in 100 year event considering climate change. The majority of the site is at significant residual risk in an extreme 1 in 1000 year event. In flow path so any mitigation measures, such as land raising would need careful consideration. Proceeding with development here would need careful consideration of urban form. |

| | | Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | Recommendation | Commentary |
| Strategic Location/ development site | Proposed land use | Is the development within existing flood-risk area? | What are the scale and nature of flood risks? | What scale of residual risk measures will be required? | How will egress and access be assured? What will be the emergency planning impact? | Will there be a change in number of people at risk? | Will there be a change in number of properties at risk? | Will mitigation measures have an impact on other areas downstream or adjacent? | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas<br>Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development<br>A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)<br>Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas<br>Acceptable subject to FRA | |
| | | | | | | | | | necessary) | |
| Salford Central - James Street/ Rodney Street (S0428) | Mixed | -- | - | - | - | - | + | = | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | Limited residual risk, with exception of an extreme 1 in 1000 year event from the Grey Irwell. Development here would need careful consideration of urban form to account for this residual risk. |
| Salford Central - Adelphi Street (S0429) | Mixed | - | - | - | - | - | + | = | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | Areas to the north and riverside of the site are at residual risk from the River Irwell, with significant depths and hazards in places in an extreme 1 in 1000 year event. Development here would need careful consideration of urban form to account for this residual risk. |
| Exchange Greengate - Salford Approach (S0417) | Mixed | - - | - | - - | - - | - | + | - | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both | The southern part of the site is at risk in a 1 in 100 year event when considering climate change and significant residual risk in an extreme 1 in 1000 year event. In flow path so any mitigation measures, such as land raising would need careful consideration. Proceeding with development here |

| | | Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | Recommendation | Commentary |
| Strategic Location/ development site | Proposed land use | Is the development within existing flood-risk area? | What are the scale and nature of flood risks? | What scale of residual risk measures will be required? | How will egress and access be assured? What will be the emergency planning impact? | Will there be a change in number of people at risk? | Will there be a change in number of properties at risk? | Will mitigation measures have an impact on other areas downstream or adjacent? | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas<br>Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development<br>A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)<br>Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas<br>Acceptable subject to FRA | |
| | | | | | | | | | spatially and in the design response (1st floor accommodation may be necessary) | would need careful consideration of urban form. |
| Exchange Greengate - Boond Street (S0418) | Mixed | - - | - | - | - - | - | + | - | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | The majority of the site is at some residual risk in an extreme 1 in 1000 year event. In flow path so any mitigation measures, such as land raising would need careful consideration. Proceeding with development here would need careful consideration of urban form. |
| Exchange Greengate - Gorton Street (S0419) | Mixed | - - | - | - - | - - | - | + | - | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary) | The majority of the site is at significant residual risk in an extreme 1 in 1000 year event. In flow path so any mitigation measures, such as land raising would need careful consideration. Proceeding with development here would need careful consideration of urban form. |
| Exchange Greengate - New Bond Street (S0420) | Mixed | - - | - | - - | - - | - | + | - | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be | The majority of the site is at significant residual risk in an extreme 1 in 1000 year event. In flow path so any mitigation measures, such as land raising |

| | | Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | Recommendation | Commentary |
| Strategic Location/ development site | Proposed land use | Is the development within existing flood-risk area? | What are the scale and nature of flood risks? | What scale of residual risk measures will be required? | How will egress and access be assured? What will be the emergency planning impact? | Will there be a change in number of people at risk? | Will there be a change in number of properties at risk? | Will mitigation measures have an impact on other areas downstream or adjacent? | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas<br>Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development<br>A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)<br>Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas<br>Acceptable subject to FRA | |
| | | | | | | | | | steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary) | would need careful consideration. Proceeding with development here would need careful consideration of urban form. |
| Exchange Greengate - Collier Street (S0421) | Mixed | -- | - | - | - | - | + | = | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | Limited residual risk, with exception of an extreme 1 in 1000 year event with climate change from the Grey Irwell. Awareness of this potential risk of flooding should be raised. |
| Exchange Greengate - King Street (S0422) | Mixed | - - | - | - | - - | - | + | - | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | The majority of the site is at some residual risk in an extreme 1 in 1000 year event, considering climate change. In flow path so any mitigation measures, such as land raising would need careful consideration. Proceeding with development here would need careful consideration of urban form. |
| Exchange Greengate - Salford Approach Car Park (S0423) | Mixed | -- | - | - | - | - | + | = | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable | Limited residual risk, with exception of an extreme 1 in 1000 year event with climate change from the Grey Irwell. Awareness of this potential risk of flooding should be raised. |

| Strategic Location/ development site | Proposed land use | A<br>Is the development within existing flood-risk area? | B<br>What are the scale and nature of flood risks? | C<br>What scale of residual risk measures will be required? | D<br>How will egress and access be assured? What will be the emergency planning impact? | E<br>Will there be a change in number of people at risk? | F<br>Will there be a change in number of properties at risk? | G<br>Will mitigation measures have an impact on other areas downstream or adjacent? | Recommendation | Commentary |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) | | | | | | | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas<br>Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development<br>A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)<br>Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas<br>Acceptable subject to FRA | |
| | | | | | | | | | development will not be placed in high flood risk areas | |
| Exchange Greengate - Greengate (S0424) | Mixed | - - | - | - - | - - | = | + | - | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary) | The site is partly at risk when considering a 1 in 100 year event with climate change and the majority of the site is at significant residual risk in an extreme 1 in 1000 year event. In flow path so any mitigation measures, such as land raising would need careful consideration. Proceeding with development here would need careful consideration of urban form. |
| Charlestown Riverside (S0002) | Housing | - | -- | - | - | - | = | - | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary) | Most at risk from overtopping in an extreme 1 in 1000 year event. Potential for breach in defences may be difficult to warn for. Significant residual risk in extreme event affecting around 60% of site would need to be carefully planned for. In flow path so any mitigation measures, such as land raising would need careful consideration. Proceeding with development here would need careful consideration of urban form. |

| | | Flood risk indicators adopted as measure of Acceptability<br>(-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | Recommendation | Commentary |
| Strategic Location/ development site | Proposed land use | Is the development within existing flood-risk area? | What are the scale and nature of flood risks? | What scale of residual risk measures will be required? | How will egress and access be assured? What will be the emergency planning impact? | Will there be a change in number of people at risk? | Will there be a change in number of properties at risk? | Will mitigation measures have an impact on other areas downstream or adjacent? | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas<br>Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development<br>A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)<br>Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas<br>Acceptable subject to FRA | |
| Lower Broughton (S0001) | Housing | - | -- | - - | -- | - | - | - | Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development | Significant risk affecting the majority of the site in a 1 in 100 year event when considering climate change and residual risk from overtopping in extreme events or breach of defences.<br>May be difficult to warn for breach. In flow path so any mitigation measures, such as land raising would need careful consideration. Development in these areas would need significant alterations to urban form and hence development in areas of the highest residual risk in a 1 in 100 year event considering climate change should be sequentially avoided. |
| Charlestown and Lower Kersal (S0405) | Employment | - | - | - | - | = | + | = | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | Riverside areas at are at some risk from the River Irwell in a 1 in 100 year event considering climate change and residual risk, with significant depths and hazards in places, in an extreme 1 in 1000 year event. Development here would need careful consideration of urban form to account for this residual risk, with appropriate low vulnerability uses in the highest risk areas. |

| Strategic Location/ development site | Proposed land use | A | B | C | D | E | F | G | Recommendation | Commentary |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) | | | | | | | | |
| | | Is the development within existing flood-risk area? | What are the scale and nature of flood risks? | What scale of residual risk measures will be required? | How will egress and access be assured? What will be the emergency planning impact? | Will there be a change in number of people at risk? | Will there be a change in number of properties at risk? | Will mitigation measures have an impact on other areas downstream or adjacent? | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas<br>Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development<br>A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)<br>Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas<br>Acceptable subject to FRA | |
| **Cambridge Industrial Estate (S0399)** | Housing | - | -- | - | - | - | = | - | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary) | At risk in a 1 in 100 year event when considering climate change and breach, although depths would be manageable. Significant residual risk in extreme events. Access and egress may be difficult. In flow path so any mitigation measures, such as land raising would need careful consideration. Proceeding with development here would need careful consideration of urban form, with appropriate low vulnerability uses in the higher risk areas and should be sequentially avoided in the areas of highest risk in a 1 in 100 year event, considering climate change. |
| **Salford Quays and Ordsall** | | | | | | | | | | |
| Media City UK (S0415) including Salford Quays (S0017) and Land at Erie Basin (S0014) | Mixed | - | - | - - | - | - | + | - | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be | The south east and canal side areas of the site are at residual risk from the MSC, with significant depths and hazards in places in an extreme 1 in 1000 year event. In flow path so any mitigation measures, such as land raising would need careful consideration. Development in these areas would need significant alterations to urban form and hence development in areas of the highest residual risk |

| Strategic Location/ development site | Proposed land use | A<br>Is the development within existing flood-risk area? | B<br>What are the scale and nature of flood risks? | C<br>What scale of residual risk measures will be required? | D<br>How will egress and access be assured? What will be the emergency planning impact? | E<br>Will there be a change in number of people at risk? | F<br>Will there be a change in number of properties at risk? | G<br>Will mitigation measures have an impact on other areas downstream or adjacent? | Recommendation | Commentary |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) | | | | | | | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas<br>Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development<br>A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)<br>Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas<br>Acceptable subject to FRA | |
| | | | | | | | | | necessary) | should be sequentially avoided. |
| Ordsall Riverside (S0392) | Mixed | - | - | - - | - - | - | - | - | Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development | The majority of the site is at significant residual risk from the MSC in a 1 in 100 year event considering climate change, which increases for an extreme event. In flow path so any mitigation measures, such as land raising, would need careful consideration. Development in these areas would need significant alterations to urban form and hence development in areas of the highest residual risk should be sequentially avoided. |
| **Salford North West** | | | | | | | | | | |
| Linnyshaw (S0004) | Housing | - | ++ | + | - | - | + | = | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable | Residual risk from an extreme event or culvert blockage on the Whittle Brook and some localised surface water issues. These should be explored further in a |

| | | Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | Recommendation | Commentary |
| Strategic Location/ development site | Proposed land use | Is the development within existing flood-risk area? | What are the scale and nature of flood risks? | What scale of residual risk measures will be required? | How will egress and access be assured? What will be the emergency planning impact? | Will there be a change in number of people at risk? | Will there be a change in number of properties at risk? | Will mitigation measures have an impact on other areas downstream or adjacent? | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas<br>Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development<br>A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)<br>Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas<br>Acceptable subject to FRA | |
| | | | | | | | | | development will not be placed in high flood risk areas | FRA. |
| Great Universal Stores (S0397, S0398) | Housing | - | ++ | ++ | + | = | + | = | Acceptable subject to FRA. | Limited surface water flood risk should be explored further in a FRA. |
| Legh Street (S0395) | Housing | - - | - - | + | - | - | + | = | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | Development to the south of the site would need to take account of the risk from a breach on the Bridgewater Canal in urban design. It would be difficult to provide flood warning for such an occurrence. |
| Cawdor Street (S0396) | Housing | - - | - - | + | - | - | + | = | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | Development on the site would need to take account of the risk from a breach on the Bridgewater Canal in urban design. It would be difficult to provide flood warning for such an occurrence. |
| **Barton and Irlam** | | | | | | | | | | |
| Barton (S0412) | Employment | - | - | - - | - | - | - | = | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more | The east of the site (adjacent to the Salteye Brook) is at significant residual risk from the MSC when considering climate change for a 1 |

| Strategic Location/ development site | Proposed land use | A: Is the development within existing flood-risk area? | B: What are the scale and nature of flood risks? | C: What scale of residual risk measures will be required? | D: How will egress and access be assured? What will be the emergency planning impact? | E: Will there be a change in number of people at risk? | F: Will there be a change in number of properties at risk? | G: Will mitigation measures have an impact on other areas downstream or adjacent? | Recommendation | Commentary |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas | |
| | | | | | | | | | Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development | |
| | | | | | | | | | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary) | |
| | | | | | | | | | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | |
| | | | | | | | | | Acceptable subject to FRA | |
| | | | | | | | | | vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary) | in 100 year event. The majority is at significant residual risk in an extreme 1 in 1000 year event. Development in these areas would need significant alterations to urban form, with appropriate low vulnerability uses in the highest risk areas and hence development in areas of the highest residual risk should be sequentially avoided. |
| Barton Stadium (S0011) | Employment | - | - | - - | - - | - | - | = | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary) | The north of the site (adjacent to the Salteye Brook) is at significant residual risk from the MSC when considering climate change for a 1 in 100 year event. Access and egress could be difficult and would need to be provided to the east. Development in these areas would need significant alterations to urban form, with appropriate low vulnerability uses in the highest risk areas and hence development in areas of the highest residual risk should be sequentially avoided. |
| Irlam Wharf Road (S0009) | Employment | - | - | -- | - - | = | - | = | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. | Significant residual risk in an extreme 1 in 1000 year event from the MSC affects entire site. Access and egress could be difficult and proceeding with development here would need careful |

Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators)

| | | Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | Recommendation | Commentary |
| Strategic Location/ development site | Proposed land use | Is the development within existing flood-risk area? | What are the scale and nature of flood risks? | What scale of residual risk measures will be required? | How will egress and access be assured? What will be the emergency planning impact? | Will there be a change in number of people at risk? | Will there be a change in number of properties at risk? | Will mitigation measures have an impact on other areas downstream or adjacent? | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas<br>Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development<br>A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)<br>Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas<br>Acceptable subject to FRA | |
| | | | | | | | | | Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary) | consideration of urban form, with appropriate low vulnerability uses in the highest risk areas. |
| Irlam and Cadishead, Liverpool Road (S0408) | Housing | - | - | - | - | - | + | = | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | Limited residual risk, with exception of an extreme event with climate change from the MSC. Awareness of this potential risk of flooding should be raised. |
| Irlam and Cadishead (S0404) | Housing | - | - | -- | - | - | - | = | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary) | Canal side areas to the south west are at residual risk from the MSC in a 1 in 100 year event considering climate change, with significant residual risk in an extreme event affecting around 60% of the site. Proceeding with development here would need careful consideration of urban form. |

| | | Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | Recommendation | Commentary |
| Strategic Location/ development site | Proposed land use | Is the development within existing flood-risk area? | What are the scale and nature of flood risks? | What scale of residual risk measures will be required? | How will egress and access be assured? What will be the emergency planning impact? | Will there be a change in number of people at risk? | Will there be a change in number of properties at risk? | Will mitigation measures have an impact on other areas downstream or adjacent? | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas<br>Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development<br>A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)<br>Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas<br>Acceptable subject to FRA | |
| **Trafford Core** | | | | | | | | | | |
| Pomona Island (T0467) | Employment | - | - - | -- | - - | - | - | - | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas | The majority of the site is at significant residual risk from the MSC, with significant depths and hazards in a 1 in 100 year event considering climate change. Serves a function in allowing water from the Bridgewater Canal at times of high flow (from the River Medlock) to pass into the MSC and decreasing risk from the Bridgewater Canal to the south in Trafford. Difficult to warn for flood risk from the Bridgewater Canal. Access and egress difficult. Making the development safe from flooding could have a counter effect on flood risk elsewhere and flood conveyance must be preserved. Limited lower vulnerability land uses could be provided and subject to a flood action plan. |
| Old Trafford (T0468) | Mixed | + | ++ | + | + | = | + | = | Acceptable subject to FRA | Localised flood risk from the Corn Brook in extreme flood events that should be taken account of in site master-planning. |
| Wharfside (T0469) | Mixed | - | - | - | - | - | + | = | Acceptable with some detailed consideration of | The north west and canal sides areas of the site are at residual risk |

| Strategic Location/ development site | Proposed land use | A | B | C | D | E | F | G | Recommendation | Commentary |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) | | | | | | | | |
| | | Is the development within existing flood-risk area? | What are the scale and nature of flood risks? | What scale of residual risk measures will be required? | How will egress and access be assured? What will be the emergency planning impact? | Will there be a change in number of people at risk? | Will there be a change in number of properties at risk? | Will mitigation measures have an impact on other areas downstream or adjacent? | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas<br>Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development<br>A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)<br>Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas<br>Acceptable subject to FRA | |
| | | | | | | | | | flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | from the MSC, although depth and hazard should be manageable through careful consideration of urban form to account for the residual risk. |
| Trafford Park Core (T0471) | Employment | - | - - | -- | - | = | - | = | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary) | The north east of the site is at residual risk from the MSC, with significant depths and hazards in places in 1 in 100 year event, considering climate change. Development in these areas would need significant alterations to urban form and hence development in areas of the highest residual risk should be sequentially avoided. Development on other parts of the site would need to take account of the risk from a breach on the Bridgewater Canal in urban design. It would be difficult to provide flood warning for such an occurrence. |
| Trafford Quays (T0463) | Mixed | - - | - - | -- | - | - | + | = | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an | Canal side areas of the site are at residual risk from the MSC, with significant depths and hazards in places in 1 in 100 year event, considering climate change. Development in these areas would need significant alterations to urban |

| | | Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | Recommendation | Commentary |
| Strategic Location/ development site | Proposed land use | Is the development within existing flood-risk area? | What are the scale and nature of flood risks? | What scale of residual risk measures will be required? | How will egress and access be assured? What will be the emergency planning impact? | Will there be a change in number of people at risk? | Will there be a change in number of properties at risk? | Will mitigation measures have an impact on other areas downstream or adjacent? | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas<br>Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development<br>A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)<br>Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas<br>Acceptable subject to FRA | |
| | | | | | | | | | important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary) | form and hence development in areas of the highest residual risk should be sequentially avoided. Development on the south of the site would need to take account of the risk from a breach on the Bridgewater Canal in urban design. It would be difficult to provide flood warning for such an occurrence. |
| Trafford Centre Rectangle (T0472) (excluding the Trafford Quays area) | Mixed | - - | - - | + | - | - | + | = | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | A very small area of the site adjacent to Trafford Quays is at residual risk from the MSC, with significant depths and hazards in places in an extreme event. Development in these areas would need significant alterations to urban form and hence development in areas of the highest residual risk should be sequentially avoided. Development on much of the site would need to take account of the risk from a breach on the Bridgewater Canal in urban design. It would be difficult to provide flood warning for such an occurrence. |

**TRAFFORD COUNCIL**

| | | Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | Recommendation | Commentary |
| Strategic Location/ development site | Proposed land use | Is the development within existing flood-risk area? | What are the scale and nature of flood risks? | What scale of residual risk measures will be required? | How will egress and access be assured? What will be the emergency planning impact? | Will there be a change in number of people at risk? | Will there be a change in number of properties at risk? | Will mitigation measures have an impact on other areas downstream or adjacent? | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas<br>Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development<br>A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)<br>Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas<br>Acceptable subject to FRA | |
| Victoria Warehouse (T0462) | Mixed | - | ++ | + | + | = | = | = | Acceptable subject to FRA | Limited areas bordering the Bridgewater Canal are potentially at risk from the MSC in an extreme event. This should be confirmed in a FRA. |
| **Trafford South and Central** | | | | | | | | | | |
| Stretford Crossroads (T0473) | Mixed | - - | - - | + | - | - | + | = | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | Development on the south east of the site would need to take account of the risk from a breach on the Bridgewater Canal in urban design. It would be difficult to provide flood warning for such an occurrence. |
| Sale Town Centre (T0479) | Mixed | - | ++ | ++ | + | = | + | = | Acceptable subject to FRA | Limited surface water flood risk should be explored further in a FRA. |
| Woodfield Road (T0476) | Mixed | - | ++ | + | - | = | + | = | Acceptable subject to FRA | A small area to the north east of the site is potentially at risk from a breach from Bridgewater Canal and there is surface water flood risk. These should be explored further in a FRA. |
| Altrincham Town Centre (T0477), including Altair (T0466) | Mixed | - | ++ | + | + | = | + | = | Acceptable subject to FRA | Surface water flood risk should be explored further in a FRA. |

**TRAFFORD COUNCIL**

**Flood risk indicators adopted as measure of Acceptability**
**(-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators)**

Recommendation key:

- Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas
- Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development
- A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary)
- Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas
- Acceptable subject to FRA

| Strategic Location/ development site | Proposed land use | A<br>Is the development within existing flood-risk area? | B<br>What are the scale and nature of flood risks? | C<br>What scale of residual risk measures will be required? | D<br>How will egress and access be assured? What will be the emergency planning impact? | E<br>Will there be a change in number of people at risk? | F<br>Will there be a change in number of properties at risk? | G<br>Will mitigation measures have an impact on other areas downstream or adjacent? | Recommendation | Commentary |
|---|---|---|---|---|---|---|---|---|---|---|
| **Carrington and Partington** | | | | | | | | | | |
| Carrington (T0474) | Mixed | - | - - | -- | - | - | + | = | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary) | The north of the site is at residual risk from the MSC considering climate change, with significant residual risk in an extreme event. This part of the site is also at risk from the River Mersey, with significant risk in a 1 in 100 year event considering climate change or if a breach were to occur. Development in these areas would need significant alterations to urban form and hence development in areas of the highest residual risk should be sequentially avoided. |
| Partington (T0475) (excluding the Partington Canalside area) | Mixed | - | - | - | - | - | + | = | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | Limited residual risk from the MSC, with exception of an extreme event. Limited flood risk from the Red Brook to the south. Proceeding with development in flood risk areas would need careful consideration of urban form. |
| Partington Canalside (T0465) | Housing | - | - | -- | - | - | - | = | A limited range of land uses could be put forward after careful consideration and detailed FRA, but | Canal side areas to the south west are at residual risk from the MSC in a 1 in 100 year event considering climate change, with significant |

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|---|---|---|---|---|---|---|---|---|---|---|
| | | **Flood risk indicators adopted as measure of Acceptability** (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators) | | | | | | | | |
| | | A | B | C | D | E | F | G | Recommendation | Commentary |
| Strategic Location/ development site | Proposed land use | Is the development within existing flood-risk area? | What are the scale and nature of flood risks? | What scale of residual risk measures will be required? | How will egress and access be assured? What will be the emergency planning impact? | Will there be a change in number of people at risk? | Will there be a change in number of properties at risk? | Will mitigation measures have an impact on other areas downstream or adjacent? | Counter to strategic approach to flood risk management, flood risk unacceptable and difficult to manage for the land use envisaged. Exception Test would be difficult to pass. Sequentially difficult to rearrange site to guide vulnerable development to lower risk areas | |
| | | | | | | | | | Limited land uses may be possible, with a lower yield/and or constrained urban form. Lower vulnerability land uses possible, but some opportunity to sequentially place appropriate development within the development | |
| | | | | | | | | | A limited range of land uses could be put forward after careful consideration and detailed FRA, but more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary) | |
| | | | | | | | | | Acceptable with some detailed consideration of flood risk issues in a FRA and where planning policies will ensure vulnerable development will not be placed in high flood risk areas | |
| | | | | | | | | | Acceptable subject to FRA | |
| | | | | | | | | | more vulnerable uses should be steered to lower risk areas. Flood risk is an important influence on how the area could be developed, both spatially and in the design response (1st floor accommodation may be necessary) | residual risk in an extreme event affecting around 50% of the site. Proceeding with development here would need careful consideration of urban form. |

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# 10 Recommendations for further work

## 10.1 Introduction

Table 10.1 provides recommendations for further work to be carried out by each council.

**Table 10-1 Level 2 SFRA Recommendations for further work**

| Local Authorities | SFRA Section | Recommendation | Other stakeholders |
|---|---|---|---|
| Manchester, Trafford, Salford and other locally hydraulically connected local authorities including Oldham, Tameside, Stockport, Bury, Rochdale, Wigan and Bolton | Chapter 2 Flooding from rivers | Further work would improve the understanding of flood risk by undertaking a holistic review of flood risk from all watercourses, which would include linking the Lower Irwell, Grey Irwell, Manchester Ship Canal, Irk, Medlock, Corn Brook, Worsley Brook, Mersey and Sinderland Brook models. | Environment Agency |
| Salford | Chapter 3 Flooding from canals | Salford City Council should work closely with British Waterways during further restoration of the Manchester, Bury and Bolton Canal to minimise flood risk from the canal to local communities. | British Waterways |
| Manchester, Trafford, Salford, Oldham, Tameside, Stockport, Bury, Rochdale, Wigan and Bolton and other hydraulically linked local authorities, including Cheshire East | Chapter 5 Surface water and sewers | Undertake an AGMA wide SWMP. The AGMA SWMP would take a consistent approach to the assessment of surface water flood risk across Greater Manchester, followed by more detailed investigations of Critical Drainage Areas targeted at those CDAs with the highest risk. The AGMA SWMP would extend to all ten authorities a consistent methodology to develop surface water risk maps and identify CDAs.<br><br>The AGMA SWMP initiative should be supported. If, however, sufficient funding is not available to undertake an AGMA SWMP, Manchester City, Salford City and Trafford Councils should form a partnership with their neighbours, United Utilities and the Environment Agency to undertake SWMPs for:<br>● Didsbury, Levenshulme and Fallowfield (including the Chorlton Platt Gore catchment)<br>● Manchester and Trafford South (including the Sinderland and Longford Brook catchments)<br>● Salford North West (including the Worsley and Ellen Brook catchments)<br>● Conurbation Core (including river catchments in Central Manchester)<br>Details of these are provided below. | United Utilities, Environment Agency, British Waterways, the Manchester Ship Canal Company |
| Manchester, Stockport, Tameside | Chapter 5 Surface water and sewers | Undertake an SWMP for the Didsbury and Levenshulme and Fallowfield CDAs.<br><br>This should include a drainage strategy for | United Utilities, Environment Agency |

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| | | development sites, to identify areas suitable for SUDS and how flood risk can be managed and reduced downstream. | |
| Manchester, Trafford, Stockport, Cheshire East | Chapter 5 Surface water and sewers | Undertake an SWMP for the Manchester and Trafford South CDA.<br><br>This should include a drainage strategy for the collection of development sites, including the Airport, to identify areas suitable for SUDS and how flood risk can be managed and reduced downstream. | United Utilities, Environment Agency, British Waterways, the Manchester Ship Canal Company |
| Salford, Bolton, Wigan, Bury | Chapter 5 Surface water and sewers | Undertake an SWMP for the Salford North West CDA.<br><br>This should include a drainage strategy for the collection of development sites, including at Linnyshaw, to identify areas suitable for SUDS and how flood risk can be managed and reduced downstream. | United Utilities, Environment Agency, the Manchester Ship Canal Company |
| Manchester, Trafford, Salford, Tameside, Oldham, Rochdale, Bury, Bolton. | Chapter 5 Surface water and sewers | Undertake an SWMP for the Conurbation Core CDA. This should include a drainage strategy for the collection of development sites to identify areas suitable for SUDS and how flood risk can be managed and reduced downstream.<br><br>There is a significant risk of localised flooding from many different but integrated sources, including hidden and culverted watercourses, open watercourses, sewers, canals and the major river network that should be investigated in detail for Greater Manchester. This assessment could be used to further inform future development on localised flood risk and should also feed into a strategy for runoff from new development that has the potential to reduce flood risk, both within the Regional Centre/ Inner Areas and downstream. | United Utilities, Environment Agency, British Waterways, the Manchester Ship Canal Company |
| Manchester, Salford | Chapter 9 Development strategy | Undertake a Flood Risk Management Strategy to ensure the development needs and the different sources of flood risk are managed strategically for Manchester and Salford City Centres, including Lower Kersal, Charlestown (Salford) and Lower Broughton. The study would need to work in tandem with SWMP work being taken forward.<br><br>Local authorities should work closely with the Environment Agency through their emerging strategy work following on from the River Irwell CFMP to explore opportunities to reduce flood risk and deliver regeneration. | Environment Agency, British Waterways, the Manchester Ship Canal Company, United Utilities |
| Salford, Trafford | Chapter 9 Development strategy | Undertake a Flood Risk Management Strategy to ensure the development needs and the different sources of flood risk are managed strategically for SFRA Strategic Locations at risk of flooding from the Manchester Ship Canal (Salford Quays and Ordsall, Trafford Core, Barton and Irlam and Carrington and Partington). The study would need to work in tandem with SWMP work being taken forward. | Environment Agency, the Manchester Ship Canal Company, United Utilities |

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|---|---|---|---|
| | | Local authorities should work closely with the Environment Agency through their emerging strategy work following on from the River Irwell CFMP to explore opportunities to reduce flood risk and deliver regeneration. | |
| Manchester, Trafford | Chapter 9 Development strategy | Undertake a Flood Risk Management Strategy to ensure the development needs and the different sources of flood risk are managed strategically for the Sinderland Brook and River Mersey catchments. The study would need to work in tandem with SWMP work being taken forward.<br><br>Local authorities should work closely with the Environment Agency through their emerging strategy work following on from the Upper Mersey CFMP to explore opportunities to reduce flood risk and deliver regeneration. | Environment Agency, British Waterways, the Manchester Ship Canal Company, United Utilities |
| Salford | Chapter 9 Development strategy | Undertake a Flood Risk Management Strategy to ensure the development needs and the different sources of flood risk are managed strategically for the Worsley and Ellen Brook catchments in Salford North West. The study would need to work in tandem with SWMP work being taken forward.<br><br>Salford City Council should work closely with the Environment Agency through their emerging strategy work following on from the River Irwell CFMP to explore opportunities to reduce flood risk and deliver regeneration. | Environment Agency, the Manchester Ship Canal Company, United Utilities |

These recommendations were made whilst the report was being drafted. It is noted that the AGMA SWMP has received funding and is currently being undertaken.

Offices at

Atherstone
Doncaster
Edinburgh
Haywards Heath
Limerick
Newcastle upon Tyne
Newport
Northallerton
Saltaire
Skipton
Tadcaster
Wallingford
Warrington

Registered Office
South Barn
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