Oldham Council Hybrid SFRA

Volume III: Level 2 SFRA

Final
January 2010

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Structure of the Oldham SFRA

The Oldham SFRA is supplied as three Volumes, described in the table below. Readers should refer to Volume I: SFRA User Guide for guidance on how to use the information provided in the SFRA.

SFRA Volume	Title of volume	Contents
I	User Guide	Volume I has been developed to provide guidance on the use of the SFRA for Local Authority Spatial Planning, Regeneration, Development Management and Emergency Planning officers and Developers.
II	Level 1 SFRA	Volume II 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 provides evidence for LPA officers to apply the Sequential Test and identifies the need to pass the Exception Test where required.
III	Level 2 SFRA	Volume III provides evidence on a key community basis. It provides more detailed information on flood risk from the River Tame, Diggle Brook, Chew Brook and Wince Brook, the Rochdale and Huddersfield Narrow Canals and surface water. The additional detail can also inform a sequential approach to development allocation within flood risk areas and mitigation options where appropriate.

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Revision History

Revision Ref / Date Issued	Amendments	Issued to
Draft v1.0 (November 2009)		Georgina Brownridge (Oldham Council), Sandrine Thomas (Environment Agency)
Draft v2.0 (December 2009)	Comments from Oldham Council and the Environment Agency	Georgina Brownridge (Oldham Council), Sandrine Thomas (Environment Agency)
Final (January 2010)	Comments from Oldham Council and the Environment Agency	Georgina Brownridge (Oldham Council), Sandrine Thomas and Sylvia Whittingham (Environment Agency)

Contract

This report describes work commissioned by Oldham Council, on behalf of Oldham Council, by a letter dated 20 July 2009. Oldham's representative for the contract was Georgina Brownridge. 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 Level 2 SFRA report for Oldham Council. 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 Georgina Brownridge, Paul McGrath, Graham Birch, Adele Hayes, Gary May and Sue Eachus (Oldham MBC), Sandrine Thomas, Sylvia Whittingham and Andy Cameron (Environment Agency).

We would also like to thank Neil D’Arcy at British Waterways for his contribution in understanding the risk of flooding from canals.

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Executive Summary

Flood risk in Oldham 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.

The Oldham Hybrid Strategic Flood Risk Assessment (SFRA) is presented across three separate report volumes:

- Volume I: User Guide
- Volume II: Level 1 SFRA
- Volume III: Level 2 SFRA

The Level 2 SFRA (this volume) provides a detailed understanding of flood risk across the borough 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. Readers should refer to the SFRA User Guide on how the Level 2 SFRA can be used to apply both of these tests.

This document provides an understanding of actual risk 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 are 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 risk of reservoir failure was not considered in the SFRA due to implications for national security.

The cumulative impacts of development on flood risk have also been considered within the SFRA. The assessment highlights the responsibility Oldham Council has to manage flood risk because of its location at the top of the watershed. It also shows that development management policies to reduce surface water discharges from new development could have some benefit locally.

Flood risk across the borough

The main issues in the borough appear to be from surface water, including the potential impact that development could have on flood risk downstream, followed by canals, and in particular the Huddersfield Narrow Canal in the Tame Valley. Fluvial flooding is less of a problem in the borough due to the steep nature of the river valleys and limited floodplain in the upper reaches of the Rivers Beal, Irk, Medlock and Tame.

Surface water drainage from new developments is critical in reducing the risk of localised flooding. The SFRA has identified the following Critical Drainage Areas within the borough:

- Chadderton / Wince Brook
- Hollinwood / Moston Brook
- East Oldham / Wood Brook and Upper Tame
- Shaw / River Beal

Understanding flood risk from a planning perspective

This Level 2 SFRA provides an overview of flood risk from a planning perspective to aid the council when undertaking the Exception Test. The SFRA presents a summary of flood risk from all sources to groups of strategic sites within communities, which has been summarised below. For each of these, an outline mitigation 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.

Table A: Summary of flood risk to development sites

Communities	Development sites	Flood risk	Planning conclusion
Chadderton	This includes the Foxdenton Strategic Site (EMP080), Business & Industry land at Junction Mill (EMP051) and Causeway North (EMP047) and the Greengate Primary Employment Zone (EMP012).	Primary risk from surface water Secondary risk from the Rochdale Canal and Wince Brook	Sites are acceptable with some detailed consideration of flood risk issues If land uses are changed to housing then development is sequentially not preferred but a range of land uses could be put forward after careful consideration and a FRA
Hollinwood	This includes Hollinwood Junction Masterplan Strategic Site (EMP081), the Hollinwood North Primary Employment Zone (EMP008) and Business & Industry sites at Sellers Way (EMP044), Sefton Street (EMP045), Stable Street (EMP046), Mersey Road North (EMP036) and Albert Street (EMP057), and the Morrisons Supermarket, Hollinwood Avenue (EMP072)	Primary risk from surface water Secondary risk from the Rochdale Canal	Sites are acceptable with some detailed consideration of flood risk issues
Oldham Town Centre	Oldham Town Centre (EMP035) employment site and the Business & Industry site on Oldham Way (EMP056).	Primary risk from surface water	Acceptable subject to a Flood Risk Assessment (FRA) If land uses are changed to housing (HOU407 and HOU408) then sites are acceptable with some detailed consideration of flood risk issues
Saddleworth	This includes the Building Schools for the Future site at Diggle (SCH002), the Business & Industry site at Huddersfield Road (EMP037), the Mixed Use Development at Lumb Mill (MIX001) and the Uppermill Town District & Major Shopping Location (EMP063).	Primary risk from surface water and the River Tame Secondary risk from the Huddersfield Narrow Canal	Parts of the proposed development are sequentially not preferred (Building Schools for the Future site at Diggle (SCH002)) but a range of land uses could be put forward after careful consideration and a FRA If land uses are changed to housing then development is sequentially not preferred but a range of land uses could be put forward after careful consideration and a FRA
Shaw	This includes the Shaw District Centre (EMP068) and Primary Employment Zone, the Beal Lane Business & Industry site (EMP050) and the Asda Stores (EMP075).	Primary risk from the River Beal Secondary risk from surface water	Sites are acceptable with some detailed consideration of flood risk issues.

Recommendation for further work

The SFRA has made the following recommendation for further work:

1. A **Scoping SWMP** in partnership with United Utilities, British Waterways and the Environment Agency to identify particular hotspots where surface water solutions can be identified or more detailed modelling is needed. A Drainage Strategy should be undertaken as part of or alongside this for key development areas (including Foxdenton, Hollinwood, Oldham Town Centre and key HMR areas) to identify locations suitable for SUDS and how flood risk can be managed and reduced downstream. The SWMP may be usefully undertaken as part of an AGMA wide SWMP.

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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
BSF	Building Schools for the Future
CDA	Critical Drainage Area
CFMP	Catchment Flood Management Plans
EA	Environment Agency
FEH	Flood Estimation Handbook
FFL	Finished Floor Levels
FRA	Flood Risk Assessment
FRM	Flood Risk Management
GIS	Geographic Information Systems
HMR	Housing Market Renewal
LDDs	Local Development Documents
LDF	Local Development Framework
LIDAR	Light Detection and Ranging
LPAs	Local Planning Authorities
LDF	Local Development Framework
NFCDD	National Flood and Coastal Defence Database
OS	Ordnance Survey
PEZ	Primary Employment Zones
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
SMP	Shoreline Management Plans
SOP	Standard of Protection
SUDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
UKCIP	United Kingdom Climate Impacts Programme
UU	United Utilities
WCS	Water Cycle Study

1 Introduction

1.1 Background

1.1.1.1 JBA Consulting was commissioned in July 2009 by Oldham Council 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 as it fills in the gaps from the Level 1 SFRA and fulfils the criteria for a Level 2 SFRA.

1.1.1.2 The SFRA has been prepared in accordance with current best practice, Planning Policy Statement 25 Development and Flood Risk (PPS25)[1] and the PPS25 Practice Guide[2].

1.1.1.3 The SFRA is presented across three separate report volumes:

- Volume I: User Guide
- Volume II: Level 1 SFRA
- Volume III: Level 2 SFRA.

1.1.1.4 This document (Volume III) 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 (Volume II).

1.2 General scope and objectives of SFRAs

1.2.1.1 Flooding is a natural process and does not respect political demarcations or administrative boundaries; it is influenced principally by natural elements of rainfall, tides, geology, topography, rivers and streams and man made interventions such as flood defences, roads, buildings, sewers and other infrastructure. As was seen in the summer of 2007, flooding can cause massive disruption to communities, damage to property and possessions and even loss of life.

1.2.1.2 For this reason it is best to try and avoid developing in flood risk areas in the first instance. Where this is not possible then the vulnerability to flooding of the proposed land use should be considered and measures taken to minimise flood risk to people, property and the environment. This is the thrust of the risk based sequential approach to managing flood risk and it is the backbone of PPS25.

1.2.1.3 Current Government policy requires local authorities to demonstrate that due regard has been given to flood risk in the planning process. It also requires that flood risk is managed in an effective and sustainable manner and where new development is necessary in flood risk areas (exceptionally), the policy aim is to make it safe and not increase flood risk elsewhere. Where possible flood risk should be reduced overall.

1.2.1.4 A SFRA is a planning tool that enables a council to select and develop more vulnerable site allocations away from areas susceptible to flooding. The assessment focuses on the existing site allocations within the borough but also sets out the procedure to be followed when assessing additional sites for development in the future.

1.2.1.5 It is recognised that considerable land use pressures for regeneration, inward investment and economic growth exist across the borough. Revisions to the Regional Spatial Strategy (RSS) and the associated Regional Flood Risk Assessment (RFRA) should be consistent with the SFRA and guide the council in their strategies, policies and decision making in respect of their Local Development Frameworks (LDFs).

[1] Communities and Local Government (2006) Planning Policy Statement 25: Development and Flood Risk
[2] Communities and Local Government (2008) Planning Policy Statement 25: Development and Flood Risk – Practice Guide

1.2.1.6 In addition to informing the assessment of existing site allocations, the Level 1 and Level 2 SFRAs will inform decision making on non-allocated planning applications and flood management measures to reduce flood risk to existing development and emergency planning.

1.2.1.7 The key objectives of a SFRA are to:

- Investigate and identify the extent and severity of flood risk to the area at present and in the future, under the terms of PPS25,
- Contribute to the Council's Sustainability Appraisal (SA) and LDF,
- Enable the Council to apply the Sequential Test and assess the likelihood of development passing the Exception Test,
- Provide strategic flood risk guidance and advice to planners and developers,
- Help LPAs to identify specific locations where further and more detailed flood risk data and assessment work is required. This includes the scope for Surface Water Management Plans (SWMPs) and/or Water Cycle Studies (WCSs),
- Identify the level of detail required for site-specific Flood Risk Assessments (FRAs),
- Inform the emergency planning process,
- Improve stakeholder joint working and the sharing of data, information and the understanding of flood risk, and
- Provide a reference document.

1.2.1.8 There is a trend developing since the publication of the PPS25 Practice Guide in 2008 for SFRAs to be more than a land use planning tool and provide a broader and inclusive vehicle for integrated, strategic and local flood risk management assessment and delivery. Since publication of the Pitt Review, it is apparent that SFRAs will provide the central store for data, information and consideration for all flood risk issues from all sources at a local level and provide the linkage between Catchment Flood Management Plans (CFMPs), Shoreline Management Plans (SMPs), Regional Flood Risk Appraisals (RFRAs), SWMPs and appropriate sustainable land uses over a number of planning cycles.

1.2.1.9 SFRAs need to be fit for the future to help inform communities to meet the considerable flood risk management and climate change related challenges ahead.

1.3 Study area

1.3.1.1 Oldham Council is one of ten metropolitan districts that comprise the conurbation of Greater Manchester. At the sub-regional level, Oldham Council is part of the Greater Manchester 'New Growth Point'. This is a programme to increase levels of housing building across the sub-region as part of the Government's aspiration for 3 million new homes by 2020. It may see an increase of 20% on the Council's Regional Spatial Strategy (RSS) annual average housing figures (2011-2017).

1.3.1.2 The key areas where continued development and regeneration is expected within the study area include: Oldham Town Centre, Foxdenton, Hollinwood and the Housing Market Renewal (HMR) areas.

1.3.1.3 The Level 1 SFRA assessed all of the proposed development sites across the borough including employment and SHLAA allocations. The Level 2 SFRA has identified the communities where there is a development focus and assesses the strategic sites in greater detail (largely excluding SHLAA sites). However, the Level 2 SFRA maps have included all of the potential development sites for reference purposes.

1.3.1.4 The Bury, Rochdale and Oldham (BRO) Level 2 SFRA only included a small part of Oldham Council, the Beal catchment. This is located in the north of the borough, as it drains northwards into the River Roch (Rochdale Council). The Oldham Level 2 SFRA has incorporated the findings of the BRO SFRA to provide a stand alone SFRA for Oldham Council.

1.4 Level 2 SFRA scope and objectives

1.4.1.1 The Level 2 SFRA provides a detailed understanding of flood risk across Oldham 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 Oldham 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 (e.g. culverts, canals).

1.4.1.2 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 Oldham. 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.

1.4.1.3 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.

1.4.1.4 The Level 2 SFRA is structured as follows:

1. **Introduction**.
2. **Flooding from rivers**. Provides an assessment of the risk at key development sites along Wince Brook, Diggle Brook, the River Tame and Chew Brook.
3. **Flooding from canals**. Provides an assessment of areas that could potentially be affected by overtopping or breach from the Rochdale Canal and Huddersfield Narrow 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, 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.
6. **Cumulative impacts**. Provides an understanding of the impact that development could have on flood risk both within Oldham and downstream.
7. **Hydraulic interactions**. Understanding the potential interactions between different sources of flood risk in Oldham is critical. These have been mapped and tabulated in the Level 2 SFRA.
8. **Summary of flood risk**. The risk of flooding from all sources has been summarised for key communities.
9. **Outline Mitigation Strategy**. This provides advice on how development could proceed in flood risk areas and be compliant with the requirements of PPS25.

2 Flooding from Rivers

A more detailed assessment of fluvial flood risk has been undertaken where there is known high flood risk and where there is a focus for future development. This has been undertaken for Wince Brook at Foxdenton and the River Tame at three key sites: Diggle School, Frenches Wharf and the Robert Fletcher site. For other rivers where there is lower risk, the Level 1 assessment will provide an adequate evidence base.

2.1 Introduction

2.1.1.1 The Oldham Level 1 SFRA (Volume II) presents the risk of flooding from watercourses across the borough. This volume of the SFRA has focussed on those areas at greatest risk where strategic development sites have been proposed. The following sites have been assessed in greater detail to provide an evidence base for the Sequential and Exception Tests.

- **Foxdenton Strategic Site (EMP080)** - blockage analysis along Wince Brook culvert
- **Diggle School, Building Schools for the Future (SCH002)** - extent, depth and hazard along Diggle Brook
- **Robert Fletcher Ltd, Major Developed Site in Greenbelt (EMP062)** - extent of flooding from Chew Brook
- **Frenches Wharf, Mixed Use Development Site (MIX002)** - post development scenario for emergency planning along the River Tame (refer to Volume I: User Guide)

2.1.1.2 The river 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 Oldham Council. Detailed studies should seek to refine the understanding of flood risk from all sources where a specific site risk assessment is being prepared.

2.2 Flood Defences

2.2.1.1 The Environment Agency's National Flood and Coastal Defence Database (NFCDD) and the River Irwell and Upper Mersey CFMPs were used to establish the existing flood defences along the main rivers in the borough (see Table 2-1).

2.2.1.2 The River Irwell and Upper Mersey CFMPs have set the long term policy direction for future Flood Risk Management (FRM) in Greater Manchester. It is important to consider FRM in the context of the relevant CFMP policy for that area to understand the management of assets over the lifetime of development. Table 2-1 shows the overall CFMP policies for the borough rather than individual actions for each asset across the catchment. However, it should be noted that the CFMP is a strategic document that sets the direction of FRM 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. The residual risk of flooding in an extreme flood event or from the failure of defences should always be carefully considered.

2.2.1.3 The River Irwell and Upper Mersey CFMPs will help steer future investment, policies and overall risk management activities for the catchment through the implementation of CFMP action plans. As the timescale associated with the actions may not match the long term action plans, resources and funding of other organisations, the Environment Agency see National Indicator 189 (Flood and coastal erosion risk management) as the basis for working with Local Authorities by developing further detail and identifying the financial requirements for the successful implementation of CFMP actions. Using NI189 will also allow the Environment Agency and other organisations to target joint efforts and resources in the most beneficial way.

2.2.1.4 The Environment Agency have an action in the River Irwell CFMP to deliver flood risk strategies for Shaw to Rochdale (which includes the River Beal in Oldham) and Central Manchester (which includes part of the River Irk in Oldham). The Upper Mersey CFMP includes an action for the Environment Agency to undertake a study considering the justification and appropriate solutions for reducing flood risk on the River Tame, including at Uppermill and Diggle in Oldham. These studies present a significant opportunity for the local authority to work closely with the Environment Agency to help reduce flood risk.

2.2.1.5 Raised defences in Oldham are generally small privately owned structures which typically protect factories or old mills. The condition and standard of protection of these structures is generally unknown but considered to be below a 1 in 100 year flood event standard in many places.

2.2.1.6 At two locations between the Huddersfield Narrow Canal and the River Tame raised canal embankments are present. In the event of the defence failing the canal could flood into the river increasing the flood hazard. Therefore it is important to understand the interaction between canals and rivers (see Chapter 7).

2.2.1.7 The condition of existing flood defences and whether they will continue to be maintained and/or improved in the future is an issue that needs to be considered as part of the risk based sequential approach and in the light of this, whether proposed land allocations are appropriate and sustainable. In addition, detailed Flood Risk Assessments (FRAs) will need to explore the condition of defences thoroughly, especially where these defences are informal and contain a wide variation of condition grades. It is important that all of these assets are maintained in a good condition.

2.2.1.8 The NFCDD was reviewed to identify key Environment Agency and privately owned assets across the borough. In order to verify and improve the database an asset survey was undertaken by a JBA Chartered Engineer for the key assets along the River Tame, which was identified as the area with the highest fluvial flood risk and development pressures.

2.2.1.9 Asset locations were visually inspected for the general surrounding topography, a general impression of the flood risk to the nearby proposed development sites, the areas benefitting from the defences and the natural floodplain. A photographic record of key structures was created and notes were also made of the watercourse condition in the vicinity of the structures such as weed growth, sediment deposition or where a lack of channel maintenance was evident. Photographs from the Wince Brook assessment were also referenced in the asset database.

2.2.1.10 A GIS layer was produced which contained the following information:

- NFCDD reference
- Asset type
- Maintainer
- Asset description and location
- Asset length and height
- Asset condition
- Standard of protection
- Data source
- Watercourse
- CFMP Policy
- Photograph reference
- Notes taken by engineer during site visit

2.2.1.11 Figure 2-1 shows a typical private raised defence along the River Tame. The photograph shows that this structure is in need of repair.

Figure 2-1: Raised defence along River Tame, Uppermill

Table 2-1: Assets and CFMP policies

CFMP Policy Unit	Watercourse	Asset description (owner)	CFMP Policy
River Irwell CFMP			
South Oldham to Droylsden (Medlock)	Wood Brook Medlock	• Flood wall along footpath to Station Road (Environment Agency) • Walled channel at Strinesdale Centre (private) • Raised wall at Orb Mill (private)	P3: Continue with existing or alternative actions to manage flood risk at the current level
North Oldham (Irk)		• Only culverts, maintained channels and natural channels	P4: Take further action to sustain the current level of flood risk into the future
Middleton and Chadderton Flood Risk Area (Irk)	River Irk	• Raised bank from Kiln Hill road bridge to Church Inn footbridge (private)	P5: Take further action to reduce flood risk
Milnrow & Shaw Flood Risk Area (Roch)	Beal Old Brook	• ABD associated with maintained channel around Linney Lane (private) • Concrete flood wall along both banks (Environment Agency)	P5: Take further action to reduce flood risk
Rural Roch (Roch)	Beal	• Concrete panel wall upstream Moss Hey Street (private) • Mainly culverts, maintained channels	P6: Take action with others to store water or

CFMP Policy Unit	Watercourse	Asset description (owner)	CFMP Policy
		and natural channels	manage run-off in locations that provide overall flood risk reduction or environmental benefits, locally or elsewhere in the catchment
		Upper Mersey CFMP	
Peak District		• Only natural channels	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
Tame	Tame	• Raised masonry wall along industrial buildings, Stackcote Road (private) • Raised masonry wall at Pringle Mill (private) • Raised masonry wall upstream of High Street (private) • Raised masonry wall downstream of High Street (private) • Raised masonry wall at Delph Mill (private) • Raised masonry wall at Saddleworth Business Park (private) • Raised earth embankment and concrete wall at Mill, Delph New Road (private) • Raised masonry wall along Delph New Road (private) • Raised earth embankment at Mill, upstream of Dobcross (private) • Raised wall at Kentworth Estate (private) • Raised earth embankment and masonry wall at Kentworth Gardens and along High Street (private) • Raised masonry channel side wall and concrete wall opposite Springs Street and at Mill (private) • Raised masonry wall, Carr Lane (private) • Raised earth embankment between Huddersfield Narrow Canal and River Tame, Oldham Road (private) • Raised earth embankment along old Mill, Oldham Road (private) • Raised masonry wall, Frenches Wharf (private)	P5: Take further action to reduce flood risk

CFMP Policy Unit	Watercourse	Asset description (owner)	CFMP Policy
	Hull Brook	• Raised earth embankment along sewage works, Greenfield (private) • Raised earth embankment and concrete wall around Manns Wharf, Greenfield (private) • Raised earth embankment along Well-i-Hole Road (private) • Reservoir side channel bank, Hull Mill Dam (private) • Reservoir bypass channel and head bank, Ainley Wood reservoir (private)	
	Diggle Brook	• Raised masonry wall, Lee Side (private) • Raised earth embankment at Wrigley Mill upstream of Spurn Lane (private) • Raised masonry channel side wall downstream of Wool Road (private) • Raised earth embankment between Huddersfield Narrow Canal and Diggle Brook, upstream of confluence with River Tame (private)	
	Chew Brook	• Raised embankment at Greenfield Mill (private) • Raised embankment at Waterside Mill (private) • Raised defence at Manchester Road (private) • Raised defence at old mill (private) • Raised defence at Landhill Lane alongside the cricket ground (private)	

2.3 Wince Brook

2.3.1.1 Wince Brook flows through the Foxdenton Strategic Site (EMP080). The brook is then in culvert through the Greengate Primary Employment Zone (EMP012) and under the Rochdale Canal. The Level 1 SFRA concluded that the Wince Brook culvert capacity is relatively large and limited flooding occurs during the 1 in 1000 year event. The Level 2 assessment has looked at the residual risk from culvert blockages, which could increase flood risk locally. The 1D ISIS model produced for the Level 1 SFRA has been used to assess culvert blockage scenarios.

2.3.1.2 Two culverts were blocked: the entrance to the long culvert leading to the sewage treatment works (see Figure 2-2) and the culvert under the Rochdale Canal (see Figure 2-3). Standard blockages of 20% and 80% were applied. Map 2.12 shows the predicted flood extent under these blockage scenarios.

2.3.1.3 When a 20% blockage was applied to both culverts the flood extent did not change significantly for the 1 in 100 year plus climate change event or the 1 in 1000 year events. This indicates the culvert capacity is adequate even with a 20% blockage. However, under the 80% blockage scenario there was a significant increase in surcharging around the culvert inlets, along Springs Brook, Foxdenton Lane and across part of Foxdenton Park.

2.3.1.4 The likelihood of an 80% blockage is low unless the current maintenance routine, such as trash screen clearances stopped and fly tipping occurred. The blockage scenarios have been undertaken as a strategic and conservative assessment. A FRA would benefit from a CCTV survey and a more detailed assessment of what blockage scenario would be realistic for the assessment of residual risk.

Figure 2-2: Long culvert leading to sewage treatment works

Figure 2-3: Rochdale Canal culvert

2.4 Diggle Brook

2.4.1.1 The Diggle School site (SCH002) is located in the upper Tame catchment in Saddleworth. Diggle Brook, a tributary of the River Tame, passes through the site and places parts of the site within Flood Zone 2 and 3. A 1D-2D ISIS-TUFLOW model was constructed to refine the fluvial flood risk and model the potential flood depths and hazard across the site.

2.4.1.2 Flood extents, hazards and depths for each scenario (1 in 100 year, 1 in 100 year considering climate change, 1 in 1000 year and 1 in 1000 year considering climate change) have been provided on maps at the back of this volume. An animation has also been produced for the 1 in 1000 year event. This 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.

2.4.1.3 Flood hazard is based on a multiplier of flood depth, flood velocity and a debris factor[3] and is presented on the following scale:

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

2.4.1.4 The modelled flood outlines are broadly similar to the existing Environment Agency Flood Zones and imply that the fluvial flood risk is low across much of the Diggle School site. Flooding is limited to a narrow zone on either side of Diggle Brook that reaches a maximum width of approximately 60 metres at the southern end of the site. The flood extent is not predicted to vary much between a 1 in 25 year and a 1 in 1000 year event because the floodplain is effectively constrained as land rises steeply away from the channel, which limits the risk to surrounding areas. Flood depth and hazard are predicted to increase with the magnitude of the flood event but flood depths on the limited floodplain areas are modelled to be generally lower than 0.50m even during a 1 in 1000 year flood event. The flood hazard across the floodplain is not predicted to be high.

2.4.1.5 Although there is a flood risk from Diggle Brook, the residual risk from the Huddersfield Narrow Canal (see Figure 2-4) and potentially Diggle Reservoir, is more significant. Chapter 7 discusses the interaction between the different sources of flood risk present at Diggle School.

[3] 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.

Figure 2-4: Part of the Diggle School Site

2.5 Chew Brook

2.5.1.1 The Robert Fletcher site (EMP062) at Greenfield has been identified as an important site to assess within the Level 2 SFRA (see Figure 2-5). Chew Brook flows along the northern boundary of the site. Previous Environment Agency Flood Maps indicated that the site was within Flood Zone 2. However, this has been revised following the Upper Mersey Flood Mapping Study (2008), which predicts that flood levels during a 1 in 1000 year event would remain in bank both upstream of and adjacent to the Robert Fletcher site.

2.5.1.2 A set of ISIS model runs was carried out for the SFRA using the supplied Upper Mersey Flood Risk Mapping (FRM) ISIS model (2008) of Chew Brook and these confirmed that water would remain wholly in bank during an extreme 1 in 1000 year flood event. This was still the case even when the extreme event flow was increased by 20% to simulate the potential impact of climate change. The high capacity of Chew Brook adjacent to the Robert Fletcher site and low resultant fluvial flood risk to adjacent areas is partly attributed to the fact that the brook is designed to take reservoir overflows, which could be up to the 1 in 10,000 year flood event.

2.5.1.3 Although, the direct fluvial flood risk to the Robert Fletcher site from Chew Brook is modelled to be low, there is residual flood risk to the site from Dovestone Reservoir that can not be quantified in the SFRA. In addition, there is a mill pond and a reservoir outflow channel adjacent to the site that are both elevated above current ground levels at the site and these could also pose a residual risk to the site.

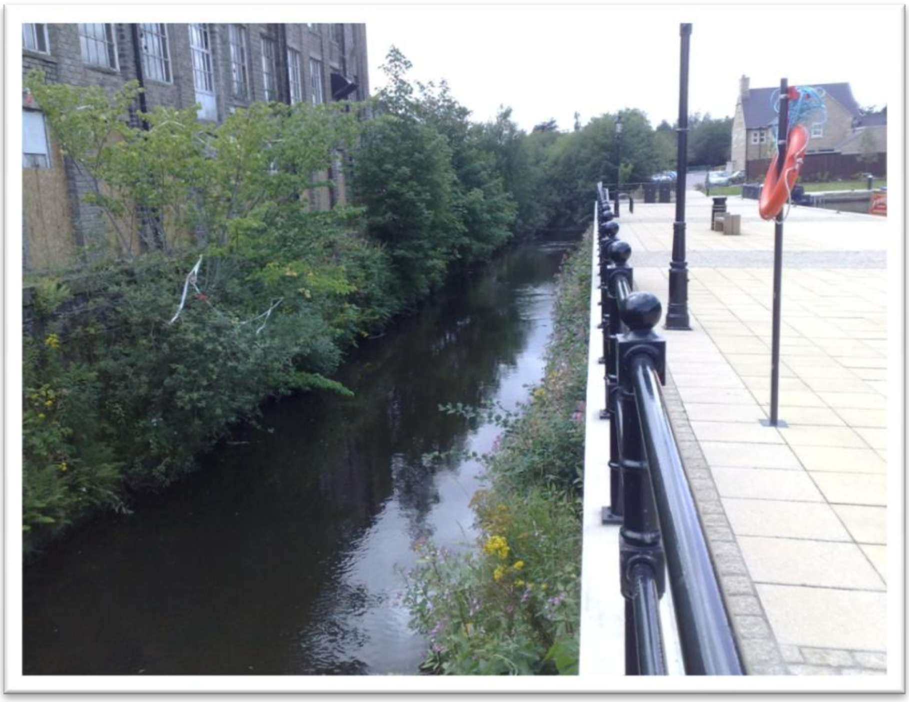
Figure 2-5: Proposed Robert Fletcher Site

2.6 River Tame

2.6.1.1 The Frenches Wharf site (MIX002) adjacent to the River Tame between Uppermill and Greenfield has been granted reserved matters approval for all the component parts of the site. The site includes a Tesco store with car park, a public house (already built) and marina (already built), as well as two areas of housing (some of which is already built). The Environment Agency has recommended that Finished Floor Levels (FFL) should be set to the 1 in 100 year plus climate change level with 600mm freeboard allowance for habitable areas (including the Tesco store).

2.6.1.2 The River Tame passes through the site (see Figure 2-6) and the Huddersfield Narrow Canal runs along the western boundary.

Figure 2-6: River Tame at Frenches Wharf



2.6.1.3 The Environment Agency has designated part of the site as an Area Benefitting from Defences (ABD). However, on inspection, the existing brick wall has a pipe outlet through it and is covered in Japanese Knotweed (see Figure 2-6). This river asset acts as an informal wall rather than a defence. Therefore, this structure should not be regarded as providing a 1 in 100 year standard of protection to the land on the left bank. However, this wall will be redundant once ground raising has been carried out at the development site.

2.6.1.4 A post development scenario was assessed in the SFRA for emergency planning purposes. The Level 2 SFRA has constructed a 1D-2D link ISIS-TUFLOW model to assess the flood depths and hazard across the site assuming the development has proceeded and based on the Environment Agency's recommended FFLs in various FRAs[4]. This model was constructed because although the developed site should be safely above estimated flood levels the development could have an impact on river levels or overland flood flow routes. For example, there was a possibility that flood water could potentially flow along Wellington Road, hence cutting the development off from emergency access.

2.6.1.5 The SFRA model results predict that the development is safe from flooding even during an extreme (1 in 1000 year) event. During this event flood water is modelled to collect upstream in the Churchill Fields area up to a depth of 1.20 metres but the flood level hereabouts is insufficient to enable flow to occur along Wellington Road behind the development.

[4] Fairhurst & Partners, Proposed Retail Development Wellington Road, Greenfield, FRA, October 2007 and Clarkbond, Marstons Site, Greenfield, FRA, 2007

2.7 Summary

- The fluvial flood risk across the Foxdenton and Frenches Wharf sites is low. This is also true of much of the Diggle School site; although a narrow strip either side of Diggle Brook is currently modelled to be at risk from a 1 in 25 year event.
- The culvert capacity along Wince Brook is adequate provided appropriate inspection and maintenance continues. There is a residual risk from culvert blockage.
- There is a residual risk at the Diggle School site from the Huddersfield Narrow Canal and potentially Diggle reservoir.
- Emergency planning is not likely to be an issue at the Frenches Wharf site as Wellington Road is modelled to remain dry even during an extreme 1 in 1000 year event.
- There is a residual risk at the Robert Fletcher site from Dovestone Reservoir and the adjacent mill pond and overflow channel.

3 Flooding from Canals

The SFRA has undertaken a strategic assessment of the risk of overtopping and breach from the Rochdale Canal and Huddersfield Narrow Canal.

3.1 Introduction

3.1.1.1 There are two canals in the borough:

1. The Rochdale Canal. This is navigable from Littleborough and runs parallel to the River Roch and then turns south west through Chadderton, before joining the Bridgewater Canal in Central Manchester.
2. The Huddersfield Narrow Canal. The canal passes through Saddleworth along the Tame Valley to the Ashton Canal at Ashton-under-Lyne.

3.1.1.2 These canals 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 crafts.

3.1.1.3 British Waterways is a key stakeholder in the management of canals and has been consulted as part of the SFRA process.

3.1.1.4 The interaction between these canals and the main rivers are integral to the understanding of flood risk. The Level 1 SFRA (Vol II, section 2.7) has introduced the potential flooding mechanisms from the Rochdale Canal and Huddersfield Narrow Canal.

3.2 Flood risk from canals

3.2.1.1 The canals do not generally pose a direct flood risk as they are a regulated 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.

3.2.1.2 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 flooding.

3.2.1.3 The probability of a breach is managed by continued maintenance by the respective canal owners. High embankments are known as Principal Embankments and British Waterways have a more stringent management regime in such areas. No attempt is made in this SFRA to assess this probability, other than noting that such events are very 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.

3.2.1.4 Severe canal breaches have occurred on the Rochdale Canal in the past at the River Irk. The event with the worst consequences was caused by a blocked culvert underneath the canal which dammed the River Irk behind until the pressure burst the canal embankment.

3.2.1.5 A "Canal Hazard Zone" has been created for the Rochdale Canal and the Huddersfield Narrow Canal to show areas that could potentially be affected by flooding in the event of breach of raised canal embankments.

3.2.1.6 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 risk of canal overtopping and breach are outlined below.

3.2.1.7 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 exact inflows and outflows into the canal system. The assumptions behind any modelling should be considered when using and reviewing the hazard zone that has been produced.

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

3.2.2 Canal overtopping methodology

3.2.2.1 In locations where surrounding ground levels are the same as or lower than average 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. This was based on a number of assumptions and used LIDAR data (although LIDAR data could not be relied on to provide accurate bank height information). The same assumptions were applied to both the Rochdale Canal and Huddersfield Narrow Canal and the same methodology was applied.

3.2.2.2 An estimation of the potential peak flow along the canal, and the rainfall-runoff into the canal, is crucial when estimating overtopping flood risk from canals. Higher inflows increase the potential for overtopping and associated flood risk. An estimation of flood conditions was generated by modelling a single pound (length of canal between two locks) in the 1-Dimensional modelling package HEC-RAS. Flood inflows were estimated by generating hydrographs for two contributing flood mechanisms of overflow from the upstream pound and lateral surface runoff from the individual pound catchment.

3.2.2.3 The model predicted a small amount of overtopping, which implies that the canal system is essentially self regulating and although overtopping is possible the hazard is likely to be low. Any overtopping volumes are likely to be small compared to the general surface water runoff during a storm event. The refined surface water maps (see Maps 5.1 and 5.2 (A to G)) can be used to identify where water appears to pass between the canal and the adjacent land and, hence, give an indication of areas potentially at risk from overtopping. Further assessment would be necessary for any site located within a surface water flow path to determine the true nature of the flood i.e. is the flow direction out of the canal, therefore due to overtopping, or into the canal, therefore not due to overtopping.

3.2.3 Canal breach methodology

3.2.3.1 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.

3.2.3.2 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. For this study, the potential maximum flood extent is limited by the maximum volume of water within a pound length (a stretch of a canal between two locks). However, during a joint probability flood event or if there is an interaction between a canal and watercourse the flood volume could be increased. Chapter 7 looks at the interaction between different sources of flooding, such as at the Diggle School site (SCH002).

3.2.3.3 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.

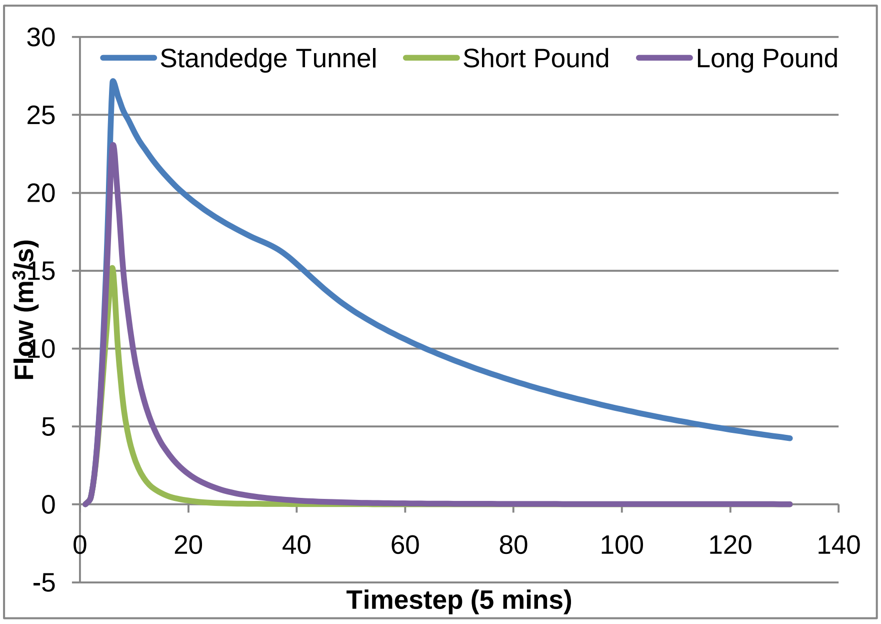
1. Continuous erosion of the embankment (e.g. via overtopping),
2. Slip of the raised embankment which would allow an approximately semi-circular breach, parallel to the canal, to bed level, then
3. Progressive erosion of the bed of the canal in two directions away from the breach location along the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

3.2.3.4 The potential breach outflow volume is either dictated by canal pound length or, for long pound lengths, how quickly the operating authorities can react to prevent further water loss. Average pound lengths were calculated for the respective canals and possible breach locations were identified. Areas lower than the estimated minimum canal water levels were assumed to be at potential risk from a canal breach. Canal water levels and surrounding ground levels were determined using LIDAR data.

3.2.3.5 A breach hydrograph was developed using a 1-D HECRAS model to represent the three stage mechanism with the starting water level as bankfull. The respective pound lengths were applied to the model.

3.2.3.6 The breach hydrographs obtained from HECRAS (see Figure 3-1) were fed into a two dimensional JFLOW model to assess potential flood inundation extents along the length of the canal. Inflows were applied to the JFLOW model at 100m intervals along the canals at potential breach locations. The modelled extents from the individual inflows were combined and a 10m buffer zone was added, to provide a Canal Breach Hazard Zone for both canals.

Figure 3-1: Sample of Breach Hydrographs for the Huddersfield Narrow Canal



3.2.4 Flooding from the Rochdale Canal

3.2.4.1 Canal flooding is an unlikely occurrence and so should be considered to be a residual risk. The locations where canal breach is most likely are summarised below:

- The most likely breach locations along the Rochdale Canal are in the lower lying areas of Chadderton and Failsworth.
- The aqueduct across the River Irk is a location where breach has occurred in the past (1923 and 2003). Surrounding farmland falls within the Canal Hazard Zone.
- A breach event along the canal places the residential estate to the north of the Foxdenton Strategic Site (EMP080) within the Canal Hazard Zone.
- A breach event in Failsworth could place land adjacent to Old Road between the railway line and the canal at risk and also a residential area around Poplar Street and Farm Street.
- The following strategic development sites fall within the Canal Hazard Zone:
    - Foxdenton Strategic Site (EMP080) / Greengate Primary Employment Zone (EMP012)
    - Failsworth District Centre (EMP064)

- West Failsworth PEZ (EMP015)
- Morrisons Supermarket, Poplar Street (EMP071)

3.2.5 Flooding from the Huddersfield Narrow Canal

3.2.5.1 Canal flooding is an unlikely occurrence and so should be considered to be a residual risk. The locations where canal breach is most likely are summarised below:

- A breach of the raised embankments (see Figure 3-2) would result in canal flood water flowing towards the River Tame and southwards along the Tame Valley.
- Immediately downstream of the Standedge Tunnel, at Diggle Works, the canal passes approximately 9m above Diggle Brook. A breach in this location would result in large volumes of water entering Diggle Brook.
- The canal is situated on raised land to the east of the Diggle School site (SCH002). Embankment breach at this location (see Map 3.1 C) would result in canal flood water flowing across the north east part of the site and along the Diggle Brook floodplain. There would be considerable hazard to the site during such an event.
- A breach in Uppermill could cause a similar flood extent to Flood Zone 3, including areas between the canal and the River Tame, Churchill fields, parts of Frenches Wharf (pre-development) and the sewage works at Greenfield. Based on proposed Finished Floor Levels at Frenches Wharf, the residual flood risk from the canal is expected to reduce once the site has been developed.
- The following strategic development sites fall within the Canal Hazard Zone:
  - Warth / Ellis Mills PEZ (EMP007)
  - Diggle School (SCH002)
  - Uppermill District Centre (EMP063)
  - Frenches Wharf Mixed Use Development (MIX002)

Figure 3-2: Potential breach location on Huddersfield Narrow Canal at Uppermill

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

4.1.1.1 The Level 1 SFRA (Volume II) shows there a number of reservoirs within or upstream of Oldham. Section 2.6 of the Level 1 SFRA identifies reservoirs and the main urban area at risk immediately downstream of them.

4.1.1.2 Explicit consideration of reservoir overtopping and breach should be considered in detailed site based FRAs where the reservoir is within or in close proximity to the proposed development.

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 Oldham. United Utilities flood risk data and sewer network models were not available for the SFRA. 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.

5.1 Introduction

5.1.1.1 This section presents information regarding flood risk from surface water and sewers within the SFRA area. Future 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.

5.1.1.2 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 has 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 in the Upper Tame Valley within this study area, is testament to this problem. Surface water flooding in Oldham tends to be highly localised and relatively frequent following intense rainfall, causing disruption to local communities.

5.1.1.3 Managing surface water discharges from development is 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.

5.1.1.4 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[5], Making Space for Water[6], the Pitt Review[7] and the Draft Flood and Water Management Bill[8] 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 Draft Flood and Water Management Bill requires developers where practical, to include sustainable drainage in new developments to reduce flood risk and improve water quality. It includes '*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, local authorities will be responsible for approving SUDS for new developments and adopting and maintaining them.

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[5] Defra (2008) *Future Water*

[6] 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*

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

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

5.1.1.5 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 taken place. 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) to take the lead in local FRM delivery.

5.2 SFRA refined surface water mapping

5.2.1.1 The national Areas Susceptible to Surface Water Flooding (ASSWF) 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 ASSWF 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 the borough.

5.2.1.2 An extreme 1 in 200 year rainfall event was chosen, as used for the ASSWF 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.

5.2.1.3 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.

5.2.1.4 Most new sewers are designed to a 1 in 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. 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.

5.2.1.5 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 are beyond the scope of the SFRA. The Greater Manchester Water Cycle Strategy (yet to be commissioned) should consider the provision of water infrastructure to new developments and this will include consideration of sewer capacity.

5.2.1.6 The SFRA surface water flooding results are shown in Map 5.1 and 5.2 (A to G).

5.3 Critical Drainage Areas

5.3.1.1 The Town and Country Planning Order 2006[9] 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[10] 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.

5.3.1.2 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 (see SFRA User Guide: Vol I). These are areas with complex surface water flooding problems that would benefit from a Surface Water Management Plan and subsequent drainage strategy.

5.3.1.3 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.
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.

5.3.1.4 Screening for Critical Drainage Areas (CDAs) within the borough was undertaken using data from the following sources:

- Local authority incident records
- Discussions with Local Authority Drainage Engineers
- The national Areas Susceptible to Surface Water Flooding map
- 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

5.3.1.5 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 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.

5.3.1.6 Using the data, screening was undertaken to identify Critical Drainage Areas. This is shown in Table 5-1.

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

[10] 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	Reason	Taken forward?
Chadderton/ Wince Brook	A large amount of development is planned for this catchment, which has the potential to increase flood risk downstream in the River Irk catchment if surface water discharges are not carefully managed. The SFRA analysis shows that there is a high risk of surface water flooding to properties in the Failsworth area. 1 postcode area with 5 or more properties affected by internal flooding on the DG5 register.	Yes, surface water flooding risk and large amount of new development with potential to increase flood risk if surface water runoff is not carefully managed.
Hollinwood/ Moston Brook	A large amount of development is planned for this catchment, which has the potential to increase flood risk downstream in the River Irk catchment if surface water discharges are not carefully managed. The SFRA analysis shows that there is a high risk of surface water flooding to properties in the Stock Brook area. Wince Brook is a former Critical Ordinary Watercourse that has been associated with localised flooding.	Yes, surface water flooding risk and large amount of new development with potential to increase flood risk if surface water runoff is not carefully managed.
Saddleworth/ Upper Tame	There has been frequent surface water flooding reported at Uppermill, which may be attributed to the local drainage system and surface water runoff. Flooding in the Armit Road/ Hollin Crescent area of Greenfield is likely to be related to localised drainage issues. White Brook is a former Critical Ordinary Watercourse that has been associated with localised flooding.	Yes, frequent flooding and potential for new development to help reduce flood risk. Combined with Grotton/ Wood Brook to form the East Oldham/ Wood Brook and Upper Tame CDA due to close geographical proximity.
Grotton/ Wood Brook	There has been frequent surface water flooding reported at Grotton, which may be attributed to the local drainage system and surface water runoff. The SFRA analysis shows that there is a high risk of surface water flooding to properties in the Hey area. Thornley Brook is a former Critical Ordinary Watercourse that has been associated with localised flooding. 1 postcode area with 5 or more properties affected by internal flooding on the DG5 register.	Yes, frequent flooding and potential for new development to help reduce flood risk. Combined with Saddleworth/ Upper Tame to form the East Oldham/ Wood Brook and Upper Tame CDA due to close geographical proximity.

CDA	Reason	Taken forward?
Shaw/ Beal	A large amount of development is planned for this catchment, which has the potential to increase flood risk downstream in the River Roch catchment if surface water discharges are not carefully managed. The SFRA analysis shows that there is a high risk of surface water flooding to properties in the Shaw area, although many of these properties may be at direct risk of flooding from the River Beal. The last major flood to affect Shaw was in 1964, which was associated with intense and localised rainfall. Since this time there has been relatively frequent but localised rainfall that is likely to be related to localised drainage issues. Pencil Brook is a former Critical Ordinary Watercourse that has been associated with localised flooding.	Yes, surface water flooding risk and large amount of new development with potential to increase flood risk if surface water runoff is not carefully managed.
Royton/ Upper Irk	The SFRA analysis shows that there is a high risk of surface water flooding to properties in the Royton area, although most of these properties are at fluvial risk of flooding from the River Irk.	No, there is not a history of surface water flooding and the risk assessment does not show that there is likely to be a high risk of surface water flooding. The risk is thought to be primarily related to fluvial flooding from the River Irk.
Southern Oldham/ Upper Medlock	There have been localised incidents of flooding at Daisy Nook that are likely to be related to a localised maintenance issue.	No, there is not a significant history of surface water flooding (only localised incidents at one location) and the risk assessment does not show that there is likely to be a high risk of surface water flooding.

5.3.1.7 The CDAs are shown in Map 5.3 and 5.4 (A to G) and it can be seen that without risk based information for the sewer network the CDAs cover an extensive area. 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 a SWMP would be beneficial.

5.4 Surface water flood risk

5.4.1.1 The SFRA surface water maps were assessed against OS AddressPoint data to provide an assessment of flood risk to properties in the CDAs. The United Utilities Drainage Areas contain attributes showing the number of properties that have been affected by surface water flooding (it should be noted that this shows historical incidences and not flood risk). Both of these are provided in Table 5-2.

Table 5-2: Flood risk/ incidences in Critical Drainage Areas

CDA	Current risk (potential properties)	Future risk (potential properties)	Flood incidences per UU drainage area (historic flooding)
Chadderton/ Wince Brook	45	57	2
Hollinwood/ Moston Brook	88	131	1
East Oldham/ Wood Brook and Upper Tame	156	189	7
Shaw/ Beal	89	229	0

5.5 Recommendations for Surface Water Management

5.5.1.1 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 council, 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 (Volume II), but a brief summary is provided below.

5.5.1.2 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.

5.5.1.3 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 SWMP partnership to develop sustainable options to manage surface water flood risk. Where there are possible interactions with canals British Waterways should also be involved.

5.5.1.4 Based on the above analysis the following recommendations are made for future surface water management:

Table 5-3: Recommendations for future surface water management

CDA	Local authority	Recommendation
Chadderton/ Wince Brook	Oldham, Rochdale	Whilst surface water flooding is a key flood risk issue in Oldham that occurs relatively frequently, it is recognised that the risk here is much lower than it is in large urban centres elsewhere in Greater Manchester. Flooding in Oldham is mostly localised, affecting a few properties and related to specific local drainage issues. Oldham is unique in Greater Manchester as it sits at the top of the Beal, Irk, Medlock and Tame catchments and
Hollinwood/ Moston Brook	Oldham, Manchester, Tameside	
East Oldham/ Wood Brook and	Oldham, Rochdale, Calderdale, Kirklees,	

CDA	Local authority	Recommendation
Upper Tame	Tameside	therefore the potential for development to increase flood risk elsewhere needs to be considered (see Chapter 7).
Shaw/ Beal	Oldham, Rochdale, Calderdale	It is recommended that Oldham Council undertake a Scoping SWMP in partnership with United Utilities, British Waterways and the Environment Agency to identify particular hotspots where surface water solutions can be identified or more detailed modelling is needed. A Drainage Strategy should be undertaken as part of or alongside this for key development areas (including Foxdenton, Hollinwood, Oldham Town Centre and key HMR areas) to identify locations suitable for SUDS and how flood risk can be managed and reduced downstream. The SWMP may be usefully undertaken as part of the AGMA wide SWMP proposal that is discussed below.

5.5.1.5 It should be noted that CDAs overlap into downstream and potentially upstream local authority areas. However, the overlap upstream into Calderdale and Kirklees is minimal and may be related to the accuracy of the DEM used to define catchments. Unless there is development planned alongside the council boundaries in these areas, it is unlikely that future development in Calderdale or Kirklees will have an impact on surface water flood risk in Oldham. There may be additional sewered catchments in other council areas that drain into the CDAs where they extend beyond the Oldham Council area. Due to local topography these sewered catchments are not likely to drain into the Oldham Council area. Oldham Council should work closely with neighbouring authorities to ensure that a consistent approach is taken to cross boundary drainage issues. One approach to this is discussed below in 5.6.1.3 to 5.6.1.5.

5.5.1.6 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 a SWMP or a Drainage Strategy, which may or may not be undertaken at the same time as a SWMP. Such solutions can provide great benefits besides water management, including providing recreational facilities, improving biodiversity and making communities a better place to live. 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.

5.6 Taking Surface Water Management Plans forward

5.6.1.1 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.

5.6.1.2 The assessment and recommendations in the SFRA highlight that flood risk in Oldham comes from many different, but inter-related sources. These should all be considered as part of a 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.

5.6.1.3 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 Oldham has the potential to increase or decrease flood risk elsewhere and needs to be carefully managed.

5.6.1.4 Due to the large number of above and below ground hydraulic interactions between the 10 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.

5.6.1.5 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 10 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 discussed in section 5.3. Such a 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.

5.6.1.6 The AGMA SWMP initiative should be supported. If, however, sufficient funding is not available to undertake an AGMA SWMP, Oldham Council should form a partnership with their neighbours, United Utilities and the Environment Agency to undertake a SWMP for Oldham as recommended in Table 5-3.

6 Cumulative impacts of future development and drainage design

A strategic assessment of the impact of development within Oldham and on flood risk downstream has been undertaken. The results of this can be used to inform policies on sustainable drainage for new developments.

6.1 Introduction

6.1.1.1 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. It should be noted that the sewer network in many places in Greater Manchester is over 100 years old and was designed to drain significantly less development than exists today. Development has 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 in the Upper Tame catchment in particular in this study area, is testament to this problem.

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

6.1.1.3 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.

6.1.1.4 There is significant development planned for Oldham 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. The Greater Manchester Sub-Regional SFRA identified hydrological links between the different local authorities within AGMA.

6.2 Considering downstream impacts - scope and assessment methodology

6.2.1.1 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.

6.2.1.2 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.

6.2.1.3 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.

6.2.1.4 Three cases were analysed:

1. Current baseline.
2. Worst case scenario
3. Best case scenario

6.2.1.5 The impact of 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.

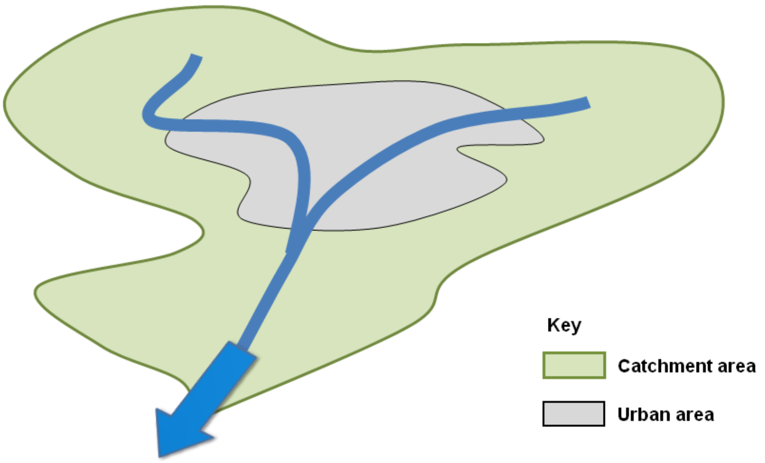
6.2.1.6 Impacts were assessed using four different models:

- The River Tame model
- The River Medlock model
- The River Irk model
- The River Irwell CFMP model

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

6.2.1.8 Flood Estimation Handbook (FEH) methods were used to calculate 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 6-1.

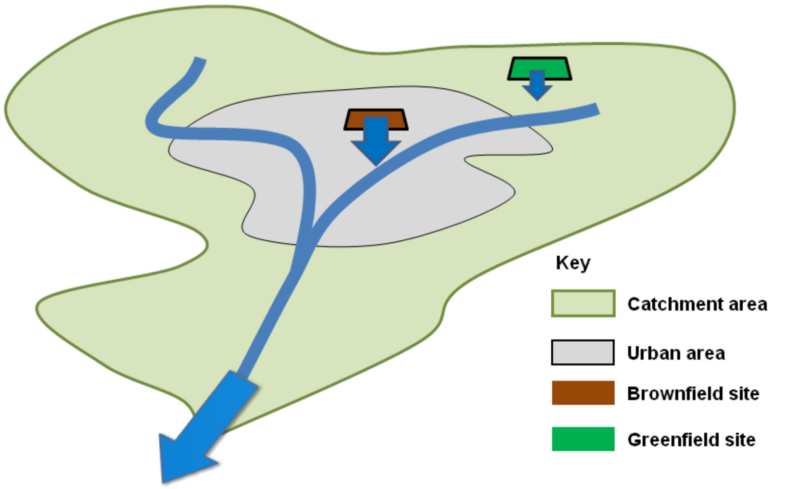
Figure 6-1: FEH calculation of flood hydrology for baseline flow



6.2.2 Current baseline case

6.2.2.1 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 6-2.

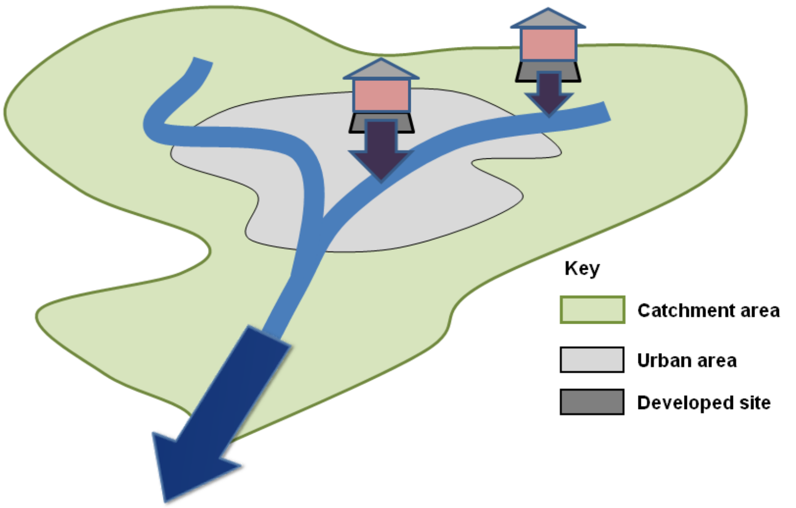
Figure 6-2: Contribution of development sites to the current baseline flow



6.2.3 Worst case

6.2.3.1 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 flows downstream, as shown in Figure 6-3.

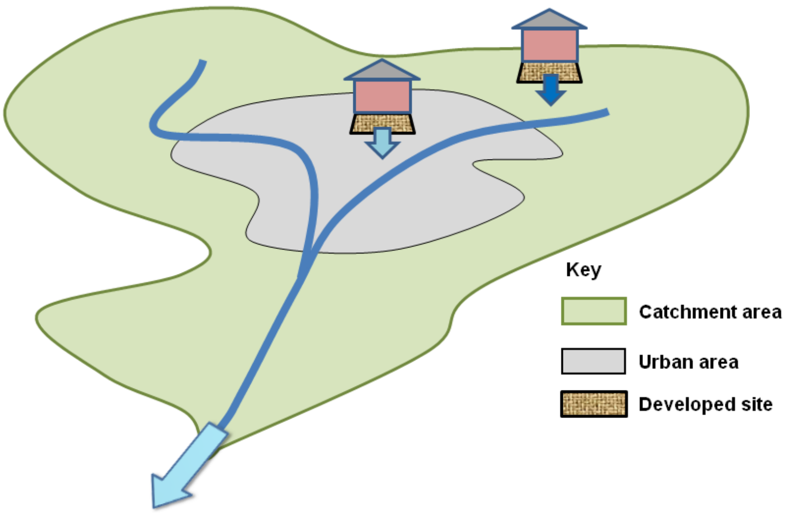
Figure 6-3: Contribution of development sites in the worse case scenario



6.2.4 Best case

6.2.4.1 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 flows, as shown on Figure 6-4.

Figure 6-4: Contribution of development sites in the best case scenario



6.3 Results

6.3.1.1 The following two figures show changes in water level for the locations within and downstream of the borough. These changes are indicative of changes that are expected in the river network under the different development cases. Figure 6-5 shows predicted water level increases based on the worse case scenario discussed above. Figure 6-6 shows predicted water level reductions based on the best case scenario discussed above (all figures are in metres).

6.3.1.2 In the River Irk catchment flood levels could increase by 0.23m locally in Chadderton and by 0.01m further downstream in Manchester as a result of inappropriate development and no retention of surface water or SUDS. In the River Tame catchment the impact is greatest locally, with increases in levels of 0.16m in Uppermill.

6.3.1.3 In contrast, appropriate development which retains surface water through SUDS and other techniques could reduce downstream flood levels in the Irk and Medlock catchments in Manchester by 0.01m and 0.12m respectively.

Figure 6-5: Worst case scenario: increases in water level at downstream locations

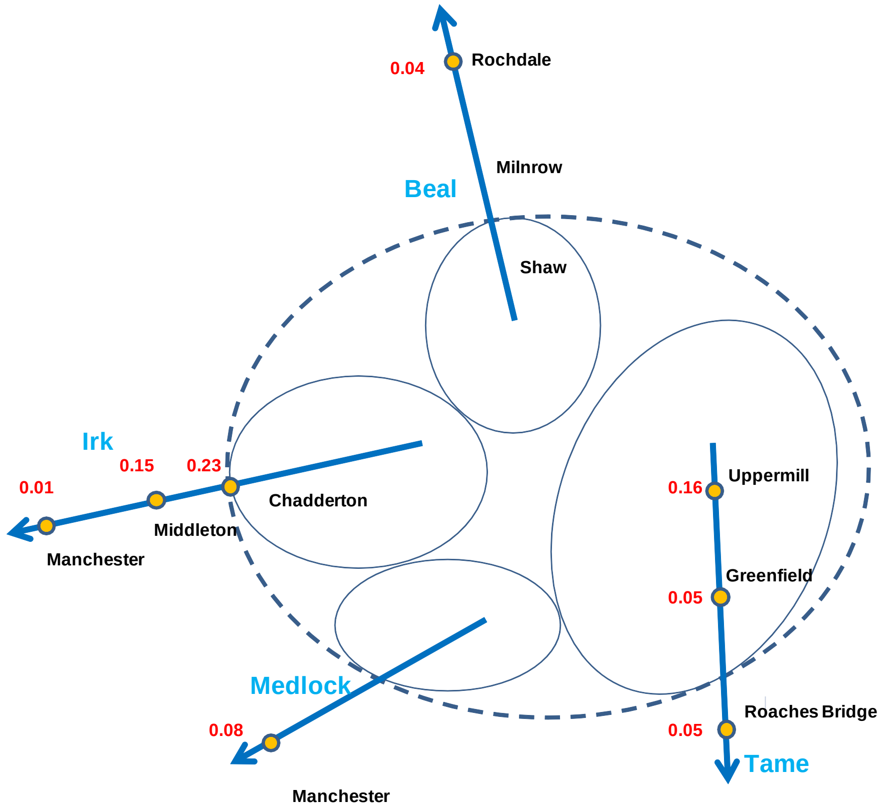
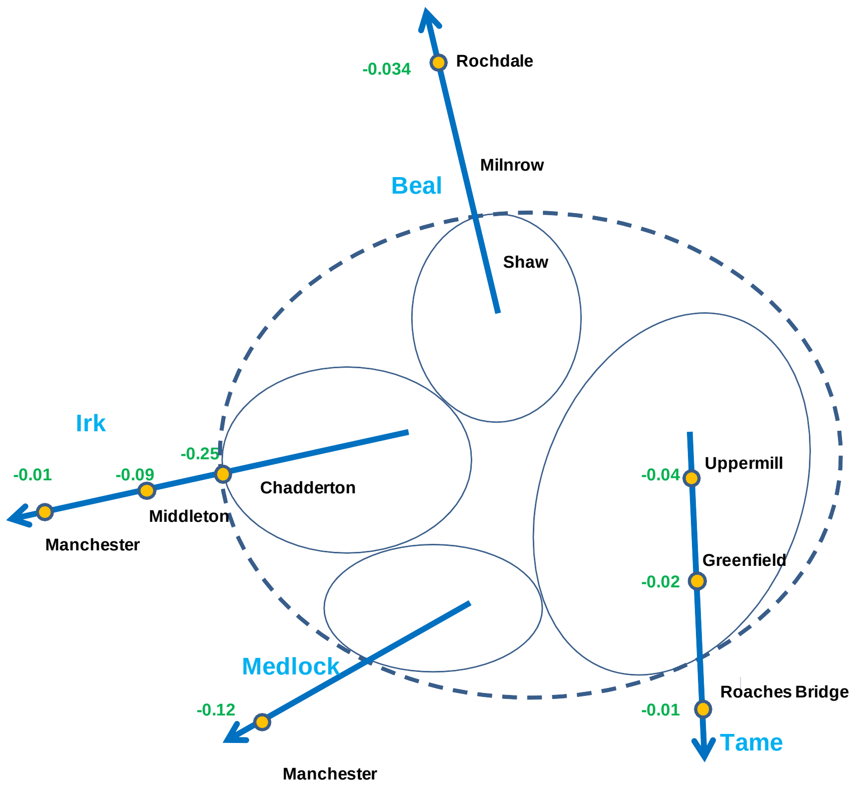


Figure 6-6: Best case scenario: Decreases in water level at downstream locations



6.4 Discussion

6.4.1.1 The analysis undertaken for the SFRA shows developing sites with large impermeable areas and no attenuation will increase flood risk locally and to a lesser extent further downstream. Unattenuated development, particularly in the Irk catchment (which includes developments in Foxdenton and parts of Hollinwood and Oldham Town Centre) could have the largest impact on water levels in downstream districts (into Manchester).

6.4.1.2 The results indicate that by using SUDS to reduce surface water runoff from development sites below existing levels there will be a beneficial impact on flood risk locally and further downstream. This highlights the benefit of undertaking Drainage Strategies, as discussed in section 5.

6.4.1.3 The analysis shows that development management policies to reduce surface water discharges from new development could have some benefit locally and downstream. This highlights the need for local authorities both within AGMA and in the wider River Roch, Irk, Medlock and Tame catchments to work together to reduce flood risk through the planning process.

7 Hydraulic linkages

Flood risk across the borough 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 and surface water to prompt the appropriate consideration of these issues in site specific FRAs and further studies such as a SWMP and Drainage Strategies.

7.1 Introduction

7.1.1.1 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.

7.1.1.2 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.

7.1.1.3 This strategic study has not concentrated on quantifying the effects of the hydraulic interactions which may occur in Oldham, 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 7.1 (A to E).

7.1.1.4 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 borough. 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

7.2.1.1 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, such as the Huddersfield Narrow Canal at Diggle. 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 result in a significant and sudden increase in flood risk downstream.

7.2.1.2 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.

7.2.1.3 For this study possible interaction locations between rivers and canals have been identified using a GIS desk-based approach. The Environment Agency's Flood Zone 2 and the Canal Hazard Zone produced for the SFRA have been used. Initially locations where Flood Zone 2 crossed or abutted canals were recorded. Subsequently, the canal breach and overtopping outlines were screened against the watercourses across the borough. 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 conservative approach.

Table 7-1 summarises locations within the study limits where canal and river interactions are considered possible. 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
RCH_001	The Rochdale Canal passes over the River Irk in an aqueduct. There has been past flooding on the River Irk when the embankment at the Rochdale Canal breached in 1923 and 2003. Should this aqueduct or adjacent embankments overtop or breach then flood water from the canal would flow into the Irk and across the natural floodplain (farmland). Flow from the river into the canal is not considered possible.	SD891063
RCH_002	It is possible that overtopping or breach of the Rochdale Canal in Chadderton would result in additional water flowing into Wince Brook and/or Springs Brook. It is not considered possible for flow from Wince Brook or Springs Brook to enter the canal at this location because of the elevation difference.	SD981047
HUD_001	It is possible that overtopping or breach of the Huddersfield Canal at Diggle would result in additional water flowing into Diggle Brook. It is not considered possible for flow from Diggle Brook to enter the canal at this location because of the elevation difference.	SD005079
HUD_002	It is possible that breach of the Huddersfield Canal at the Diggle School site (SCH002) would result in additional	SD981037

Location ID	Summary	NGR
	water flowing across the site and into Diggle Brook. It is not considered possible for flow from Diggle Brook to enter the canal at this location because of the elevation difference.	
HUD_003	In the event of the raised embankment between Diggle Brook and Huddersfield Narrow Canal (see Figure 7.1) breaching floodwaters would enter the river. It is not considered possible for flow from Diggle Brook to enter the canal at this location because of the elevation difference.	SD996065
HUD_004	It is possible that breach of the Huddersfield Canal around the confluence of Diggle Brook and the River Tame would result in additional water flowing into the River Tame. It is not considered possible for flow from the River Tame to enter the canal at this location because of the elevation difference.	SD995063
HUD_005	Excess flows along the Huddersfield Canal spill into the River Tame at Uppermill through a spill structure (see Figure 7.2). It is not considered possible for flow from the River Tame to enter the canal at this location because of the elevation difference.	SD995058
HUD_006	It is possible that overtopping or breach of the Huddersfield Canal at Uppermill would result in additional water flowing into the River Tame. It is not considered possible for flow from the River Tame to enter the canal at this location because of the elevation difference.	SD994049
HUD_007	It is possible that overtopping or breach of the Huddersfield Canal at Grasscroft would result in additional water flowing into the River Tame. Clough Lane watercourse also joins the River Tame at this location. It is not considered possible for flow from the River Tame to enter the canal at this location because of the elevation difference.	SD981037

Figure 7-1: Huddersfield Narrow Canal (yellow) and Diggle Brook (blue) interaction, upstream of confluence with River Tame

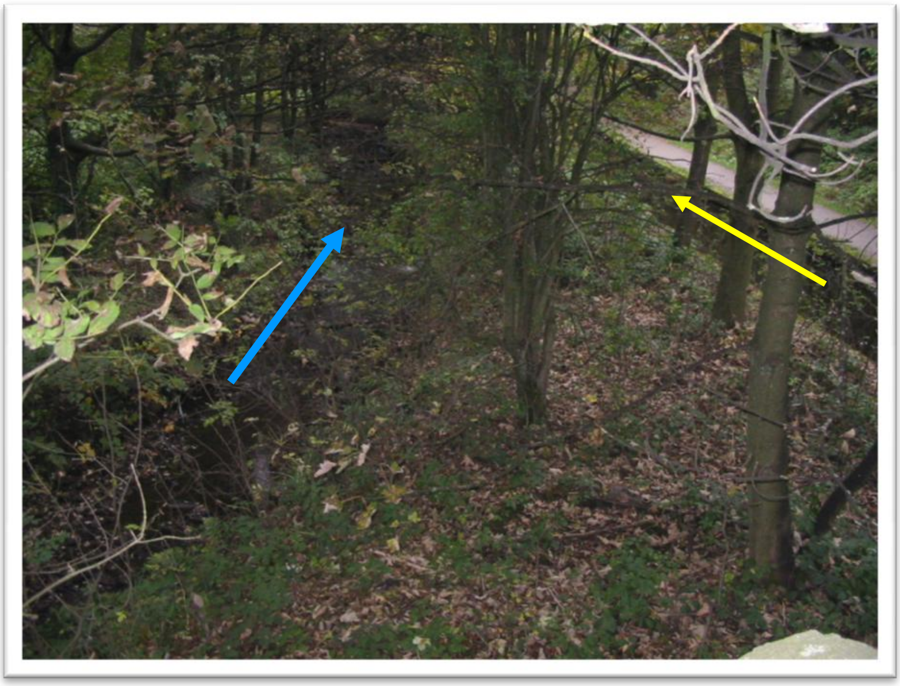


Figure 7-2: Spills from Huddersfield Narrow Canal into the River Tame, Uppermill

7.2.2 Diggle School Site

7.2.2.1 The hydraulic interaction between the Huddersfield Narrow Canal and Diggle Brook could influence flood risk at the Diggle School site (SCH002). A joint analysis was carried out in which a breach close to Diggle Works (several hundred metres upstream from the site) on the Huddersfield Narrow Canal coincided with the peak of a 1 in 100 year with climate change fluvial flood event along Diggle Brook. The resultant flood extent across the Diggle School site was not much larger than without the breach. However, flood depths on site were typically increased by between 0.30 and 0.50 metres. By comparison, a breach of the canal embankments adjacent to the school site would result in more extensive flooding of the site (see section 3.2.5).

7.3 Hydraulic interactions resulting from reservoir breach

7.3.1.1 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

7.4.1.1 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. 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. These interactions highlight the importance of representing other hydraulic systems in pluvial modelling studies.

7.5 Canal interactions

7.5.1.1 The Rochdale Canal passes through the west of the borough, while the Huddersfield Narrow Canal is located on the eastern side. Therefore, there is no interaction between different canals in the borough.

7.6 Hydraulic interactions affecting the sewer network

7.6.1.1 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.

8 Summary of risk

A summary of flood risk issues for groups of development sites (Strategic Locations and communities) 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

8.1.1.1 The development sites which are at the greatest risk of flooding and may need to undergo the Exception Test have been grouped into key communities and summarised in terms of flood risk. This will help provide an evidence base for the inclusion of sites within the Oldham Council Core Strategy. Chapter 9 then proposes an outline mitigation strategy by highlighting the mitigation measures that should be considered in accordance with PPS25.

8.1.1.2 This review of sites and communities 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.

8.1.1.3 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.

8.1.1.4 The risk to these key sites has also 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?
- 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?
- Could assets overtop during climate change or extreme events?
- Is overall residual risk significant in the area?
- Is surface water flooding an issue?
- Is flood risk a significant environmental issue/constraint?
- Does development need to be considered strategically?
- If 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?

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

- The implications of seeking to manage the actual risks to acceptable levels
- The effects of climate change on existing defence and the residual risk due to overtopping
- The consequences of the residual risk in the event that the defences fail

8.1.1.6 The summary tables below provide an overview of flood risks to the key sites across the borough. 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.

8.2 Sustainability Appraisal

8.2.1.1 The Council's Sustainability Appraisal, land allocations and development management policies should be informed by the Oldham Level 2 SFRA and carried out in liaison with the Environment Agency.

8.2.1.2 Included in the Sustainability Appraisal is a flood risk objective to *'mitigate and adapt to climate change, and to promote sustainable development in the borough by avoiding development within areas of flood risk and where necessary controlling and mitigating the impact and residual risks'*.

8.2.1.3 The relevant sustainability objectives are to:

- promote the sustainable regeneration of the borough (EC1)
- contribute to reducing the effects of climate change (ENV8)
- minimise the impact of, and mitigate against flooding (ENV14)

8.2.1.4 The SA Indicators to do this are the:

- number of planning applications granted contrary to Environment Agency advice on flooding and water quality grounds
- number of new developments incorporating SUDs

8.2.1.5 The Oldham 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

8.3.1.1 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.

8.3.1.2 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.

8.3.1.3 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.*

8.3.1.4 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 Strategic Locations and key communities

8.4.1.1 The key communities assessed include:

1. **Chadderton**

   This includes the Foxdenton Strategic Site (EMP080), Business & Industry land at Junction Mill (EMP051) and Causeway North (EMP047) and the Greengate Primary Employment Zone (EMP012).

2. **Hollinwood**

   This includes Hollinwood Junction Masterplan Strategic Site (EMP081)), the Hollinwood North Primary Employment Zone (EMP008), along with a number of small Business & Industry sites at Sellers Way (EMP044), Sefton Street (EMP045), Stable Street (EMP046), Mersey Road North (EMP036) and Albert Street (EMP057) and the Morrisons Supermarket, Hollinwood Avenue (EMP072).

3. **Oldham Town Centre**

   This includes the Oldham Town Centre employment site (EMP035) and the Business & Industry site on Oldham Way (EMP056).

4. **Saddleworth**

   This includes the Building Schools for the Future site at Diggle (SCH002), the Business & Industry site at Huddersfield Road, Diggle (EMP037), the Mixed Use Development at Lumb Mill, Delph (MIX001) and the Uppermill Town, District & Major Shopping Location (EMP063).

5. **Shaw**

   This includes the Shaw District Centre (EMP068) and Primary Employment Zone, the Beal Lane Business & Industry site (EMP050) and the Asda Stores, Shaw (EMP075).

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

8.4.1.3 The majority of development sites within the key communities (with the exception of Saddleworth) are allocated for employment uses (and classified as less vulnerable in PPS25) and therefore the Exception Test does not apply. However, the flood risk summary below will be useful for any sites that may change their land use (e.g. from employment to housing) or for future windfall sites.

8.4.1.4 This assessment has been based on strategic sites. **If more vulnerable uses are proposed then the Exception Test will be required where the site falls within Flood Zone 3**. An assessment of the need for the Exception Test where the SHLAA data indicates that there may be alternative land uses and/ or further sites has been undertaken in Chapter 9.

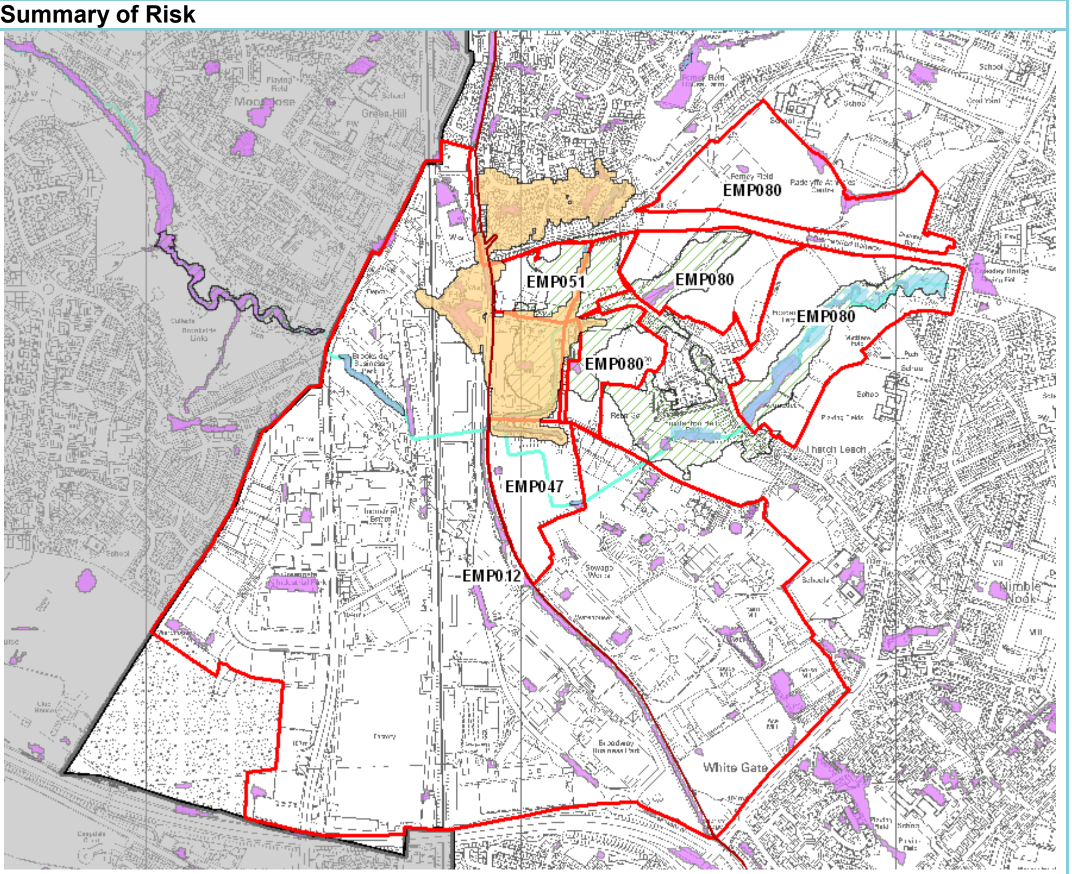
Chadderton

8.4.1.5 A summary of the actual level of flood risk for the Chadderton community is summarised in the table below.

Table 8-1: Risk of Flooding in Chadderton

Community	Chadderton				
Catchment	Irk				
Primary Source of Flood Risk	Rochdale Canal, Wince Brook				
Secondary Sources of Flood Risk	Surface water				
Development Sites (ref)	**Environment Agency Flood Maps**				
	Total area (km^2)	**Flood Zone 1 (%)**	**Flood Zone 2 (%)**	**Flood Zone 3a (%)**	**Flood Zone 3b (%)**
Foxdenton Strategic Site (EMP080)	0.42	94.96	0.96	0.51	3.57
Land at Junction Mill (EMP051)	0.06	95.01	1.09	1.02	2.88
Causeway North (EMP047)	0.07	98.00	0.29	0.13	1.58
Greengate / Broadgate PEZ (EMP012)	1.85	99.54	0.05	0.03	0.38

Summary of Risk



- Wince Brook 1 in 1000 year flood extent
- Culvert blockage scenario (80%) for 1 in 100 plus climate change event
- Rochdale Canal Hazard Zone (breach)
- Refined surface water map - intermediate susceptibility

Understanding Actual Risk	**Comment (Yes / No)**
Are the development sites in the area at significant risk during a 1 in 100 year event?	No
Is there a consistent asset standard of protection? (asset includes culverts and canals)	No
Is there a consistent asset condition?	No
Is there a possibility of assets breaching?	Yes - canal
Could assets overtop during climate change or extreme events?	Yes - canal
Is overall residual risk significant in the area?	Yes
Is surface water flooding an issue?	Yes
Is flood risk a significant environmental issues/constraint?	No
Is the area at significant risk during a 1 in 1000 year event?	No
Managing Flood Risk	
Does development need to be considered strategically?	Yes - to minimise downstream impacts
Can development proceed in a piecemeal basis?	No
Flood Risk Management Strategy required?	No
Is floodplain compensation required?	No
Can the loss of floodplain be compensated within site?	No
Likelihood of passing Exception Test	
Will there be off site effects?	Yes, increased runoff
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

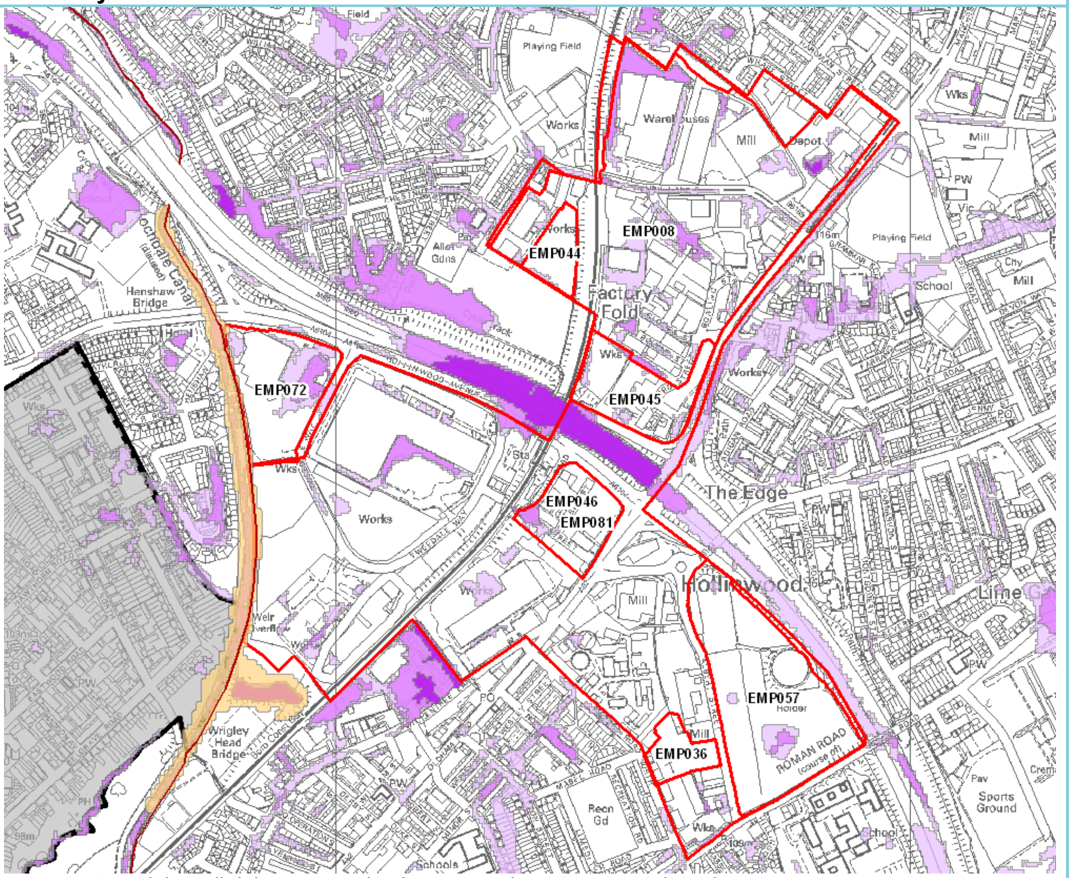
Hollinwood

8.4.1.6 A summary of the actual level of flood risk for the Hollinwood community is summarised in the table below.

Table 8-2: Risk of Flooding in Hollinwood

Community	Hollinwood				
Catchment	Irk				
Primary Source of Flood Risk	Rochdale Canal				
Secondary Sources of Flood Risk	Surface water				
Development Sites (ref)	**Environment Agency Flood Maps**				
	Total area (km^2)	**Flood Zone 1 (%)**	**Flood Zone 2 (%)**	**Flood Zone 3a (%)**	**Flood Zone 3b (%)**
Hollinwood Junction Masterplan Strategic Site (EMP081)	0.69	100.00	0.00	0.00	0.00
Hollinwood North Primary Employment Zone (EMP008)	0.21	100.00	0.00	0.00	0.00
Sellers Way (EMP044)	>0.01	100.00	0.00	0.00	0.00
Sefton Street (EMP045)	0.02	100.00	0.00	0.00	0.00
Stable Street (EMP046)	0.02	100.00	0.00	0.00	0.00
Mersey Road North (EMP036)	>0.01	100.00	0.00	0.00	0.00
Albert Street (EMP057)	0.07	100.00	0.00	0.00	0.00
Morrisons Supermarket, Hollinwood Avenue (EMP072)	0.03	100.00	0.00	0.00	0.00

Summary of Risk



	Rochdale Canal Hazard Zone (breach)
	Refined surface water map - less susceptible
	Refined surface water map - intermediate susceptibility
	Refined surface water map - more susceptible

Understanding Actual Risk	**Comment (Yes / No)**
Are the development sites in the area at significant risk during a 1 in 100 year event?	No
Is there a consistent asset standard of protection? (asset includes culverts and canals)	No
Is there a consistent asset condition?	No
Is there a possibility of assets breaching?	Yes - canal
Could assets overtop during climate change or extreme events?	Yes - canal
Is overall residual risk significant in the area?	Yes, from canals
Is surface water flooding an issue?	Yes
Is flood risk a significant environmental issues/constraint?	No
Is the area at significant risk during a 1 in 1000 year event?	No
Managing Flood Risk	
Does development need to be considered strategically?	Yes - to minimise downstream impacts
Can development proceed in a piecemeal basis?	No
Flood Risk Management Strategy required?	No
Is floodplain compensation required?	No

Understanding Actual Risk	**Comment (Yes / No)**
Can the loss of floodplain be compensated within site?	No
Likelihood of passing Exception Test	
Will there be off site effects?	Yes, increased runoff
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

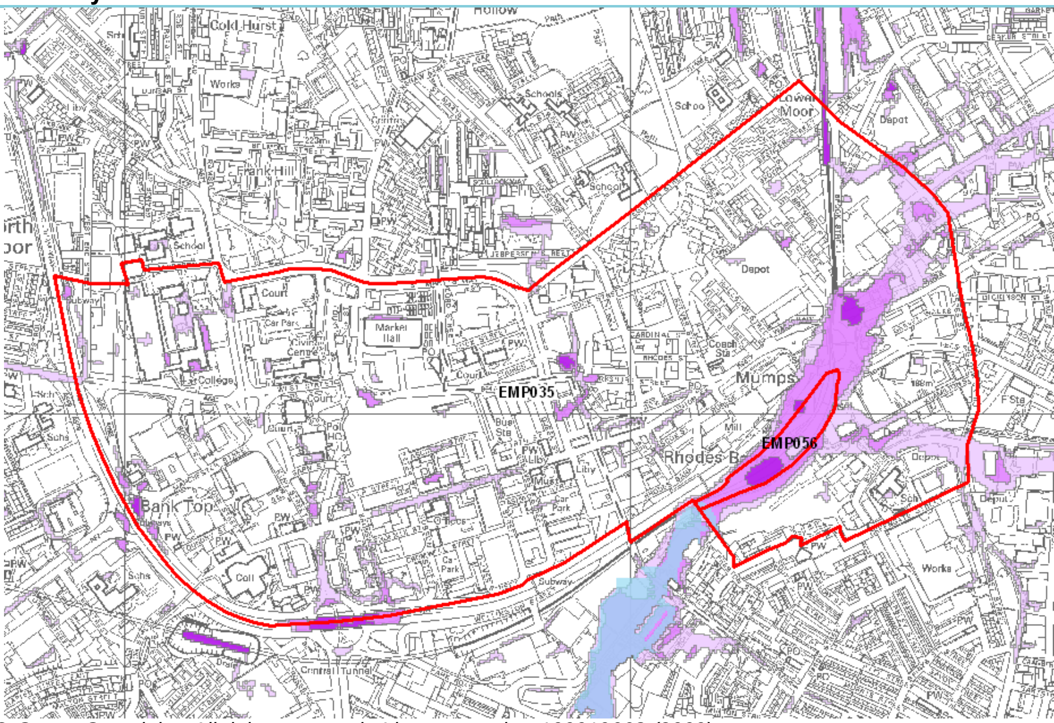
Oldham Town Centre

8.4.1.7 A summary of the actual level of flood risk for the Oldham Town Centre community is summarised in the table below.

Table 8-3: Risk of Flooding in Oldham Town Centre

Community	Oldham				
Catchment	Irk and Medlock				
Primary Source of Flood Risk	Surface water				
Secondary Sources of Flood Risk	Snipe Clough				
Development Sites (ref)	**Environment Agency Flood Maps**				
	Total area (km^2)	**Flood Zone 1 (%)**	**Flood Zone 2 (%)**	**Flood Zone 3a (%)**	**Flood Zone 3b (%)**
Oldham Town Centre (EMP035)	1.17	99.92	0.08	0.00	0.00
Oldham Way Business & Industry site (EMP056).	0.02	98.52	1.48	0.00	0.00

Summary of Risk



- Snipe Clough 1 in 1000 year flood extent
- Refined surface water map - less susceptible
- Refined surface water map - intermediate susceptibility
- Refined surface water map - more susceptible

Understanding Actual Risk	**Comment (Yes / No)**
Are the development sites in the area at significant risk during a 1 in 100 year event?	No
Is there a consistent asset standard of protection? (asset includes culverts)	No
Is there a consistent asset condition?	No

Is there a possibility of assets breaching?	No
Could assets overtop during climate change or extreme events?	No
Is overall residual risk significant in the area?	No
Is surface water flooding an issue?	Yes, within specific sites in the natural valley of the Snipe Clough as shown by the refined surface water mapping
Is flood risk a significant environmental issues/constraint?	No
Is the area at significant risk during a 1 in 1000 year event?	Yes, Snipe Clough culvert
Managing Flood Risk	
Does development need to be considered strategically?	Yes - to minimise downstream impacts
Can development proceed in a piecemeal basis?	No
Flood Risk Management Strategy required?	No
Is floodplain compensation required?	No
Can the loss of floodplain be compensated within site?	No
Likelihood of passing Exception Test	
Will there be off site effects?	Yes, increased runoff
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

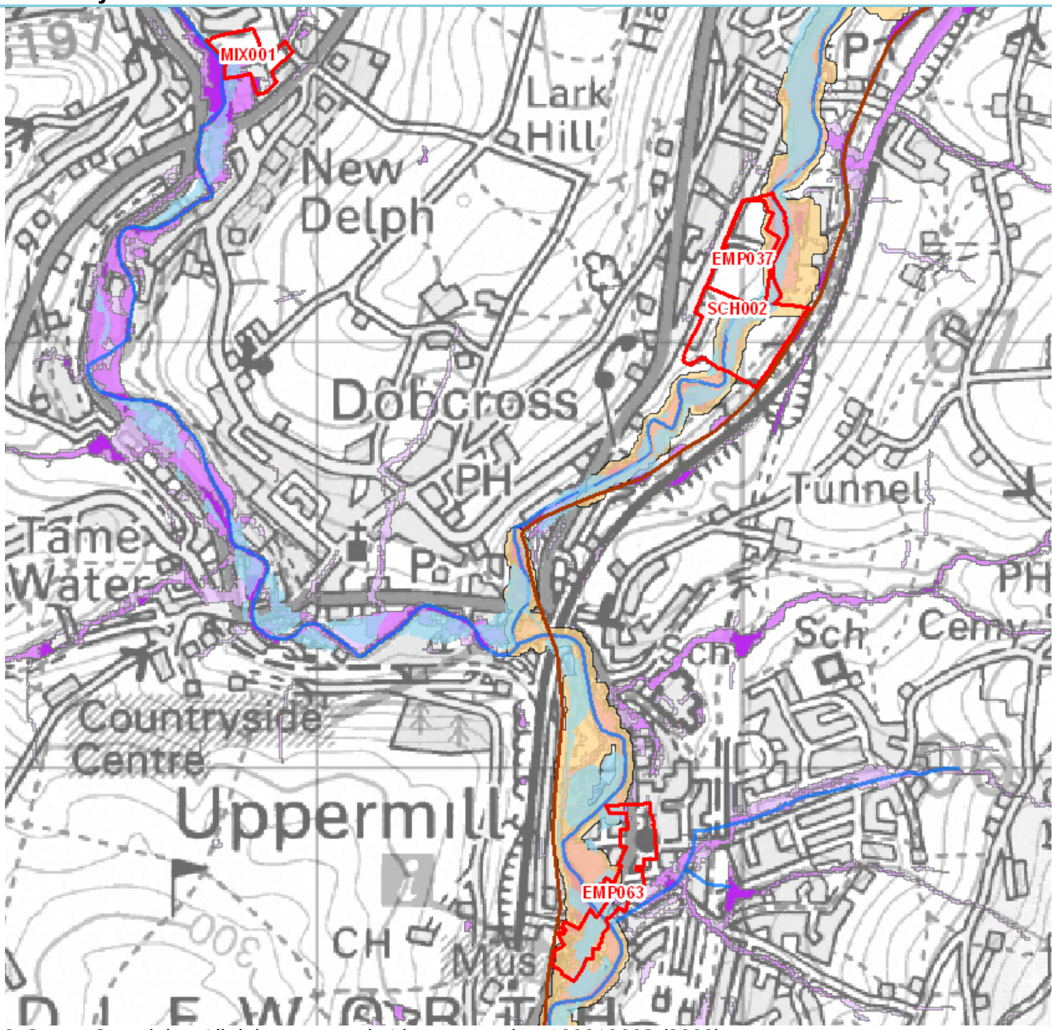
Saddleworth

8.4.1.8 A summary of the actual level of flood risk for the Saddleworth community is summarised in the table below.

Table 8-4: Risk of Flooding in Saddleworth

Community	Saddleworth				
Catchment	Tame				
Primary Source of Flood Risk	Tame, surface water				
Secondary Sources of Flood Risk	Huddersfield Narrow Canal				
Development Sites (ref)	**Environment Agency Flood Maps**				
	Total area (km^2)	**Flood Zone 1 (%)**	**Flood Zone 2 (%)**	**Flood Zone 3a (%)**	**Flood Zone 3b (%)**
Diggle School (SCH002)	0.05	78.63	15.90	1.52	3.95
Huddersfield Road, Diggle (EMP037)	0.03	96.19	3.80	0.01	0.00
Lumb Mill, Delph (MIX001)	0.01	82.13	17.64	0.21	0.02
Uppermill District Centre (EMP063)	0.03	73.75	22.86	2.28	1.11

Summary of Risk



- Rochdale Canal Hazard Zone (breach)
- Refined surface water map - less susceptible
- Refined surface water map - intermediate susceptibility
- Refined surface water map - more susceptible
- 1 in 1000 year flood extent

Understanding Actual Risk	Comment (Yes / No)
Are the development sites in the area at significant risk during a 1 in 100 year event?	Yes
Is there a consistent asset standard of protection? (asset includes defences and canals)	No
Is there a consistent asset condition?	No
Is there a possibility of assets breaching?	Yes
Could assets overtop during climate change or extreme events?	Yes
Is overall residual risk significant in the area?	Yes
Is surface water flooding an issue?	Yes
Is flood risk a significant environmental issues/constraint?	Yes
Is the area at significant risk during a 1 in 1000 year event?	Yes

Understanding Actual Risk	Comment (Yes / No)
Managing Flood Risk	
Does development need to be considered strategically?	Yes - to minimise downstream impacts
Can development proceed in a piecemeal basis?	No
Flood Risk Management Strategy required?	No
Is floodplain compensation required?	No
Can the loss of floodplain be compensated within site?	No
Likelihood of passing Exception Test	
Will there be off site effects?	Yes, increased runoff
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

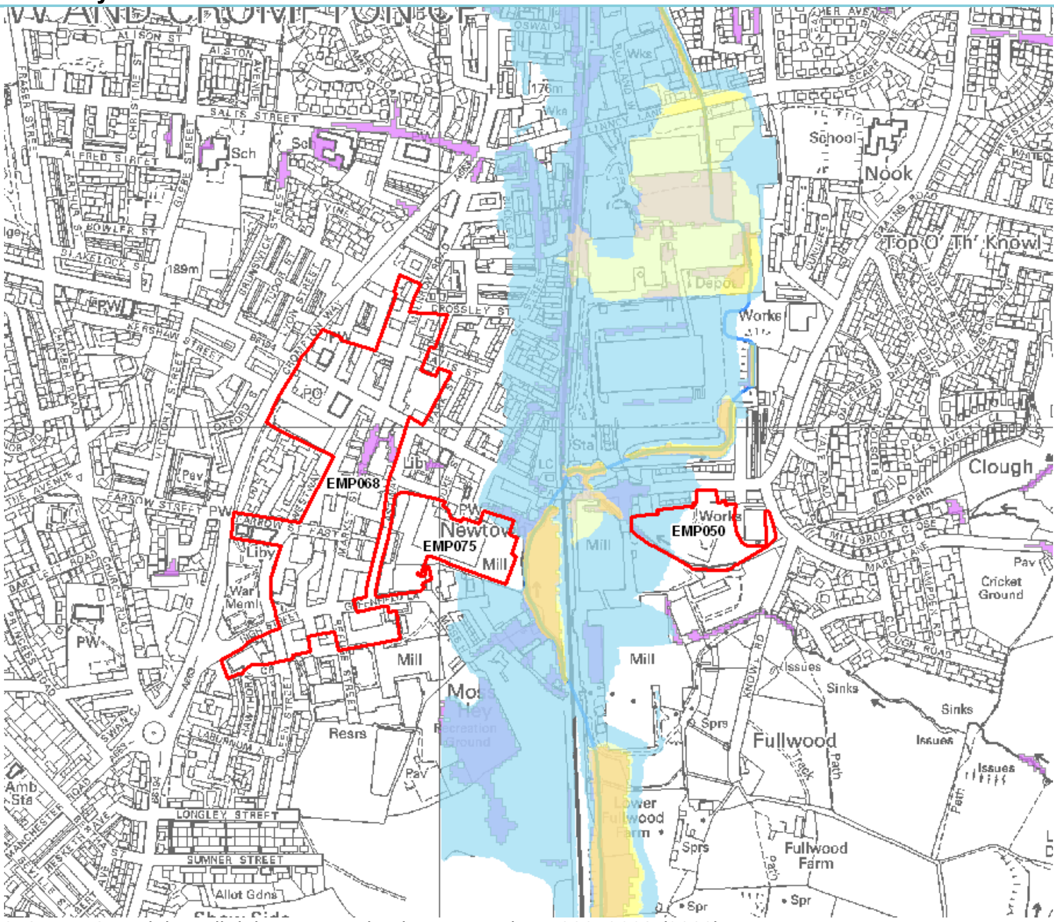
Shaw

8.4.1.9 A summary of the actual level of flood risk for the Shaw community is summarised in the table below.

Table 8-5: Risk of Flooding in Shaw

Community	Shaw				
Catchment	Beal				
Primary Source of Flood Risk	River Beal				
Secondary Sources of Flood Risk	Surface water				
Development Sites (ref)	**Environment Agency Flood Maps**				
	Total area (km^2)	**Flood Zone 1 (%)**	**Flood Zone 2 (%)**	**Flood Zone 3a (%)**	**Flood Zone 3b (%)**
Shaw District Centre (EMP068)	0.07	100.00	0.00	0.00	0.00
Beal Lane, Shaw (EMP050)	0.01	74.46	25.54	0.00	0.00
Asda Stores, Shaw (EMP075)	0.02	97.42	2.58	0.00	0.00

Summary of Risk



- Flood Zone 3b
- Flood Zone 3a
- Flood Zone 2
- Refined surface water map - intermediate susceptible

Note - where the surface water maps and flood zones overlap the colours may conflict

Understanding Actual Risk	**Comment (Yes / No)**
Are the development sites in the area at significant risk during a 1 in 100 year event?	No
Is there a consistent asset standard of protection? (asset includes defences and culverts)	No
Is there a consistent asset condition?	No
Is there a possibility of assets breaching?	Yes
Could assets overtop during climate change or extreme events?	Yes
Is overall residual risk significant in the area?	No
Is surface water flooding an issue?	Yes
Is flood risk a significant environmental issues/constraint?	Yes
Is the area at significant risk during a 1 in 1000 year event?	Yes
Managing Flood Risk	
Does development need to be considered strategically?	No

Understanding Actual Risk	**Comment (Yes / 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?	No
Likelihood of passing Exception Test	
Will there be off site effects?	Yes, increased runoff
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

9 Outline Mitigation Strategy

Chapter 9 proposes an outline mitigation strategy by highlighting the mitigation measures that should be considered in accordance with PPS25.

9.1 Introduction

9.1.1.1 A mitigation approach for each of the key communities is presented below. Recommendations and flood risk management requirements in line with PPS25 guidelines have been proposed. Section 9.5 discusses the range of planning considerations and mitigation strategies available. Their suitability has been summarised in Table 9-1. In addition, a "flood risk balance sheet" (Table 9-2) has been prepared, which is designed to facilitate the Exception Test and demonstrate the acceptability and soundness of the proposed development sites.

9.2 Chadderton

9.2.1.1 The Chadderton community includes a number of development sites proposed for employment uses. The actual level of fluvial flood risk to the sites is low. However, there is residual risk from the Rochdale Canal. If any of the employment sites within Flood Zone 3 (adjacent to Wince and Springs Brooks as shown in SFRA modelled 1 in 100 year flood extent) are re-allocated for housing use (SHLAA sites) then the Exception Test will be required. The User Guide (Volume I) outlines the Exception Test in greater detail.

9.2.1.2 The fluvial risk from Wince Brook is low due to the large capacity of Wince Brook culvert. However, there is residual risk in the event of the culvert becoming blocked by debris or fly tipping. The site specific FRA should consider this residual risk and carry out a detailed survey of the culvert to confirm the standard of protection and maintenance requirements.

9.2.1.3 The culverts across these sites will require further consideration as the Environment Agency generally recommend that culverts are opened up (de-culverted), where possible, to reduce the risk of flooding (due to blockages), for easy access and maintenance and to enhance the biodiversity value of the site. Alternatively, continued culvert inspection and maintenance by the Environment Agency would ensure this risk is well managed. When de-culverting is not practicable, a full 8 metre easement is required on either side (as this is a Main River) to allow access for maintenance or repair.

9.2.1.4 The Rochdale Canal passes through the proposed sites. The Greengate PEZ (EMP012), Causeway North (EMP047), Land at Junction Mill (EMP051) and the Foxdenton Strategic Site (EMP080) are within the Canal Hazard Zone. Subject to the findings of more detailed Flood Risk Assessments, these development sites should manage this residual risk by appropriate access, egress, emergency planning procedures and finished floor levels which incorporate a freeboard allowance for the risk from the Rochdale Canal.

9.2.1.5 A secondary source of flooding is from surface water. As this community is comprised of a significant area of brownfield land, retaining as much surface water as possible would be beneficial locally and downstream. 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 and not discharge into the combined sewer system. This area lies within the Chadderton/ Wince Brook Critical Drainage Area (CDA) and managing surface water discharges from development and exceedance flows is critical. Developers should follow the guidance for developers on these issues in the SFRA User Guide.

9.3 Hollinwood

9.3.1.1 The Hollinwood community includes a number of development sites proposed for employment uses. All of the proposed sites fall within Flood Zone 1 and therefore the risk of flooding is low. However, there is a residual risk from the Rochdale Canal. Since all of the sites are within Flood Zone 1 then if employment sites are re-allocated for housing use (SHLAA sites) the Exception Test will not be required.

9.3.1.2 The Rochdale Canal passes along the western boundary of the Hollinwood Junction Masterplan Strategic Site (EMP081). Only the edge of this site and the Morrisons Supermarket site (EMP072) are within the Canal Hazard Zone. Subject to the findings of more detailed Flood Risk Assessments, these development sites should manage this residual risk by appropriate access, egress, emergency planning procedures and finished floor levels which incorporate a freeboard allowance for the risk from the Rochdale Canal.

9.3.1.3 A secondary source of flooding is from surface water. As this community is comprised of a significant area of brownfield land, retaining as much surface water as possible would be beneficial locally and downstream. 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 and not discharge into the combined sewer system. This area lies within the Hollinwood/ Moston Brook CDA and managing surface water discharges from development and exceedance flows is critical. Developers should follow the guidance for developers on these issues in the SFRA User Guide.

9.4 Oldham Town Centre

9.4.1.1 The Oldham Town Centre (EMP035) is intended for employment uses. The majority of the site falls within Flood Zone 1, although a small part of the site and Oldham Way Business & Industry site (EMP056) could be affected by the 1 in 1000 year event if Snipe Clough culvert surcharges. If any of the employment sites within Flood Zone 3 (flooding from the Snipe Clough) are re-allocated for housing use (SHLAA sites) then the Exception Test will be required. This applies to sites HOU407 and HOU408 on review of the current Environment Agency Flood Zones, although the revised SFRA analysis for Snipe Clough suggests that these sites would only be at risk in a 1 in 1000 year event if Snipe Clough culvert surcharges.

9.4.1.2 The primary source of flooding is from surface water. The area at greatest risk is the lower lying land following the route of Snipe Clough culvert and also the railway line to Oldham Mumps. As this community is comprised of brownfield land, retaining as much surface water as possible would be beneficial both locally and downstream. 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 and not discharge into the combined sewer system. Part of this area lies within the Chadderton/ Wince Brook CDA and managing surface water discharges from development and exceedance flows is critical. Developers should follow the guidance for developers on these issues in the SFRA User Guide.

9.5 Saddleworth

9.5.1.1 Part of the Diggle School (SCH002) and Lumb Mill Mixed Use Development site (MIX001) fall within Flood Zone 3. Therefore, the Exception Test needs to be undertaken. As the Uppermill District Centre (EMP063) is intended for employment uses, the site does not need to undergo the Exception Test. However, a site specific FRA must prove that the development will be safe from flooding. If any of the employment sites within Flood Zone 3 (adjacent to the River Tame and its tributaries) are re-allocated for housing use (SHLAA sites) then the Exception Test will be required. The User Guide (Volume I) outlines the Exception Test in greater detail.

9.5.1.2 The Diggle Brook flows through the Diggle School site; however, the risk from this small watercourse is estimated to be low. The sequential approach to development layout should be applied within the site so that the most vulnerable development is located away from the watercourse. Flood depths are predicted to be shallow and flood hazard is considered to be low. Where flood depths are up to 0.6m, this risk can be managed by appropriate access, egress, flood warning and emergency planning procedures.

9.5.1.3 Whilst the actual risk to Diggle School from Diggle Brook is low, the residual risk from the Huddersfield Canal is more significant, as it lies on higher ground to the east of the site. This residual risk could potentially cause the greater flood hazard to the school, which is in the Canal Hazard Zone. Subject to the findings of more detailed Flood Risk Assessments, these development sites should manage this residual risk by appropriate access, egress, emergency planning procedures and finished floor levels which incorporate a freeboard allowance for the risk from the canal.

9.5.1.4 The sequential approach should be applied to the Lumb Mill mixed use site so that the more vulnerable development (e.g. housing) is located away from the River Tame. Flood depths are predicted to be shallow (see Map 1.5 (A to G) in Level 1 SFRA). Where flood depths are up to 0.6m, this risk can be managed by appropriate access, egress, flood warning and emergency planning procedures.

9.5.1.5 The Uppermill District Centre covers a large area across Uppermill and includes the High Street Bridge across the River Tame. The primary risk to this site is from surface water rather than fluvial flooding. The Saddleworth community, including Uppermill, has experienced several past flooding incidences, the most recent being in June 2009. The source of flooding was primarily from excess surface water rather than the River Tame overtopping. Therefore, it is important to consider the most effective means of managing surface water in this community. A SWMP would help to identify the flood "hotspots" and a strategic approach to reducing this risk.

9.5.1.6 All 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 and not discharge into the combined sewer system. This area lies within the East Oldham/ Wood Brook - Upper Tame CDA and managing surface water discharges from development and exceedance flows is critical. Developers should follow the guidance for developers on these issues in the SFRA User Guide.

9.5.1.7 The Huddersfield Narrow Canal follows the course of the River Tame and there is a potential residual risk from canal breach. Subject to the findings of more detailed Flood Risk Assessments, this residual risk should be managed to future development by appropriate access, egress, emergency planning procedures and finished floor levels which incorporate a freeboard allowance for the risk from the canal.

9.6 Shaw

9.6.1.1 The key development sites in the Shaw community are intended for employment use. Fluvial food risk is low as only the Shaw District Centre (EMP068) and Beal Lane site (EMP050) fall within Flood Zone 2.

9.6.1.2 A review of the SHLAA sites shows that two sites upstream of Shaw are within Flood Zone 3 (HOU203 Bullcote Lane and HOU217 Royton Moss). The Exception Test will be required for these sites. Flooding in a 1 in 100 year event is not likely to significantly affect housing sites in Shaw itself.

9.6.1.3 The main sources of flooding in Shaw are surface water and fluvial flooding from the River Beal. No detailed modelling of the River Beal was undertaken in this area as fluvial risk is already relatively well understood and there is limited residual risk associated with flood defences.

9.6.1.4 There is the potential for future development to impact on river flows along the Beal and the Roch if surface water discharges are not controlled from development sites. As a worst case, this could be an increase in the order of 0.04m on peak water levels in Rochdale. However, this is seen as unlikely and it is expected that a reduction in peak water levels of around 0.03m may be achieved in Rochdale with the implementation of sustainable drainage techniques for new development. The impact of development on flows further downstream in Bury would be reduced, with minimal impacts in Salford.

9.6.1.5 All 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 and not discharge into the combined sewer system. This area lies within the Shaw/ Beal CDA and managing surface water discharges from development and exceedance flows is critical. Developers should follow the guidance for developers on these issues in the SFRA User Guide.

9.7 Planning considerations

9.7.1 Site layout and design

9.7.1.1 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.

9.7.1.2 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.

9.7.1.3 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.

9.7.2 Modification of ground levels

9.7.2.1 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.

9.7.2.2 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 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.

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

9.7.3 Local flood storage

9.7.3.1 Where development reduces the volume of floodplain storage it will be necessary to provide compensatory storage locally. This could be an environmental wetland area, designated washland (designed to flood) or a flood basin. This can also be considered within urban design if areas are designated to flood in a flood event (e.g. ground floor of a development with residential on first floor).

9.7.3.2 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.

9.7.3.3 The need for compensatory storage must been discussed at the earliest stage of planning as this will be a major constraint as this requirement may have significant implications for the yields achieved for individual sites due to the associated land take this may require.

9.7.4 Raised defences

9.7.4.1 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.

9.7.4.2 Temporary or demountable defences are not acceptable flood protection for a new development unless flood risk is residual only.

9.7.5 Temporary barriers

9.7.5.1 Temporary barriers consist of moveable flood defences which can be fitted into doorways and/or 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.

9.7.6 Permanent barriers

9.7.6.1 Permanent barriers can include built up doorsteps, rendered brick walls and toughened glass barriers.

9.7.7 Developer contributions to flood defences

9.7.7.1 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.

9.7.8 Building design

9.7.8.1 The raising of floor levels within a development avoids damage occurring to the interior, furnishings and electrics in times of flood. If it has been agreed with the Environment Agency that, in a particular instance, the raising of floor levels is acceptable, they should be raised to 600mm above the maximum water level during a 1 in 100 year flood event plus climate change. This additional height that the floor level is raised is referred to as the ‘freeboard’. The flood depth maps provide an indication of the scale of land raising that may be necessary.

9.7.8.2 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.

9.7.8.3 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.

9.7.9 Resistance and resilience

9.7.9.1 There may be instances where flood risk remains to a development. For example, where the use is water compatible, where an existing building is being changed, where residual risk remains behind defences, or where floor levels have been raised but there is still a risk in a 1 in 1000 year event. 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.

9.7.9.2 The 2007 document '*Improving the Flood Performance of New Buildings'* provides further details on possible resistance and resilience measures[11].

9.7.9.3 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

9.7.9.4 Resilience measures will be specific to the nature of flood risk, and as such will be informed and determined by the FRA.

9.7.10 Making development safe

Safe access and egress

9.7.10.1 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 with climate change.

9.7.10.2 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

9.7.10.3 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.

9.7.10.4 More information on flood plans for development is provided in Section 6 of the User Guide (Volume I).

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

9.8 Summary

9.8.1.1 Table 9-1 presents a summary of some of the potential mitigation measures for the key communities. The subsequent table (Table 9-2) provides a matrix (flood risk balancing sheet), which is designed to facilitate the Exception Test and demonstrate the acceptability and soundness of the proposed development sites.

Table 9-1: Suitability of Mitigation Measures

Mitigation measure	Key Communities				
	Chadderton	**Hollinwood**	**Oldham Town Centre**	**Saddleworth**	**Shaw**
Site layout and design	Yes	Yes	Yes	Yes	Yes
Modification of Ground Levels	Yes	Yes	No	Yes	Yes
Raised Defences	No	No	No	No	No
Temporary Barriers	No	No	No	No	No
Permanent barriers	No	No	No	No	No
Building Design	Yes	Yes	Yes	Yes	Yes
Resistance and Resilience	Yes	Yes	No	Yes	Yes
Local flood storage	No	No	No	No	No

Table 9-2: Flood Risk Balancing Sheet

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 the emergency planning impact?	Will there be a change in number of people at risk? After scheme (if known)	Will there be a change in number of properties at risk? After scheme (if known)	Will there be an impact of the mitigation measures elsewhere?
+ No risk - Risk area within resilient communities - - Vulnerable community, which would struggle to recover	+ + Benign, and understood - Risk is significant but understood - - Difficult to warn, unpredictable, may result in operational failure of defences, from multiple sources	++ None required + Measures could reduce risk to existing development - Standard, no major alteration to layout and form - - Flood resistance is dominant in design	+ No special provisions, safe - Needs to be managed, should be safe, must be proven in FRA - - Special provision, natural response will not be obvious. Safety not guaranteed, and may not convince LPA/EA when examined in detail	+ Reduction = Neutral impact - Increase	+ Reduction (preferable outcome in PPS25) = Neutral impact - Increase	+ Reduction = Neutral impact - Increase in flood risk elsewhere (Exception test requires no impact)

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Table 9-2: Flood Risk Balancing Sheet

OLDHAM 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
Policy area	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 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 there be an impact of the mitigation measures elsewhere?	Counter to strategic approach, flood risk unacceptable. Exception Test would be difficult to pass. Not recommended Sequentially not preferred, where limited land uses may be possible Sequentially not preferred but a range of land uses could be put forward after careful consideration and FRA Acceptable with some detailed consideration of flood risk issues Acceptable subject to FRA
Chadderton Community									
Foxdenton Strategic Site (EMP080)	Employment	-	-	-	-	=	-	+	Acceptable with some detailed consideration of flood risk issues
Land at Junction Mill (EMP051)	Employment	-	-	-	-	=	-	+	Acceptable with some detailed consideration of flood risk issues
Causeway North (EMP047)	Employment	-	-	-	-	=	-	+	Acceptable with some detailed consideration of flood risk issues
Greengate / Broadgate PEZ (EMP012)	Employment	-	-	-	-	=	-	+	Acceptable with some detailed consideration of flood risk issues
SHLAA Sites (HOU568, 569, 579, 580)	Housing	-	-	-	-	-	-	-	Sequentially not preferred but a range of land uses could be put forward after careful consideration and FRA
Hollinwood Community									
Hollinwood Junction Masterplan Strategic Site (EMP081)	Employment	-	-	-	-	=	-	+	Acceptable with some detailed consideration of flood risk issues
Hollinwood North PEZ (EMP008)	Employment	-	-	-	-	=	-	+	Acceptable with some detailed consideration of flood risk issues
Sellers Way (EMP044)	Employment	-	-	-	-	=	-	+	Acceptable with some detailed consideration of flood risk issues
Sefton Street (EMP045)	Employment	-	-	-	-	=	-	+	Acceptable with some detailed consideration of flood risk issues
Stable Street (EMP046)	Employment	-	-	-	-	=	-	+	Acceptable with some detailed consideration of flood risk issues
Mersey Road North (EMP036)	Employment	-	-	-	-	=	-	+	Acceptable with some detailed consideration of flood risk issues
Albert Street (EMP057)	Employment	-	-	-	-	=	-	+	Acceptable with some detailed consideration of flood risk issues

Morrisons Supermarket, Hollinwood Avenue (EMP072)	Employment	-	-	-	-	=	-	+	Acceptable with some detailed consideration of flood risk issues
Oldham Town Centre Community									
Oldham Town Centre (EMP035)	Employment	-	++	-	-	=	=	+	Acceptable subject to FRA
Oldham Way Business & Industry site (EMP056)	Employment	-	++	-	-	=	=	+	Acceptable subject to FRA
SHLAA Sites (HOU407, 408)	Housing	-	++	-	-	-	-	+	Acceptable with some detailed consideration of flood risk issues
Saddleworth Community									
Diggle School (SCH002)	School	- -	- -	- -	- -	-	-	-	Sequentially not preferred but a range of land uses could be put forward after careful consideration and FRA
Lumb Mill, Delph (MIX001)	Mixed	-	-	-	-	-	-	+	Acceptable with some detailed consideration of flood risk issues
Uppermill District Centre (EMP063)	Employment	-	-	-	-	=	-	+	Acceptable with some detailed consideration of flood risk issues
SHLAA Sites (HOU015, 055, 057, 058, 060, 065, 066, 114, 141, 148, 154, 829)	Housing	-	-	-	-	-	-	-	Sequentially not preferred but a range of land uses could be put forward after careful consideration and FRA
Shaw Community									
Shaw District Centre (EMP068)	Employment	-	++	-	-	=	=	+	Acceptable subject to FRA
Beal Lane, Shaw (EMP050)	Employment	-	-	-	-	=	-	+	Acceptable with some detailed consideration of flood risk issues
Asda Stores, Shaw (EMP075)	Employment	-	++	-	-	=	=	+	Acceptable subject to FRA
SHLAA Sites (HOU203, 217)	Housing	-	++	-	-	-	-	+	Acceptable with some detailed consideration of flood risk issues

Appendix

A . Maps

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Offices at

Atherstone
Doncaster
Edinburgh
Haywards Heath
Limerick
Newcastle upon Tyne
Northallerton
Northampton
Saltaire
Skipton
Tadcaster
Wallingford
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