Halton Borough Council
Preliminary Flood Risk Assessment Review
June 2017

Draft for Submission to Environment Agency 22 June 2017

Subject to Halton Borough Council Board Approvals:

- **Environment and Urban Renewal Policy and Performance Board - 28 June 2017**
- **Executive Board - 20 July 2017**

Executive Summary

This Preliminary Flood Risk Assessment has been prepared by Halton Borough Council as Lead Local Flood Authority (LLFA) in order to meet the duties to manage local flood risk and deliver the requirements of the Flood Risk Regulations (2009) and the Flood and Water Management Act (2010).

The production of the Preliminary Flood Risk Assessment (PFRA) is imposed by Sections 10-12 of the Flood Risk Regulations (2009) and it is the first step in the management of local flood risk. The PFRA process is aimed at providing a high level overview of flood risk from local flood sources through a review of historic flooding incidents and the predicted future extents of flooding, based on the outputs of computer models from both Halton Borough Council and the Environment Agency. Section 17 of the Flood Risk Regulations (2009) states subsequent reviews must be carried out at intervals of no more than 6 years. This document is the first review of the original PFRA published in June 2011.

In January 2017 the Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency (EA) replaced its guidance on significant risk for the identification of flood risk areas for Lead Local Flood Authorities (LLFAs) about the criteria for assessing and reviewing whether a risk of flooding is significant. The Regulations require LLFAs to determine whether any part or parts of their area face significant risk of flooding and to identify any such areas as Flood Risk Areas (FRAs). This was produced under regulation 14(3) of the Flood Risk Regulations 2009 (FRR), and replaced the previous guidance published in 2010. LLFAs are only required to do this in relation to local flood risks which include flooding from surface water, ground water and ordinary watercourses.

LLFAs do not need to consider risks of flooding from the sea, main rivers or reservoirs, except where these may affect flooding from another source. Flood hazard and risk maps and flood risk management plans must subsequently be prepared for the FRAs identified.

The purpose in reviewing the results lies with the determination of whether the level of flood risk is severe enough to be reported at both a European and National scale. DEFRA has identified that a FRA containing a cluster of over 30,000 people would be considered for significant European importance. Of the indicative FRAs that have been identified nationally, none are located within Halton Borough Council administrative area. Depending on the approach taken to EU exit, there may be potential to make changes to the FRR in the coming years. EU exit does not, however, alter the requirement for LLFAs to review preliminary assessment reports and FRAs by 22nd June 2017 as the UK will still be a full member of the EU at that point. Any proposals to refine the approach to mapping flood hazard and risk or preparing FRMPs will be consulted on later in the cycle.

It is the responsibility of the LLFA to decide what it considers as a historical flood with “significant harmful consequences” at a local level. Initially there was no specific guidance determining the national flooding importance level. Halton Borough Council have liaised with several neighbouring LLFAs in shaping and finalising this significance level. This has led to the formation of the Cheshire Mid-Mersey Partnership with the aim to identify and resolve flooding issues at both the Tactical and Strategic levels whilst adhering to best industrial practices.

Halton Borough Council has decided that a flood of “significant harmful consequences” would have one or more of the characteristics listed in table 1.

Table 1: Flood Event of Significant Harmful Consequences

Impact of flooding on:	Category	Consequence
Human Health	Number of individuals	≥ 200
Economic Activity	Number of critical services	≥ 2
	Number of residential properties	≥ 83
	Number of non-residential properties	≥ 20
	Principal Highway Network	Transport links impassable for more than 12+ hours.

A review of information on past flood incidents have been received from various stakeholders, both locally and nationally, which include water and sewerage companies, utility companies, the Canal & River Trust, the Emergency Services, and other Risk Management Authorities. There were several limitations associated with the stakeholder data. The main issues related to inconsistent and incomplete records, resulting in limited knowledge of flooding sources and the consequences of events. There have been no flooding events identified from local sources that have been deemed to have "significant consequences".

An analysis of data available on future flood risk has found that there could be flooding with adverse consequences as a result of surface water flooding. Modelling outputs provided by the Environment Agency indicate that up to 936 properties, 809 residential and 127 business, could be at risk from surface water flooding in a 1% (1 in 100) annual probability rainfall event. Therefore the scale of risk is not sufficient enough to be considered a FRA, reportable at a European Level. There is more detailed mapping that has been conducted as part of Halton Borough Council's Surface Water Management Plan, however it does not cover the whole of the administrative area.

During the investigation process into historic and future flood risk there have not been any flooding instances which need to be reported at either a National or European level. Furthermore, the surface water modelling undertaken by the Environment Agency indicates that there is potential to be a significant number of properties at risk in the future.

The information on flood risk gathered for this PFRA will be used for future steps to guide flood risk management in Halton Borough Council. The methodology for producing this PFRA has been based on the Environment Agency's Final PFRA Guidance and DEFRA's Guidance on selecting Flood Risk Areas, both published in January 2017. Section 17 of the Flood Risk Regulations (2009) states subsequent reviews must be carried out at intervals of no more than 6 years. This document is the first review of the original PFRA published in June 2011.

To progress Halton Borough Council's approach to flood risk management, including ongoing work post-PFRA submission, it will be designed to meet its objectives under the Flood Risk Regulations (2009) and the Flood and Water Management Act (2010) to:

- Continue to develop links with adjacent LLFAs and other bodies responsible for flood risk management;
- Utilise data collected to maintain a manageable GIS database, controlled centrally, for use on future development control queries, investigation, planning etc.;
- Provide assessments to identify the flood risk management prioritisations over the entire administrative area;
- Update the current Local Flood Risk Management Strategy;
- Continually update the Asset Register;
- Record, document and (where appropriate) investigate future floods.
- Require developers to give priority attention to the use Sustainable Urban Drainage Systems (SuDS), unless demonstrated to be inappropriate.

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Abbreviations

AOD: Above Ordinance Datum;

AStSWF: Areas Susceptible to Surface Water Flooding;

AStGwF: Areas Susceptible to Groundwater Flooding;

BGS: British Geological Survey;

BUA: Built-up Areas;

BUASD: Built-up Areas Sub-divisons;

CFMP: Catchment Flood Management Plan;

COW: Critical Ordinary Watercourse

DEFRA: Department for Environment, Food and Rural Affairs;

EA: Environment Agency;

EC: European Community;

EU: European Union;

FWMA: Flood and Water Management Act;

FRA: Flood Risk Area;

GIS: Geographical Information Systems;

IPCC: Intergovernmental Panel on Climate Change;

LGF: Local Government Forum;

LLFA: Lead Local Flood Authority;

NRD: National Receptor Dataset;

OEFRPG: Operational Emergency Flood Response Plan Groups;

OFWAT: Water Services Regulation Authority;

OS: Ordinance Survey;

PFRA: Preliminary Flood Risk Assessment;

RFCC: Regional Flood and Coastal Committee

RoFSW: Risk of Flooding from Surface Water

SFRA: Strategic Flood Risk Assessment;

SuDS: Sustainable Urban Drainage System;

SWMP: Surface Water Management Plan;

UKCP09: United Kingdom Climate Projections 2009;

uFMfSW: Updated Flood Map for Surface Water;

WAG: Welsh Assembly Government;

HBC: Halton Borough Council.

Environment Agency (Self-Assessment Form – January 2017)

The Environment Agency have produced and written a Self-Assessment Form (January 2017) and associated guidance for the LLFA with options for its delivery for the 2nd Edition Review. Halton Borough Council has rewritten the PFRA and is not adding an amendment to the existing PFRA (2011). To adhere to the requirements the following table is produced as a checklist.

PFRA report section			Activity for PFRA/FRA review	Response
1	Governance and partnership	1.1	Since publication of the PFRA in 2011, have there been any changes to, or creation of new, risk management authorities (RMAs) with responsibilities in the LLFA area?	New FWMA Schedule Enactment
		1.2	Are all roles and responsibilities for collecting and recording flood risk data and information clearly defined, including the respective roles and responsibilities of upper and lower tier authorities and other RMAs where relevant?	
2	Data systems and management	2.1	Do you have an up to date record of relevant sources of flood risk data and information for the LLFA area, including those held by other organisations?	EA modelling data has been revised and utilised since June 2011. Asset Register in place since June 2011. Modelling undertaken 2012.
		2.2	Have sources of 'locally agreed surface water information' been established and maintained for the LLFA area and agreed with relevant partners?	
		2.3	Are systems in place to collect, record and share data and information for the purpose of assessing flood risk in the LLFA area?	
		2.4	Are systems in place to assure the quality and security of data and information recorded for the purpose of assessing flood risk in the LLFA area?	
		2.5	Do you understand the condition and performance of the public, third party and private assets in your register in terms of flood risk?	
3	Past floods since Dec 2011 only) required for reporting to the European Commission	3.1	Have any flood events occurred since publication of the original PFRA report in December 2011 that have added to or changed your understanding of significant flood risk in the LLFA area? See the guidance document on which floods to report.	Updated records from flood events since the June 2011 Release.
		3.2	Has your current understanding of significant flood risk in the LLFA area changed as a result of the consequences of floods that have occurred since 2011? How?	
4	Future flood information Information on future floods is required for reporting to the European Commission	4.1	Have you created or received new information on potential future floods that has added to or changed your understanding of significant flood risk in the LLFA area since publication of your original PFRA report in 2011?	EA modelling data has been revised and utilised since June 2011. Ongoing investigations and data gathering.
		4.2	Have you created or received new information to improve the understanding of the future impact of climate change on flood risk in the LLFA area?	
		4.3	Have you created or received new information on long term developments to improve your understanding of flood risk in the LLFA area?	

PFRA report section			Activity for PFRA/FRA review	Response
		4.4	Has your understanding of flood risk in the LLFA area changed since 2011 as a result of new information on the potential consequences of future floods, the impact of climate change or long term developments? How?	
5	Identification of Flood Risk Areas for 2nd planning cycle Identified FRAs are required for reporting to the European Commission	5.1	Are the indicative FRAs an appropriate representation of significant surface water flood risk in your LLFA area?	Information within the PFRA 2017-23
		5.2	Do the consequences of flooding from other local sources, i.e. groundwater or ordinary watercourses, or from combined multiple sources, indicate any other areas of significant risk?	
		5.3	Has your PFRA review identified any other information which indicates other areas of significant risk?	
		5.4	On the basis of the national evidence provided and your review, do you agree with the indicative FRAs for your area?	
		5.5	On the basis of local evidence and your review, are you amending or identifying any additional FRAs for your area?	
6	Updating the original preliminary assessment	6.1	Have you completed an addendum to update your preliminary assessment report? Updates are required for reporting to the European Commission	Information within the PFRA 2017-23

1. Introduction

1.1 Background

Following extensive flooding across the United Kingdom in 2007, Sir Michael Pitt on behalf of the UK Government undertook a comprehensive review of the lessons to be learned from the floods and made a series of recommendations. The Pitt Review (2008) was the catalyst for Local Authorities and partner agencies to become more responsible for flood risk with many of the recommendations incorporated into the Flood and Water Management Act 2010 (FWMA 2010).

The FWMA 2010 identified a number of responsibilities, powers and duties to be executed in phases to help manage flood risk in a more holistic way. The FWMA 2010 defines a lead role for local authorities and designated Halton Borough Council a Lead Local Flood Authority (LLFA) responsible for the management of local sources of flooding such as surface water. An overview of these duties is provided in Section 3. The Environment Agency retained its role in managing flood risk from main rivers and coastal sources.
Alongside the Act, the EC Floods Directive (Directive 2007/60/EC) on the assessment and management of flood risk was transposed into domestic law in England and Wales under the European Communities Act 1972 via the Flood Risk Regulations 2009 (FRR 2009). The purpose of the EC Floods Directive is to establish a framework for assessing and managing flood risk across the European Community.

Halton Borough Council as a "Lead Local Flood Authority" (LLFA) has a duty to prepare a Preliminary Flood Risk Assessment (PFRA) in accordance with Part 2 of the FRR 2009 which sets out the requirements. Halton Borough Council published its original PFRA in June 2011 and subsequent reviews must be carried out at intervals of no more than 6 years. This document is the first revision of the original PFRA.

The PFRA (and any subsequent maps and plans) form part of the local flood risk management strategy that Halton Borough Council is required to prepare under the FWMA 2010.

1.2 Preliminary Flood Risk Assessments (PFRA)

The PFRA is a high level screening exercise to identify areas in which the risk of local flooding is significant and warrants further examination through the production of maps and management plans.

The Flood Risk Regulations (2009) provide a framework for managing flood risk over a 6 year cycle, comprising:

1. **Production of a Preliminary Flood Risk Assessment report;**
2. **Identification of Flood Risk Areas;**
3. **Production of appropriate Flood Hazard and Flood Risk Maps and,**
4. **Preparing Flood Risk Management Plans.**

This report marks the first of a four stage process. This document is the first revision of the original PFRA published in June 2011. The outcome of the review is to provide evidence for the identification of FRAs (Stage 2). The PFRA makes use of existing and available data, and focuses on local flood risk sources.

The identification of FRAs will establish whether or not the final two stages of preparing hazard and risk maps and flood risk management plans are required for the administrative area.

The local sources of flooding for the purposes of the PFRA are:

- **Groundwater** - Water that flows out from the ground due to high water tables locally or regionally;
- **Ordinary Watercourses** - Out of channel flows from small watercourses such as streams, brooks and drainage ditches that are not regarded to be Main River by the Environment Agency;
- **Surface runoff** - Water that flows over land following a heavy rainfall event, before it enters a natural watercourse or an artificial drainage network.

Note for the purpose of the PFRA the LLFA does not have to report on flood risk from Main Rivers and the sea, reservoirs and canals, except where these may affect flooding from another source. With the exception of canals flood risk is the responsibility of the Environment Agency. For canals, the primary responsibility for land drainage and flood prevention rests with private parties. The Rivers and Canals Trust do not have any specific statutory responsibilities (under FWMA 2010) in relation to flooding and, therefore, its responsibilities are those of an owner and operator of its canals and other waterways.

Table 2 indicates the work required to meet the requirements of the FRR. This PFRA aims to meet the review/revision element of the first two requirements.

Table 2: Elements of Work required under the Flood Risk Regulations, 2009.

Timescale for first edition	Assessment or Plan	Description	Timescale for first review / revision
22nd June 2011	Prepare **Preliminary Flood Risk Assessment** Report	The PFRA should focus on local flood risk arising from **surface water, groundwater, Ordinary Watercourses, and canals.**	22nd June 2017
22nd June 2011	On the basis of the PFRA, identify **Indicative FRAs**	Indicative Flood Risk Areas are a defined term, and are areas of nationally significant risk affecting 30,000 people or more. The PFRA is also required to record **"locally significant risk areas"** which are flood areas, above a locally determined threshold of affected people, and having significant harmful consequences.	22nd June 2017
22nd June 2013	Prepare **Flood Hazard Maps** and **Flood Risk Maps** for each FRA	The hazard and risk maps will show the **likely extent, depth, direction, speed of flow and probability** of possible floods and their **consequences**.	22nd June 2019
22nd June 2015	Prepare **Flood Risk Management Plans** for each FRA	The Flood Risk Management Plans will set out what the **risk management objectives** are, the measures proposed to achieve those objectives and how the measures are to be implemented.	22nd June 2021

The PFRA provides a useful source of reference for future local flood risk management strategies, informing the production of Flood Hazard and Flood Risk Maps (Stage 3), and contributing to the preparation of Future Flood Risk Management Plans (Stage 4).

1.3 UK Exit from the European Union

Depending on the approach taken to EU exit, there may be potential to make changes to the FRR in the coming years. EU exit does not, however, alter the requirement for LLFAs to review preliminary assessment reports and FRAs by 22nd June 2017 as the UK will still be a full member of the EU at that point. Any proposals to refine the approach to mapping flood hazard and risk or preparing FRMPs will be consulted on later in the cycle.

2. Aims and Objectives of the PFRA

2.1 Aims

The primary aim of this PFRA is to provide an assessment of potential local flood risk by applying a high level screening exercise across the administrative area of Halton Borough Council; hereby referred to as the study area.

The analysis uses existing and available information and is intended to reassess governance and partnership working, as well as information sharing within the adjacent LLFA areas, since the first publication of the report in June 2011 so that efficient flood risk management strategies are developed. This version of the PFRA will also provide assurance the Council's roles, responsibilities, and continual development under the FRR 2009 and FWMA 2010. The PRFA review is an opportunity to ensure those assessments are up to date and fit for purpose.

The risk of local flooding is defined as significant by European Standards for the PFRA if the flooding is affecting a cluster of more than 30,000 people. These local flooding risks are grouped in areas and are deemed Indicative FRAs. If these areas are found to exist within the Local Authority Boundary then they may warrant further examination at a later stage through the production of Flood Risk and Hazard maps and Flood Management plans.

2.2 Objectives

The objectives of this PFRA are to:

- Identify relevant partner organisations involved in future assessment of flood risk and summarise the means of future and ongoing stakeholder engagement.
- Describe arrangements for partnership and collaboration for ongoing collection, assessment and storage of flood risk data and information.
- Provide a summary of the systems used for data sharing and storing including provisions for quality assurance, security and data licensing arrangements.
- Summarise the methodology adopted for the PFRA with respect to data sources, availability and review procedures.
- Assess historic flood events within the study area from local sources of flooding (including flooding from surface water, groundwater and Ordinary Watercourses) and where possible, the consequences and impacts of these events.
- Establish an evidence base of historic flood risk information which will be built upon in the future and will to support and inform the preparation of Halton Borough Council Local Flood Risk Strategy.
- Assess the potential harmful consequences of future flood events within the study area.
- Review the provisional national assessment of indicative FRAs provided by the Environment Agency and provide an explanation and justification for any amendments required to the FRAs.

2.3 Halton Borough Council PFRA Study Area

The study area for Halton Borough Council PFRA is the administrative boundary of the Borough.

Halton covers some 90km² and is situated in the North West of England between Warrington and Liverpool. The latest population estimate, released by the Office for National Statistics (ONS) and based on the 2015 mid year population estimates, gives a population for the borough of 126,528. This is an increase of around 8,000 compared with the 2009 figure quoted in the previous PFRA 2011 report.

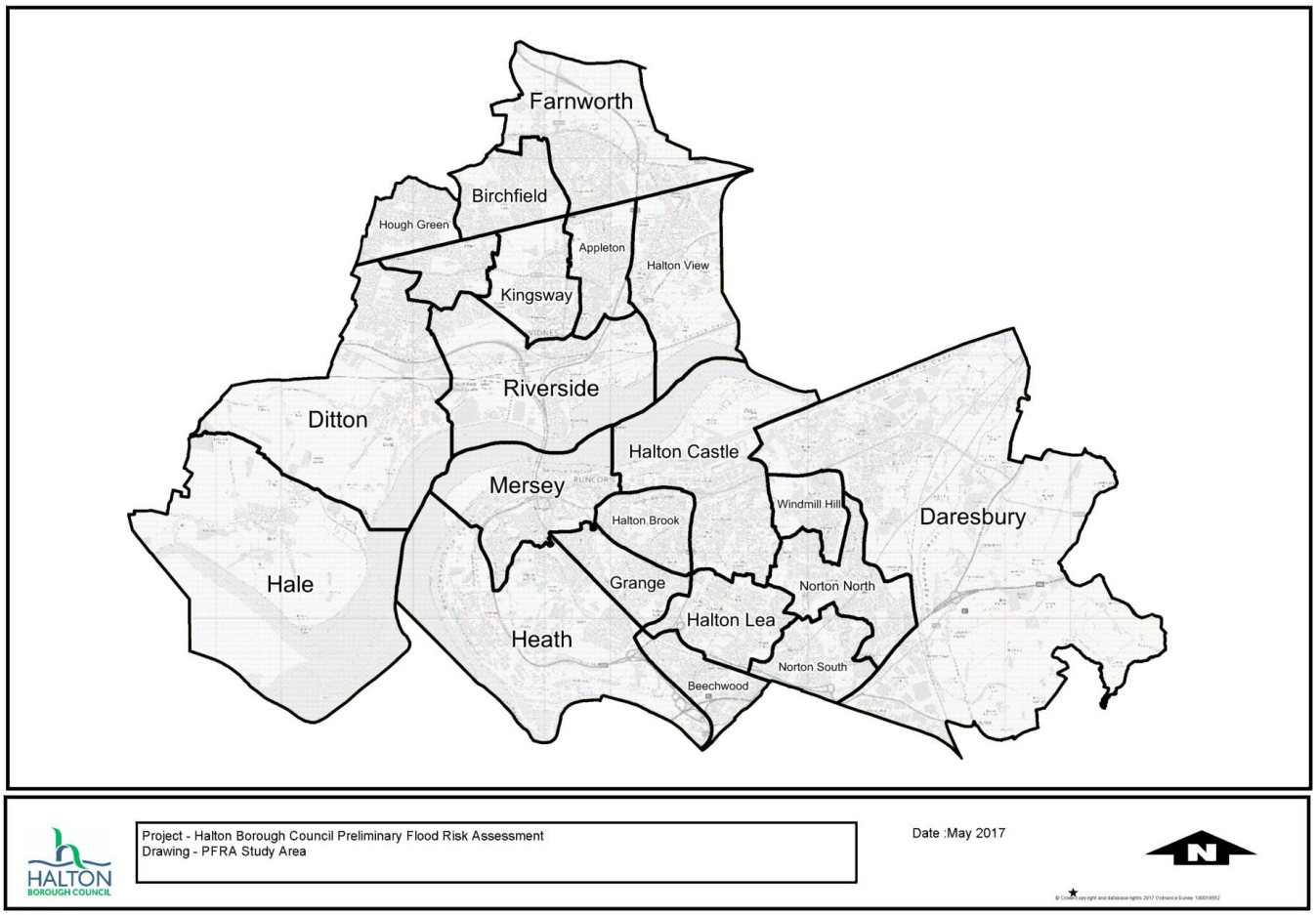
The study area of the PFRA covers the whole of Halton, from Barrow's Green in the north to Weston in the south, and the outskirts of Daresbury in the east to Hale in the west. It also includes a section of the Weaver Navigation. Two waterways, the tidal River Mersey and Manchester Ship Canal, divide the main urban area. In addition three large urban watercourses, Bowers, Ditton and Keckwick Brooks drain into the River Mersey. Responsibility for maintaining these Main Rivers rests with the Environment Agency.

There are two canals operated by subsidiary companies on behalf of Peel Ports Group within Halton, they are:

- Bridgewater Canal operated by the Bridgewater Canal Company Ltd,
- Manchester Ship Canal operated by Manchester Ship Canal Company Ltd.

Halton Borough Council owns and maintains parts of the Sankey Canal within the Halton Borough Council boundary.

Figure R1: PFRA Study Area



3. Lead Local Flood Authority (LLFA) Responsibilities

3.1 Introduction

The preparation of a PFRA is just one of several responsibilities of LLFAs under FRR 2009 and FWMA 2010. This section provides an overview of other responsibilities Halton Borough Council are obliged to fulfil under their role as a LLFA.

Table 3: Flood Risk Responsibilities

Level of Flood Risk	Organisation	Responsibilities
National Flood Risk	Environment Agency	Responsible for Main Rivers, the Sea and Reservoirs
Local Flood Risk	Lead Local Flood Authority	Responsible for Canals (where not in private ownership), Groundwater, Ordinary Watercourses, and Surface runoff The LLFA is the unitary authority for the area, or if there is no unitary authority, the county council.' Note for Canals - Peel Ports Group and the Rivers and Canals Trust do not have any specific statutory responsibilities (under FWMA 2010) in relation to flooding and, therefore, its responsibilities are those of an owner and operator of its canals and other waterways.
Local Flood Risk	Water Company (i.e. United Utilities)	Responsible for sewers except where it is wholly or partly caused by rainwater not entering the system. Floods or raw sewage caused by blocking of a sewer for example are not covered by the regulations, neither is flooding from burst water mains.

3.2 Co-ordination of Flood Risk Management

In his Review of the Summer 2007 flooding, Sir Michael Pitt stated that "the role of local authorities should be enhanced so that they take on responsibility for leading the coordination of flood risk management in their areas". As the designated LLFA, Halton Borough Council is therefore responsible for leading local flood risk management across the area.

Local knowledge and technical expertise necessary for Halton Borough Council to fulfil their duties as a LLFA lies with the Council and other partner organisations. It is therefore crucial that the Council work alongside these partners as they undertake their responsibilities to ensure effective and consistent management of local flood risk. Since the first publication of the PFRA in June 2011 a number of partnerships and working groups have been established across different organisations.

3.2.1 Stakeholder Engagement

As part of the PFRA process, Halton Borough Council as LLFA will continue to engage with stakeholders representing the following organisations and authorities:

- United Utilities;
- Environment Agency;
- Peel Ports Group (including the Manchester Ship Canal Company Ltd);
- Local Fire and Rescue Service;
- Local Police Service.

Data has also been collated internally within Halton Borough Council.

The Environment Agency, United Utilities and Halton Borough Council are all classed as Risk Management Authorities (RMAs). It is crucial that the Council continues to forge successful partnership RMAs to ensure effective coordination and management of flood risk across the area.

3.2.2 Other Lead Local Flood Authority (LLFA) Engagement

Due to the position of the study area being situated within the River Mersey Catchment, Halton Borough Council are in consultation with neighbouring Local Authorities.

Halton Borough Council is part of a sub-regional LLFA working group formed in 2010; the Cheshire and Mid-Mersey Flood Working Group. The group (hereby known was the Partnership) operates at both Tactical and Strategic levels.

The Risk Management Authorities (RMAs) of the Partnership are:

- Warrington Borough Council – Partnership Lead;
- Halton Borough Council;
- Cheshire East Council;
- Cheshire West and Chester Council;
- St Helens Borough Council;
- Staffordshire County Council;
- Environment Agency;
- United Utilities.

The Partnership has a critical role to play in managing the risk of flooding from all sources and in working with communities to help them become more resilient. It provides a forum to enable RMAs, other partners and communities, to identify how they can work together to deliver an improved and more effective and efficient flood risk management service.

The Operational Group

Engineers from Halton Council, United Utilities and Environment Agency meet on a quarterly basis or as required if flood events occur to discuss issues and scheme delivery. The Operational Level is where day-to-day Flood Risk Management activities take place.

The Tactical Group

Technical and operational leads/managers meet on a monthly basis to coordinate delivery, share skills and implement decisions made at the Strategic level. The Tactical Group is chaired by Warrington Borough Council and reports directly to the Strategic Group who are responsible for setting the overall strategic direction of the partnership.

The Strategic Group

Set the strategic direction for joint working and the management of flood risk across the Partnership. Elected Members and senior representatives from the RMAs meet each quarter. The meetings are timed to coincide with financial the planning cycle of the Regional Flood & Coastal Committee (RFCC).

Regional Flood & Coastal Committee (RFCC)

The RFCC for the North West region provides a local democratic role in the identification and management of flood and coastal erosion risk in order to ensure the purposeful and efficient spending of public money and other resources.

The RFCC works across with LLFAs, the Environment Agency and other RMAs to develop a mutual understanding of risk across its locality, and use this understanding to help develop plans to manage risk reflecting DEFRA's aims for flood and coastal erosion risk management. RFCC meetings are held each quarter, although there may be additional meetings at a sub-group level where local authorities are working together.

The RFCC provides a platform for frequent knowledge transfer with all Partnerships situated in the North West region. These are;

- Cheshire Mid-Mersey
- The Association of Greater Manchester Authorities (AGMA);
- Cumbria;
- Lancashire;
- Merseyside.

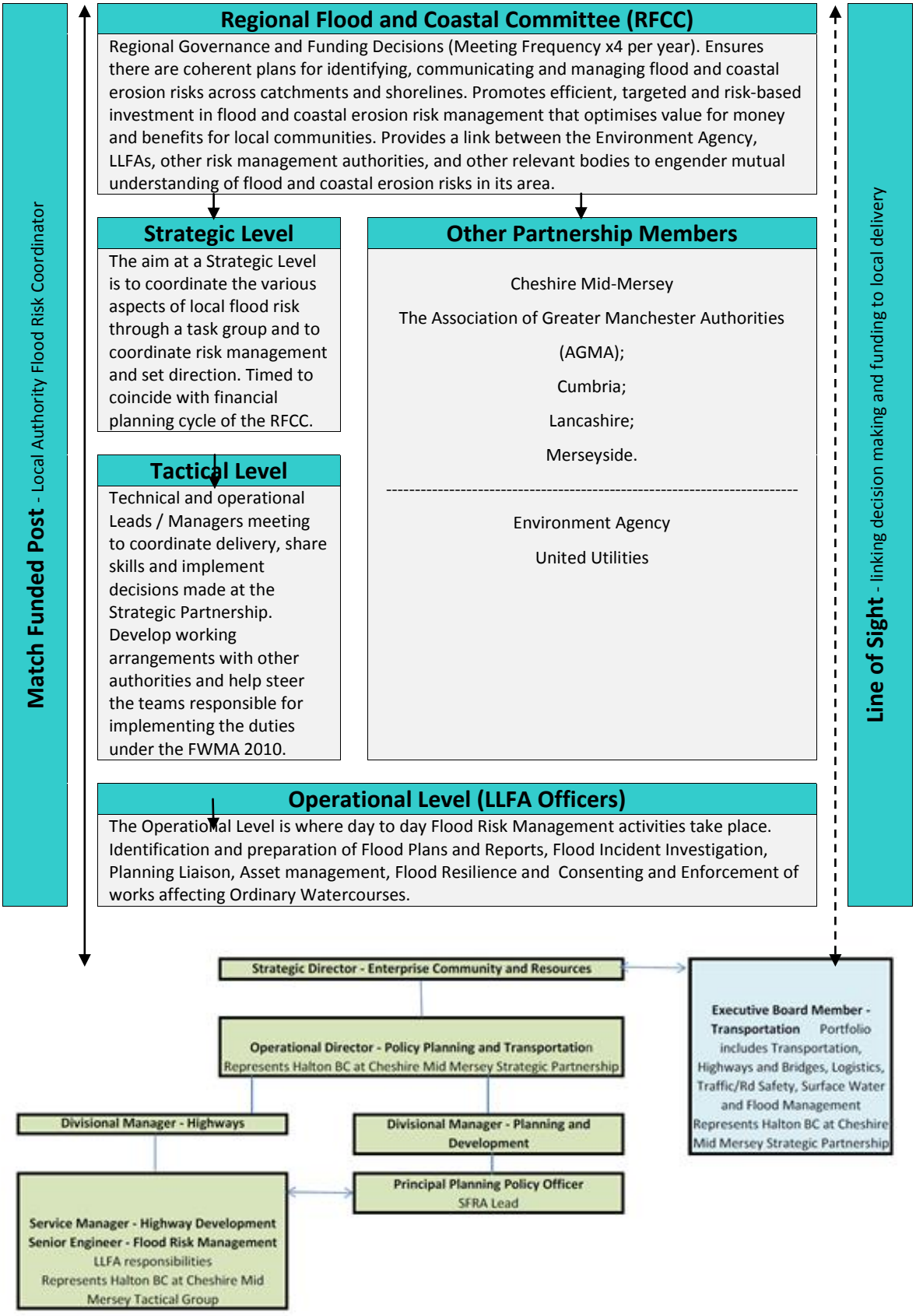


Figure R2: a) Cheshire Mid-Mersey Flood and Coastal Erosion Risk Management Partnership Structure & b) Governance & Structure within Halton Borough Council

3.2.3 Public Engagement

It is recognised that members of the public may also have valuable information to contribute to local flood risk management. The Environment Agency's 'Building Trust with Communities' (2005) document provided the basis for Halton Borough Council of how to communicate risk including the causes, probability and consequences to the general public and professional forums such as local resilience. The enforcement of FRR 2009 and FWMA 2010 into UK law accelerated the need for Council's to increase public engagement. This has brought significant benefits to local flood risk management including building trust, gaining access to additional local knowledge and increasing the chances of stakeholder acceptance of options and decisions proposed in future flood risk management plans.

3.3 Further Responsibilities

In addition to increasing partnership relations, coordinating, and leading on local flood management there are a number of other key responsibilities that have arisen for LLFAs since the introduction of the FRR 2009 and FWMA 2010. These responsibilities include:

- **Investigating flood incidents** – Section 19 of FWMA 2010 state LLFAs have a duty to investigate and record details of significant flood events within their area. This duty includes identifying which authorities have flood risk management functions and what they have done or intend to do with respect to the incident, notifying risk management authorities where necessary and publishing the results of any investigations carried out.

- **Asset Register** – Section 21 of FWMA 2010 state LLFAs have a duty to maintain a register of structures or features which, in the opinion of the authority, are likely to have a significant effect on a flood risk in its area, and a record of information about each of those structures or features, including information about ownership and state of repair. The register must be available for inspection and the Secretary of State will be able to make regulations about the content of the register and records.

- **Local Strategy for Flood Risk Management** – Under Section 9 of FWMA 2010 LLFAs are required to develop, maintain, apply and monitor a local strategy for flood risk management in its area. The local strategy will build upon information such as national risk assessments and will use consistent risk based approaches across different local authority areas and catchments. Halton's current Strategy was adopted in 2015, and is subject to ongoing review, with a full revision due in 2021 in line with the PFRA process.

- **Works powers** – LLFAs have powers to undertake works to manage flood risk from surface runoff and groundwater, consistent with the local flood risk management strategy for the area.

- **Designation powers** – Under Schedule 1 Section 30 of the FWMA 2010, LLFAs and the Environment Agency have powers to designate structures and features that affect flooding or coastal erosion in order to safeguard assets that are relied upon for flood or coastal erosion risk management.

- **Duty to Cooperate and Share information** – LLFAs, as well as other Flood Authorities (Environment Agency, Water Company, other LLFAs) have a duty to cooperate with each other, and also the power to request information, in connection with flooding, of any person or body.

- **Consenting changes to Ordinary Watercourses (Amendment to Land Drainage Act 1991: Sections 23, 24 and 25)** – 'Regulation' is the management of activities undertaken on watercourses. It involves granting consent for acceptable work to be carried out and taking enforcement action if work is unacceptable. If riparian owners wish to build a culvert/structure or make any alteration likely to affect the flow of an ordinary watercourse, land drainage consent is required from the Council as an LLFA.

Halton Borough Council have fully complied to the aforementioned responsibilities since the first publication of the PFRA and will continue to strengthen these for the period 2017 – 2023.

4. Methodology and Data Review

4.1 Introduction

The PFRA is a high-level screening exercise used to identify areas where the risk of flooding is considered to be significant and warrants further examination and management through the production of flood risk and flood hazard maps and flood risk management plans.

In January 2017 DEFRA replaced its guidance on significant risk for the identification of FRAs for LLFAs about the criteria for assessing and reviewing whether a risk of flooding is significant. This replaced the previous guidance published in 2010 (updated March 2011).

The PFRA involves:

- Collecting information on past (historic) and future (potential) floods.
- Assembling the information into a preliminary assessment report.
- Identifying FRAs.

4.1.1 Methodology

The following phased process has been undertaken in order to produce this report:

Table 4: Report Phases

Phase	Description
1	➢ Key partnership liaison - internal and external data collection ➢ Stakeholder partnership meetings
2	➢ Review and analysis of historic flood risk data ➢ Review and analysis of future flood risk data ➢ GIS mapping of data ➢ Draft report writing
3	➢ Review of indicative FRAs ➢ GIS mapping ➢ Draft report writing
4	➢ Internal draft report review from EA and internal Council staff ➢ Draft PFRA submitted to EA by 22nd June 2017 ➢ Council board approval

4.2 Phase 1 – Data Collection

4.2.1 Partner Organisations

The following authorities and organisations that were identified and contacted to share data for the preparation of the PFRA include:

- United Utilities;
- Environment Agency;
- Local Planning Authority;
- Emergency Services.

4.2.2 Critical Services

Within this PFRA critical services have been mentioned throughout. Critical services are defined by the EA as:

- Schools;
- Police Stations / Prisons;
- Nursing / Care / Retirement Homes;
- Fire Stations / Ambulance Stations / Hospitals;
- Electricity Installations / Sewage Treatment Works.

4.2.3 Data Collection

Table 7 catalogues the relevant information and datasets received from partner organisations and provides a description of each of the datasets that were obtained by Halton Borough Council.

The data is geo-referenced where possible. This has made it possible to display this information using GIS software and overlay layers to identify the spatial distribution of historic flood events and relate these datasets to receptor information, in order to assess the overall flood risk.

The majority of the data has been specifically provided for this PFRA study and is not publicly available due to data protection requirements, therefore there are restrictions on data use. Halton Borough Council must adhere to these data security measures. All data collected is stored on secured local servers, which are password protected.

Table 5 illustrates the restrictions on the use of this data.

Table 5: Summary of data restrictions and licensing details

Organisation	Restrictions on Use of Data
United Utilities	The use of provided data is restricted to Halton Borough Council and their partners for the preparation of its preliminary flood risk assessment
Environment Agency	The use of some data is restricted to Halton Borough Council and their consultants for the preparation of its preliminary flood risk assessment. The use of other data is unrestricted.

Table 6: Data Quality Assessment

Data Quality Score	Description	Explanations	Example
1	Best possible	No better available; not possible to improve in the near future	• High resolution LIDAR • River/sewer flow data • Rain gauge data
2	Data with known deficiencies	Best replaced as soon as new data are available	• Typical sewer or river model that is a few years old
3	Gross assumptions	Not invented but based on experience and judgement	• Location, extent and depth of much surface water flooding • Operation of un-modelled highway drainage • 'future risk' inputs e.g. rainfall, population
4	Heroic assumptions	An educated guess	• Ground roughness for 2D models

Table 7: Relevant Information and Datasets Description

Owner	Dataset	Description	Rating
Environment Agency	Risk of Flooding from Surface Water (RoFSW)	Published 2013 national surface flood map supersedes Areas Susceptible to Surface Water Flooding maps (2008) and Updated Flood Map for Surface Water (2010) Dataset provides banding for High, Medium and Low risk to depth and velocity. Dataset is updated annually.	2
	Flood Map (Rivers & Sea)	Shows the extent of flooding from rivers with a catchment of more than 3km^2 and from the sea.	2
	Areas Susceptible to Groundwater Flooding (AStGF)	1 kilometre square grid that identifies at a broad scale areas susceptible to flooding from groundwater on the basis of geological and hydrogeological conditions.	3
	National Receptor Database (NRD)	A national dataset of social, economic, environment and cultural receptors including residential properties, school, hospitals, transport infrastructure and electricity substations.	2
	Indicative Flood Risk Areas	Nationally identified flood risk areas, based on the definition of 'significant' flood risk described by DEFRA & WAG.	2
	Historic Flood Map (HFM)	GIS layer showing the maximum extent of all individual Recorded Flood Outlines from river, the sea and groundwater springs and shows areas of land that have previously been subject to flooding	3
	Mersey Estuary Catchment Flood Management Plan (CFMP)	CFMP's consider all types of inland current and future flooding, from rivers, groundwater, surface water and tidal flooding and are used to plan and agree the most effective way to manage flood risk in the future.	2
	LiDAR Data	Topographic Information held for Halton Borough Council is generally high resolution.	1
	Rain Gauge Information	2no. Gauge information available at selected sites across Halton Borough Council – available on request	2
	Telemetry	EA operates telemetry system across Halton, watercourse level and flow information collected. – available on request	1
Halton Borough Council	Anecdotal information	Anecdotal information: flood risk, flood history and local flood hotspots.	4
	Area Flood Risk Studies	Flood Risk Studies commissioned by the Council.	2
	CMM Partnership Ordinary Watercourse Critical Asset Identification & Condition Survey	Outputs from partnership work consist of: • Identification of critical assets • CCTV survey of identified culverts • Flood modelling • Ordinary Watercourse Condition data	2
	Halton Borough Council Flood Risk Asset Inspection Project	Borough wide asset inspection works undertaken by Consultant on behalf of Halton Borough Council & Blockage Sensitivity Testing.	2
	Strategic Flood Risk Assessment Level 1	The Stage 1 SFRA focuses on collecting information regarding all sources of flooding. This helps to identify the spatial distribution of flood risk sources.	3
	Strategic Flood Risk Assessment Level 2	The Stage 2 SFRA focuses on the details nature of flood hazard taking into account the presence of flood risk management measures such as flood defences and the location of key development and regeneration areas.	2
	Critical Infrastructure dataset	Contains information of critical infrastructure.	2
	Water Cycle Strategy	The Water Cycle Strategy identifies the water services infrastructure that is needed to support and enable sustainable development in the mid Mersey area.	2
	Surface Water Management Plan Flood Depth Mapping	Surface Water Flood Modelling conducted as part of the SWMP Stage 2.	2
	Surface Water Management Plan Stage Interim Reports	Information on future surface water flood risk is outlined in these documents.	2
	S19 Flood Investigation reports	LLFAs have a duty to investigate and record details of significant flood events within their area. Reports include photographic evidence during and after flood event.	2
	Historic Flooding Records	Historic records of flooding from surface water, groundwater and ordinary watercourses.	2
	Asset Register / Record	Register of flood risk management assets.	2
	Scheme Business Cases	Business cases for schemes contain information regarding risk and potential solutions.	2
United Utilities	Flooding Register	Registers logs and records of sewer flooding incidents for each area.	2
	Modelling Information	Models of drainage systems operated and maintained by United Utilities.	2
	Asset Register	Asset register available to Halton Borough Council on request.	2
	Telemetry	Information regarding sewer performance	2
Fire & Rescue	Incident Response Register	Issue logs of all events recorded by Cheshire Fire and Rescue Service. This includes internal floods such as burst pipes and sewerage problems. Data from the website has been used as this is considered to be the best available data and for further information readers should visit the following website - http://www.cheshirefire.gov.uk/	2
Other	Media Records	Information obtained from online media – news websites / social media etc.	2

4.2.4 Data Limitations

The first edition of the PFRA identified a number of issues during the data collection process. Whilst a number of processes have since been improved a number of limitations still remain.

Inconsistent Recording Systems

Previously the lack of a consistent flood data being captured within one central recording system within Halton Borough Council had led to inconsistencies in the recording of flood event data. Halton Borough Council will continue to address this issue as part of day to day flood incident recording and in undertaking its' duties under Sections 19 and 21 of the FWMA 2010. Whilst sections of the study area that have recently been flooded have been scrutinised for consistency, the limitation of inconsistent recording still applies for those sections of the study area that have only experienced flooding historically.

Incomplete Datasets

Some of the datasets collated are not exhaustive and are questionable to accurately represent the complete local flood risk issues in a particular area. Halton Borough Council, along with the other stakeholders, has strived to reduce the number of incomplete datasets since 2011. Records for recent flooding locations are now more comprehensive, however knowledge gaps still remain in sections of the study area that have only experienced flooding historically and therefore hinder the identification of accurate FRAs.

Varied Quality of Data

Depending upon stakeholder objectives of collecting information there have been leniencies in the varied quality in historic flood records. This has made it difficult to accurately assess the consequences of historic local flooding.

Records of Consequences of Flooding

It is not always possible to clearly identify and compartmentalise flooding, particularly from engineered systems that are typically interconnected, which results in flooding from a combination of sources.

Data records provided by the other partner organisations were not always comprehensive for specific past flood events. Since 2011 there has been increased co-operation with stakeholders to standardise the recording procedure to become more aligned and comprehensive, increasing confidence to identifying flooding source and consequence.

Quality Assurance

Data collected was subject to quality assurance measures to monitor and record the quality and accuracy of acquired information and datasets. A data quality score was given, which is a qualitative assessment based on the Data Quality System provided in the Surface Water Management Plans (SWMP) Technical Guidance document (March 2010). This system is explained in Table 6. A confidence rating for the dataset was then determined as summarised in Table 7.

4.3 Phase 2 – Data Review and Analysis

4.3.1 Assessing Historic Flood Risk

Existing datasets, reports and anecdotal information from the stakeholders have been collated and reviewed to identify details of major past flood events which had locally significant harmful consequences. The analysis included an assessment of economic damage, environmental and cultural consequences and impact on the local population.

For further information on historical flooding please refer to Section 5 of this PFRA.

4.3.2 Assessing Future Flood Risk

The identification of FRAs through the PFRA should also take into account future floods, defined as any flood that could potentially occur in the future. This definition includes predicted floods extrapolated from current conditions in addition to those with an allowance for climate change. The assessment of future flood risks will primarily rely on a technical review of the Environment Agency's Risk of Flooding from Surface Water (RoFSW) maps first published in 2013 and updated annually.

The previous PFRA relied upon a technical review of surface water flood depth maps (1 in 200 annual chance of flood with 180 minute duration) produced for the Surface Water Management Plan (SWMP) as the best available information. For areas not covered by the SWMP modelling the Environment Agency's Areas Susceptible to Surface Water Flooding Map was used. Both datasets have been superseded by the RoFSW which when compared to observe actual flooding better represents the flood extents.

In January 2017 the PFRA guidance, first published in 2011, was revised due to increased understanding of the FWMA 2010 requirements, data collection and recording methods, completion of flood alleviation schemes, and technological advances to produce more accurate model predictions. Table 8 summarises the main differences between the guidance documents.

Table 8: Differences between assessment criteria

Description	2011 PFRA	2017 PFRA
Rainfall Return Period for analysis	1 in 30 year (3.3%) 1 in 200 year (0.5%)	1 in 30 (3.3%) 1 in 100 (1%) 1 in 1000 (0.1%)
Number of "blue squares" formed within a 3x3 km square grid to create a cluster. Refer to Section 4.1 for further information	5	5

RoFSW maps were generated using 'direct rainfall' modelling (the application of rainfall to all cells in a 2D model, and runoff is routed within the hydraulic model). RoFSW maps do not take into account any non-surface water influences such as rivers, sea, sewers or groundwater.

Table 9: Risk Categories for RoFSW maps

Banding	Return Period
High	>1 in 30 years (3.3%).
Medium	Between 1 in 100 (1%) and 1 in 30 years (3.3%).
Low	Between 1 in 1000 (0.1%) and 1 in 100 years (1%).
Very Low	<1 in 1000 years (0.1%).

Risk categories, to depth and velocity of flood waters, have been assigned based on the information provided by the Environment Agency. **Even though it is based as an annual chance of the event occurring, there is no limit on the event taking place at multiple times throughout the year.**

Table 10: Information contained in the RoFSW banding

Predicted Depth (mm) Banding	Predicted Velocity (m/s) Banding
>900 300 to 900 <300	>0.25 <0.25

Further information regarding the Risk of Flooding from Surface Water Maps (formerly known as the updated Flood Map for Surface Water - uFMfSW) is available at the following webpage: https://www.gov.uk/government/publications/flood-maps-for-surface-water-how-they-were-produced

The following factors were considered when assessing the future flood risk across the study area:

- Topography.
- Location, and type, of drainage systems.
- Characteristics of watercourses (lengths, modifications).
- Location of Ordinary Watercourses and Flood Plains that retain water.
- Residential / economical areas.
- Effectiveness of any works constructed for the purpose of flood risk management.
- Current and predicted impact of climate change.
- Proposals for future development.

For further information on future flooding please refer to Section 6 of this PFRA.

4.4 Phase 3 – Reviewing Indicative Flood Risk Areas

Information on historic and future flood risk has been used to formally review FRAs. Flood risk indicators have been used to determine the impacts, and consequences, of flooding on human health, economic activity, environment and cultural heritage.

The flood risk indicators have been selected and analysed by DEFRA and the Environment Agency in order to identify areas where flood risk and potential consequences exceed a pre-determined threshold. The areas that have been identified using this methodology, and exceed 30,000 people at risk, have been mapped nationally and identified as Indicative FRAs (Appendix A, Figures 11-14).

Table 11: Key Flood Risk Indicators and Impacts

Impact of flooding on:	Flood Risk Indicators
Human Health	Number of residential properties. Critical services (Hospital, Police / Fire / Ambulance Stations, Schools, Nursing, Homes, etc.). The number of critical services can be identified using the National Receptor Dataset (NRD). However the LLFAs note that NRDs do not show the impact of flooding of individual sites.
Economic Activity	Number of non-residential properties. Principal road that is flooded for longer than 12 hours. Area of agricultural land. With the details of the lengths placed into NRDs. it is also important to consider significant consequences by looking at the importance of the route (national, regional, local), alternatives and diversions. This is important in a case of any settlement, routes, rail networks being cut off by flooding.
Environment	Designated sites (SSSIs, SACs, SPAs, etc.) and BAP habitat. It also identifies the flooding consequences around pollution (PPC, COMAH) and Contaminated land.
Cultural Heritage	Cultural heritage sites (World Heritage Sites), Scheduled Ancient Monuments, Listed Buildings, Conservation Areas, Registered Parks and Gardens.

4.4.1 The Criteria

Table 12 sets out for people, services, properties and communities, the level of flood risk which LLFAs should consider to be significant for the purposes of the Regulations. These indicators and criteria relate to the risk of surface water flooding from a rainfall event with a 1% (or 1 in 100) chance of occurring in any one year.

The Environment Agency has provided a set of indicative FRAs for LLFAs to consider. These are shown in Figure 15, Appendix A. LLFAs are only required to do this in relation to local flood risks, including risks of flooding from surface water, groundwater and ordinary watercourses. They do

not need to consider risks of flooding from the sea, main rivers or reservoirs, except where these may affect flooding from another source.

Table 12: Indicators and criteria for assessing whether the risk of local flooding is significant for the purposes of identifying FRAs

Method	Definition	Indicator	Criteria
Cluster method	A cluster is formed where, within a 3x3 km square grid, at least 5 of the 1km squares meet the criteria for one or more of the indicators. Where multiple overlapping grids meet the requirement, these are unified to form a larger cluster. All of the clusters (both small and large) have been identified as indicative flood risk areas.	Number of people at risk of surface water flooding*	200 people or more per 1km grid square Number of people taken as 2.34 times the number of residential properties at risk.
		Number of key services at risk of surface water risk* e.g. utilities, emergency services, hospitals, schools	More than one per 1km grid square
		Number of reportable properties (residential and non-residential) properties at risk*	20 or more per 1km grid square
Communities at risk method	Community areas, as defined by the Office for National Statistics built-up areas (BUAs) and built-up areas sub-divisions (BUASD), where there is a large number of properties at risk.	Number of reportable properties (residential and non-residential) properties at risk*	3,000 or more reportable properties (residential and non-residential) within a BUA/BUASD.

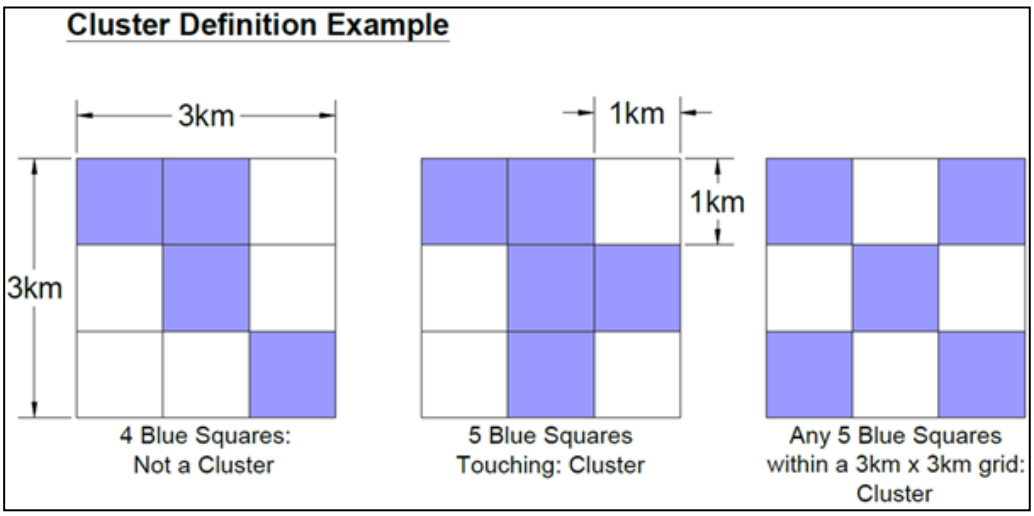
*Risk of surface water flooding from a rainfall event with a 1% (or 1 in 100) chance of occurring in any one year

The Environment Agency has used two methods and information held nationally to derive these indicative areas. The methods are:

1. The Flood Risk Areas cluster method

As used in the first cycle to identify high concentrations of risk. The country was divided into 1km squares and national information used to identify the squares meeting one or more of the cluster method related criteria in Table 12. A cluster is formed wherever, within a 3x3 km square grid, there are at least 5 squares meeting the criteria. Often multiple grids that meet this requirement will overlap. Overlapping grids are unified to form a larger cluster. All clusters, large and small are identified as indicative FRAs.

A rainfall event with a 1% chance (1 in 100 year return period) of occurring in any year has been utilised to generate the clusters rather than 0.5% chance (1 in 200 year return period) as in 2011 PFRA. This is because current surface water risk products do not include the assessment of a 0.5% chance rainfall event.



2. The Environment Agency's Communities at Risk method

Developed since 2010 which complements and validates the cluster method by identifying built up areas where total flood risk is high. Indicative FRAs are identified wherever there are 3,000 or more reportable properties (residential and non- residential) at risk within a built-up area (BUA) or built-up area sub-division (BUASD) as defined by the Office for National Statistics.

As with method 1, this is for a rainfall event with a 1% chance of occurring in any year.

When determining their FRAs, Halton Borough Council began with the Environment Agency's indicative FRAs and used its local knowledge and information to provide confidence with reference to Table 7.

The Environment Agency has suggested some additional indicators and criteria to consider in relation to Table 7 at the local level which may be sufficient for a flood risk to be considered significant factors to identify a change from the indicative FRAs:

- Flood risk from other local sources e.g. groundwater, local watercourses
- The combined impact of flooding from multiple sources.
- Areas susceptible to more frequent, less extensive flooding, that could over time result in significant damages.
- Vulnerable local sites, such as caravan parks or camp sites.
- Consequences of flooding for agricultural land.
- Consequences of flooding for roads, rail or other infrastructure.
- Consequences of flooding for internationally or nationally designated environmental sites or internationally or nationally important cultural heritage features, and
- Location of sites subject to Integrated Pollution Prevention and Control or Control of Major Accident Hazard regulation.

There is no national criterion for these local factors, but when considering whether a local factor related risk is significant, it should be assessed whether the magnitude of risk in relation to a local factor, or a combination of local factors, is comparable to the scale of the risk presented by the criteria in Table 12. Additional information to the methods used by the Environment Agency to develop indicative FRAs for this PRFA review is contained in Appendix B

4.4.2 Review

The following sections consider these additional local factors. Mapping has been presented in Appendix A and further analysis has been undertaken to ascertain the scale of the potential risk, to identify whether it is necessary to declare additional FRAs within Halton.

Method 1 - The Flood Risk Areas cluster method

Referring to Figure 2 of Appendix A there are 3 "blue squares" (1km grid squares) identified within the Halton Borough Council Boundary. Only 3 of these are contained within a 3x3 km square grid. No cluster identified.

The DEFRA / EA identified 1km^2 Squares Above Flood Risk Threshold (Blue Squares) for Halton is shown in Figure 2 of Appendix A.

Method 2 - The Environment Agency's Communities at Risk method

Table 13: Indicative FRAs – Method 2 'Communities at Risk' Approach

Rank	Sub Division	Total properties at risk	Intersecting LLFAs	% of BuA within LLFA boundary
28	Liverpool	4,413	Halton	0.0%
			Knowsley	15.3%
			Liverpool	82.9%
			Sefton	1.7%

Figure 15, Appendix A shows the geographical extent of the national Indicative Flood Risk Area (with over 30,000 people) for Liverpool which is ranked 13 by number of people at risk in England. The proposed Flood Risk Area also covers large parts of the Liverpool, Knowsley and Sefton LLFA administrative areas. This area encroaches slightly into a predominantly rural area within Halton. It does not correspond with any future flood high risk areas (identified in the Halton Borough Council PFRA using local flood risk knowledge and data) which are summarised in the mapping of Annex A

It is proposed that minor changes to the Liverpool indicative Flood Risk Area in Halton to more accurately reflect local conditions. The Liverpool Flood Risk Area has been removed from the Halton area as it only slightly encroaches into a predominantly rural area, on the periphery, of the borough and does not coincide with the locally defined areas of consequence. This revision reflects the relevant administrative boundaries, urban areas, the limited historical flood incident records in the area and the analysis of significant future flood risk resulting from this study. Halton Borough Council will take on the responsibility of reporting this information within Annex 3 of their Preliminary Assessment Spreadsheet.

4.4.3 Conclusion

There are no indicative FRAs or Clusters identified within the Halton Borough Council administrative area.

5. Historic Flood Risk – Assessment of Past Flooding

5.1 Introduction

This section summarises the readily available and relevant information on historic floods. The PFRA guidance requires floods identified with "significant harmful consequences" to be reported in the spreadsheet in Annex 1 of this report.

"Significant harmful consequences" are considered to be impacts of flooding that may have negative consequences for human health, the social and economic welfare of individuals and communities, infrastructure, and the environment (including cultural heritage).

The definition of a past flood with "significant harmful consequences" is determined by the LLFA. The level of significance is chosen so that only relatively harmful flood events are included in the PFRA. Such flood events are those that would be deemed significant when considered from a national perspective.

For the purposes of this PFRA, the definition of "significant" has been defined by Halton Borough Council as followed:

Table 14: Historically Significant Harmful Consequences

Impact of flooding on:	Category	Consequence
Human Health	Number of individuals	≥ 200
Economic Activity	Number of critical services	≥ 2
	Number of residential properties	≥ 83
	Number of non-residential properties	≥ 20
	Principal Highway Network	Transport links impassable for more than 12+ hours.
Environment	-	-
Cultural Heritage	-	-

Using the definition above, Halton Borough Council has no records of local floods with historically significant harmful consequences.

Irrespective of "significance", Halton Borough Council considers that all flood events that affect property or people justify consideration. Therefore, where known, information on all flood events has been gathered. A summary of the information specific to each source of flooding relevant to the PFRA is included in this chapter. Other floods that do not meet the criteria, or for which the consequences are not known, are not included in Annex 1, as per the PFRA guidance, but their locations are plotted on the relevant figures.

It is noted that flooding can be the result of complex interactions between the different sources (e.g. Main River and surface water) and the degree of influence from other sources are not always fully understood.

The Halton Borough Council Local Flood Risk Management Strategy, first published in March 2015, addressed these issues from the first publication of the PFRA. The strategy is to be reviewed by June 2021.

5.2 Overview

5.2.1 Surface Water Flooding (Overland Flow)

Surface water flooding, also known as pluvial flooding, results from overland flow before the runoff enters a watercourse or drainage system. It is usually the result of high intensity rainfall exceeding the hydraulic capacity of the receiving system. However it can also occur with lower intensity rainfall when the land has a low permeability and/or is already saturated, frozen or developed.

Surface water flooding within the United Kingdom is becoming a regular issue due to the high rate of developments creating large impermeable surfaces.

Figures 3 and 5 (Appendix A) show the locations of all known past flood events collated from key RMAs and stakeholders. There are a total of 97 recorded historical surface water flooding events of varying significance and type.

Halton Borough Council has identified no incidents of historically significant harmful consequences for surface water flooding. Areas affected by surface water flooding which have not been classified as having significant harmful consequences will be reviewed as part of Halton Borough Council's longer-term strategy.

5.2.2 Ordinary Watercourse Flooding (Fluvial)

Flooding from any type of watercourse, also known as fluvial flooding, occurs when intensive or prolonged rainfall causes a watercourse to exceed hydraulic capacity. The additional inflow causes the water to rise above its banks or retaining structures and subsequently flows onto the land.

All watercourses within the study area have been identified using the Environment Agency's Detailed River Network (DRN) and are classified as either Main River or Ordinary Watercourse. These are indicated in Figure 4.

Main Rivers are usually larger rivers and streams. Other rivers are called Ordinary Watercourses. The Environment Agency carries out maintenance, improvement or construction work on Main Rivers to manage flood risk under the Water Resources Act 1991. Environment Agency powers to carry out flood defence work apply to main rivers only. Lead local flood authorities, district councils and internal drainage boards carry out flood risk management work on ordinary watercourses. The Environment Agency decides which watercourses are Main Rivers. It consults with other risk management authorities and the public before making these decisions. The Main River map is then updated to reflect these changes. Inclusion of Main Rivers is beyond the scope of this PFRA.

Ordinary Watercourses are any watercourses that are not designated a Main River by the Environment Agency and therefore come under the powers of Halton Borough Council. These include every river, stream, ditch, drain, cut, dyke, sluice, sewer (other than a public sewer) and passage through which water flows and which does not form part of a Main River.

Ordinary Watercourses with known flood risks associated to them (limited channel capacity, channel constrictions or a poor maintenance regime) were previously designated Critical Ordinary Watercourses (COWs). These were not classified as Main River but which the Council had agreed with the Environment Agency to be critical because they have the potential to put at risk from flooding large numbers of people or property. In 2006/7, the Environment Agency reclassified all COWs as Main Rivers and took over responsibility for their maintenance and management, in a process known as enmainment.

Halton Borough Council has identified no historically significant harmful consequences for fluvial flooding from Ordinary Watercourses. Areas affected by fluvial flooding which have not been classified as having significant harmful consequences will be reviewed as part of Halton Borough Council's longer-term strategy.

5.2.3 Sewer Flooding

Sewer flooding is often caused by drainage systems exceeding hydraulic capacity during periods of intensive, or prolonged, rainfall. These drainage systems, owned and maintained by the sewage undertaker (United Utilities), receive either:

- Foul only flows;
- Surface water flows;
- Both foul and surface water flows (combined system).

Combined sewerage systems are mostly associated with sections of the study area developed during the Victorian era. To maintain hydraulic efficiency the combined system contains a number of relief structures to divert excess flows to adjacent watercourses to reduce the risk of sewer flooding from manholes. These structures are known as Combined Sewer Overflows (CSOs). The operation of these increases the risk of fluvial flooding, as well as pollution of the watercourse. Developments from the late 1970s / early 1980s have been constructed using individually separate foul and surface water systems.

There are some housing developments from the early 20th century that utilise the principles of the separate system where both foul and surface water flows are routed in the one manhole. These dual manholes operate in a similar manner to CSOs and are normally situated at the head of the sewerage network, whereas CSOs are situated in the main body of the system. Dual manholes can cause major pollution problems from storm sewage discharges or dry weather discharges via surface water sewers as a result of foul sewer blockages.

United Utilities have provided an incident register for locations that have experienced internal (i.e. flooding within a property) and external flooding from a number of sources. The register has been filtered to identify hydraulic issues, such as overloading of the sewerage system or restriction at outfall locations caused by high level in the receiving watercourse. "Other" causes of flooding, for example blockages, asset failure or other operational issues, have been discounted from this PFRA.

Figure 5 in Appendix A presents the historic sewer flooding information provided by United Utilities. There have been a total of 14 flooding incidents (10 external and 4 internal) across the study area. Areas where the historic data suggests that sewer flooding may be a particular issue are Appleton and Grange Wards. This corresponds with Halton Bough Council records.

Halton Borough Council has identified no historically significant harmful consequences due to flooding from the sewerage system. Areas affected by sewer flooding which have not been classified as having significant harmful consequences will be reviewed as part of Halton Borough Council's longer-term strategy.

5.2.4 Groundwater Flooding

Groundwater flooding occurs when the water table rises above normally expected and anticipated levels and emerges at the ground surface. Groundwater flooding occurs in response to a combination of already high groundwater levels (regularly during mid or late winter) and intense or unusually prolonged periods of rainfall. Other mechanisms which produce groundwater flooding including:

- Artificial structures;
- Groundwater rebound (which occurs when abstraction, typically for drinking water, industrial or mine dewatering purposes, stops and water levels return to pre-abstraction levels);
- Mine water rebound;
- High in-bank river levels.

The occurrence of groundwater flooding is usually localised and, unlike flooding from watercourses, does not generally pose a significant risk to life due to the slow rate at which the water level rises but can last several months and can cause significant social and economic disruption to the affected areas.

Halton Borough Council has identified no historically significant harmful consequences due to flooding from groundwater. Areas affected by groundwater flooding which have not been classified as having significant harmful consequences will be reviewed as part of Halton Borough Council's longer-term strategy.

5.2.5 Canals

Canals are heavily controlled and are unlikely to respond in the same manner during periods of rainfall as natural watercourses. The probability of flooding is more associated with residual risks, such as overtopping of canal banks, breaching of embanked reaches or asset (gate) failure. Each canal also has significant interaction with other sources of flood risk, such as the main rivers and the minor watercourses that feed them, or drains that cross beneath them.

There are two canals operated by subsidiary companies on behalf of Peel Ports Group within Halton, they are:

- Bridgewater Canal operated by the Bridgewater Canal Company Ltd,
- Manchester Ship Canal operated by Manchester Ship Canal Company Ltd.

Halton Borough Council owns and maintains parts of the Sankey Canal within the Halton Borough Council boundary.

Halton Borough Council has identified no historically significant harmful consequences for flooding from canals within the administrative boundary. There has been one historical significant flooding incident from the Manchester Ship Canal; this was contained within the administrative area of neighbouring Warrington Borough Council. Details are contained within Warrington Borough Council's PFRA 2017 document.

Areas affected by canal flooding which have not been classified as having significant harmful consequences will be reviewed as part of Halton Borough Council's longer-term strategy.

5.2.6 Interaction with Main Rivers

Many of the sources previous mentioned connect to the Main Rivers which eventually drain to the Irish Sea. For the study area the Main Rivers are:

- The River Mersey
- The Weaver Navigation (engineered section of the River Weaver)
- Rams Brook
- Ditton Brook
- Bowers Brook
- Stewards Brook
- Keckwick Brook

Ordinary Watercourses flow into Main Rivers, and vice versa, and Main Rivers flow into or under canals and urban drainage systems outfall into Main Rivers. Flooding mechanisms associated with these interactions are often the result of flow backing up because another source has prevented normal discharge.

The Environment Agency is responsible for managing these main tributaries of the River Mersey.

The Canals and Rivers Trust are responsible for the section of the Weaver Navigation through Halton

Information about historical flooding will often be due to an unknown source, or because of interactions between sources. This interaction will be difficult to identify without detailed flood risk studies.

High water levels in the River Mersey are common due to tidal and fluvial events. Although flooding from main rivers does not need to be included in the PFRA, it is thought that there is a strong link between surface water flooding, sewer flooding incidents and flooding from ordinary watercourses and water levels on the River Mersey and its tributaries. There is evidence to suggest that surface water flooding is exacerbated in some areas, during high tidal cycles when gravity drains and outfalls are blocked with high tidal waters. However, due to the incomplete nature of the information available at present, the degree of influence on local flood risks cannot be determined.

Information about historical flooding will often be due to an unknown source, or because of interactions between sources. This interaction will be difficult to identify without detailed flood risk studies.

5.3 Summary

Halton Borough Council have reviewed and identified that there are no nationally significant or historical local significant flooding incidences within the study area. There are instances of flooding that are not significant, which the Council are aware. The consequence of past flooding means that no records match the threshold to be reported in the Annex Spreadsheets as historic locally significant flooding.

6. Future Flood Risk

6.1 Introduction

Whilst analysis of past flooding provides valuable information on the nature and extents of flooding that has occurred in Halton in the past, it does not necessarily inform us about how and where flooding may occur in the future.

Predictions of future flood risk are produced using combinations of hydrological and hydraulic modelling and analysis of past hydrological records to make future predictions. The following sections of this PFRA discuss the potential sources of flooding within the study area. The following sources of flooding have been considered in subsequent sections of this report:

- Ordinary watercourses (fluvial);
- Surface water;
- Groundwater;
- Canals;
- Reservoirs.

6.2 Overview

6.2.1 Surface Water Flooding

As identified in Table 7 there are a number of national and local level surface water flooding datasets available for the study area.

Since 2008 The Environment Agency has produced a series of surface water flood maps to aid local authorities in determining areas at risk of flooding. The latest version of the maps is the Risk of Flooding from Surface Water (RoFSW) maps. This has been previously discussed in Section 4.3.2 of this report.

Environment Agency guidance on using surface water flood risk information recommends that Halton Borough Council, as a LLFA, should: review, discuss, agree and record, with the Environment Agency, United Utilities, and other interested parties, what surface water flood data best represents their local conditions, known as “locally agreed surface water information”. Whilst this is not a requirement under the Regulations, it does inform the PFRA process as this information should play an important role in identifying FRAs.

Halton Borough Council has agreed with all interested parties that the Risk of Flooding from Surface Water (RoFSW) mapping is the most appropriate dataset that represents the risk of flooding from surface water within the study area at a high level.

Figure 6 (Appendix A) identifies areas within Halton Borough Council potentially at risk of surface water flooding. It should be noted that the RoFSW dataset, the successor to uFMfSW, does contain the following limitations:

- In urban areas, rainfall is reduced to 70% to represent infiltration, then a rainfall reduction of 12mm/hr is applied to represent the effects of the drainage system.
- Large subsurface drainage elements, such as flood relief culverts and flood storage, are not included. These assumptions can affect the modelled extent and pattern of flooding. Modelled flood extents are particularly sensitive to the drainage rate used.
- At the national scale there is limited recorded surface water flood data that exists for LLFAs to perform validation, so in many places no validation has been carried out yet.

- As with many other flood models the input information, model performance and modelling that were used to create the RoFSW vary for different areas; these affect the reliability of the mapped flood extents and, in turn, the suitability for different applications.
- RoFSW does not take individual property threshold heights into account.
- The flood extents show predicted patterns of flooding based on modelled rainfall. In reality, no two storms are the same, and so two floods of similar rarity may result in different patterns of flooding and consequently these maps cannot definitively show that an area of land or property is, or is not, at risk of flooding.
- It does not show future scenarios, for example climate change.

This dataset has been used to assess the potential surface water flood risk to properties across the study area, summarised in Table 15.

Table 15: Numbers of Properties, Services and People Potentially at Risk from Surface Water Flooding in the Future (RoFSW)

Susceptibility to surface water flooding banding	Category	Halton Borough Council Review	Environment Agency Review	Difference (absolute value)
High (1 in 30 yr)	All Properties	242	-	-
	Residential Properties	177	-	-
	Non-Residential Properties	62	-	-
	Key Services (inc elec)	3	-	-
	People	414	-	-
Medium (1 in 100 yr)	All Properties	964	936	28
	Residential Properties	726	809	83
	Non-Residential Properties	221	127	94
	Key Services (inc elec)	17	18	1
	People	1,699	1,893	194
Low (1 in 1000 yr)	All Properties	4,581	4,716	135
	Residential Properties	3,615	3,886	271
	Non-Residential Properties	911	830	81
	Key Services (inc elec)	55	59	4
	People	8,459	9,093	634

Halton Borough Council has carried out its own review of the affected categories. It can be seen there is some discrepancy between the data sets, most noticeable being Non-Residential Properties. This may be due to counting points that are "blank" (i.e. not defined as a property or other feature). However, as other differences are between 3 - 7% this is considered acceptable for the purpose of the PFRA and confidence may be held in the data for areas at risk 1 in 30 year event which was not completed by EA as part of PFRA. Further minor differences result from different methods used when trimming the data to the Halton Borough boundary (Actual boundary vs 1km^2 grid square)

Whilst it is recognised that due to future effects of climate change the overall susceptibility to surface water flooding will increase. Properties will still be banded as being at 'Low' risk through to 'High' risk of surface water flooding.

Property counts are derived from counts undertaken using GIS software and the National Receptor Database. The level of future flood risk and the estimated associated consequences are provided in the spreadsheet in Annex 2.

Further information to background and limitations to risk of surface water mapping by the Environment Agency can be obtained via the following link:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/297432/LIT_8988_0bf634.pdf

6.2.2 Sewer Flooding

Hydraulic (1D) sewer models have been created which cover the majority of the sewerage network maintained by United Utilities. These have been verified against a flow survey to provide an accurate representation of network performance during both dry weather and storm conditions. A suite of design storm events of differing return periods, durations, and inclusive of the effects of climate change, are then applied to the models to assess hydraulic performance. The outputs include a range of predicted surcharge levels and flood volumes at individual node locations. Clusters of flooding nodes are then grouped based upon the common hydraulic deficiencies and / or geographic location and are checked against historical records to confirm existing flooding locations, as well as a tool to predict future flooding locations.

Whilst this data allows a high-level analysis of sewer flood risk, there are a number of limitations with the data:

- Not all sewer networks are modelled.
- Model confidence is low in sections of the network that were not covered by flow monitor during the survey period.
- The models are calibrated for a particular period and conditions the flow survey was installed and may not fully take into consideration the effects of seasonality.
- 1D models do not represent the flow path unlike 2D and Integrated Catchment Modelling (ICM) models. Predicted flood volume in 1D models departures and returns to the system at the same node location, in truth this may not be the case.
- Not all models accurately represent interaction watercourses at outfall locations. A number of 1D models are to be upgraded to include representation of watercourses, Integrated Catchment Modelling (ICM) which includes the 2D element, during the coming years. This will enable increased understanding of hydraulic interactions of all systems, in particular the operational performance of CSOs and flood routing paths of surfaces waters.

Figure 5 in Appendix A presents the historic sewer flooding information provided by United Utilities. There have been a total of 14 flooding incidents (10 external and 4 internal) across the study area. Areas where the historic data suggests that sewer flooding is a particular issue are Appleton, Widnes and Grange, Runcorn. These known flooding locations are coherent with predictions from the hydraulic sewer model, and HBC records, therefore providing confidence to sections of the study area where flooding is predicted but has gone unreported.

Based on information readily available on their website in their “Strategic Direction Statement” United Utilities are proposing to address a significant number of sewer flooding problems by 2020. Based on figures from 2015, this will include a 40% reduction to the number of North West properties experiencing internal foul flooding. This is to be achieved through investment in the completion of a number of studies and capital works projects.

6.2.3 Groundwater Flooding

Groundwater flooding occurs as a result of water rising up from the underlying aquifer or from water flowing from abnormal springs. This tends to occur after long periods of sustained high rainfall, and the areas at most risk are often low-lying where the water table is more likely to be at shallow depth. Groundwater flooding is known to occur in areas underlain by major aquifers, although increasingly it is also being associated with more localised floodplain sands and gravels. Halton Borough Council’s Contaminated Land Officer, has previously confirmed that the

groundwater levels in Halton have historically been artificially depressed and they are starting to rebound but there is no known risk of any aquifers within 2m of the ground surface (there is a major aquifer within the Sherwood Sandstone Group)

The Environment Agency's national dataset, Areas Susceptible to Groundwater Flooding (AStGWF) provides the main dataset used to assess the future risk of groundwater flooding.

The AStGWF map uses four susceptible categories to show proportion of each 1km grid square where geological and hydrogeological conditions show that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring. In common with the majority of datasets showing areas which may experience groundwater emergence, this dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding. Unless an area identified as "susceptible to groundwater flooding" is also identified as "at risk from surface water flooding", it is unlikely that this location would actually experience groundwater flooding to any appreciable depth, and therefore it is unlikely that the consequences of such flooding would be significant.

The AStGWF dataset was derived using the British Geological Society (BGS) 1:50,000 scale Groundwater Flood Susceptibility Map produced in 2010, utilising the top two susceptibility bands. Two hydrogeological conceptual models have been used in the development of the susceptibility dataset. These are:

- **Permeable Superficial Deposit (PSD) flooding** - Associated with shallow unconsolidated sedimentary aquifers which overly non-aquifers. These aquifers are susceptible to flooding as the storage capacity is restricted. Direct rainfall recharge can be relatively high and the sediments may be very permeable thus creating a good hydraulic connection with adjacent watercourses. Intense rainfall can cause a rapid response in groundwater levels; rising river levels. As the upstream catchment responds to the rainfall, this can create increased heads that drive water into the aquifer.
- **Clearwater flooding** - caused by the water table in an unconfined aquifer rising above the land surface in response to extreme rainfall. Occurs when antecedent conditions of high groundwater levels and high unsaturated zone moisture content combine with intense rainfall

The Groundwater Flood Susceptibility Map does not incorporate anomalous discharge from springs or flooding associated with urban groundwater rebound, mine water discharge, urban drainage, or any other flooding associated with changes in the engineered environment.

Figure 7 in Appendix A shows the AStGWF map and indicates that some parts of the borough are at risk from rising groundwater levels. However, it is not backed up by historical evidence and high groundwater levels are known to exist in other areas not highlighted by the dataset.

As well as the national Groundwater Flood Map, there are a number of other national and more local datasets and studies which contain some details about possible groundwater flooding in Halton, for example the ESI Groundwater Flood Risk Map of England of Wales.

6.2.4 Ordinary Watercourses

There is at present no specific Borough wide modelling for ordinary watercourses however the Environment Agency have produced Flood Zone Maps which shows the results of coarse modelling of catchments over 3km^2 (Figure 8 in Appendix A). The Environment Agency Flood Map does not provide information on flood depth, speed or volume of flow.

In order to better understand the risk of flooding from ordinary watercourse, Halton Borough Council in 2012 commissioned JBA Consulting to assist the Council with development of an asset database and also to determine the flood risk associated with the assets collated.

JBA Consulting simulated flooding caused by 100% blockage scenario in pipes, culverts or bridges using JScreen software. JScreen defined the extent of flood, and analysed its consequences highlighting the different property types that are vulnerable to flood risk if a culvert or any other flood risk asset were to fail.

In 2014/15, Halton Borough Council as part of the Cheshire Mid-Mersey Partnership (CMMP) undertook a project to improve the knowledge of flood risk from the ordinary watercourse network across the partnership area by undertaking asset inspections, topographical surveys and modelling works on ordinary watercourses which had been identified using the best available information at the time as potentially high risk. This project was considered to build upon the previous work completed by JBA due to the increase in collection of information.

CH2M Hill was appointed in November 2014 under the Water and Environment Management (WEM) Framework to undertake appropriate assessment of more than 30 km of non-main watercourse across the CMMP areas. Three separate surveys were outlined to capture the required data for the proposed study outputs;

- T98 Conditional Asset Assessment.
- CCTV survey.
- Topographical survey.

Catchment wide modelling and mapping was undertaken by CH2M following the completion of the survey investigations enabling visualisation of possible implications of events with return periods of 1 in 5 year, 1 in 30 year and 1 in 100 year. The modelled flood risk mapping represents the current situation of assets on the ground using the surveyed data to populate model data. (Locations mapping shown in Figure 9, Appendix A)

Model results have been used to produce depth grids, flood outlines and property counts based on properties from the Nation Receptor Database (NRD) to identify properties at risk.

The small size of the watercourses considered within this study means there were no observed flow data sets available, therefore best practice outlined by the Environment Agency was followed:

- Catchments delineated using GIS and FEH CDROM.
- Catchment descriptors from FEH CDROM used within ReFH analysis to calculate inflows for required return periods.

Summary of property counts (locations extracted from NRD) within flood outline for modelled reach as part of CH2M Hill study are shown in the table below:

Table 16: Numbers of Properties Potentially at Risk from Surface Water Flooding in the Future (CH2M)

Location	Description	Property Count (1 in 5 year)	Property Count (1 in 30 year)	Property Count (1 in 100 year)
Halton Site 1	Widnes – St Michaels Golf Course	37	89	118
Halton Site 2	Runcorn – Sandymoor (East)	4	4	4
Halton Site 3	Runcorn – Sandymoor (West)	20	22	23
Halton Site 4	Runcorn – Beechwood (East)	5	9	9
Halton Site 5	Runcorn – Beechwood (Central)	0	0	8
Halton Site 6	Runcorn Town Park	5	6	7

Although it appears that flooding may occur, at the above sites, property counts at five of the six locations do not achieve the threshold to be determined as having "significant harmful consequences". Widnes – St Michaels is predicted to be the most vulnerable area within the administrative district of Halton Borough Council and is within the threshold of potential flooding with "significant harmful consequences" for an event with a return period of 1 in 30 years.

The level of future flood risk and the estimated associated consequences are provided in the spreadsheet in Annex 2.

Note – The River Mersey

The Environment Agency do not classify the reach of the River Mersey through Halton Borough Council as main river. Although not classified as a main river, the Environment Agency does manage the river, with the River Mersey and its five main tributaries forming the focus of the Environment Agency's Flood Risk Management Strategy for Halton Borough Council.

6.2.5 Canals

Following the Boxing Day 2015 floods, and the impact of flooding from the Manchester Ship Canal in neighbouring authorities, regular joint meetings have been held between the relevant LLFAs, EA and Manchester Ship Canal Company to enable joined up working on flood management strategies and to gain a better understanding of operations.

The main canal/river interactions are summarised below:

- River Mersey - It is possible that embankment breach or overtopping of the Manchester Ship Canal where the watercourse runs in parallel with the River Mersey could result in additional water flowing into the river.
- Sankey Brook - The Sankey Canal, (which is also known as the Sankey Brook Navigation and the St Helens Canal) runs along the valley of the Sankey Brook to the point where the brook joins the River Mersey.
- Bowers Brook - The Bowers Brook runs alongside the disused St Helens Canal at Spike Island. It is possible that breach of the canal around the confluence with Bowers Brook would result in additional water flowing into the river.
- Keckwick Brook and the Bridgewater Canal - It is possible that breach of the Bridgewater Canal around the confluence with Keckwick Brook at Preston Brook Marina would result in additional water flowing into the river. It is not considered possible for flow from Keckwick Brook to enter the canal at this location because of the elevation difference.

- Keckwick Brook and the Manchester Ship Canal - The northern end of Keckwick Brook lies in close proximity to a Manchester Ship Canal drain at Oxmoor Lake. Embankment. It is possible that breach of the MSC around the confluence with Keckwick Brook would result in additional water flowing into the river. It is also considered possible for flow from Keckwick Brook to enter the canal drain at this location.

6.2.6 Reservoirs

Key reservoirs within or upstream of Halton are as follows:

- Wharford Farm Balancing Pond, Runcorn
- Oxmoor Basin, Runcorn
- Pex Hill Reservoirs, Cronton, Knowsley
- Fiddlers Ferry Power Station Ash Lagoons, Warrington
- Fiddlers Ferry Power Station Cooling Tower Ponds, Warrington
- Clifton Brine Reservoir, Runcorn

Whilst this is not a prerequisite for the current PFRA review, and the probability of dam or embankment failure is small, the consequences of such an event occurring may be significant particularly in an urban setting.

A reservoir flood map is available at:
https://flood-warning-information.service.gov.uk/long-term-flood-risk

6.3 Summary

Based on DEFRA thresholds of more than 30,000 people at flood risk, there is no evidence to indicate that there is a significant flood risk from local flooding sources in Halton Borough Council. However as stated in the summary table below, there are up to 936 properties potentially at risk during a flood event with a 1% (1 in 100) annual probability:

LLFA Name	Residential properties (100)	Non-residential properties (100)	Key Services (100)	Number of People (100)
Warrington (B)	890	117	25	2,083
Liverpool District (B)	2,839	466	52	6,643
Knowsley District (B)	1,013	100	28	2,370
Cheshire West and Chester	1,767	251	43	4,135
Halton (B)	809	127	18	1,893
Wirral District (B)	2,367	202	43	5,539
Cheshire East	2,204	430	31	5,157
Staffordshire County	8,074	1,029	87	18,893
St. Helens District (B)	1,650	133	33	3,861
Sefton District (B)	17,388	1,501	288	40,688

7. Climate Change and Long Term Development

Generally, preliminary assessment reports in 2011 described only the broad implications of climate change at river basin district level, based on UK Climate Projections, 2009 (UKCP09).

The next set of climate projections is due in 2018 (UKCP18). Until then UKCP09 is still a valid tool to aid decision-makers to assess the full range of risks from the changing climate and advise to adapt.

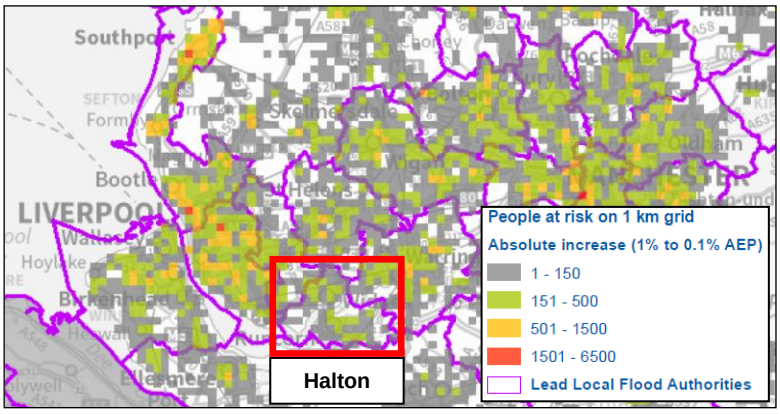
7.1 Initial Review

Whilst a significant amount of work has been completed since the introduction of the PFRA in 2011 it is still recognised that the implications of climate change for local flood risk are still not well understood.

The Environment Agency have carried out a simple analysis at the national level to compare the number of people at risk from surface water flooding from a rainfall event with a 1% chance (1 in 100 year return period) of occurring in any year to the number at risk from an event with a 0.1% chance (1 in 1000 year return period) of occurring in any year. The numbers of people at risk are counted per 1 kilometre grid square across England. The resulting 'heat map' shows how the absolute number of people at risk increases between these two rainfall events for each 1km grid square.

This method is not based on climate projections, and it does not account for future population growth. It does provide a simple way, however, of identifying areas that could be susceptible to increased rainfall intensity as a proxy for climate change. It is a reasonable proxy for an upper end climate change scenario for the end of the century, both in the pattern of change across the country and the percentage increase in intensity compared to the current climate. Figure R3 shows an extract from the 'heat map' (Figure 13, Appendix A). Red and orange squares indicate the highest increase in numbers of people at risk, and green and grey indicate lower increases.

Figure R3: Extract from the 'heat map' illustrating absolute increase in numbers of people at risk from surface water flooding for a 0.1% (1000 year) rainfall event compared to a 1% (100 year)



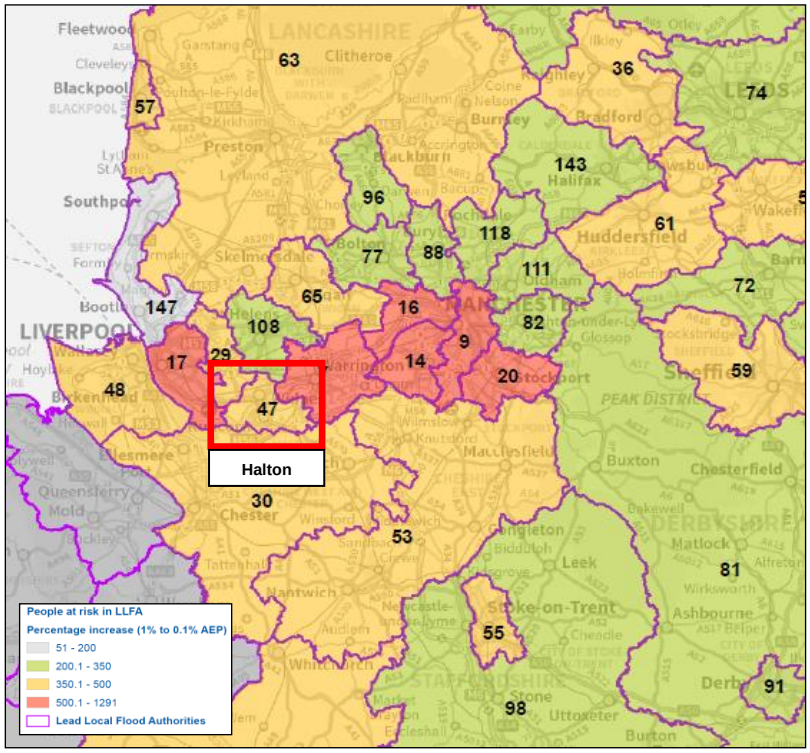
This 'heat map' provides an initial understanding of how climate change may affect local flood risk in the future, and helpful when considering the indicative FRAs as part of this PFRA review.

At the national scale the administrative area of Halton Borough Council is positioned 47th out of 152 LLFAs when reviewing the percentage increase in people at risk of flooding in LLFAs for the 0.1% rainfall event compared with the 1% event.

Table 17: Absolute and percentage Increase in the number of people at risk of flooding by LLFA for 0.1% (1000 year) rainfall event compared with 1% (100 year) event

Rank	LLFA Name	Residential properties (100 year)	Residential properties (1000 year)	Non-residential properties (100 year)	Non-residential properties (1000 year)	Key Services (inc electricity sub-station) (100 year)	Key Services (inc electricity sub-station) (1000 year)	Number of People (100 year)	Number of People (1000 year)	Absolute increase between 1 in 100 and 1 in 1000 year	Percentage increase in people at risk
7	Warrington (B)	890	7,298	117	855	25	142	2,083	17,077	14,994	720
17	Liverpool District (B)	2,839	18,152	466	2,573	52	270	6,643	42,476	35,833	539
29	Knowsley District (B)	1,013	5,483	100	426	28	109	2,370	12,830	10,460	441
30	Cheshire West and Chester	1,767	9,403	251	1,096	43	159	4,135	22,003	17,868	432
47	Halton (B)	809	3,886	127	830	18	59	1,893	9,093	7,200	380
48	Wirral District (B)	2,367	11,355	202	876	43	206	5,539	26,571	21,032	380
53	Cheshire East	2,204	10,481	430	1,343	31	148	5,157	24,526	19,369	376
98	Staffordshire County	8,074	32,580	1,029	3,912	87	412	18,893	76,237	57,344	304
108	St. Helens District (B)	1,650	6,363	133	566	33	126	3,861	14,889	11,028	286
147	Sefton District (B)	17,388	35,772	1,501	2,886	288	500	40,688	83,706	43,018	106

Figure R4: Extract from (Figure 14) percentage increase in the number of people at risk of flooding by LLFA for 0.1% (1000 year) rainfall event compared with 1% (100 year) event



Label in LLFA indicates the rank of the LLFA in order of largest to smallest percentage increase in number of people at risk.

7.2 The Impacts of Climate Change – The Evidence

Over the past century around the UK sea level rises have occurred and more of our winter rain falling in intense wet spells. Seasonal rainfall is highly variable. It seems to have decreased in summer and increased in winter, although winter amounts changed little in the last 50 years. Some of the changes might reflect natural variation; however the broad trends are in line with projections from climate models.

Greenhouse gas (GHG) levels in the atmosphere are likely to cause higher winter rainfall in future. Past GHG emissions mean some climate change is inevitable in the next 20-30 years. Lower emissions could reduce the amount of climate change further into the future, but changes are still projected at least as far ahead as the 2080's.

There is enough confidence in large scale climate models to say that Halton Borough Council and the UK must plan for change. There is more uncertainty at a local scale but model results can still help to plan to adapt. For example it is now understood that rain storms may become more intense, even though there are still uncertainties about exactly where or when. By the 2080s, the latest UK climate projections (UKCP09) are that there could be around three times as many days in winter with heavy rainfall (defined as more than 25mm in a day). It is plausible that the amount of rain in extreme storms (with a 1 in 5 annual chance, or rarer) could increase locally by 40%.

7.3 Key Projections for North West River Basin District

If emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past in the North West are:

- Winter precipitation increases of ≈14% (very likely to be between 4 and 28%)
- Precipitation on the wettest day in winter up by ≈11% (very unlikely to be more than 25%)
- Relative sea level at Morecambe very likely to be up between 6 and 36cm from
- 1990 levels (not including extra potential rises from polar ice sheet loss)
- Peak river flows in a typical catchment likely to increase between 11 and 18%

Increases in rain are projected to be greater near the coast than inland.

7.4 Implications for Flood Risk

Climate changes can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability.

Wetter winters and more of this rain falling in wet spells may increase river flooding especially in steep, rapidly responding catchments. More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers, so Halton Borough Council needs to be prepared for the unexpected.

Drainage systems in the district have been modified to manage water levels and could help in adapting locally to some impacts of future climate on flooding, but may also need to be managed differently. Rising sea or river levels may also increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses.

Where appropriate, Halton Borough Council will be involved in local studies to understand climate impacts in detail, including effects from other factors like land use. Sustainable development and

drainage will help with adaptation to climate change and manage the risk of damaging floods in future.

7.5 Adapting to Change

Past emission means some climate change is inevitable. It is essential Halton Borough Council and the UK respond by planning ahead. Halton Borough Council can prepare by understanding current and future vulnerability to flooding, developing plans for increased resilience and building the capacity to adapt. Regular review and adherence to these plans is key to achieving long-term, sustainable benefits.

Although the broad climate change picture is clear, Halton Borough Council has had to make local decisions with less certainty. A range of measures therefore will need to be considered to retain the flexibility to adapt. This approach, embodied within flood risk appraisal guidance, will help to ensure that Halton Borough Council does not increase the vulnerability to flooding.

7.6 Long Term Developments

It is possible that long term developments might affect the occurrence and significance of flooding. However current planning policy aims to prevent new development from increasing flood risk.

In England, Section 10 of National Planning Policy Framework (section of relevance formally Planning Policy Statement 25 - PPS25) on development and flood risk aims to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall.

In Wales, Technical Advice Note 15 (TAN15) on development and flood risk sets out a precautionary framework to guide planning decisions. The overarching aim of the precautionary framework is "to direct new development away from those areas which are at high risk of flooding."

Adherence to Government policy ensures that new development does not increase local flood risk. However, in exceptional circumstances the Local Planning Authority may accept that flood risk can be increased contrary to Government policy, usually because of the wider benefits of a new or proposed major development. Any exceptions would not be expected to increase risk to levels which are "significant" (in terms of the Government's criteria).

Halton Borough Council will ensure new developments will manage surface water at source and ensure developments do not contribute to flooding problems elsewhere. Where possible, new developments may relieve existing problems by improved management of surface water flows.

7.7 Local Drainage Capacity

Since the introduction of the FWMA 2010, Halton Borough Council has strived to increase its knowledge to the local drainage systems in order to ascertain capacity. This has been documented as part of the asset register, although there still remains a knowledge gap in sections of the study area. To develop flood alleviation strategies within the study area, additional investigation to identify these local drainage systems are required. This is an ongoing exercise and will be addressed in future reports.

8. Review of Indicative Flood Risk Areas

8.1 Overview

As described in Section 4 in order to ensure a consistent national approach, DEFRA have identified significant criteria and thresholds to be used for defining FRAs.

Guidance on applying these thresholds has been released in the Environment Agency's *"Review of preliminary flood risk assessments (Flood Risk Regulations 2009): Guidance for lead local authorities in England"* (25th January 2017) which superseded DEFRA's *"Selecting and reviewing Flood Risk Areas for local sources of flooding"* (first published September 2013, withdrawn February 2017). This guidance document sets out agreed key risk indicators and threshold values which must be used to determine FRAs.

The methodology is based on using national flood risk information to identify 1km grid squares where local flood risk exceeds a defined threshold. Where a cluster of these grid squares leads to an area where flood risk is most concentrated and over 30,000 people are predicted to be at risk of flooding, this area has been identified as an Indicative FRA.

Figures 11/12 in Appendix A shows the High Risk Areas identified by DEFRA.

None of the clusters shown affect more than 30,000 people across the study area and therefore there are no Indicative FRAs within the Halton Borough Council's boundary as defined by the PFRA criteria.

Halton Borough Council has accepted the current proposed indicative significant FRAs. However, it is recognised that Halton Borough Council does not have many locally significant flood risk issues.

9. Next Steps

9.1 Future Data Management Arrangements

9.1.1 Investigation

In order to continue to fulfil the role of Local Lead Flood Authority, Halton Borough Council is required to investigate future flood events and ensure continued collection, assessment and storage of flood risk data and information. The central flood data collection spreadsheet will be updated with each flood event. The method for collection is through the Council Contact Centre.

9.1.2 Policy for Investigation and Recording

All flood events will be subject to investigations and recording. Halton Borough Council has no minimum local threshold as such for formal investigation leading to publication under Section 19, but does consider a number of criteria to inform whether or not to complete a full investigation relating to:

- Internal flooding of residential/commercial property
- Major disruption to flow of traffic
- Posed risk to human health
- Adverse effect on critical infrastructure
- Harmful environment/social impacts
- Repeated flooding event which results in significant consequences

It is crucial that all records of flood events are documented consistently and in accordance with the INSPIRE Directive (2007/2/EC), European Directive transposed into UK Law in December 2009. The centralised database will be kept up to date by Halton Borough Council, who has the overall responsibility to manage flood data throughout the administrative area. This can be used as an evidence base to inform future assessments and reviews and for input into the mapping and planning stages.

9.1.3 Asset Register

Section 21 of FWMA 2010 state LLFAs have a duty to maintain a register of structures or features which, in the opinion of the authority, are likely to have a significant effect on a flood risk in its area, and a record of information about each of those structures or features, including information about ownership and state of repair. Halton Borough Council will continue to develop this database.

9.2 Review Procedures

Meeting quality standards is important in order to ensure that the appropriate sources of information have been used to understand flood risk and the most significant FRAs are identified.

The review procedure will comprise two key steps, namely, Local Authority Review and Environment Agency Review. The Review Checklist in Annex 4 of this document is used by all LLFA's and the Environment Agency to review and ensure a consistent review process is applied.

The review of the PFRA for Halton Borough Council will be undertaken by the Service Manager-Highway Development (Lead Local Flood Officer) and the Council's Environment and Urban Renewal Policy and Performance, and Executive Boards.

9.2.1 Local Authority Review

The first part of the review procedure is through an internal Local Authority review of the PFRA in accordance with appropriate internal review procedures and quality assurance. The Draft Document will then be taken for approval by the Council's Environment and Urban Renewal Policy and Performance, and Executive Boards prior to final publication by the Environment Agency (EA), following EA checks to ensure national consistency.

The PFRA must be reviewed and updated every 6 years. The first edition of the PFRA was submitted to the Environment Agency on 22nd June 2011. This report (the second edition) is the first review and is to be submitted to the Environment Agency on 22nd June 2017 under Sections 10 and 17 of FRR 2009.

9.2.2 Environment Agency Review

Under Section 10 of FRR 2009 the Environment Agency has been given a role in reviewing, collating and publishing all of the PFRAs once submitted.

The Environment Agency will undertake a technical review (area review and national review) of the PFRA, which will focus on instances where FRAs have been amended and ensure the format of these areas meets the provide standard. Once satisfied, the Environment Agency EA will then recommend submission of the PFRA to the relevant Regional Flood and Coastal Committee (RFCC) for endorsement if satisfied. RFCCs will make effective use of their local expertise and ensure consistency at a regional scale. Once the RFCC has endorsed the PFRA, the relevant Environment Agency Regional Director will sign it off.

All PFRAs obtained by the Environment Agency will then be collated, published and submitted to the European Commission by 22nd December 2017 under Section 16 of FRR 2009.

Future review cycles, of no more than 6 years, will use the same procedure described above.

9.3 Spatial Developments

The PFRA, along with the SFRA and SWMP, will inform the Local Development Framework (LDF). Strategic development will be approached through planning and development, appropriate design, situation and location of future development can all contribute to reducing the risk of flooding, including;

- Application of property and location specific flood protection measures;
- Application of sustainable urban drainage techniques for new developments;
- Identify river corridors and the natural flood plain to provide potential riverside storage and urban river corridors in built up areas.

Halton Borough Council is a statutory consultee for major developments which have surface water implications. Halton Borough Council as LLFA is to provide comments in relation to surface water drainage aspects of planning applications within 21 days, and continues to be involved in the Land Allocations Planning process.

Appendix A: Figures

Appendix B: Methods used to develop indicative FRAs for the second cycle *Extract from Review of preliminary flood risk assessments (Flood Risk Regulations 2009): guidance for lead local flood authorities in England (25th January 2017 – produced by the Environment Agency)*

We used two methods to identify areas of potentially significant risk as the basis for the indicative FRAs. In each case we used national information from the current (2016) Risk of Flooding from Surface Water (RoFSW) map - previously known as the updated Flood Map for Surface Water (uFMfSW) - and a rainfall event with a 1% chance of occurring in any year.

Method 1 - Cluster analysis for concentrations of people/property at risk

In this method, 1km grid squares of places where surface water flood risk is an issue ("blue squares") were identified wherever at least 200 people or 20 non-residential properties or more than 1 key service might be flooded.

In some areas these blue squares are densely packed together representing a concentration of high consequences from surface water flooding and providing a way of identifying areas where flood risk could be significant. Where many grid squares are close together (clustered) and the risk is most concentrated, these clusters form indicative FRAs.

All clusters contain at least 5 adjacent blue squares. The flood risk indicators used in the identification of indicative FRAs are summarised in the table below. These are similar to those used to develop indicative FRAs in 2011, but using a rainfall event with a 1% chance of occurring in any year rather than 0.5% chance as in 2011. This is because current surface water risk products do not include the assessment of a 0.5% chance rainfall event.

Table B1: Definition of flood risk indicators used in cluster analysis

Indicator	Definition	Threshold
People	Number of people at risk taken as 2.34 times the number of residential properties at risk of flooding	200 people or more per 1km grid square
Key Services	Number of key services at risk, for example utilities, emergency services, hospitals, schools	More than one per 1km grid square
Non-residential Properties	Number of non-residential properties at risk from flooding	20 or more per 1km grid square

Method 2 - Communities at risk (C@R)

Method 1 identifies locations where the density of flood risk is highest across the country. There are other locations where the total flood risk is high but not as concentrated as those areas identified in method 1. So, to complement method 1, we have used information from our C@R work.

For C@R we have analysed the surface water flood risk for communities according to Office for National Statistics built-up areas (BUAs) and built-up areas sub-divisions (BUASDs).

Built-up areas (BUAs) are characteristic of settlements including villages, towns or cities. In 2011 across England and Wales 95 per cent of the usually resident population lived in BUAs. They include areas of built-up land with a minimum of 20 hectares (200,000m^2). Any areas with less than 200 metres between them are linked to become a single BUA, with BUASDs identified.

Where available, we have used BUASDs to provide greater granularity of communities in large urban areas. Where this approach identifies 3,000 or more reportable properties at risk of surface water flooding, the BUA/BUASD forms an indicative FRA. As with method 1, this is for a rainfall event with a 1% chance of occurring in any year.

The National Receptor Database (NRD2014) property point dataset with the uFMfSW Property Point v3 attributes was used to classify a property as 'at risk' of flooding from surface water. 'At risk' properties were counted by BUASD boundary (to exclude non-reportable property points e.g. telephone boxes, advertising hoardings).

Combining method 1 and method 2 and identifying indicative FRAs

In some locations, clusters of blue squares from method 1 and BUA/BUASDs from method 2 overlap. Where this is the case, the indicative FRA is the total extent of the two areas combined.

Limitations of Analysis

Method 1 - Cluster analysis for concentrations of people/property at risk

Grid-based approach

Halton Borough Council had two main concerns regarding the approach taken by the Environment Agency.

1. The requirement for two critical services to be within the threshold may be misrepresentative of the importance of those critical services. For example:

   - Two nursing homes would outrank a hospital or;
   - Two electricity sub-stations would outrank a school.

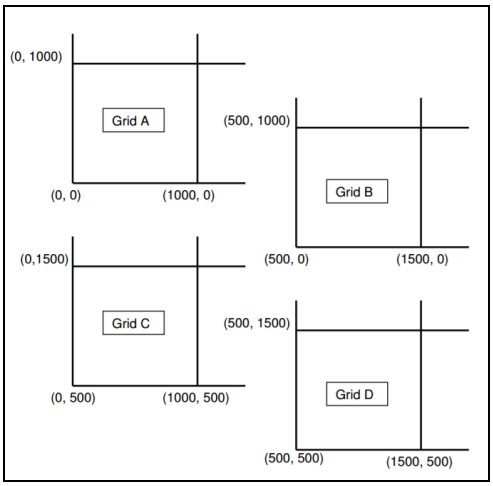
   Whilst these issues can be followed up on an individual basis, the standard procedure would not pick up a grid square containing a single, but vital, critical service.

   Halton Borough Council under took an internal review of the dataset to identify all critical services with the Borough. Halton Borough Council agrees with all the critical service locations identified by the Environment Agency at risk of flooding, including those which are above the threshold. There were no locations identified that resulted in outranking as in the aforementioned example.

2. The grid-based approach contains an arbitrary reference. The geographical location of each grid square depends upon the grid origin, which is set by the Ordnance Survey grid system. If for example the grid square was repositioned by 500m, as illustrated in Figure C-1, then the number of critical services within a 1km^2 may alter and thus may / may not adhere to the desired threshold.

   Halton Borough Council did not undertake any further analysis to a shift in the grid system as the Ordnance Survey grid system is considered to be a national standard.

Figure C-1: Variation to shift in grid system



Allocation of Critical Services

The National Receptor Dataset (NRD) contains a property categorisation code that links to methods in the Multi-Coloured Manual (MCM) for estimating flood damages based on flood depth. NRD links individual property types in the property points dataset (known as OS BaseFunction property types) to MCM codes, to facilitate flood damage estimation. Each MCM code is therefore a broad category (such as 'hospital') containing a number of detailed property types. In defining the detail of flood risk indicators the Environement Agency based indicators on MCM codes where suitable, and used more detailed OS BaseFunction property types where the property classification was not suitable. For the purpose of the PFRA, critical services are defined by the Environment Agency in Table C-1

Table C-1: Critical Services

Critical Service	MCM Code	Description
Schools	Not used	Initially MCM code 610 was considered (described as School, College, University, Nursery). However this includes some OS Base Function property types that are not critical services, such as 'vehicle driver training' and 'training'. Instead the Environment Agency chosen a set of OS Base Function types: Education First School Further Education College High School Higher Education Infant School Junior School Middle School Nursery Primary School Private School School School for the Deaf Secondary School Special School Technical School University Pre-school Education etc..
Hospitals	660	-
Nursing/Care/Retirement Homes	625	Predominately comprises nursing homes and rest homes, but also covers a number of other institutions, including prisons.
Police Stations	651	-
Fire and Ambulance Stations	650	-
Prisons	625	Predominately comprises nursing homes and rest homes, but also covers a number of other institutions, including prisons.
Sewerage Treatment Works	840	-
Electricity Installations	960	-

Halton Borough Council undertook a sensitivity analysis as part of the PFRA review. Whilst the methodology utilised by the Environment Agency is considered acceptable, caution was required to the sub-classification of these and their relevance. Reviewing the 2013 Multi-Coloured Manual (Chapter 5: Flood damage to non-residential properties) a number of NRD codes were incorrect, duplicated, or categorised as generic within the Halton Borough Council area. An example of this is illustrated in Table C-2.

Further information to the classification of NRD to MCM codes can be obtained from the following location: http://www.mcm-online.co.uk/wp-content/uploads/2015/05/Ch5-Matching-NRD-to-MCM-Codes.pdf

Table C-2: Example of Critical Services Discrepancy within Halton Borough Council

Environment Agency Review		Halton Borough Council Review	
Critical Service	**MCM Code**	**Critical Service**	**MCM Code**
Hospitals	660	Hospice	6
		Hospital	6
		Hospital / Hospice	6
		Medical	6
		Professional Medical Service	6

The internal review process identified no additional critical services at risk of flooding with respect to the Environment Agency review. However, it did provide an overview to critical services which are beyond the threshold but may be vulnerable to future flooding

Number of people at risk of surface water flooding

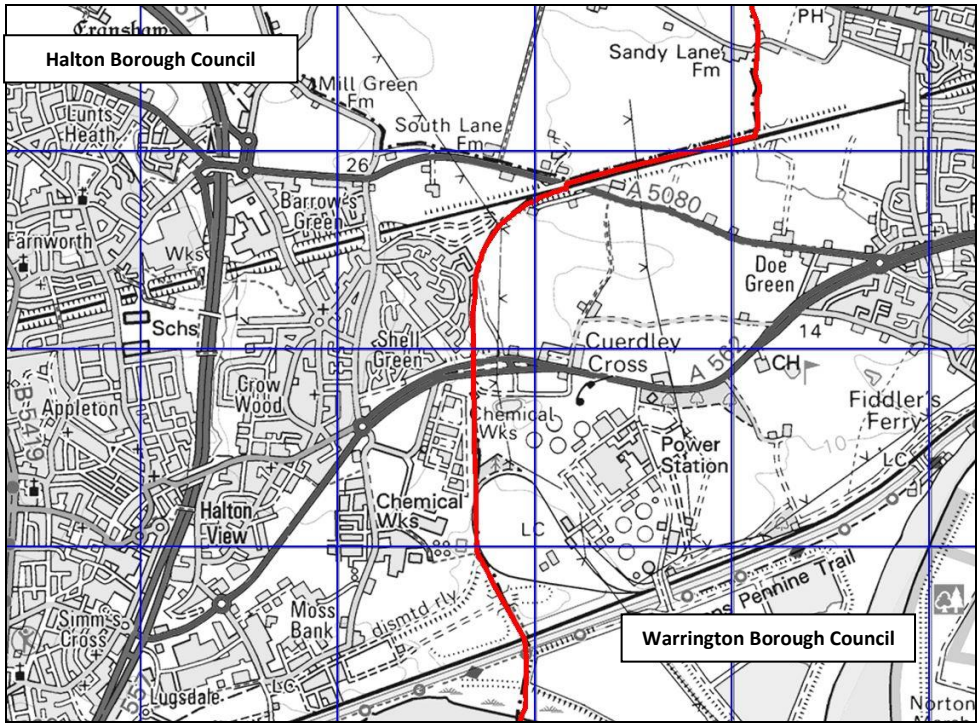
In order to verify information provided by Environment Agency, Halton Borough Council undertook an internal review to assess confidence in the data.

The population per household for the PFRA assessment has been set by the Environment Agency as 2.34. The 2.34 multiplier is based on the Office for National Statistics General Household Survey, 2006. According to the Office for National Statics Census information, the average household size in the UK was 2.30 people per household, compared to 2.40 in 2001. The average population for Halton Borough Council is 2.36 (2011 census). Whilst the population factor used for the PFRA is considered acceptable for Halton Borough Council at the national level, caution is required due to the population distribution at the local level which may result in a $1km^2$ exceeding the $\geq$200 people threshold.

Council Boundary - $1km^2$ grid vs Actual Boundary

The outputs of calculating critical services, residential and non-residential properties within the Halton area is contained within the $1km^2$ grid square provided by the Environment Agency. As illustrated in Figure C-2 the administrative boundary divides the square, thus a discrepancy is created between the Council's dataset and that provided by the Environment Agency.
Halton Borough Council was in regular consultation with neighbouring authorities to confirm the correct definition of the administrative boundary, identify any areas of cross broader developments, and confirm which grid squares may skew the results of data analysis (i.e. double counting). Only minimal discrepancies where identified thus enabling to increase confidence in the dataset provided by the Environment Agency.

Figure C-2: Example of Administrative Boundary dividing 1km^2 Grid Square



Annexes

Annexe 1	Past Floods
Annexe 2	Future Floods
Annexe 3	Flood Risk Areas
Annexe 4	PFRA Checklist