Leicester City Council

Leicester City Council
Preliminary Flood Risk Assessment

September 2011

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Revision Schedule

Final

September 2011

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Executive Summary

This document forms a Preliminary Flood Risk Assessment (PFRA) report for Leicester City Council as required in accordance with the Flood Risk Regulations 2009.

The PFRA provides a high level summary of significant flood risk, based on available and readily derivable information, describing both the probability and harmful consequences of past and future flooding. The scope of the PFRA is to consider flooding from the following sources; surface runoff, groundwater and ordinary watercourses and any interaction these have with main rivers and the sea.

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 December 2010[1]. As a Lead Local Flood Authority (LLFA), Leicester City Council must submit their PFRA to the Environment Agency for review by 22nd June 2011.

Of the ten indicative Flood Risk Areas that have been identified by the Environment Agency nationally, one covers Leicester City Council's administrative area. The Indicative Flood Risk Area for Leicester also covers some parts of neighbouring districts that are hydrologically linked. However, further areas at risk on the fringes of the Indicative Flood Risk Area have been identified (including the M1/M69 Interchange and the County police Headquarters) by Leicestershire County Council and Leicester City Council. Therefore, Leicestershire County Council and Leicester City Council have collaboratively agreed and proposed an extension to the existing Indicative Flood Risk Area. Collaborative working and knowledge sharing with neighbouring authorities is extremely important for future flood risk management in Leicester.

This PFRA reviews past flood events and future flood events to develop an understanding of flood risk across Leicester. Two past flood events have been classified as having caused significant harmful consequences – 1968 and 1993. Available and emerging information suggests future flood risk in Leicester is high and therefore this PFRA has not amended the national Indicative Flood Risk Area for Leicester.

PFRA Position Statement **September 2011**

Final PFRA document

This document forms the final PFRA for the City of Leicester. The document has been reviewed by Leicester City Council and their partners and has also been subject to scrutiny by the Leicester City Council Overview and Scrutiny Committee.

It should also be noted that this PFRA does not form a tool for development and planning purposes where the Leicester City Council Strategic Flood Risk Assessment should be referred to.

[1] http://publications.environment-agency.gov.uk/pdf/GEHO1210BTGH-e-e.pdf

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Acronyms & Abbreviations

Abbreviation	Description
AStSWF	Areas Susceptible to Surface Water Flooding
CFMP	Catchment Flood Management Plan
CLG	Communities and Local Government
Defra	Department for Environment, Food and Rural Affairs
DG5	Sewer flooding register
FMfSW	Flood Map for Surface Water
HA	Highways Agency
IDB	Internal Drainage Board
IPCC	Intergovernmental Panel on Climate Change
LA	Local Authority
LCC	Leicester City Council
LDDs	Local Development Documents
LDF	Local Development Framework
LLFA	Lead Local Flood Authority
NE	Natural England
PPS	Planning Policy Statement
SAC	Special Area for Conservation
SFRA	Strategic Flood Risk Assessment
SPA	Special Protection Area
SPD	Supplementary Planning Document
STW	Severn Trent Water
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
UKCIP	United Kingdom Climate Impacts Programme
WAG	Welsh Assembly Government

1. Introduction

1.1.1 This document forms a Preliminary Flood Risk Assessment (PFRA) report for Leicester City as required in accordance with the Flood Risk Regulations 2009.

1.2 What is a Preliminary Flood Risk Assessment?

1.2.1 A Preliminary Flood Risk Assessment (PFRA) is a high level screening exercise to identify areas of significant flood risk within a given study area. The PFRA involves collecting information on past (historic) and future (potential) floods, assembling the information into a report with supplemental Annexes and identifying Flood Risk Areas.

1.2.2 This PFRA report for Leicester City Council provides a high level summary of significant flood risk, based on available and readily derivable information, describing both the probability and harmful consequences of past and future flooding. The development of new information is not required, but new analysis of existing information may be needed.

1.2.3 This PFRA has been based on existing and readily available information and brings together information from a number of available sources such as the Environment Agency's national information (for example Flood Map for Surface Water) and existing local products such as the Strategic Flood Risk Assessment (SFRA) and the ongoing Surface Water Management Plan (SWMP).

1.3 Background

1.3.1 The key drivers behind the PFRA are two pieces of new legislation, the Flood Risk Regulations 2009 (The Regulations) which came into force on the 10th December 2009, and the Flood & Water Management Act (FWMA) which gained Royal Assent on the 8th April 2010.

1.3.2 The Regulations were created to transpose the EC Floods Directive (Directive 2007/60/EC) into domestic law in England and Wales. The Floods Directive provides a framework to assess and manage flood risks in order to reduce adverse consequences for human health, the environment (including cultural heritage) and economic activity.

1.3.3 The FWMA makes specific provision for the recommendations provided by Sir Michael Pitt in his independent review of the flooding experienced across much of England and Wales in 2007.

1.3.4 Under these pieces of legislation, all upper tier local authorities are designated 'Lead Local Flood Authorities' (LLFA) and have formally been allocated a number of key responsibilities with respect to local flood risk management. Consequently, Leicester City Council is designated as a LLFA. A full description of these responsibilities is provided in Section 2.

1.3.5 The Regulations place duties on the Environment Agency and Lead Local Flood Authorities (LLFAs) to prepare a number of documents including:

- Preliminary Flood Risk Assessments;
- Flood hazard and flood risk maps;
- Flood Risk Management Plans.

1.3.6 The purpose of the PFRA report under the Regulations is to provide the evidence for identifying nationally significant Flood Risk Areas. The report will also provide a useful reference point for all local flood risk management and inform local flood risk management strategies.

1.3.7 The scope of the PFRA is to consider past flooding and potential future flooding from sources of flooding other than main rivers, the sea and reservoirs – these fall under the responsibility of the Environment Agency. Therefore, the PFRA should address surface runoff, flooding from groundwater and ordinary watercourses and any interaction these have with local drainage systems.

1.3.8 The PFRA should also consider floods which have significant harmful consequences for human health, economic activity and the environment, where this information is available.

1.4 PFRA Timetable

1.4.1 Table 1-1 shows the elements of work required from LCC under the Regulations, along with the timescales of their respective delivery. The first two elements of work are covered by the preparation of this PFRA report.

Table 1-1: Elements of Work required under the Flood Risk Regulations 2009

22nd June 2011	**Prepare Preliminary Assessment Report.**	*The PFRA should focus on local flood risk from surface water, groundwater, ordinary watercourses and canals.*
22nd June 2011	On the basis of the PFRA, identify **Flood Risk Areas.**	*Flood Risk Areas are areas of significant risk identified on the basis of the findings of the PFRA, national criteria set by the UK Government Secretary of State and guidance provided by the Environment Agency.*
22nd June 2013	Prepare **Flood Hazard Maps** and **Flood Risk Maps** for each Flood Risk Area.	*Used to identify the level of hazard and risk of flooding within each Flood Risk Area to inform Flood Risk Management Plans.*
22nd June 2015	Prepare **Flood Risk Management Plans** for each Flood Risk Area.	*Plans setting out risk management objectives and strategies for each Flood Risk Area.*

1.5 Aims and Objectives

1.5.1 The key objectives can be summarised as follows:

- Establish an evidence base of historic flood risk information, which will be built on in the future and used to support and inform the preparation of Leicester's Local Flood Risk Management Strategy,
- Assess historic flood events within the study area from local sources of flooding (including flooding from surface water, groundwater and ordinary watercourses), and the consequences and impacts of these events,
- Assess the potential harmful consequences of future flood events within the study area,

- Review the provisional national assessment of indicative Flood Risk Areas provided by the Environment Agency and provide explanation and justification for any amendments required to the Flood Risk Areas,
- Provide a summary of the systems used for data sharing and storing, and provision for quality assurance, security and data licensing arrangements,
- Identify relevant partner organisations involved in future assessment of flood risk; and summarise 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,
- Summarise the methodology adopted for the PFRA with respect to data sources, availability and review procedures,

1.6 Study Area

1.6.1 The administrative area of Leicester City covers an area of 71km^2. The study area is heavily urbanised and this urban nature has resulted in a number of watercourses being culverted and straightened and retained by formal engineered structures. There is also a high level of interaction between the surface water sewer system and watercourses.

1.6.2 The administrative area of LCC has a population of 304,800 (ONS 2009). Leicester has a diverse multicultural population with over 70 languages spoken in the city.

1.6.3 The topography on which the city lies is quite flat either side of the wide River Soar valley, but rises to the west towards Charnwood Forest, and to the east.

1.6.4 The city is underlain by a mixed solid geology of the Upper Triassic period consisting of various sedimentary deposits including Rhaetic Beds, Keuper Marls and Sandstones. These are overlain by a drift geology consisting of moderately permeable soils which can act to impede infiltration leading to up to 40% of rainfall running off (EA, River Trent CFMP 2010).

1.6.5 The River Soar flows from south to north in the west of the city, before eventually joining the River Trent at Trent Lock. The Grand Union Canal is also situated in the city and is interlinked with the navigable reaches of the River Soar.

1.6.6 There are numerous watercourses within the Leicester City administrative boundary some of which are designated as Statutory Main River and others as Ordinary Watercourses. LCC have responsibilities for ordinary watercourses, many of which are culverted and artificially straightened.

1.6.7 Some of the ordinary watercourses that the Council are investigating as part of the SWMP include:

- Hol Brook,
- Queens Road Brook,
- Portwey Brook,
- Gilroes Brook
- Wash Brook,
- Ethel Brook,
- Western Park Brook.

2. Lead Local Flood Authority Responsibilities

2.1 Introduction

2.1.1 The preparation of a PFRA is just one of several responsibilities of LLFAs under the new legislation. This section provides a brief overview of other responsibilities Leicester City Council are obliged to fulfil under their role as a LLFA.

2.2 Leadership and Partnership

2.2.1 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, LCC is therefore responsible for leading local flood risk management across Leicester.

2.2.2 Much of the local knowledge and technical expertise necessary for LCC to fulfil their duties as LLFA lies with the city council and other partner organisations. It is therefore crucial that Leicester City Council work alongside these groups and organisations as they undertake their responsibilities to ensure effective and consistent management of local flood risk throughout the county and to contribute to the provision of a coordinated and holistic approach to flood risk management across the study area.

Existing Flood Risk Collaboration

2.2.3 LCC actively participates in an existing collaborative flood risk partnership in the region. Under the Local Resilience Forum, a Flood Risk Management Board with representatives from Leicester City Council, Leicestershire County Council, Rutland County Council and other key stakeholders such as the Environment Agency, meet quarterly to review and coordinate LLFA actions and cross-boundary issues.

2.2.4 Linked to the Flood Risk Management Board, the Local Resilience Forum (LRF) also has several working groups which include the Flood Working Group (for flood response) and the Surface Water Management Group (SWaMp) (Figure 2-1). There are also plans to develop a Planning Group to feed into the LRF. In the meantime, a representative from the LCC Housing Planning and Infrastructure Group sits on the Flood Risk Management Board.

2.2.5 Collaboration between LCC, the County and Districts also occurs through Leicester & Leicestershire Local Economic Partnership. A working group on policies affecting the Principal Urban Area is co-ordinated by the Housing Planning and Infrastructure Group which can be developed to enable cross-boundary working on flood risk and planning.

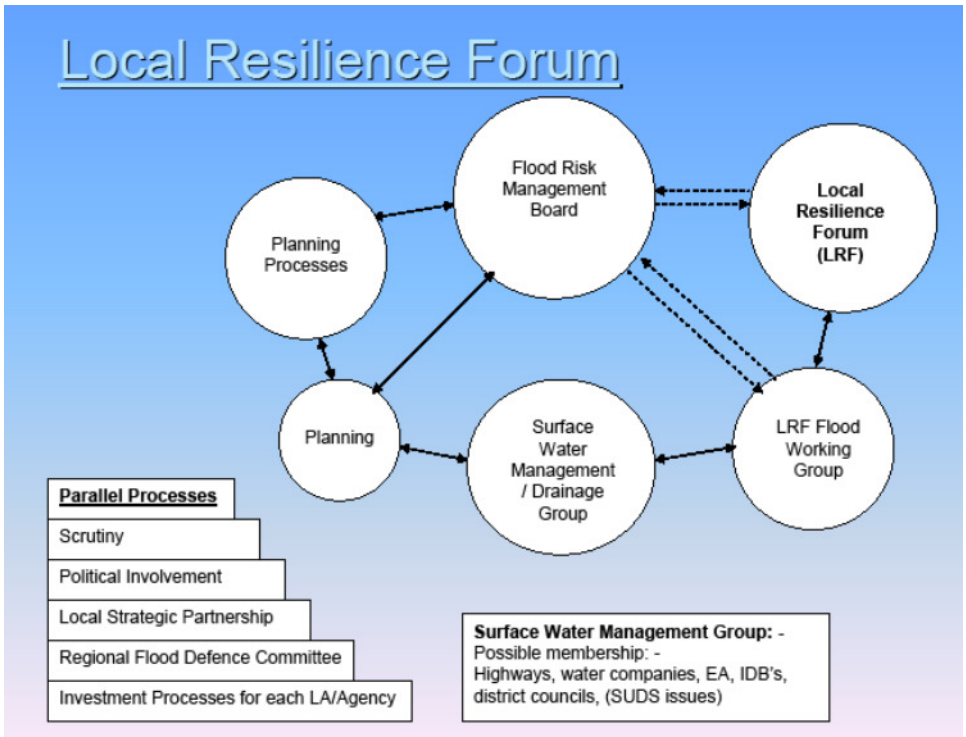

Figure 2-1: Existing flood risk collaboration under the LRF

2.2.6 LCC also has an existing internal, inter-service flood risk collaboration. The City Highways, Emergency Management, Planning, including Design and Conservation and Information Services teams currently work together on flood risk issues. This is overseen by the Director of Corporate Governance within the City Council.

Developing Flood Risk Partnerships for the Future

2.2.7 To prepare for new duties under the Flood and Water Management Act (2010), LCC are currently examining a number of organisational and procedural actions alongside a SWMP. Part of this process is to further develop and improve the existing internal and external flood risk partnerships.

2.2.8 LCC have established a 'Lead Local Flood Authority Board' and have identified six main functions that the board will fulfil. Following the function theme, LCC have identified internal members for the board (Figure 2-2) and have also specified working groups. The LLFA board is intended to work with and compliment the existing Flood Risk Management Board at the LRF level so that LCC continue to work closely with neighbouring LLFAs and key stakeholders.

2.2.9 LCC are also formalising the way that council services work together around these functions and have identified a working and reporting structure that form the corporate governance of the Lead Local Flood Authority Board.

2.2.10 The draft structure is presented in Figure 2-3. Contributing departments will all report through the Chair of the Lead Local Flood Authority Board (The chair of which has already been identified as the Director of Corporate Governance) to the Reducing Carbon Footprint Priority Board, which in turn reports to the City Mayor and Cabinet. The Overview and Scrutiny Management Board will scrutinise operations of the Lead Local Flood Authority Board in addition to reviewing and scrutinising reports, strategies, proposed options and other outputs.

2.2.11 The Lead Local Flood Authority Board will maintain close links and communications with the external partners and key stakeholders, who will also be invited to comment on and contribute to the operations of the Board.

Council Divisions

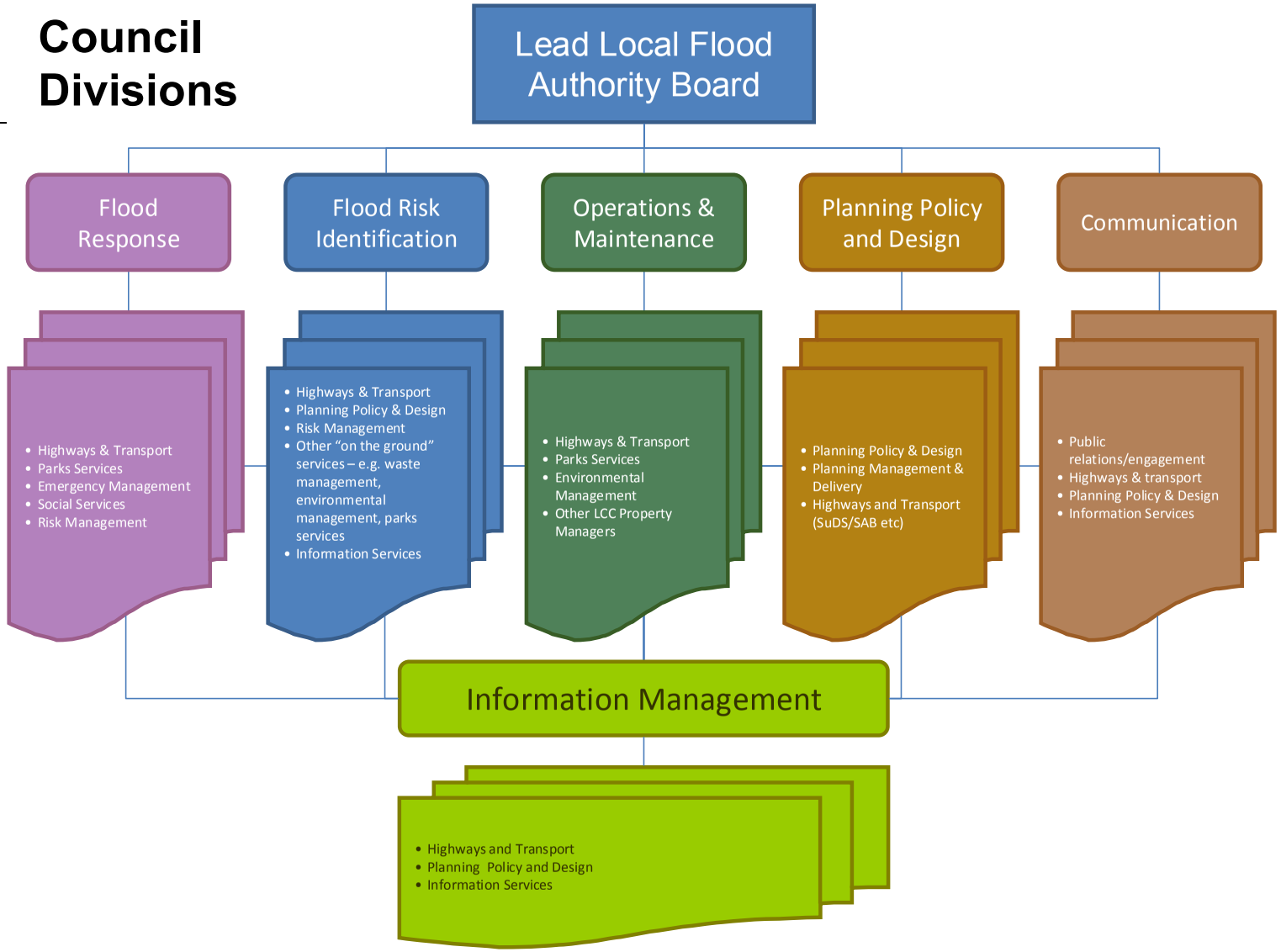

Figure 2-2: Internal membership of the proposed LCC Lead Local Flood

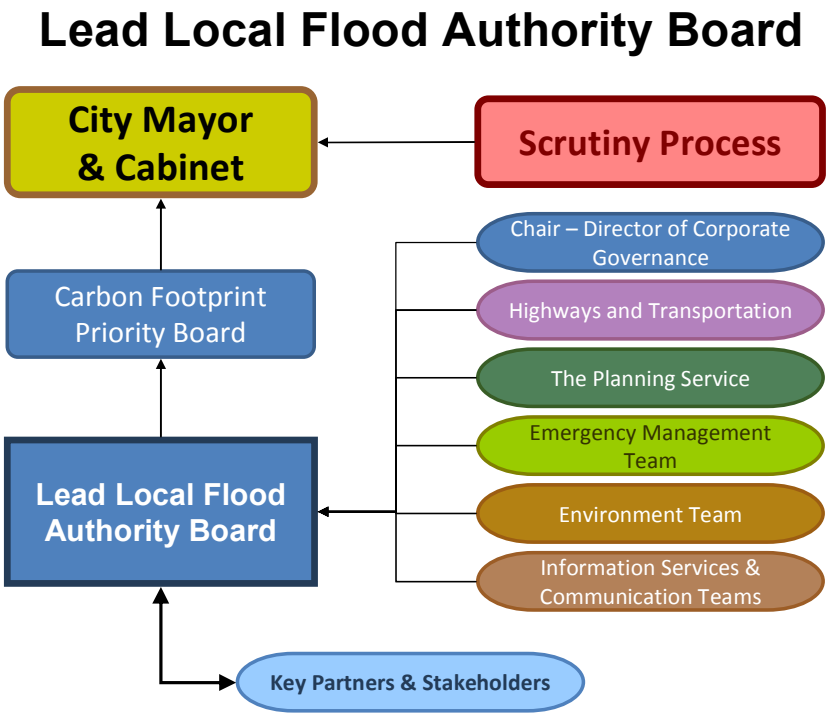

Figure 2-3: Reporting and governance structure for the LCC Lead Local Flood Authority Board

2.2.12 Key to the success of any flood risk partnership is the sharing and management of knowledge and LCC recognise this as underpinning successful flood risk management across the city. Another key component is communication at different levels from Council members to the general public.

2.2.13 LCC are committed to working collaboratively and in partnership with key stakeholders, neighbouring authorities and across departments to ensure that flood risk management in the area is properly coordinated and is carried out in a sustainable and efficient manner. To ensure that this is recognised within the Lead Local Flood Board, LCC have identified external partners under the same functions as the internal structure to allow for a consistent approach to flood risk management (Figure 2-4).

2.3 Stakeholder Engagement

2.3.1 As part of the preparation of the PFRA and SWMP for Leicester, stakeholders have been and will continue to be engaged representing the following organisations and authorities:

- Environment Agency
- Severn Trent Water Ltd
- Neighbouring Authorities and LLFAs
- British Waterways
- Network Rail
- On-Trent
- Leicestershire Fire and Rescue Services
- Highways Agency
- Natural England
- Critical Services – NHS/Utilities

External Partners

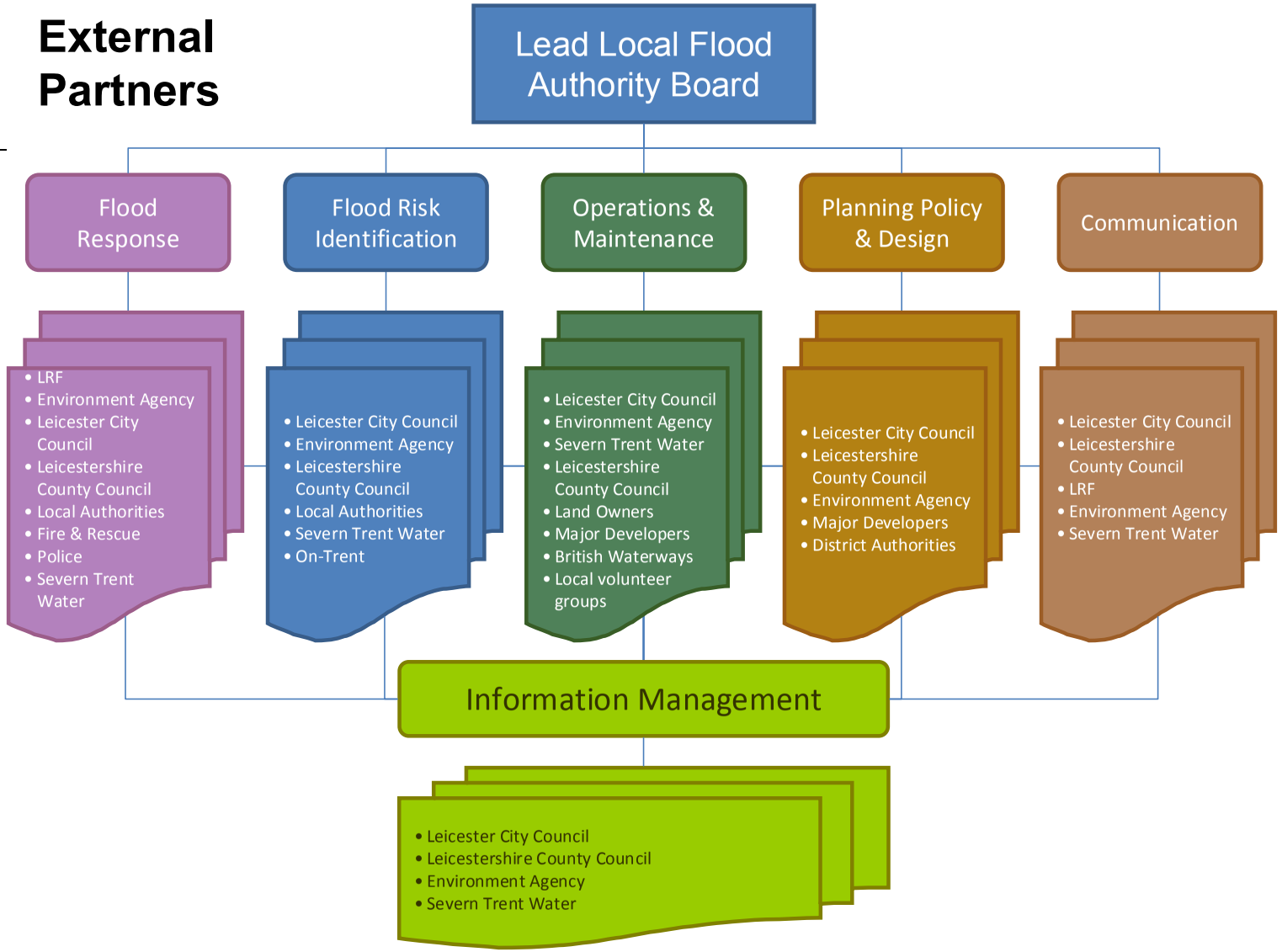

Figure 2-4: Suggested External Partners of the proposed LCC Lead Local Flood

2.4 Public Engagement

2.4.1 It is recognised that members of the public may also have valuable information to contribute to the PFRA and to local flood risk management more generally across Leicester. Stakeholder engagement can afford 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.

2.4.2 However it is also recognised that it is crucial to plan the level and timing of engagement with communities predicted to be at risk of flooding from surface water, groundwater and ordinary watercourses. This is to ensure that the potential for future management options and actions is adequately understood and costed without raising expectations before solutions can reasonably be implemented.

2.4.3 It is important to undertake some public engagement when formulating local flood risk management plans (for the Flood Risk Area covering Leicester) as this will help to inform future levels of public engagement. It is recommended that LCC follow the guidelines outlined in the Environment Agency's 'Building Trust with Communities' document which provides a useful process of how to communicate risk including the causes, probability and consequences to the general public and professional forums such as local resilience fora.

2.5 Further Responsibilities

2.5.1 Aside from forging partnerships and coordinating and leading on local flood management, there are a number of other key responsibilities that have arisen for Lead Local Flood Authorities from the Flood & Water Management Act and the Flood Risk Regulations. These responsibilities include:

- **Investigating flood incidents** – 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** – LLFAs also have a duty to maintain a register of structures or features which are considered to have an effect on flood risk, including details on ownership and condition as a minimum. 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.
- **SuDS Approving Body** – LLFAs are designated the SuDS Approving Body (SAB) for any new drainage system, and therefore must approve, adopt and maintain any new sustainable drainage systems (SuDS) within their area.
- **Local Strategy for Flood Risk Management** – 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.

- **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** – LLFAs, as well as district councils 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.

3. Methodology and Data Review

3.1 Data Sources and Availability

3.1.1 The approach for producing this PFRA was based upon the Environment Agency's PFRA Final Guidance, which was released in December 2010. The PFRA is based on readily available or derivable data and with this in mind; the following methodology has been used to undertake the PFRA.

3.2 Methodology

Data Collection from Partner Organisations

3.2.1 The following authorities and organisations were identified and contacted to share data for the preparation of the PFRA; LCC, Severn Trent Water, British Waterways, Leicester Fire and Rescue Service, and the Environment Agency.

Assessing Historic Flood Risk

3.2.2 Existing datasets, reports and anecdotal information from the stakeholders listed above were collated and reviewed to identify details of major past flood events and associated consequences including economic damage, environmental and cultural consequences and impact on the local population.

3.2.3 It was anticipated that information would be provided in a geo-referenced format. However, where this was not the case for some datasets, this data was geo-referenced where possible. This 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.

Assessing Future Flood Risk

3.2.4 The identification of Flood Risk Areas through the PFRA should also take into account future floods. The assessment of future flood risk will primarily rely on a combination of a technical review of the Environment Agency's Flood Map for Surface Water and the pluvial and ordinary watercourse modelling which is currently being undertaken for LCC as part of their SWMP.

3.2.5 The following factors were considered when assessing future flood risk across the Leicester study area; topography, location of ordinary watercourses, location of floodplains that retain water, characteristics of watercourses (lengths, modifications), effectiveness of any works constructed for the purpose of flood risk management, location of populated areas, areas in which economic activity is concentrated, the current and predicted impact of climate change and the predicted impact of any long-term developments that might affect the occurrence or significance of flooding, such as proposals for future development.

Identifying Flood Risk Areas

3.2.6 Information regarding historic and future flood risk will be used to formally identify Flood Risk Areas. To achieve this, flood risk indicators will be used to determine the impacts of flooding on human health, economic activity, cultural heritage and the environment. The use of flood risk indicators helps to develop understanding of the impacts and consequences of flooding. Key flood risk indicators are summarised in Table 3-1.

Table 3-1: Key Flood Risk Indicators

Impacts of flooding on:	Flood Risk Indicators
Human Health	Number of residential properties. Critical services (Hospitals, Police/Fire/Ambulance Stations, Schools, Nursing Homes, etc).
Economic Activity	Number of non-residential properties. Length of road or rail. Area of agricultural land.
Cultural Heritage	Cultural heritage sites (World Heritage Sites).
Environment	Designated sites (SSSIs, SACs, SPAs, etc) and BAP habitat.

3.2.7 The above 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 and identified as Indicative Flood Risk Areas. Leicester has been identified as one of ten national Indicative Flood Risk Areas. For further details, please refer to Defra's Guidance for selecting and reviewing Flood Risk Areas for local sources of flooding (December 2010).

3.3 Data Sources and Availability

3.3.1 Table 3-2 catalogues the relevant information and datasets held by partner organisations and provides a description of each of the datasets. Much of this data was collected as part of the ongoing LCC SWMP. A register of data collected for the SWMP can be found in Annex 6.

Table 3-2: Relevant Information and Datasets

	Dataset	Description
Environment Agency	Areas Susceptible to Surface Water Flooding	The first generation national mapping, which outlines areas of risk from surface water flooding across the country with three susceptibility bandings (less, intermediate and more susceptible).
	Flood Map for Surface Water	The updated (second generation) national surface water flood mapping which was released at the end of 2010. This dataset includes two flood probabilities (1 in 30 and a 1 in 200 chance of occurring) and two depth bandings (greater than 0.1m and greater than 0.3m).
	Flood Map (Rivers and the Sea)	Shows the extent of flooding from rivers with a catchment of more than 3km^2 and flooding from the sea.
	Areas Susceptible to Groundwater Flooding	Coarse scale national mapping showing areas which are susceptible to groundwater flooding.
	National Receptors Dataset	A national dataset of social, economic, environmental and cultural receptors including residential properties, schools, hospitals, transport infrastructure and electricity substations.
	Indicative Flood Risk Areas	Nationally identified flood risk areas, based on the definition of 'significant' flood risk described by Defra and WAG.
	Historic Flood Map	Attributed spatial flood extent data for flooding from all sources.
	River Trent (CFMP)	CFMPs consider all types of inland 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.
	Strategic Flood Risk Mapping reports, models and outputs	Under the Environment Agency's Strategic Flood Risk Mapping programme, detailed river models and flood risk maps have been produced for the main rivers in Leicester.
Leicester City Council	Strategic Flood Risk Assessments (SFRA)	SFRAs contain useful information on historic flooding, including local sources of flooding from surface water, groundwater, ordinary watercourses and canals.
	Historical flooding records	Historical records of flooding from surface water, groundwater and ordinary watercourses including reports from 1993, 1998, 1992. Location of Flood Retention Basins
Severn Trent Water	DG5 Register for Severn Trent areas	DG5 Register logs and records of sewer flooding incidents in each area.
British Waterways	British Waterways canal network	Detailed GIS information on the British Waterways canal network, including the location of canal centrelines, sluices, locks, culverts, etc.
	Records of canal breaches and overtopping events	Records of historical canal breaches and canal overtopping events across Leicester.
Leicestershire Fire & Rescue Services	Call out records for flooding incidents.	Records of flooding incidents for Leicester City where the Fire and Rescue Service has been called out to assist (for example, pumping or resuce).

3.4 Data Limitations

3.4.1 A brief assessment of the data collection and review process is included in this section to provide transparency with respect to the methodology. LCC and their key stakeholders are aware of many of the limitations that existing datasets present. As part of their duties under the Flood and Water management Act, LCC will be formally recording flood incidents and maintaining an asset register that will improve the quantity, quality and consistency of future flood risk datasets. A number of issues arose during the data collection process, as described below:

Inconsistent Recording Systems

3.4.2 Flood events are currently recorded by the City Highways Team. However, incidents are also recorded by other departments within the council such as the Emergency Management Team or the Environment Team. At present, there is no formal and consistent process for recording flooding incidents. So, one team may keep a full record of a flood incident including the numbers of properties affected, dates, times, flow routes etc. whilst another may only record the fact that an incident has occurred. However, this will change as the Lead Local Flood Authority Board consults with Council teams and implements new procedures.

3.4.3 At present, the recording of flood incidents amongst external stakeholders is also undertaken in an inconsistent manner. Consequently, this has led to a variation in the level of detail and quantity of data available. Further information on addressing this issue in the future is included in Section 7.

Incomplete Datasets

3.4.4 The Highways team holds digital records (excel and also in GIS) of locations affected by flooding from 1983 to present day. They also hold some paper records of other historical flood events together with locations known to regularly flood during heavy rainfall. However, as highlighted above, some of the datasets collated are not exhaustive and may not accurately represent the complete flood risk issues in a particular area. This is to be expected with historical datasets but nonetheless could impact on the identification of flood risk areas.

Records of Consequences of Flooding

3.4.5 Very few data providers were able to provide comprehensive details of the consequences of specific past flood events, which made accurately assessing the consequences of historic flooding difficult.

3.5 Quality Assurance

3.5.1 The datasets used to inform this PFRA were collected for the LCC SWMP and Level 2 SFRA. All data received has been subject to quality assurance measures to monitor and record the quality and relevance of the data and information. A data quality score was given, which is a qualitative assessment based on the Data Quality System provided in the SWMP Technical Guidance document (March 2010). This system is explained in Table 3-3.

Table 3-3: Data Quality System from SWMP Technical Guidance (March 2010)

Data Quality Score	Description	Explanations	Example
1	Best available	No better available; not possible to improve in the near future	High resolution LiDAR, river flow data, rain-gauge data
2	Data with known deficiencies	Best replaced as soon as new data is 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 surface water flooding
4	Heroic assumptions	An educated guess	Ground roughness for 2d models

3.5.2 The use of this system provides a basis for analysing and monitoring the quality of data that is being collected and used in the preparation of the PFRA.

3.6 Security, Licensing and Use Restrictions

3.6.1 A number of datasets used in the preparation of this PFRA are subject to licensing agreements and use restrictions. The following national datasets provided by the Environment Agency are available to local authorities and their consultants for emergency planning and strategic planning purposes:

- Flood Map for Rivers and the Sea
- Areas Susceptible to Surface Water Flooding
- Areas Susceptible to Groundwater Flooding
- Flood Map for Surface Water
- National Receptor Database

3.6.2 A number of the data sources used are publicly available documents, such as:

- Strategic Flood Risk Assessment
- Catchment Flood Management Plan
- Surface Water Management Plan (ongoing)

3.6.3 The use of some of the datasets made available for this PFRA has been restricted. These include records of property flooding held by the Council and Severn Trent Water Ltd. Necessary precautions must be taken to ensure that all information given to third parties is treated as confidential and is in accordance with data and licensing agreements. The information must not be used for anything other than the purpose stated in the agreement. No information may be copied, reproduced or reduced to writing, other than what is necessary for the purpose stated in the agreement.

3.6.4 Some datasets may only be licensed for use by the Council for a limited period of time and this should be taken into account when updates or revisions are made to the PFRA or subsequent studies.

3.6.5 The security of data is also a key consideration when it comes to collecting, collating and storing sensitive data. All data collected is stored on local servers which are password protected. Leicester City Council must adhere to these data security measures to ensure that sensitive data is held in a secure manner.

4. Past Flood Risk

4.1 Overview of Historic Flooding in Leicester

4.1.1 Flood records across Leicester were collected from the data sources discussed in Table 3-2. Records of over 700 historical flood events and flooding hotspots were collected across LCC's administrative area. From the total number of historical incidents recorded by LCC, it appears that the June 1993 event was one of the most significant. January 1998, October 1998 and November 1989 have also numerous incidents (Figure 4-1). A summary map highlighting the locations of these past flood events has been produced and is illustrated in Figure 4-2.

4.1.2 However, other historical records such as local newspapers and articles, suggest that one of the largest flooding events to occur in Leicester was in July 1968 where up to 1800 properties were affected.

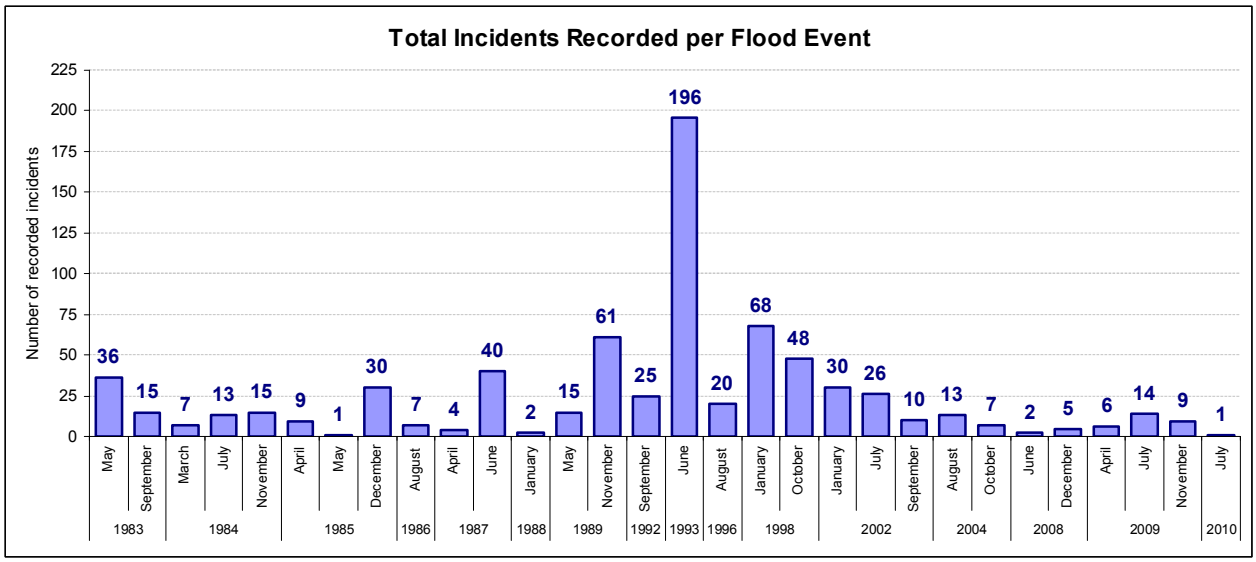

Figure 4-1: Total number of recorded flood incidents by LCC

4.1.3 These flood events came from a range of flood sources including blocked drains and gullies, sewers, ordinary watercourses and surface water flooding. In many cases the source of flooding was unknown or not recorded. Of the historical records reviewed, nearly 400 have some description of the flood source. However, over 300 records are unclear with regards to the flood source or impact.

4.1.4 Table 4-1 provides a summary of the consequences of the recorded floods where the information was available.

4.1.5

Table 4-1: Summary of recorded historic flooding incidents in Leicester

Flood Event		Source of Flooding	Consequences of Flooding
1968	July	Main rivers, ordinary watercourses, surface water, sewerage, blocked drains and gullies, ponding	Flooded roads, footpaths, gardens, property (cellars, basements, garages, ~1800 houses), commercial property (shops, factories, hotels etc)
1983	May	Surface water, sewer, possible groundwater	Flooded roads, footpaths, gardens, property (cellars, basements)
	September		
1984	March	Surface water, ponding, ordinary watercourse flooding, sewer, possible groundwater	Flooded roads, footpaths, gardens, property (cellars, basements, garages, houses)
	July		
	November		
1985	April	Surface water, ponding, blocked drains and gullies, blockage in ordinary watercourse	Mainly flooded roads and footpaths. Car park affected, property (cellars and gardens), commercial property (shop)
	May		
	December		
1986	August	Blocked drains and gullies, blockages on ordinary watercourses	Mainly flooded roads and footpaths.
1987	April	Surface water, blocked drains and gullies	Mainly flooded roads and footpaths.
	June	Surface water, ponding, ordinary watercourse flooding, sewer, possible groundwater	Flooded roads, footpaths, gardens, property (cellars, basements, garages, houses), commercial property (pub, factory)
1988	January	Surface water	1 property and school (or grounds) affected
1989	May	Surface water, sewer, ordinary watercourse	Mainly flooded roads and footpaths, driveways, commercial property (shop)
	November	Surface water, ponding, ordinary watercourse flooding, sewer, possible groundwater	Flooded roads, footpaths, gardens, property (cellars, basements, garages, houses), commercial property (hotels and industrial units)
1992	September	Surface water, sewer, ordinary watercourse	Flooded roads, footpaths, gardens, property (houses)
1993	June	Surface water, ponding, ordinary watercourse flooding, sewer, possible groundwater	Flooded roads, footpaths, gardens, property (cellars, basements, garages, ~71 houses), commercial property (shops, sports centre, hotels and industrial units)
1996	August	Surface water, sewer, ordinary watercourse	Flooded roads, footpaths, gardens, property (cellars, basements)
1998	January	Surface water, sewer, ordinary watercourse	Flooded roads, footpaths, gardens, property (houses), school
	October		
2002	January	Surface water, ponding, blocked drains and gullies, blockage in ordinary watercourse	Flooded roads, footpaths, gardens, property (houses)
	July		
	September		

Table 4-1: Summary of recorded historic flooding incidents in Leicester

Flood Event		Source of Flooding	Consequences of Flooding
2004	August	Surface water, blocked drains and gullies	Flooded roads, footpaths, gardens, property (houses)
	October		
2008	June	Surface water, blocked drains and gullies	Mainly flooded roads and footpaths.
	December		
2009	April	Surface water, ponding, blocked drains and gullies, blockage in ordinary watercourse	Mainly flooded roads and footpaths, driveways, property (houses), commercial property (Hotel)
	July		
	November		
2010	July	Surface water, blocked drains and gullies	Mainly flooded roads and footpaths.

Significant Flood Event

4.1.6 A summary of information specific to each source of flooding considered as part of the PFRA is included below.

4.2 Surface Water Flooding

4.2.1 Surface water flooding occurs when heavy rainfall exceeds the capacity of local drainage networks and water flows across the ground. Pluvial/surface water flooding has historically and continues to be a significant problem in Leicester. The flashy nature and short duration of such events has made them difficult to predict and protect against. Numerous events have been recorded in the past and are included on Figure 4-2.

4.3 Ordinary Watercourse flooding

4.3.1 Flooding from ordinary watercourses can occur as a result of the channel capacity being exceeded, a blockage occurring, or as a result of small culverted sections surcharging.

4.3.2 Several ordinary watercourses have caused flooding in the past and some records exist for these incidents. The main consequence appears to be flooding to roads and gardens, but properties have also been affected. Ordinary watercourses that are known to have flooded include Portwey Brook, Ethel Brook, Gilroes Brook, Hol Brook and Wash Brook.

4.4 Flooding from Canals

4.4.1 Information was obtained from British Waterways which details the canal network throughout Leicester, including the location of canals, weirs, sluices and locks. British Waterways also provided details of historic breaches or overtopping events that have occurred across the city.

4.5 Groundwater Flooding

4.5.1 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.

4.5.2 Groundwater flooding incidents are thought to have occurred in Leicester in the past and have affected basements, cellars and other underground facilities. However, according to Council officers, it is often unclear as to whether the flooding is caused as a result of high groundwater levels or as a result of nearby drainage and distribution networks (burst water pipes, broken sewers etc) or other local factors.

4.6 Sewer Flooding

4.6.1 In urban areas, rainwater is frequently drained into surface water sewers or sewers containing both surface and waste water known as 'combined sewers'. Flooding can result when the sewer is overwhelmed by heavy rainfall, becomes blocked or is of inadequate capacity. Due to the potential for sewer flooding in urbanised areas, the data that utility companies hold on the public sewer network can be of high importance in identifying possible flood sources for an area.

4.6.2 Much of the sewer network in Leicester could date back to Victorian times and sections of the network are of unknown capacity and condition. More recent sewers are likely to have been designed to the guidelines in "Sewers for Adoption" (WRC, 2006). These sewers tend to have a design standard of up to the 1 in 30 year storm event (equating to approximately a 1 in 5 year flood flow), although in many cases, it is thought that this design standard is not achieved, especially in privately owned systems.

4.6.3 Severn Trent Water (STW) are keen to participate in flood risk management in Leicester and have agreed to share with LCC certain datasets that can assist in identifying flood sources in the city, one of which was the DG5 register of sewer flooding (terms and conditions apply due to the potentially sensitive information contained in the datasets which may mean that some data cannot be shared publicly).

4.6.4 In order to fulfil statutory commitments set by OFWAT, water companies must maintain verifiable records of sewer flooding, which is achieved through their DG5 registers. Water companies are required to record flooding arising from public foul, combined or surface water sewers and identify where properties have suffered internal or external flooding. The DG5 register does not however indicate areas or properties at risk of future flooding.

4.6.5 DG5 registers from Severn Trent Water were analysed to investigate the occurrence of sewer flooding incidents across Leicester. Sewer flooding has been recorded at numerous locations in the study area. This includes both surface water (643 events) and foul water (636 events) and both internal (66 events) and external flooding (100).

4.6.6 It is important to note that the DG5 register indicates areas reported to STW that have experienced flooding in the past (typically the last 10 years) as a result of insufficient hydraulic capacity in the sewer network. The flood records provided could be misleading as they may not be a complete and accurate record of flood events in the study area as some minor flooding incidents may go unreported, particularly if no property is affected by internal flooding.

4.6.7 Furthermore, maintenance work may have been undertaken by STW since the flooding incident(s) occurred. Sewer flooding models provide a much more detailed and useful appreciation of the risk posed. However much of this work is not yet publicly available due to commercially sensitive issues or the Data Protection Act (1998).

4.6.8 Until more detailed and suitable data becomes available, LCC, the EA and STW have agreed to continue to liaise to determine how sewer flooding data can best be used to inform flood risk management in Leicester.

4.7 Consequences of Historic Flooding

4.7.1 The Regulations require LLFAs to assess historical flood events that have had significant or harmful consequences. A significant or harmful flood event is one that can be viewed as serious enough to be reported to Europe and must therefore be assessed as part of the PFRA and included in Annex 1.

4.7.2 However, this does not prevent LLFAs from including details of less severe historical flood events within the PFRA if they are considered relevant and useful to demonstrate flood risk issues. The Environment Agency indicate[2] that the following factors may be taken into account by LLFAs when assessing whether a historic flood event had significant harmful consequences:

- Flooding was registered on a national scale, even if only occurring over a relatively small area.
- The flood event was memorable or notable.
- Flooding is considered by a LLFA to be significant (based on local knowledge) when taking into account the scale, harmful consequences (for human health, economic activity and the environment) and the level of response (for example, did it results in the formation of a strategic flood risk management group).
- The scale of the flood impacts and also their severity. For instance, internal flooding of a large number of properties is likely to be considered significant, but flooding to a large number of gardens is not.
- The quality of recorded information is sufficient to determine if there were 'significant harmful consequences.'

[2] Environment Agency: Flood Risk Regulations PFRA FAQs v2-1, March 2011

4.7.3 As a result of the issues discussed in Section 3.4, insufficient data is available to draw definitive conclusions on the significance and consequences on people, the economy and the environment, of most of the recorded historic flood events. Only two of the incidents – July 1968 and June 1993 – have any information on the numbers and types of properties affected. Records suggest that flooding for both events occurred through a combination of surface water, sewer flooding, and ordinary watercourses overtopping.

4.7.4 The July 1968 flood event reportedly affected 1800 homes and 28 factories and so clearly had consequences on people and the economy. Using a figure of 2.34 people per household, (based on the Office of National Statistics guidance), 4,212 people may have been affected by the July 1968 flood event. Similarly, the June 1993 event affected approximately 71 homes, which may have affected 166 people. As a result these two historic flood events have been considered to have had 'significant harmful consequences' and therefore have been recorded in Annex 1 of the Preliminary Assessment Spreadsheet.

4.7.5 It should also be noted that following the 1968 flood event, a significant programme of flood risk management measures was implemented in Leicester, including flood storage basins, watercourse channels works and constructions of walls and embankments.

4.7.6 Flood records do exist for Leicester before 1968, however the quality and accuracy of these records is uncertain. In addition, land use, watercourse routes, drainage and flood risk infrastructure have changed so much, that the relevance of these events are thought to be less significant to current and future flood risk management in Leicester.

4.7.7 A complete record of locations where flooding has occurred will be kept by LCC as a future evidence base. This base will be built up in the future through ensuring full details of flood events are recorded; this will then be used to support and inform future PFRA cycles as well as Leicester's Local Flood Risk Management Strategy.

5. Future Flood Risk

5.1 Overview of Future Flood Risk

Surface Water Flooding

5.1.1 A SWMP is currently underway for the entire Leicester Principal Urban Area (PUA), and the draft results of the SWMP pluvial modelling have been used to inform this PFRA. Results from the pluvial modelling will also be available to inform the second cycle of the PFRA process and the production of flood hazard and flood risk maps for this area.

5.1.2 The Environment Agency has produced a national assessment of surface water flood risk in the form of two national mapping datasets. The first generation national mapping, Areas Susceptible to Surface Water Flooding (AStSWF), contains three susceptibility bandings for a rainfall event with a 1 in 200 chance of occurring. The national methodology has since been updated to produce the Flood Map for Surface Water (FMfSW), a revised model containing two flood events (1 in 30 annual chance and 1 in 200 annual chance) and two depth bandings (greater than 0.1m and greater than 0.3m). The Flood Map for Surface Water is illustrated in Figure 5-1, highlighting areas at risk of surface water flooding in the future.

5.1.3 Using Environment Agency data, the number of properties at risk of surface water flooding within the Leicester Indicative Flood Risk Area has been estimated (please note that the property count includes hydrological linked neighbouring authorities that are covered by the Indicative Flood Risk Area).

5.1.4 For a rainfall event with a 1 in 200 annual chance of occurring, 36,900 properties are at risk within the Leicester City Council boundary from flooding to a depth of 0.1m and 13,200 properties are at risk from flooding to a depth of 0.3m[3]. Of these properties at risk, over half are residential properties. Further details on the potential harmful consequences of future flooding are included in Annex 2 of the Preliminary Assessment Spreadsheet.

Groundwater Flooding

5.1.5 Although it is thought that groundwater flooding has occurred in the past, there is no local information available which provides evidence on future groundwater flood risk across Leicester and groundwater rebound is not believed to be an issue in the county. The Environment Agency's national dataset, Areas Susceptible to Groundwater Flooding, has been used to form the basis of the assessment of future flood risk from groundwater. This dataset is illustrated in Figure 5-2 and areas at high risk from groundwater flooding are identified.

Flooding from Ordinary Watercourses

5.1.6 The fluvial flood map has been used to assess the risk of flooding from ordinary watercourses. The Detailed River Network was used to identify ordinary watercourses and this was cross referenced with the Flood Map for Rivers and the Sea to assess future flood risk from this source.

[3] Environment Agency Spreadsheet: "LLFA_Property_Counts_Rounded_for_PFRA", March 2011

5.1.7 However there is insufficient data in the Flood Map regarding ordinary watercourses within the study area to make an accurate assessment of the future flood risk associated with these watercourses. As part of the LCC SWMP, 8 ordinary watercourses are being modelled to assess in greater detail than the flood map, what the future flood risks may be.

5.1.8 Outputs from this modelling will be reviewed by the Lead Local Flood Board and key stakeholders (including the Environment Agency) and may be used to identify new flood risk areas in Leicester.

Flooding from Canals

5.1.9 There is no available information on future flood risk from canals. However, British Waterways are currently working on a study to better understand the future flood risk from canals, which will be available to inform the second cycle of the PFRA process.

5.2 Locally Agreed Surface Water Information

5.2.1 A definition of 'locally agreed surface water information' has been considered in conjunction with the Environment Agency and Severn Trent Water in order to agree what surface water information best represents local conditions across Leicester. Currently the FMfSW, which gives an overview of the future flood risk from surface water across Leicester, forms the agreed available surface water flooding information in Leicester. This dataset is illustrated in Figure 5-1.

5.2.2 However, the SWMP that is currently being completed for Leicester has completed city-wide pluvial modelling at a greater level of detail than the FMfSW dataset. The pluvial modelling has been used to identify and revise the numbers of properties at risk of surface water flooding in Leicester. The outputs from the pluvial modelling have been distributed to key stakeholders for review, comment and verification. Until the modelled outputs have been agreed by the Lead Local Flood Board, they cannot be used in this cycle of the PFRA, however it is anticipated that the results will form the Locally Agreed Surface Water Information for Leicester for the next cycle of the PFRA.

5.3 Potential Consequences of Future Flooding

5.3.1 The Environment Agency has used the FMfSW mapping and the NRD to identify a number of areas across the country which exceed a given threshold, described in Table 5-2 below.

Table 5-1: Flood risk threshold used to identify future consequences of flooding

'Significant harmful consequences' defined as greater than…	***Description***
200 people *or*	*Flooded to a depth of 0.3m during a rainfall event with a 1 in 200 chance of occurring (or 0.5%)*
20 businesses *or*	
1 critical service	

5.3.2 This assessment was carried out based on 1km^2 national grid squares, and the grid squares that exceed this criterion were identified. The grid squares within Leicester where flood risk is considered to exceed this threshold are illustrated on Figure 5-3. These areas represent where flood risk is considered to be the most severe across the Country.

5.3.3 The potential consequences on key flood risk indicators (as discussed in Table 3-1) have been assessed by the Environment Agency; this information has been included in Annex 2 of the Preliminary Assessment Spreadsheet.

5.4 Climate Change and Long Term Developments

The impacts of climate change

5.4.1 The impact of climate change on local flood risk is relatively poorly understood. Several national flood maps have informed the preliminary assessment report - specifically the Flood Map for Surface Water (surface runoff), Areas Susceptible to Surface Water Flooding (surface runoff), Areas Susceptible to Groundwater Flooding (groundwater) and Flood Map (ordinary watercourses). These do not show the impact of climate change on local flood risk.

5.4.2 There was consensus amongst climate model projections presented in the IPCC fourth assessment report for northern Europe suggesting that in winter high extremes of precipitation are very likely to increase in magnitude and frequency. These models project drier summers with increased chance of intense precipitation — intense heavy downpours interspersed with longer, relatively dry periods (Solomon et al., 2007).

5.4.3 The pluvial and ordinary watercourse modelling being undertaken as part of the LCC SWMP have simulated the potential effects of climate change on flood risk in Leicester.

UKCP09

5.4.4 United Kingdom Climate Projections 2009 (UKCP09) provides the most up to date projections of future climate for the UK (http://ukclimateprojections.defra.gov.uk/). In terms of precipitation, the key findings are:

5.4.5 By the 2080s, under Medium emissions, over most of lowland UK central estimates are for heavy rain days (rainfall greater than 25 mm) to increase by a factor of between 2 and 3.5 in winter, and 1 to 2 in summer.

5.4.6 By the 2080s, under Medium emissions, across regions in England & Wales the central estimate (50% probability) for winter mean precipitation % change ranges from +14 to +23. Central estimate for summer mean precipitation % change ranges from -18 to -24.

5.4.7 Certain key processes such as localised convective rainfall are not represented within this modelling so there is still considerable uncertainty about rarer extreme rainfall events for the UK. We can be more certain that heavy rainfall will intensify in winter compared to summer. The proportion of summertime rainfall falling as heavy downpours may increase. The impact of these changes on local flood risk is not yet known.

Appraisal guidance

5.4.8 Current project appraisal guidance (Defra, 2006) provides indicative sensitivity ranges for peak rainfall intensity, for use on small catchments and urban/local drainage sites. These are due to be updated following the UKCP09 projections above. They describe the following changes in peak rainfall intensity; +5% (1990-2025), +10% (2025-2055), 20% (2055-2085) and +30% (2085-2115). This was reviewed by the Met Office in 2008 using UKCP09 models (Brown et al., 2008). They suggest that, on the basis of our current understanding, these levels represent a pragmatic but not a precautionary response to uncertainty in future climate impacts. In particular for a 20% Annual Exceedance Probability (AEP) event (1 in 5 year chance), increases in precipitation intensity of 40% or more by the 2080s are plausible across the UK at the local scale.

Long term developments

5.4.9 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.

5.4.10 In England, 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."

5.4.11 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), but should be recorded here so that they can be reviewed in the future.

5.5 Proposed Major Developments

5.5.1 The current LCC Local Development Framework Adopted Core Strategy[4] identifies that 25,600 new houses are required between 2006 and 2026. Therefore, there are a number of proposed major developments within the City that include strategic development and regeneration areas. The specific flood risks to some of these areas are currently being assessed as part of the LCC Level 2 SFRA in accordance with PPS25.

5.5.2 In addition to development within Leicester City, a number of sustainable urban extensions (SUEs) are proposed in neighbouring LA areas. The Level 2 SFRA will consider the flood risk posed to and from the SUEs:

- Ashton Green (Leicester City Council),
- New Lubbesthorpe (Blaby District Council),

[4] Leicester City Local Development Framework - Adopted Core Strategy, November 2010

- East of Thurmaston (Charnwood Borough Council),
- Anstey / Glenfield (Charnwood Borough Council),
- North of Birstall (Charnwood Borough Council),
- Harborough (Harborough District).

5.5.3 As the SUEs are in neighbouring LA areas, it is vital that the Lead Local Flood Authority Board works in partnership with neighbouring authorities.

6. Review of Indicative Flood Risk Areas

6.1 Overview

6.1.1 In order to ensure a consistent national approach, Defra and WAG have identified significance criteria and thresholds to be used for defining flood risk areas. Guidance on applying these thresholds has been released in Defra's document "Selecting and reviewing Flood Risk Areas for local sources of flooding". In this guidance document, Defra have set out agreed key risk indicators and threshold values which must be used to determine Flood Risk Areas.

6.1.2 The methodology is based on using national flood risk information to identify 1km squares where local flood risk exceeds a defined threshold; these areas within Leicester are illustrated in Figure 5-3. Where a cluster of these grid squares leads to an area where flood risk is most concentrated, and over 30,000 properties are predicted to be at risk of flooding, this area has been identified as an Indicative Flood Risk Area.

6.1.3 This guidance has now been released and the Environment Agency has applied it to identify Indicative Flood Risk Areas across the country.

6.1.4 The area of Leicester has been identified as an Indicative Flood Risk Area. It must be noted that the designated area also covers hydrologically linked areas of adjoining administrative areas which are separate Lead Local Flood Authorities. Due to the hydrological linkage, the Indicative Flood Risk Area cannot be easily split and therefore it is important that a cross boundary and collaborative approach is taken to managing local flood risk as local issues can often stem from a wider catchment issue.

6.1.5 Environment Agency figures suggest that within the Leicester Indicative Flood Risk Area, there are up to 14,130 residential properties and 2,273 non-residential properties are at risk of deep flooding (>0.3 m).

6.2 Review of Indicative Flood Risk Area

6.2.1 Figure 5-3 shows the geographical extent of the indicative Flood Risk Area for Leicester. As discussed in the previous section, the proposed Flood Risk Area also covers a large part of the other neighbouring Councils which are not part of Leicester City Council's administrative area but form part of the drainage catchment. These include Charnwood Borough Council, Blaby District Council and Harborough District Council and due to the hydrological linkage, the Indicative Flood Risk Area cannot be easily split, therefore it is important that a cross boundary and collaborative approach is taken to managing local flood risk in Leicester.

6.2.2 Based on the 1km^2 grid and the currently available locally agreed surface water dataset, the Environment Agency FMfSW, the Indicative Flood Risk Area appears to give a fair representation of flood risk in Leicester City.

6.2.3 However, several areas with critical infrastructure and residential and commercial properties have been identified as being at risk of flooding on the fringes of the Indicative Flood Risk Area. In total, an additional 220 residential and 45 non-residential properties have been identified at risk in this area. Given the importance of this infrastructure (including the M1/M69 interchange and the County Police Headquarters) and the extent of the properties at risk, LCC and Leicestershire County Council have worked together and have agreed that the current Indicative Flood Risk Area should be extended. The extended area has a total of 14,350 residential and 2,318 non-residential properties at risk and is shown on Figure 5-3 in Annex 5.

7. Identification of Flood Risk Areas

7.1.1 LCC has reviewed the Indicative Flood Risk Area against the Environment Agency data together with other flooding information received and, in collaboration with Leicestershire County Council, propose to increase the size of the Indicative Flood Risk Area. This is due to areas of significant infrastructure (including the M1/M69 interchange and the County Police Headquarters) and properties identified at risk of flooding on the south western fringe of the Indicative Flood Risk Area. The proposed extension to the Indicative Flood Risk Area is shown in Figure 5-3 in Annex 5.

7.1.2 The proposed extension will ensure that the Indicative Flood Risk Area covers hydrologically linked areas of neighbouring authorities that include critical infrastructure and properties at risk of flooding. Therefore it is important that a cross boundary and collaborative approach is taken to managing local flood risk in Leicester.

7.1.3 As discussed in Section 5, there is a SWMP currently underway for Leicester. Once the outputs have been reviewed by the Lead Local Authority Flood Board and key stakeholders, additional new flood risk areas may be identified based on critical drainage areas identified in the SWMP. The outputs from this study will be used to support and inform the next stages of the requirements of the Flood Risk Regulations.

8. Next Steps

8.1 Future Data Management Arrangements

8.1.1 In order to continue to fulfil their role as LLFA, Leicester City Council is required to investigate future flood events and ensure continued collection, assessment and storage of flood risk data and information.

8.1.2 However, it is crucial that all records of flood events are documented consistently and in accordance with the INSPIRE Directive (2007/2/EC). It is recommended that a centralised database will be kept up to date by Leicester City Council, who has the overall responsibility to manage flood data through the whole administrative area of Leicester City. This can be used as an evidence base to inform future assessments and reviews and for input into the mapping and planning stages.

8.1.3 The proposed method for flood event data collection and management will be developed by the Lead Local Flood Authority Board. As part of this PFRA and the SWMP for Leicester, a GIS database of historical flood events has been prepared that is based on a simple spreadsheet system. This allows the database to be updated and completed by Council teams and key stakeholders without the need for specialist software.

8.1.4 An extract of the spreadsheet is presented below in Figure 8-1 and Figure 8-2. The fields are colour coded to represent the details which are absolutely compulsory, and those which would be useful to have but not essential.

Leicester City Council

Flood Event Data Recording System

Compulsory	Preferred	Optional

Records kept from: 00/01/1900
Records kept to: 00/01/1900

Total flood events: 0

Flood Event (Outline Name)	Event Date	Location (Address, Town)	Location (Post Code)	Event Duration (hours)	Estimated Return Period of Event	Depth of Flooding (m)	Extent of Flooding (m^2)	Flooding Source	Confidence of Source * (see notes)	Residential Properties Flooded	Commerical Properties Flooded

Figure 8-1: Flood Event Data Recording System - Part One

									Rainfall Event	
Commerical Properties Flooded	Critical Infrastructure at Risk	Damage Caused	Photos of Flood Event	Photo File Location	Details of any Actions Taken	Issue Resolved	Additional Notes or Information	Rainfall Depth (mm)	Rainfall Duration (hours)	

Figure 8-2: Flood Event Data Recording System - Part Two

8.2 Scrutiny & Review Procedures

8.2.1 The scrutiny and review procedures that must be adopted when producing a PFRA are set out by the European Commission. 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 flood risk areas are identified.

8.2.2 Another important aspect of the review procedure is to ensure that the guidance is applied consistently. A consistent approach will allow all partners to understand the risk and manage it appropriately. The scrutiny and review procedure will comprise two key steps, as discussed below.

Local Authority Review

8.2.3 The first part of the review procedure is through an internal Lead Local Flood Authority Board review of the PFRA, in accordance with appropriate internal review procedures. Internal review should be undertaken to ensure the PFRA meets the required quality standards, before it is submitted to the Environment Agency.

8.2.4 Within Leicester, the PFRA was presented to the Leicester Lead Local Flood Authority Board for review on the 25th March 2011. It has also been taken for scrutiny by the Leicester City Council Overview and Scrutiny Committee. Finally, the PFRA will be presented to the Reducing Carbon Footprint Board and the City Mayor for internal approval before being delivered to the Environment Agency for final approval.

Environment Agency Review

8.2.5 Under the Flood Risk Regulations, the Environment Agency has been given a role in reviewing, collating and publishing all of the PFRAs once submitted.

8.2.6 The Environment Agency will undertake a technical review (area review and national review) of the PFRA, which will focus on instances where Flood Risk Areas have been amended and ensure the format of these areas meets the provided standard. If satisfied, they will recommend submission to the relevant Regional Flood and Coastal Committee (RFCC) for endorsement. 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, before all PFRAs are collated, published and submitted to the European Commission.

8.2.7 The Environment Agency has a role to review, collate and publish the outputs from PFRAs. However, the Environment Agency have advised that LCC publish the PFRA on their website where it can be linked to from the Environment Agency website.

8.2.8 The first review cycle of the PFRA will be led by Leicester City Council in 6 years time and must be submitted to the Environment Agency by the 22nd of June 2017. They will then submit it to the European Commission by the 22nd of December 2017 using the same review procedure described above.

8.3 Prepare Flood Risk and Flood Hazard Maps

8.3.1 Part 3 of The Regulations state that LLFAs within indicative flood risk areas must prepare flood risk and flood hazard mapping for each Flood Risk Area by 22nd December 2013. As highlighted earlier, LCC are currently undertaking a SWMP that includes detailed surface water and ordinary watercourse modelling. The outputs of this modelling include flood risk and flood hazard mapping for Leicester.

8.4 Prepare Flood Risk Management Plans

8.4.1 Part 4 of Regulations state that LLFAs must prepare flood risk management plans for each Flood Risk Area by 22nd December 2015. The SWMP forms the first step towards forming a Flood Risk Management Plans for Leicester. The Leicester Lead Local Flood Board will build on the SWMP to formulate a Flood Risk Management Plan together with its partners.

8.5 Prepare the 2nd cycle of the PFRA

8.5.1 Section 17 of the Flood Risk Regulations state that LLFAs must prepare a revised Preliminary Assessment Report by 22nd June 2017, and carry out subsequent reviews every 6 years.

8.5.2 Further information can be found on the Environment Agency PFRA e-Learning module http://learning.environment-agency.gov.uk/courses/FCRM/capacity which has been developed as part of Defra's Capacity Building Strategy and is designed to provide users with an increased knowledge of the background and methodology involved in carrying out a PFRA.

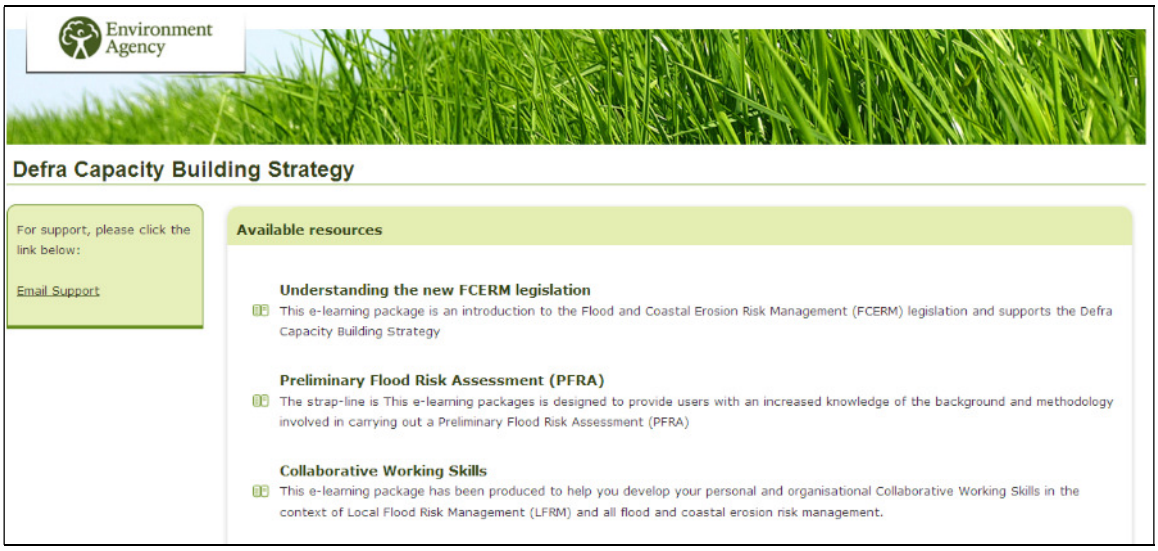

Figure 8-3 Environment Agency e-Learning module

9. References

- Defra, Selecting and reviewing Flood Risk Areas for Local Sources of Flooding: Guidance to Lead Local Flood Authorities, (December 2010)
- Defra, Surface Water Management Plan Technical Guidance, (March 2010)
- Defra (2006) Flood and Coastal Defence Appraisal Guidance, FCDPAG3 Economic Appraisal, Supplementary Note to Operating Authorities – Climate Change Impacts
- Environment Agency, Building Trust With Communities, 2009
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- Office of National Statistics, Mid Year Estimates of Population (2007) Leicester
- Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Avery, M. Tignor and H.L. Miller (eds.). Summary for Policymakers. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. 9. Available for download from http://www.ipcc.ch/ipccreports/ar4-wg1.htm
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Annex 1: Records of Past Floods and their Significant Consequences

ANNEX 1: Records of past floods and their significant consequences (preliminary assessment report spreadsheet)

Field:	Flood ID	Summary description	Name of Location	National Grid Reference	Location Description	Start date	Days duration	Probability	Main source of flooding	Additional source(s) of flooding	Confidence in main source of flooding	Main mechanism of flooding	Main characteristic of flooding
Mandatory / optional:	Mandatory	Mandatory	Mandatory	Mandatory	Optional	Optional for first cycle	Optional for first cycle	Optional for first cycle	Optional for first cycle	Optional	Optional	Optional for first cycle	Optional for first cycle
Format:	Unique number between 1-9999	Max 5,000 characters	Max 250 characters	12 characters: 2 letters, 10 numbers	Max 250 characters	'yyyy' or 'yyyy-mm' or 'yyyy-mm-dd'	Number with two decimal places	Max 25 characters	Pick from drop-down	Max 250 characters, same source terms	Pick from drop-down	Pick from drop-down	Pick from drop-down
Notes:	A sequential number starting at 1 and incrementing by 1 for each record.	Description of the flood and its adverse or potentially adverse consequences. Where available, information from other fields (Start date, Days duration, Probability, Main source, Main mechanism, Main characteristic, Significant consequences) should be repeated here.	Name of the locality associated with the flood, using recognised postal address names such as streets, towns, counties. If the flood affected the whole LLFA, then record the name of the LLFA.	National Grid Reference of the centroid (centre point, falls within polygon) of the flood extent, or of the area affected if there is no extent information.	A description of the general location that was flooded.	The date when the flood commenced - when land not normally covered by water became covered by water.	The number of days (duration) of the flood - that land not normally covered by water was covered by water. Values should be within the range 0.01 - 999.99 (permitting records to the nearest quarter of an hour, where appropriate).	The chance of the flood occuring in any given year - record X from "a 1 in X chance of occuring in any given year". Where this is difficult to estimate, a range can be recorded.	Pick the source from which the majority of flooding occurred. Refer to the PFRA guidance for definitions of sources.	If flooding occurred from, or interacted with, any other sources (other than the Main source of flooding), report the source(s) here, using the same source terms.	Pick a broad level of confidence in the Main source of flooding from; 'High' (compelling evidence of source - about 80% confident that source is correct), 'Medium' (some evidence of source but not compelling - about 50% confident that source is correct) 'Low' (source assumed - about 20% confident that source is correct) or 'Unknown'.	Pick a mechanism from; 'Natural exceedance' (of capacity), 'Defence exceedance' (floodwater overtopping defences), 'Failure' (of natural or artificial defences or infrastructure, or of pumping), 'Blockage or restriction' (natural or artificial blockage or restriction of a conveyance channel or system), or 'No data'.	Pick a characteristic from; 'Flash flood' (rises and falls quite rapidly with little or no advance warning), 'Natural flood' (due to significant precipitation, at a slower rate than a flash flood), 'Snow rapid snow melt), 'Debris flow' (conveying a high degree of debris), or 'No data'. Most UK floods are 'Natural floods'.
Example:	1	On the 14 April 1998 an intense storm system produced surface water flooding across Essex, concentrated in the west of the county. The flooding lasted about 6 hours, and 23 residential properties were recorded as suffering internal flooding, in Epping and North Weald. The surface runoff exceeded the drainage capacity in several places, and so probably had a 1 in 30 to 1 in 50 chance of occuring in any given year.	Essex	SX1234512345	Several towns and villages across west Essex	1998-04-15	0.25	20-50	Surface runoff		High	Natural exceedance	Natural flood
Records begin here:	1	July 1968 intense and prolonged rainfall led to 1800 residential properties and over 25 factories being flooded. Flooding from brooks and surface water	Leicester City	SK5690004500	City wide	1968-07							
	2	June 1993 intense rainfall led to flooding in Leicester, particularly to the north of the city. Flooding came from ordinary watercourses, sewers and surface water	Leicester City	SK5971005430	City wide	1993-06							

Field:	Significant consequences to human health	Human health consequences - residential properties	Property count method	Other human health consequences	Significant economic consequences	Number of non-residential properties flooded	Property count method	Other economic consequences	Significant consequences to the environment	Environment consequences	Significant consequences to cultural heritage	Cultural heritage consequences
Mandatory / optional:	Mandatory	Optional	Optional	Optional	Mandatory	Optional	Optional	Optional	Mandatory	Optional	Mandatory	Optional
Format:	Pick from drop-down	Number between 1-10,000,000	Pick from drop-down	Max 250 characters	Pick from drop-down	Number between 1-10,000,000	Pick from drop-down	Max 250 characters	Pick from drop-down	Max 250 characters	Pick from drop-down	Max 250 characters
Notes:	Were there any significant consequences to human health when the flood occurred, or would there be if it were to re-occur?	Record the number of residential properties where the building structure was affected either internally or externally by the flood, or that would be so affected if the flood were to re-occur.	Where residential or non-residential properties have been counted, it is important to record the method of counting, to aid comparisons between counts. Choose from; 'Detailed GIS' (using property outlines, as per Environment Agency guidance), 'Simple GIS' (using property points), 'Estimate from map', or 'Observed number'.	If there were other Significant consequences to human health, describe them including information such as the number of critical services flooded.	Were there any significant economic consequences when the flood occurred, or would there be if it were to re-occur?	Record the number of non-residential properties where the building structure was affected either internally or externally by the flood, or that would be so affected if the flood were to re-occur.	Where residential or non-residential properties have been counted, it is important to record the method of counting, to aid comparisons between counts. Choose from; 'Detailed GIS' (using property outlines, as per Environment Agency guidance), 'Simple GIS' (using property points), 'Estimate from map', or 'Observed number'.	If there were other Significant economic consequences, describe them including information such as the area of agricultural land flooded, length of roads and rail flooded.	Were there any significant consequences to the environment when the flood occurred, or would there be if it were to re-occur?	If there were Significant consequences to the environment, describe them including information such as national and international designated sites flooded, and pollution sources flooded.	Were there any significant consequences to cultural heritage when the flood occurred, or would there be if it were to re-occur?	If there were Significant consequences to cultural heritage, describe them including information such as the number and type of heritage assets flooded.
Example:	Yes	23	Observed number		No				No		No	
Records begin here:	Yes	1800	Observed number		Yes	28	Observed number		No		No	
	Yes	71	Observed number		Yes				No		No	

Field:	Comments	Data owner	Area flooded	Flood event outline confidence	Flood event outline source	Survey date	Photo ID	Lineage	Sensitive data	Protective marking descriptor	European Flood Event Code
Mandatory / optional:	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Auto-populated
Format:	Max 1,000 characters	Max 250 characters	Number with two decimal places	Pick from drop-down	Pick from drop-down	'yyyy' or 'yyyy-mm' or 'yyyy-mm-dd'	Max 50 characters	Max 250 characters	Pick from drop-down	Max 50 characters	Max 42 characters
Notes:	Any additional comments about the past flood record.		The total area of the land flooded, in km^2	Choose from; 'High' (data includes one of: Aerial video, Aerial photos, Professional survey, Flood level information, EA flood data recording staff notes), 'Medium' (data includes one of: EA/LA ground video, EA/LA ground photos, EA/LA flood event outline map, LA/professional partner officer site records, Public ground video), 'Low' (not confident) or 'Unknown'.			Provide references to relevant specific photographs, or to a set of relevant photographs. It may not be practical to reference all relevant photographs for each flood event.	Lineage is how and what the data is made from. Has this data been created by using data owned or derived from data owned by 3rd party (external) organisations? If yes please give details.	Has the information been classified under the Government's Protective Marking Scheme? Include protective marking time limit where known. Note: If "Approved for Access" then report "Unmarked".	For use where organisations apply the Government's Protective Marking Scheme.	This field will autopopulate using the LLFA name provided on the "Instructions" tab, and the Flood ID. It is an EU-wide unique identifier and will be used to report the flood information. Format: UK+ONS Code+-P or F+-LLFA Flood ID+. "ONS Code" is a unique reference for each LLFA. "P or F" indicates if the event is past or future. "LLFA Flood ID" is a sequential number beginning with 0001.
Example:		Epping Forest District Council	Medium		Site survey	1998-04-20		Ordnance Survey Address/Point; CEH 1:50k River Centreline; NextMap DTM.	Unmarked	Private	UKE1000001 2P0001
Records begin here:											UKE0600016P0001
											UKE0600016P0002

Annex 2: Records of Future Floods and their Consequences

ANNEX 2: Records of future floods and their consequences (preliminary assessment report spreadsheet)

Field:	Flood ID	Description of assessment method	Name of Location	National Grid Reference	Location Description	Name	Flood modelled	Probability	Main source of flooding	Additional source(s) of flooding	Confidence in main source of flooding	Main mechanism of flooding	Main characteristic of flooding	Significant consequences to human health	Human health consequences - residential properties	Property count method	Other human health consequences	Significant economic consequences	Other economic consequences	Significant consequences to the environment	Environment consequences	Significant consequences to cultural heritage	Cultural heritage consequences	Comments	Data owner	Area flooded	Confidence in modelled outline	Model date	Model Type	Hydrology Type	Lineage	Sensitive data	Protective marking descriptor	European Flood Event Code
Mandatory / optional:	Mandatory	Mandatory	Mandatory	Mandatory	Optional	Optional	Optional	Mandatory	Mandatory	Optional	Optional	Mandatory	Mandatory	Mandatory	Optional	Optional	Optional	Mandatory	Optional	Mandatory	Optional	Mandatory	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Auto-populated
Format:	Unique number between 1-9999	Max 1,000 characters	Max 250 characters	12 characters: 2 letters, 10 numbers	Max 250 characters	Max 250 characters	Max 250 characters	Max 25 characters	Pick from drop-down	Max 250 characters, same source terms	Pick from drop-down	Pick from drop-down	Pick from drop-down	Pick from drop-down	Number between 1-10,000,000	Pick from drop-down	Max 250 characters	Pick from drop-down	Max 250 characters	Pick from drop-down	Max 250 characters	Pick from drop-down	Max 250 characters	Max 1,000 characters	Max 250 characters	Number with two decimal places	Pick from drop-down	yyyy or 'yyyy-mm' or yyyy-mm-dd'	Max 250 characters	Max 250 characters	Max 50 characters	Max 42 characters
Notes:	A sequential number starting at 1 and incrementing by 1 for each record.	Description of the future flood information and how it has been produced. Cover Regulation 12(b) requirements of (a) topography, (b) the location of watercourses, (c) the location of flood plains that retain flood water, (d) the characteristics of watercourses, and (e) the effectiveness of any works constructed for the purpose of flood risk management. Information from other relevant fields (Probability, Main source, Name) should be repeated here.	Name of the locality associated with the flood, using recognised postal address names such as streets, towns, counties. If the flood affects the whole LLFA, then record the name of the LLFA.	Reference of the centroid (centre point, falls within polygon) of the flood extent, or of the area affected if there is no extent information. If the flood affects the whole LLFA, then record the centroid of the LLFA.	A description of the general location that could be flooded.	Name of the model or map product or project which produced the future flood information	Background, or additional information on the probability of the flood modelled - such as whether Probability refers to probability of rainfall or water on the ground.	The chance of the flood occuring in any given year - record X from '1 in X chance of occurring in any given year'.	Pick the source which generates the majority of flooding. Refer to the PFRA guidance for definitions of sources.	If the flood is generated by, or interacts with, any other sources (other than the Main source of flooding), report the source(s) here, using the same source terms.	Pick a broad level of confidence in the Main source of flooding from: 'High' (compelling evidence source - about 80% confident that source is correct), 'Medium' (some evidence of source but not compelling - about 50% confident that source is correct) 'Low' (source assumed - about 20% confident that source is correct) or 'Unknown'.	Pick a mechanism from: 'Natural exceedance' (of capacity), 'Defence exceedance' (floodwater overtopping defences), 'Failure' (of a natural or artificial defences or infrastructure, or of pumping), 'Blockage or restriction' (natural or artificial blockage or restriction of a conveyance channel or system), or 'No data'.	Pick a characteristic from: 'Flash flood' (rises and falls quite rapidly with little or no advance warning), 'Natural flood' (due to significant precipitation, at a slower rate than a flash flood), 'Snow melt flood' (due to rapid snow melt), 'Debris flow' (conveying a high degree of debris), or 'No data'. Most UK floods are 'Natural floods'.	Would there be any significant consequences to human health if the future flood were to occur?	Record the number of residential properties where the building structure would be affected either internally or externally if the flood were to occur.	Where residential or non-residential properties have been counted, it is important to record the method of counting, to aid comparisons between counts. Choose from: 'Detailed GIS' (using property outlines, as per Environment Agency guidance), 'Simple GIS' (using property points), 'Estimate from map', or 'Observed number'.	If there would be other Significant consequences to human health, describe them including information such as the number of critical services flooded.	Would there be any significant economic consequences if the future flood were to occur?	Record the number of non-residential properties where the building structure would be affected either internally or externally if the flood were to occur.	Where residential or non-residential properties have been counted, it is important to record the method of counting, to aid comparisons between counts. Choose from: 'Detailed GIS' (using property outlines, as per Environment Agency guidance), 'Simple GIS' (using property points), 'Estimate from map', or 'Observed number'.	If there would be other Significant economic consequences, describe them including information such as the number of agricultural land flooded, length of roads and rail flooded.	Would there be any significant consequences to the environment if the future flood were to occur?	If there would be Significant consequences to the environment, describe them including information such as national and international designated sites flooded, and pollution sources flooded.	Would there be any significant consequences to cultural heritage if the future flood were to occur?	If there would be Significant consequences to cultural heritage, describe them including information such as the number and type of heritage assets flooded.	Any additional comments about the future flood record.	Epping Forest District Council	The total area of the land flooded, in km^2	Pick a broad level of confidence in the modelled flood outline from: 'High' (good match to past flood extents - about 80% confident that outline is correct), 'Medium' (reasonable match - about 50% confident that outline is correct), 'Low' (poor match, sparse data - about 20% confident that outline is correct) or 'Unknown'.	Type of software used to create future flood information.	Type of hydrology method used to create future flood information.	Lineage is how and what the data is made from. Has this data been created by using data owned or derived from data owned by 3rd party (external) organisations? If yes please give details.	Has the information been classified under the Government's Protective Marking Scheme? Include protective marking time limit where known. Note: If "Approved for Access" then report "Unmarked".	For use where organisations apply the Government's Protective Marking Scheme.	This field will autopopulate using the LLFA name provided on the "Instructions" tab, and the Flood ID. It is an EU-wide unique identifier and will be used to report the flood information. Format: UK-ONS Code+-P or F+-LLFA Flood ID+_"ONS Code" is a unique reference for each LLFA, "P or F" indicates if the event is past or future, "LLFA Flood ID" is a sequential number beginning with 0001.
Example:	1	See records below for examples of description of assessment method.	Essex	SX1234512345		Flood Map for Surface Water - 1 in 200 deep	Probability refers to the probability of the rainfall event, in this case producing flooding of greater than 0.3m depth.	200	Surface runoff		High	Natural exceedance	Natural flood	Yes	12000	Detailed GIS		No			No		No		Epping Forest District Council		Medium-Low	2008-08	2D-TuFlow	FEH (Revised Rainfall Runoff)	Ordnance Survey AddressPoint; CEH 1:50k River Centreline; NextMap DTM.	Unmarked	Private	UKE100000012F0001
Records begin here:	1	• Topography is derived from LIDAR (in larger urban areas, on 1, 2 and 3m grids; original accuracy ± 0.15m) and Geoperspective data (original accuracy ± 1.5m), processed to remove buildings and vegetation, then degraded to a composite 5m DTM. Manual edits applied where flow paths clearly omitted e.g. below bridges. • Flow routes dictated by topography; no allowance made for manmade drainage. The DTM may miss flow paths below bridges. • Areas that may flood are defined by dynamically routing a 6.5 hour duration storm with 1 in 200 chance of occurring in any year, over the DTM using JBA's JFLOW–GPU model. • Manning's n of 0.1 is used throughout, to allow broad scale effects of buildings and other obstructions to be approximated. • No allowance made for drainage, pumping or other works constructed for the purpose of flood risk management. • The 'less susceptible' layer shows where modelled flooding is 0.1-0.3m deep; you must not interpret this as depth of flooding, rather as indicative of susceptibility to	Leicester	SK5890004500		Areas Susceptible to Surface Water Flooding (ASWF) - Less	Probability refers to the probability of the rainfall event. This identifies areas which are 'less susceptible' to surface water flooding. For more information refer to "What are Areas Susceptible to Surface Water Flooding" Environment Agency December 2010.	200 Surface runoff	High	Natural exceedance	Natural flood	Yes							Available from EA		No		No		JBA Consulting (distributed by Environment Agency under licence)		Low	2009-07	JFLOW-GPU	Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with areal reduction factor applied to convert point rainfall estimate to more representative figure. Curve then used to derive 6.5 hr, 1:200 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile.		Protect	Commercial	UKE06000016F0001
	2	• Topography is derived from LIDAR (in larger urban areas, on 1, 2 and 3m grids; original accuracy ± 0.15m) and Geoperspective data (original accuracy ± 1.5m), processed to remove buildings and vegetation, then degraded to a composite 5m DTM. Manual edits applied where flow paths clearly omitted e.g. below bridges. • Flow routes dictated by topography; no allowance made for manmade drainage. The DTM may miss flow paths below bridges. • Areas that may flood are defined by dynamically routing a 6.5 hour duration storm with 1 in 200 chance of occurring in any year, over the DTM using JBA's JFLOW–GPU model. • Manning's n of 0.1 is used throughout, to allow broad scale effects of buildings and other obstructions to be approximated. • No allowance made for drainage, pumping or other works constructed for the purpose of flood risk management. • The 'intermediate susceptibility' layer shows where modelled flooding is 0.3-1.0m deep; you must not interpret this as depth of flooding, rather as indicative of	Leicester	SK5890004500		Areas Susceptible to Surface Water Flooding (ASWF) - Intermediate	Probability refers to the probability of the rainfall event. This identifies areas with 'intermediate susceptibility' to surface water flooding.	200 Surface runoff	High	Natural exceedance	Natural flood	Yes							Available from EA		No		No		JBA Consulting (distributed by Environment Agency under licence)		Low	2009-07	JFLOW-GPU	Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with areal reduction factor applied to convert point rainfall estimate to more representative figure. Curve then used to derive 6.5 hr, 1:200 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile.		Protect	Commercial	UKE06000016F0002
	3	• Topography is derived from LIDAR (in larger urban areas, on 1, 2 and 3m grids; original accuracy ± 0.15m) and Geoperspective data (original accuracy ± 1.5m), processed to remove buildings and vegetation, then degraded to a composite 5m DTM. Manual edits applied where flow paths clearly omitted e.g. below bridges. • Flow routes dictated by topography; no allowance made for manmade drainage. The DTM may miss flow paths below bridges. • Areas that may flood are defined by dynamically routing a 6.5 hour duration storm with 1 in 200 chance of occurring in any year, over the DTM using JBA's JFLOW–GPU model. • Manning's n of 0.1 is used throughout, to allow broad scale effects of buildings and other obstructions to be approximated. • No allowance made for drainage, pumping or other works constructed for the purpose of flood risk management. • The 'more susceptible' layer shows where modelled flooding is >1.0m deep; you must not interpret this as depth of flooding, rather as indicative of susceptibility to flooding	Leicester	SK5890004500		Areas Susceptible to Surface Water Flooding (ASWF) - More	Probability refers to the probability of the rainfall event. This identifies areas which are 'more susceptible' to surface water flooding.	200 Surface runoff	High	Natural exceedance	Natural flood	Yes							Yes		No		No		JBA Consulting (distributed by Environment Agency under licence)		Low	2009-07	JFLOW-GPU	Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with areal reduction factor applied to convert point rainfall estimate to more representative figure. Curve then used to derive 6.5 hr, 1:200 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile.		Protect	Commercial	UKE06000016F0003
	4	• Topography is derived from 64.5% LIDAR (on 0.25m-2m grids; original accuracy ± 0.15m) and 35.5% NEXTMap SAR (on 5m grid; original accuracy ± 1.0m), processed to remove buildings & vegetation, then combined on a 2m grid; buildings added with an arbitrary height of 5m based on OS MasterMap 2009 building footprints, then resampled to a 5m grid DTM. Manual edits applied where flow paths clearly omitted e.g. below bridges. • Flow routes dictated by topography; a uniform allowance of 12mm/hr has been made for manmade drainage in urban areas. Infiltration allowance reduces runoff to 39% in rural areas and 70% in urban areas. • Areas that may flood are defined by dynamically routing a 1.1 hour duration storm with 1 in 30 chance of occurring in any year over the DTM using JBA's JFLOW–GPU model. • Manning's n of 0.1 in rural areas; 0.03 in urban areas, to reflect explicit modelling of buildings in urban areas. • No allowance made for local variations in drainage, pumping or other works constructed for the purpose of flood risk management.	Leicester	SK5890004500		Flood Map for Surface Water (FMSW) - 1 in 30	Probability refers to the probability of the rainfall event, in this case producing flooding of greater than 0.1m depth.	30 Surface runoff	High	Natural exceedance	Natural flood	Yes							Yes		No		No		Environment Agency		Medium-Low	2010-11	JFLOW-GPU	Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with areal reduction factor applied to convert point rainfall estimate to more representative figure. Curve then used to derive 1.1 hr, 1:30 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile. See "Description of assessment method" for allowances for infiltration and drainage.	Rainfall Hyetograph, EA 2m Composite DTM, OSMM Topography	Unmarked		UKE06000016F0004
	5	• Topography is derived from 64.5% LIDAR (on 0.25m-2m grids; original accuracy ± 0.15m) and 35.5% NEXTMap SAR (on 5m grid; original accuracy ± 1.0m), processed to remove buildings & vegetation, then combined on a 2m grid; buildings added with an arbitrary height of 5m based on OS MasterMap 2009 building footprints, then resampled to a 5m grid DTM. Manual edits applied where flow paths clearly omitted e.g. below bridges. • Flow routes dictated by topography; a uniform allowance of 12mm/hr has been made for manmade drainage in urban areas. Infiltration allowance reduces runoff to 39% in rural areas and 70% in urban areas. • Areas that may flood are defined by dynamically routing a 1.1 hour duration storm with 1 in 30 chance of occurring in any year over the DTM using JBA's JFLOW–GPU model. • Manning's n of 0.1 in rural areas; 0.03 in urban areas, to reflect explicit modelling of buildings in urban areas. • No allowance made for local variations in drainage, pumping or other works constructed for the purpose of flood risk management.	Leicester	SK5890004500		Flood Map for Surface Water (FMSW) - 1 in 30 deep	Probability refers to the probability of the rainfall event, in this case producing flooding of greater than 0.3m depth.	30 Surface runoff	High	Natural exceedance	Natural flood	Yes							Yes		No		No		Environment Agency		Medium-Low	2010-11	JFLOW-GPU	Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with areal reduction factor applied to convert point rainfall estimate to more representative figure. Curve then used to derive 1.1 hr, 1:30 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile. See "Description of assessment method" for allowances for infiltration and drainage.	Rainfall Hyetograph, EA 2m Composite DTM, OSMM Topography	Unmarked		UKE06000016F0005
	6	• Topography is derived from 64.5% LIDAR (on 0.25m-2m grids; original accuracy ± 0.15m) and 35.5% NEXTMap SAR (on 5m grid; original accuracy ± 1.0m), processed to remove buildings & vegetation, then combined on a 2m grid; buildings added with an arbitrary height of 5m based on OS MasterMap 2009 building footprints, then resampled to a 5m grid DTM. Manual edits applied where flow paths clearly omitted e.g. below bridges. • Flow routes dictated by topography; a uniform allowance of 12mm/hr has been made for manmade drainage in urban areas. Infiltration allowance reduces runoff to 39% in rural areas and 70% in urban areas. • Areas that may flood are defined by dynamically routing a 1.1 hour duration storm with 1 in 200 chance of occurring in any year over the DTM using JBA's JFLOW–GPU model. • Manning's n of 0.1 in rural areas; 0.03 in urban areas, to reflect explicit modelling of buildings in urban areas. • No allowance made for local variations in drainage, pumping or other works	Leicester	SK5890004500		Flood Map for Surface Water (FMSW) - 1 in 200	Probability refers to the probability of the rainfall event, in this case producing flooding of greater than 0.1m depth.	200 Surface runoff	High	Natural exceedance	Natural flood	Yes							Yes	Available from EA	No		No		Environment Agency		Medium-Low	2010-11	JFLOW-GPU	Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with areal reduction factor applied to convert point rainfall estimate to more representative figure. Curve then used to derive 1.1 hr, 1:200 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile. See "Description of assessment method" for allowances for infiltration and drainage.	Rainfall Hyetograph, EA 2m Composite DTM, OSMM Topography	Unmarked		UKE06000016F0006
	7	• Topography is derived from 64.5% LIDAR (on 0.25m-2m grids; original accuracy ± 0.15m) and 35.5% NEXTMap SAR (on 5m grid; original accuracy ± 1.0m), processed to remove buildings & vegetation, then combined on a 2m grid; buildings added with an arbitrary height of 5m based on OS MasterMap 2009 building footprints, then resampled to a 5m grid DTM. Manual edits applied where flow paths clearly omitted e.g. below bridges. • Flow routes dictated by topography; a uniform allowance of 12mm/hr has been made for manmade drainage in urban areas. Infiltration allowance reduces runoff to 39% in rural areas and 70% in urban areas. • Areas that may flood are defined by dynamically routing a 1.1 hour duration storm with 1 in 200 chance of occurring in any year over the DTM using JBA's JFLOW–GPU model. • Manning's n of 0.1 in rural areas; 0.03 in urban areas, to reflect explicit modelling of buildings in urban areas. • No allowance made for local variations in drainage, pumping or other works	Leicester	SK5890004500		Flood Map for Surface Water (FMSW) - 1 in 200 deep	Probability refers to the probability of the rainfall event, in this case producing flooding of greater than 0.3m depth.	200 Surface runoff	High	Natural exceedance	Natural flood	Yes							Yes	Available from EA	No		No		Environment Agency		Medium-Low	2010-11	JFLOW-GPU	Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with areal reduction factor applied to convert point rainfall estimate to more representative figure. Curve then used to derive 1.1 hr, 1:200 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile. See "Description of assessment method" for allowances for infiltration and drainage.	Rainfall Hyetograph, EA 2m Composite DTM, OSMM Topography	Unmarked		UKE06000016F0007
	8	• Areas Susceptible to Groundwater Flooding (ASGWF) is a strategic scale map showing groundwater flood areas on a 1km square grid • This data has used the top two susceptibility levels of the British Geological Society (BGS) 1:50,000 Groundwater Flood Susceptibility Map, which was developed on a 50m grid from: • NEXTMap 5m grid DTM. • National Groundwater Level data on a 50m grid • BGS 1:50 000 geological mapping, with classifications of permeability • It covers consolidated aquifers (chalk, limestone, sandstone etc.) and superficial deposits. • Flood plains are not explicitly identified; the mapping identifies where groundwater is likely to emerge, and not where the water is subsequently likely to flow or pond. • No allowance is made for engineering works, or for groundwater rebound or abstraction to prevent groundwater rebound. • Shows the proportion of each 1km grid square which is susceptible to groundwater	Leicester	SK5890004500		Areas Susceptible to Groundwater Flooding (ASGWF)	Does not describe a probability, but shows places where groundwater emergence more likely to occur.	Unknown	Groundwater		High	Natural exceedance	Natural flood	Yes					Yes		No		No		Data developed specifically for PFRA, and is unlikely to be suitable for any other purposes.	Environment Agency		Low	2010-11	ArcGIS	Uses data which is developed from published BGS groundwater level contours, groundwater levels in BGS WellMaster database and some river levels. No probability is associated with this data.	British Geological Society (BGS) DiGMapGB-50 [Susceptibility to Groundwater Flooding].	Unmarked		UKE06000016F0008
	9	• Modelling developed from combination of national (2004) and local (generally 1998-2010) modelling. • Topography derived from LIDAR (on 0.25m-2m grids; original accuracy ± 0.15m), NEXTMap SAR (on 5m grid; original accuracy ± 1.0m), processed to remove buildings & vegetation. For local modelling, topography may include ground survey. • Location of watercourses and tidal flow routes dictated by topographic survey. • Areas that may flood are defined for catchments >3km² by routing appropriate flows for that catchment through the model to ascertain water level and thus depth and extent. • Manning's n of 0.1 used for national fluvial modelling; variable (calibrated) values for national tidal modelling; appropriate values selected for local modelling. Channel capacity assumed as QMED for national fluvial modelling; local survey methods used for local modelling. • For the purpose of flood risk management, models assume that there are no raised defences.	Leicester	SK5890004500		Flood Map (for rivers and sea) - flood zone 3	Fluvial 1 in 100, tidal 1 in 200	100 Main rivers	Sea, ordinary watercourses	Medium	Natural exceedance	Natural flood	Yes							Yes		No		No		Data updated quarterly. To understand the likelihood of future flooding, taking account of defences, refer to Areas Benefitting from Defences and National Flood Risk Assessment (NaFRA) data. Marked 'Protect' for complete national dataset only.	Environment Agency		Medium	2010-11	Varies but mainly JFLOW, ISIS, HEC-RAS, TUFLOW for fluvial, and HYDROF for tidal.	National methodology described in "National Generalised Modelling for Flood Zones - Fluvial & Tidal Modelling Methods - Methodology, Strengths and Limitations". A fluvial flood peak estimates was derived from the Flood Estimation Handbook (FEH) to generate a 1 in 100 chance fluvial flood. Local fluvial modelling uses FEH methods. Peak tidal water levels from either Dover & Tawn (DT3) or local data sets to derive 1 in 200 chance tide levels including surge from POL CSX model.	NextMap SAR DTMe, UKHO Admiralty Charts, 1:50K CEH River Centre Line, national dataset (for England and Wales) of CEH FEH QJT) Grids, POL CSX Peak Extreme Water Levels, POL CS3 Astronomical Tides, UKHO Admiralty Tide Time-Series Calibration Locations, OS 1:10 Boundary Line MHW	Protect	Commercial	UKE06000016F0009
	10	• Modelling developed from combination of national (2004) and local (generally 2004-2010) modelling. • Topography derived from LIDAR (on 0.25m-2m grids; original accuracy ± 0.15m), NEXTMap SAR (on 5m grid; original accuracy ± 1.0m), processed to remove buildings & vegetation. For local modelling, topography may include ground survey. • Location of watercourses and tidal flow routes dictated by topographic survey. • Areas that may flood are defined for catchments >3km² by routing appropriate flows for that catchment through the model to ascertain water level and thus depth and extent. • Manning's n of 0.1 used for national fluvial modelling; variable (calibrated) values for national tidal modelling; appropriate values selected for local modelling. Channel capacity assumed as QMED for national fluvial modelling; local survey methods used for local modelling. • For the purpose of flood risk management, models assume that there are no raised defences.	Leicester	SK5890004500		Flood Map (for rivers and sea) - flood zone 2	Extreme flood outline is 1 in 1000, and includes some historic where judged that this gives an indication of areas at risk of future flooding.	1000 Main rivers	Sea, ordinary watercourses	Medium	Natural exceedance	Natural flood	Yes							Yes		No		No		Data updated quarterly. To understand the likelihood of future flooding, taking account of defences, refer to National Flood Risk Assessment (NaFRA) data. Marked 'Protect' for complete national dataset only.	Environment Agency		Medium	2010-11	Varies but mainly JFLOW, ISIS, HEC-RAS, TUFLOW for fluvial, and HYDROF for tidal.	National methodology described in "National Generalised Modelling for Flood Zones - Fluvial & Tidal Modelling Methods - Methodology, Strengths and Limitations". A fluvial flood peak estimates was derived from the Flood Estimation Handbook (FEH) to generate a 1 in 1000 chance fluvial flood. Local fluvial modelling uses FEH methods. Peak tidal water levels from either Dover & Tawn (DT3) or local data sets to derive 1 in 1000 chance tide levels including surge from POL CSX model.	NextMap SAR DTMe, UKHO Admiralty Charts, 1:50K CEH River Centre Line, CEH FEH QJT) Grids, POL CSX Peak Extreme Water Levels, POL CS3 Astronomical Tides, UKHO Admiralty Tide Time-Series Calibration Locations, OS 1:10 Boundary Line MHW, Historic	Protect	Commercial	UKE06000016F0010

Annex 3: Records of Flood Risk Areas and their Rational

ANNEX 3: Records of Flood Risk Areas and their rationale (preliminary assessment report spreadsheet)

Field:	Flood Risk Area ID	Name of Flood Risk Area	National Grid Reference	Main source of flooding	Additional source(s) of flooding	Confidence in main source of flooding	Main mechanism of flooding	Main characteristic of flooding	Significant consequences to human health	Human health consequences - residential properties	Property count method	Other human health consequences	Significant economic consequences	Number of non-residential properties flooded	Property count method	Other economic consequences	Significant consequences to the environment	Environment consequences	Significant consequences to cultural heritage	Cultural heritage consequences	Origin of Flood Risk Area	Amended Flood Risk Area rationale	New Flood Risk Area rationale	Rationale detail	European Flood Risk Area Code
Mandatory / optional:	Mandatory	Mandatory	Mandatory	Mandatory	Optional	Optional	Mandatory	Mandatory	Mandatory	Optional	Optional	Optional	Mandatory	Optional	Optional	Optional	Mandatory	Optional	Mandatory	Optional	Mandatory	Mandatory	Mandatory	Mandatory	Auto-populated
Format:	Unique number between 1-9999	Max 250 characters	12 characters: 2 letters, 10 numbers	Pick from drop-down	Max 250 characters, same source terms	Pick from drop-down	Pick from drop-down	Pick from drop-down	Pick from drop-down	Number between 1-10,000,000	Pick from drop-down	Max 250 characters	Pick from drop-down	Number between 1-10,000,000	Pick from drop-down	Max 250 characters	Pick from drop-down	Max 250 characters	Pick from drop-down	Max 250 characters	Pick from drop-down	Pick from drop-down	Pick from drop-down	Max 1,000 characters	Max 42 characters
Notes:	A sequential number starting at 1 and incrementing by 1 for each record.	Name of the locality associated with the Flood Risk Area; a town, city, or county.	National Grid Reference of the centroid (centre point, falls within polygon) of the Flood Risk Area.	Pick the source from which there is a significant flood risk. Refer to the PFRA guidance for definitions of sources.	If there is also significant flood risk generated by another source (other than the Main source of flooding), report the source(s) here, using the same source terms.	Pick a broad level of confidence in the Main source of flooding from; 'High' (compelling evidence of source - about 80% confident that source is correct), 'Medium" (some evidence of source but not compelling - about 50% confident that source is correct) 'Low' (source assumed - about 20% confident that source is correct) or 'Unknown'.	Pick a mechanism from; 'Natural exceedance' (of capacity), 'Defence exceedance' (floodwater overtopping defences), 'Failure' (of natural or artificial defences or infrastructure, or of pumping), 'Blockage or restriction' (natural or artificial blockage or restriction of a conveyance channel or system), or 'No data'.	Pick a characteristic from; 'Flash flood' (rises and falls quite rapidly with little or no advance warning), 'Natural flood' (due to significant precipitation, at a slower rate than a flash flood), 'Snow melt flood' (due to rapid snow melt), 'Debris flow' (conveying a high degree of debris), or 'No data'. Most UK floods are 'Natural floods'.	Has the Flood Risk Area been identified as a result of significant consequences to human health?	Record the number of residential properties where the building structure would be affected either internally or externally by the flood.	Where residential or non-residential properties have been counted, it is important to record the method of counting, to aid comparisons between counts. Choose from; 'Detailed GIS' (using property outlines, as per Environment Agency guidance), 'Simple GIS' (using property points), 'Estimate from map', or 'Observed number'.	If the Flood Risk Area has been identified as a result of other Significant consequences to human health, describe them (such as information about the number of critical services flooded).	Has the Flood Risk Area been identified as a result of significant economic consequences?	Record the number of non-residential properties where the building structure would be affected either internally or externally by the flood.	Where residential or non-residential properties have been counted, it is important to record the method of counting, to aid comparisons between counts. Choose from; 'Detailed GIS' (using property outlines, as per Environment Agency guidance), 'Simple GIS' (using property points), 'Estimate from map', or 'Observed number'.	If the Flood Risk Area has been identified as a result of other Significant economic consequences, describe them (such as information about the area of agricultural land flooded, length of roads and rail flooded).	Has the Flood Risk Area been identified as a result of significant consequences to the environment?	If the Flood Risk Area has been identified as a result of Significant consequences to the environment, describe them (such as information about national and international designated sites flooded, and pollution sources flooded).	Has the Flood Risk Area been identified as a result of significant consequences to cultural heritage?	If the Flood Risk Area has been identified as a result of Significant consequences to cultural heritage, describe them (such as information about the number and type of heritage assets flooded).	Pick the origin from either; 'Indicative' Flood Risk Area, 'Amended' Flood Risk Area (in which case Amended Flood Risk Area rationale is mandatory), or 'New' Flood Risk Area (in which case New Flood Risk Area rationale is mandatory).	Pick the main rationale from either; 'Geography', 'Past floods', or 'Future floods'. Then provide further detail in Rationale detail. This is not mandatory if the Flood Risk Area was an indicative Flood Risk Area and has not been amended, or is a new Flood Risk Area.	Pick the main rationale from either 'Past floods', or 'Future floods'. Then provide further detail in Rationale detail. This is not mandatory if the Flood Risk Area was an indicative Flood Risk Area.	Summarise the rationale for amending an indicative Flood Risk Area, or identifying a new Flood Risk Area. Refer to Defra & WAG guidance to LLFAs on "Selecting and reviewing Flood Risk Areas for local sources of flooding". If the Flood Risk Area was an indicative Flood Risk Area and has not been amended, record "Indicative Flood Risk Area".	This field will autopopulate using the LLFA name provided on the "Instructions" tab, and the Flood Risk Area ID. It is an EU-wide unique identifier and will be used to report the Flood Risk Area information. Format: UK<ONS Code><A><LLFA Flood ID>. "ONS Code" is a unique reference for each LLFA. "A" indicates it is a Flood Risk Area. "LLFA Flood ID" is a sequential number beginning with 0001.
Example:	1	London	SX1234512345	Surface runoff	NA	High	Natural exceedance	Natural flood	Yes	50000	Detailed GIS		No				No		No		Indicative	NA	NA	indicative Flood Risk Area	UKE10000012A0001
Records begin here:	1	Leicester		Surface runoff	ordinary watercourses	High-Medium	Natural exceedance	Flash flood	Yes	14350	Simple GIS	Numerous critical infrastructure affected across IFRA as well as dwellings. Transport links affected - including significant regional links such as M1/M69 interchange	Yes	2318	Simple GIS	Severed transport links of regional importance including M1/M69 interchange. Police Headquarters affected as well as hospital. Numerous commercial and industrial properties affected - impacts of flooding likely to have longlasting economic affect with lost trading and ineterupted supply chains.	No		No		Amended	Future floods	Future Floods	Indicative Flood Risk Area increased to account for further critical infrastructure (including regionally important M1/M69 interchange and County Police Headquarters) and properties at risk to the south west of the existing IFRA. Property counts given here reflect increase in IFRA boundary. Proposed amendment has been agreed with neighbouring Lead Local Flood Authority.	UKE06000016A0001

Annex 4: Review Checklist

LLFAs should complete the pale blue sections with the relevant information, and send to their Environment Agency Local Area Contact along with the Preliminary Assessment Report and Annexes. Yellow and green boxes on this coversheet are for Environment Agency completion

Preliminary Flood Risk Assessment Review	
LLFA Name	Leicester City Council
If collaboration, list other LLFAs	Leicestershire County Council
LLFA Lead contact name	Martin Fletcher
Email address	Martin.Fletcher@leicester.gov.uk
Contact telephone number	0116 225 3360
Date sent to Environment Agency	

Documents submitted		
	LLFA	**EA date received**
Preliminary Assessment Report	Yes	
Annex 1 - Past floods reporting template	Yes	
Annex 2 - Future floods reporting template	Yes	
Annex 3 - Flood Risk Area reporting template	Yes	
Annex 4 - Review checklist	Yes	

Flood Risk Areas	
Was there an indicative Flood Risk Area?	Yes
Is a Flood Risk Area proposed?	Yes

Approvals	
LLFA approval	
Name	
Title	
Date	

For completion by Environment Agency		
Region		
Area		
Lead contact name		
	Review date	**Recommendation**
Environment Agency area		
National review panel		
RFCC/FRMW		
Regional Director Sign-off		
Ministerial referral (if applicable)		

Preliminary Flood Risk Assessment Checklist					
LLFA Name:					
	Checklist questions	**Notes for completion**	**LLFA**	**Environment Agency area review**	**Environment Agency national review**
Step 1	**Set up governance and develop partnerships**				
1.1	Have appropriate governance and partnership arrangements been set up?	Refer to section 2.3 of guidance. Governance and partnership arrangements should be to the satisfaction of the LLFA.	Yes		
1.2	Who in the LLFA reviewed the PFRA and when was it done?	Please state the review and approval process and when approval was gained e.g. Officer, Scrutiny Committee, Cabinet. Refer to Section 5 of the guidance.	Lead Local Flood Board - March 2011		
Step 2	**Determine appropriate data systems**				
2.1	Has a data management system been established and implemented?	See Annex 5 for information about data standards	Yes		
Step 3	**Collate information on past and future floods and their consequences**				
3.1	Has information been requested from all relevant partners?	See Flood Risk Regulations Part 6 Co-operation.	Yes		
3.2	Are there any gaps in available information? (This could include gaps which could have been filled but weren't, or gaps which couldn't be filled because the information wasn't available)	LLFAs - Are there gaps in certain locations, or for certain events that you are aware of, or for certain sources of flooding (such as groundwater). Respond with Yes/No and provide comments on any missing information. EA Review - Has all available information has been gathered and included?	Yes, please refer to Section 3 of report		
Step 4	**Determining locally agreed surface water information**				
4.1	Which dataset (or combination of datasets) has been determined as "locally agreed surface water information"?	LLFAs - Select from drop down. Refer to "Locally agreed surface water information" text box in section 3.5.1 (p.17) of guidance. EA review - Has this been agreed?	Flood Map for Surface Water		
4.2	Has the locally agreed surface water information been clearly stated and presented (on a map) in the Preliminary Assessment Report?	LLFAs - Select Yes/No from drop down list. Refer to "locally agreed surface water information" text box in section 3.5.1 (p.17) of guidance.	Yes		
4.3	If available, what is the total property count for locally agreed surface water information in the LLFA?	If known, please enter the total number of properties at risk in the LLFA.	37631 - simplified method including proposed increase in boundary.		
4.4	If applicable, has the method for counting properties been described in the Preliminary Assessment Report?	Refer to text box on page 17 of guidance	Yes		
4.5	Has available information on local drainage capacity (where used to inform the determination of locally agreed surface water information) been included in the report?	Refer to text box on page 17 of guidance. Information provided on drainage may inform options for any future improvements to the Flood Map for Surface Water.	Yes		

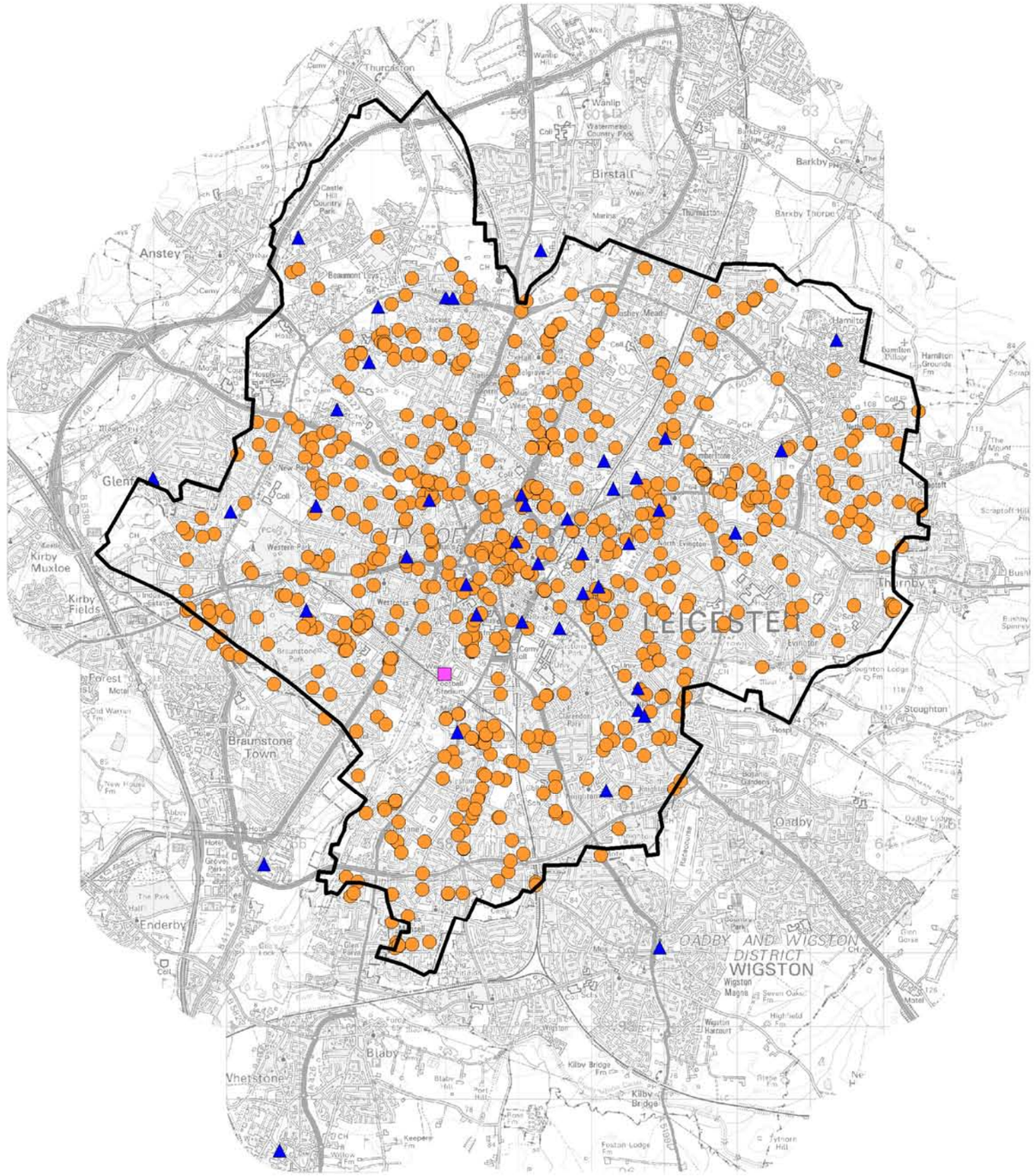
Preliminary Flood Risk Assessment Checklist					
LLFA Name:					
	Checklist questions	**Notes for completion**	**LLFA**	**Environment Agency area review**	**Environment Agency national review**
Step 5	**Complete Preliminary Assessment Report Document**				
5.1	Does the Preliminary Assessment Report cover all the content described in Annex 1 of the Environment Agency's PFRA guidance?	LLFAs - If the Preliminary Assessment Report contains all the content described in Annex 2 of the PFRA guidance, respond with a 'Yes'. If there are some elements missing, please provide a brief explanation. EA Review - Include comments on any missing content.	Yes - based on locally agreed Surface Water Information - the FMfSW		
5.2	Has a summary table of flood events been produced?	Refer to section 3.4 and 3.5 of guidance	Yes		
5.3	Has a description of past flood events been included?	Refer to section 3.4 and 3.5 of guidance	Yes		
5.4	Has additional information been included on climate change and long term developments?	Refer to 3.6 of guidance. Standard text has been provided for Preliminary Assessment Reports which meets the minimum requirements of the Flood Risk Regulations. Please respond with Yes or No, and if additional information has been included, please state the information source(s)	Yes - additional information on long term developments determined from LCC Spatial planning Team (Sustainable Urban Extensions and proposed major development areas surrounding Leicester)		
Step 6	**Record information on past and future floods with significant consequences in spreadsheet**				
6.1	Are records of past flooding with significant harmful consequences recorded on the Preliminary Assessment Report spreadsheet (Annex 1 of Prelminary Assessment Report) ?	LLFAs - past flooding should be recorded on the spreadsheet and included as Annex 1 of the Preliminary Assessment Report. EA review - Are all the mandatory fields complete?	Yes		
6.2	Are there any past floods with significant harmful consequences that have not been recorded? If so, please explain why not.	LLFAs - Respond with Yes or No. If No, provide additional information e.g. anecdotal information on flood, but not enough evidence to include EA review - Do you agree with LLFA response and comments?	Yes - possibly but not enough information available to determine if events were "significant"		
6.3	Have any additional records of future flooding (other than the national dataset information which is already completed) been recorded on the future flooding Preliminary Assessment Report spreadsheet (Annex 2 of Preliminary Assessment Report)	LLFAs - future flooding information should be recorded on the spreadsheet and included as Annex 2 of the Preliminary Assessment Report. EA review - Are all mandatory fields complete?	No		
Step 7	**Illustrate information on past and future floods**				
7.1	Have summary maps been produced for past and future floods?	Refer to section 3.4 and 3.5 of guidance	Yes		
Step 8	**Review indicative Flood Risk Areas**				
8.1	Is your LLFA within an indicative Flood Risk Area?	Indicative Flood Risk Areas were provided to LLFAs by the Environment Agency in December 2010.	Yes		
8.2	If the answer to 8.1 is yes, have you reviewed it using the locally agreed surface water information, and relevant local information in the Preliminary Assessment Report?	Refer to section 4 of guidance. LLFAs should identify whether they have reviewed against local information or just used the indicative Flood Risk Area information provided by the Environment Agency.	Yes		

Preliminary Flood Risk Assessment Checklist					
LLFA Name:					
	Checklist questions	**Notes for completion**	**LLFA**	**Environment Agency area review**	**Environment Agency national review**
Step 9	**Identify Flood Risk Areas**				
9.1	Is a Flood Risk Area proposed?	LLFA - select a response from the drop down list and then complete the relevant questions 9.1.1 - 9.1.5. (NB. Indicative Flood Risk Areas can be amended due to Geography, past flooding and/or future flooding.)	Yes - we have made changes to the indicative Flood Risk Area (respond to relevant questions 9.1.2 - 9.1.4)		
9.1.1	If the proposed Flood Risk Area is exactly the same as the indicative Flood Risk Area, please confirm.	LLFA - please confirm that the boundary of the indicative Flood Risk Area has not been changed and no change has been made to the flood risk indicators. EA review - please confirm	N/A		
9.1.2	If changes have been made to the indicative Flood Risk Area because of geography, please identify what changes have been made.	Use the drop down list to identify the reasons for the change. Options are the same as the table on page 26 of the PFRA guidance. EA review - please confirm evidence supports change	Minor change in boundary		
9.1.3	If changes have been made to the indicative Flood Risk Area because of past / historic flooding, please indicate the changes and the reasons why.	LLFA - identify the scale of the changes made e.g. major/minor increase or decrease in size of Flood Risk Area and the source of information used e.g. records of historic flooding. EA review - confirm scale of the changes made and provide indication of confidence in the evidence provided e.g. anecdotal evidence versus detailed report on flooding event.	N/A		
9.1.4	If changes have been made to the indicative Flood Risk Areas because of future flooding, please indicate the changes and the reasons why.	LLFA - identify the scale of the changes made e.g. major/minor increase or decrease in size of Flood Risk Area and the source of information used e.g. detailed modelling as part of SWMP. EA review - confirm scale of the changes made and indication of confidence in the evidence	Indicative Flood Risk Area has been increased based on critical infrastructure (police headquarters, M1/M69 ninterchange) shown to be at risk of flooding in the Areas above Threshold mapping and also on		
9.1.5	If a new Flood Risk Area is being proposed, does it meet the Defra / WAG thresholds?	Criteria and thresholds are set out in the Defra/WAG guidance on selecting and reviewing Flood Risk Areas for local sources of flooding EA review - identify the evidence provided to support this and indicate degree of confidence in the evidence.	N/A		
9.2	Does the proposed Flood Risk Area include flooding from interactions with main river, reservoirs or the sea?	LLFAs should respond with Yes or No. EA Review - Summarise the location and nature of interactions i.e. river or sea.	N/A		
9.3	Has an indicative Flood Risk Area been deleted?	LLFA - Respond with Yes/No and if an indicative Flood Risk Area has been deleted please provide a short description why. EA - confirm the evidence presented to support this is aligned to 'locally agreed surface water information'	No		
Step 10	**Record information including rationale - ONLY COMPLETE IF ANSWER TO 9.1 IS YES**				
10.1	If proposing Flood Risk Areas, have the mandatory fields in the spreadsheet been completed?	LLFAs - the spreadsheet indicates mandatory columns to be completed. EA Review - Are all mandatory fields complete?	Yes		
10.2	Has a rationale and evidence for amending/adding/deleting Flood Risk Areas been included in the Preliminary Assessment Report?	LLFAs - Refer to Table 5 on page 26 of the PFRA guidance and Annexes A-D of the Defra/WAG Guidance. Rationale should be included in "Identification of Flood Risk Areas" section of Preliminary Assessment Report. EA Review - Confirm that supporting evidence for any amendments/additions/deletions has been provided in the Preliminary Assessment Report and annexes	Yes		

Annex 5: Figures

Figure 4-2: Historic Flood Records
Figure 5-1: Flood Map for Surface Water 0.5% AEP (1 in 200 Year chance)
Figure 5-2: Areas Susceptible to Groundwater Flooding
Figure 5-3: Indicative Flood Risk Area (including proposed amendments) and Places Above Threshold
Figure 5-4: Draft SWMP Pluvial Model Outputs 0.5% AEP (1 in 200 Year chance)

NORTH



Canal Breach

🟪 Point

LCC Flood Record

● Point

Fire&Rescure Flood Record

▲ Point

Study Area

▭ Region

0 2.5 5

kilometres

Job Title

Job D135090 - Leicester City PFRA

Leicester City Council

Figure 4-2: Historic Flood Records

Scale at A3: NTS

www.scottwilson.com	Drawn	Check	Approved	Revision	Date
	GC	AW	MT	2	May 2011

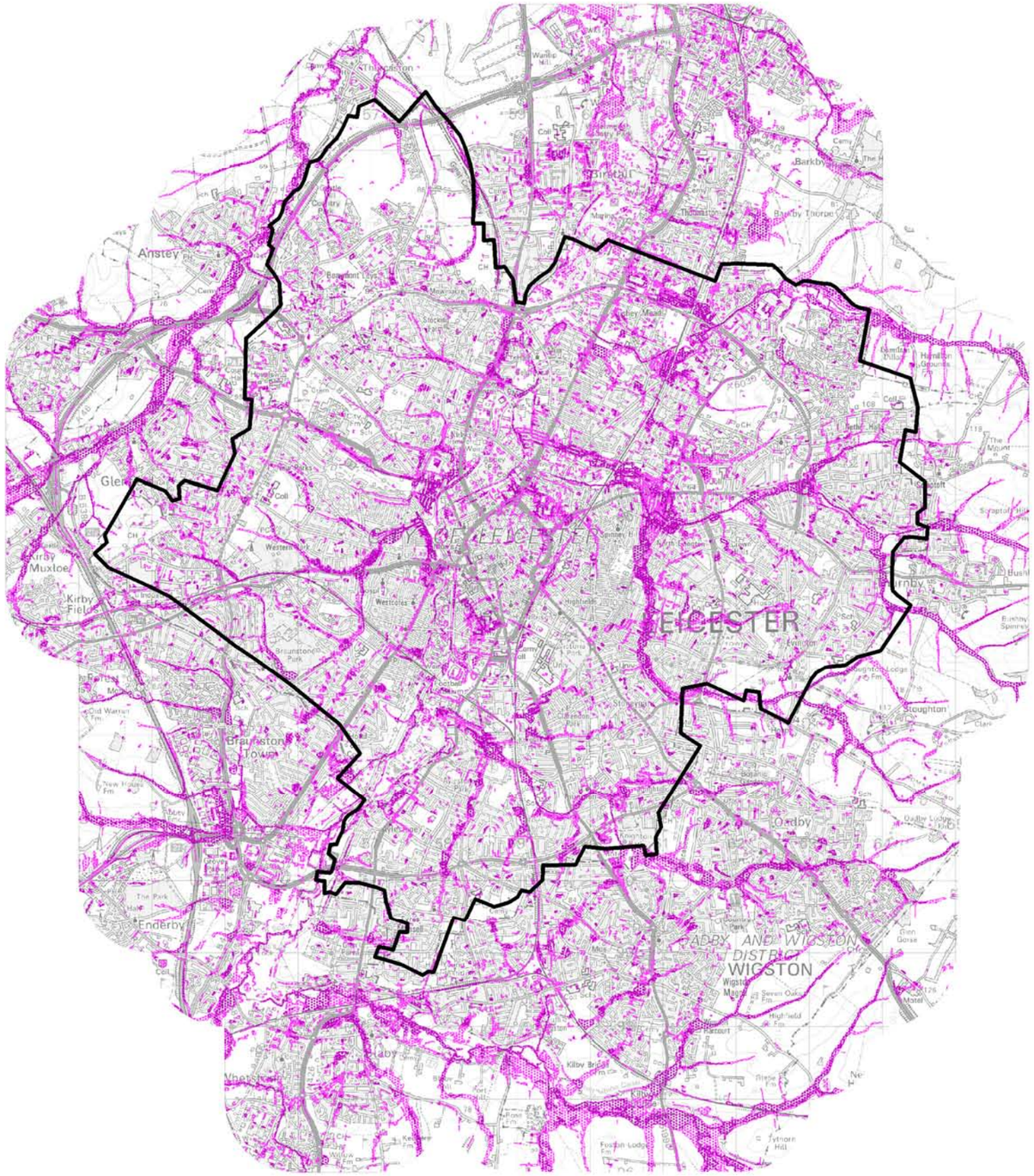
URS Scott Wilson

NORTH

Study Area

'Deep Flooding'

'Shallow Flooding'



0 2.5 5

kilometres

Job Title

Job D135090 - Leicester City PFRA

Figure 5-1: Flood Map for Surface Water 0.5% AEP (1 in 200 Chance)

Leicester City Council

Scale at A3: NTS

www.scottwilson.com	Drawn	Check	Approved	Revision	Date
	GC	AW	MT	2	May 2011

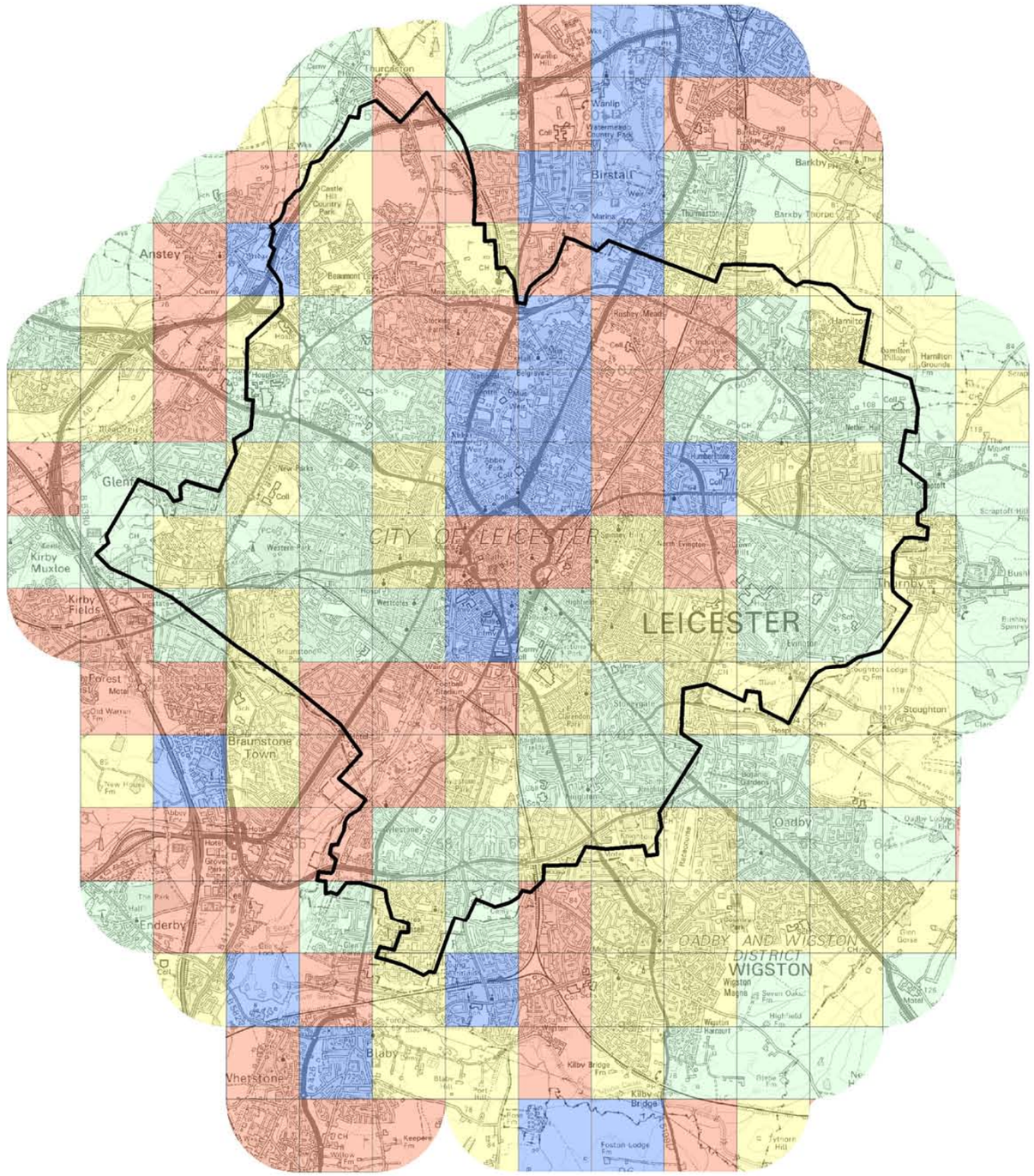
URS Scott Wilson

NORTH

Study Area

Susceptibility to Groundwater Flooding

- < 25%
- >= 25% <50%
- >= 50% <75%
- >= 75%



0 2.5 5

kilometres

Job Title

Job D135090 - Leicester City PFRA

Figure 5-2: Areas Susceptible to Groundwater Flooding

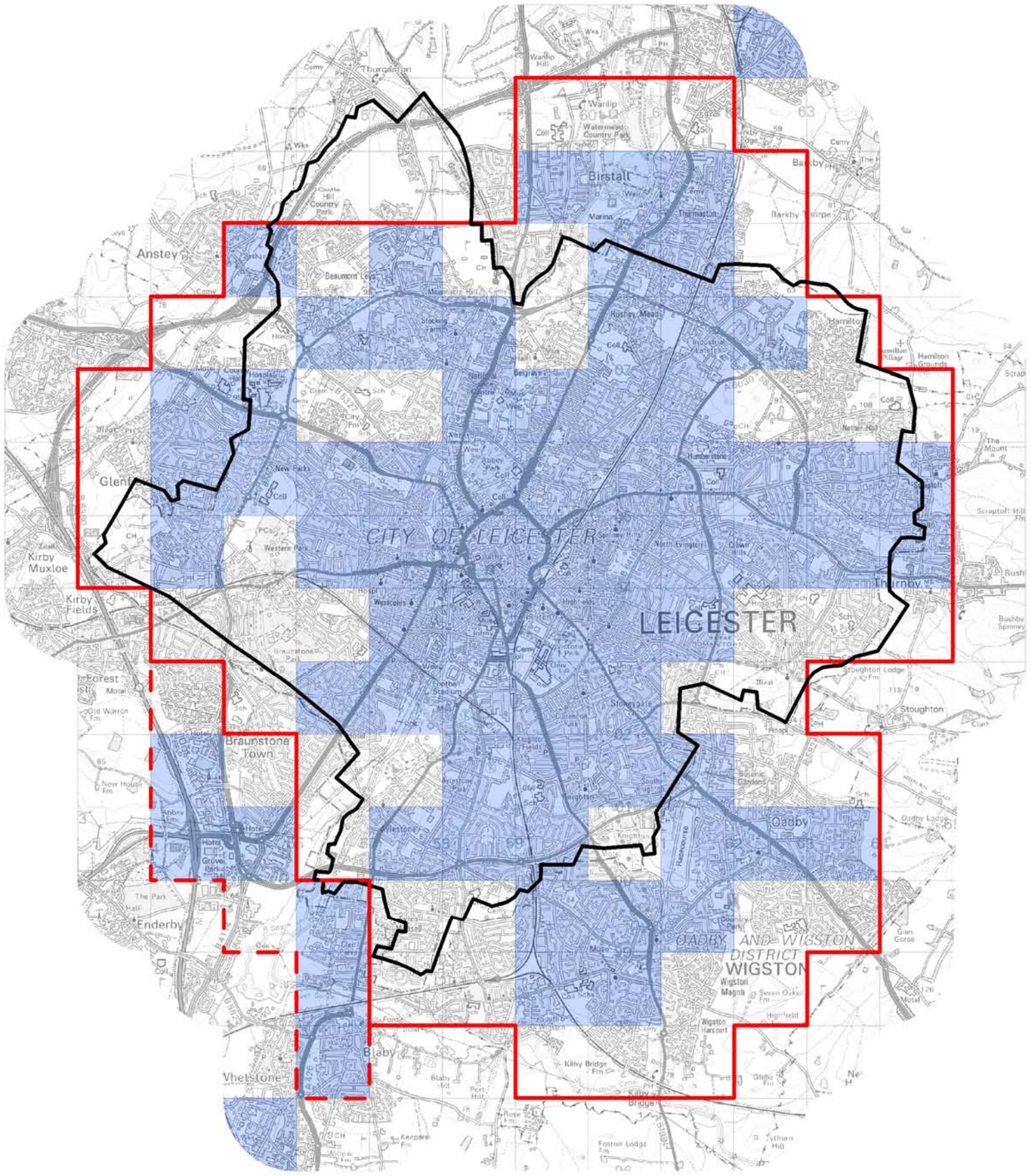
Leicester City Council

Scale at A3: NTS

www.scottwilson.com	Drawn	Check	Approved	Revision	Date
	GC	AW	MT	2	May 2011

URS Scott Wilson

NORTH



Study Area

Places Above Flood Risk Threshold

Indicative Flood Risk Area (IFRA)

Proposed Extension to IFRA

0 2.5 5

kilometres

Places above the flood risk threshold are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people >200
2. Critical services >1
3. Number of non-residential properties >20

Indicators calculated using the EAs detailed method of counting based on property outlines for the Flood Map for Surface Water - deep - for a 0.5% AEP (1 in 200 chance) rainfall event

Job Title

Job D135090 - Leicester City PFRA

Leicester City Council

Figure 5-3: Indicative Flood Risk Area (including proposed amendment) and Places Above Threshold

Scale at A3: NTS

www.scottwilson.com	Drawn	Check	Approved	Revision	Date
	GC	AW	MT	2	May 2011

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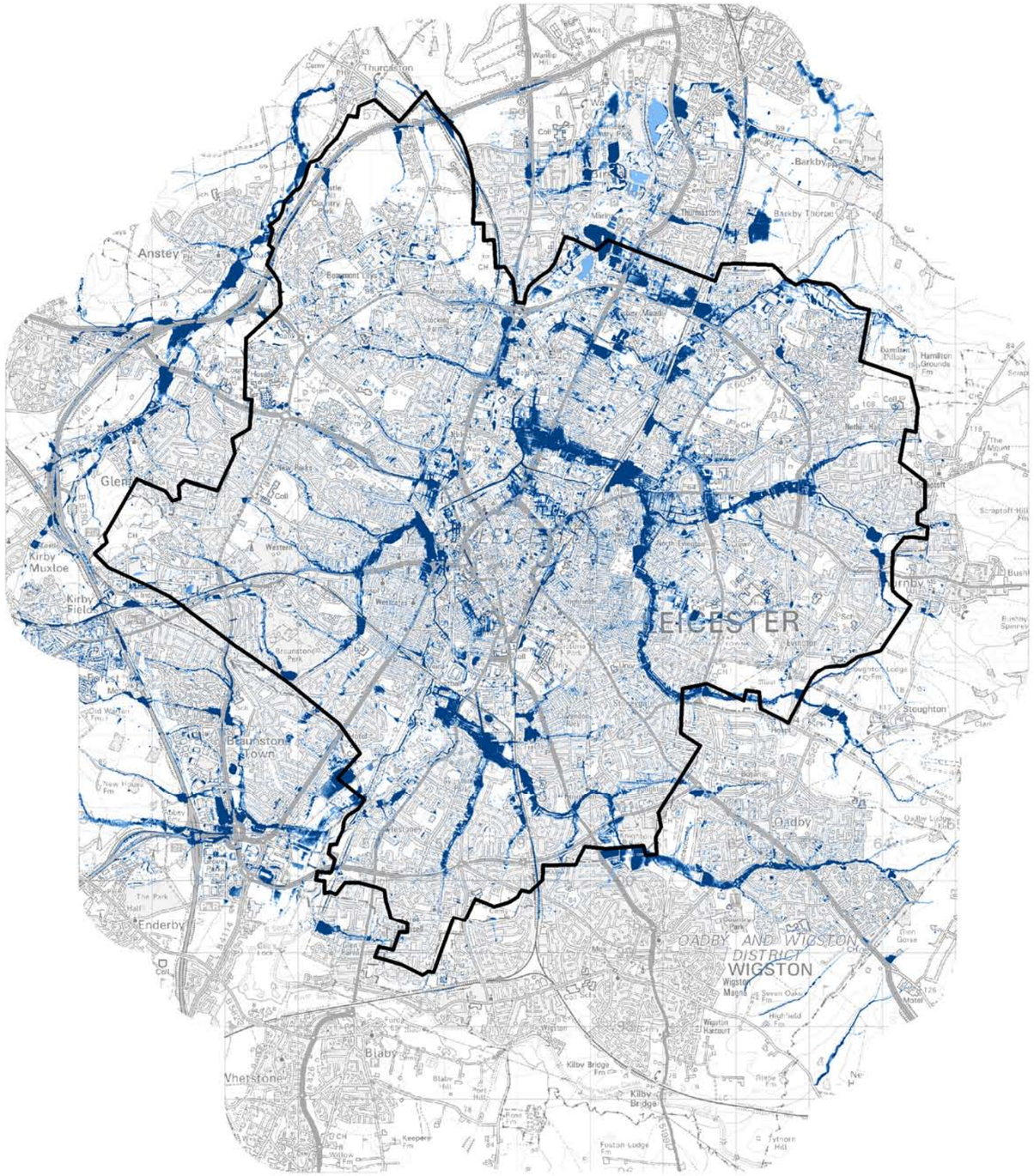
NORTH

Study Area

Deep Flooding >0.3m

Shallow Flooding >0.1m



0 2.5 5

kilometres

Job Title

Job D135090 - Leicester City PFRA

Leicester City Council

Figure 5-4: Draft Pluvial Model Outputs 0.5% AEP (1 in 200 Chance)

Scale at A3: NTS

www.scottwilson.com	Drawn	Check	Approved	Revision	Date
	GC	AW	MT	2	May 2011

URS Scott Wilson

Annex 6: SWMP Data Register

Extract from SWMP data register showing data received from LCC

Data ID	Data description	Date received	Relevance	Accuracy	Confidence
D135090/ DATA/001	Leicester SFRA JBA 2004 (report, figures, maps, photos).	20-Jul-10	1	2	Good
D135090/ DATA/002	LiDAR (topographic) ASCII grids, including 5m DTM, 2m DSM, 1m DTM and 1m DSM.	12-Nov-10	1	1	Very good
D135090/ DATA/003a	Leicester SFRA	12-Nov-10	1	2	Good
D135090/ DATA/003b	Leicester Flood Alleviation Scheme Phase 1 report (2007)	12-Nov-10	2	1	Good
D135090/ DATA/003c	Leicester Strategic Flood Risk Mapping Project (2010) *Note: Draft format only*	12-Nov-10	1	2 (draft)	Good
D135090/ DATA/003d	Leicester Critical Ordinary Watercourses (COWs) Final Report (2008)	12-Nov-10	2	1	Good
D135090/ DATA/003e	Environment Agency Lubbesthorpe Brook Flood Alleviation Scheme report (2010) *Note: Draft format only*	12-Nov-10	1	2 (draft)	Good
D135090/ DATA/005	Historic Flooding database (including location, date and cause)	16-Nov-10	1	1	Very good
D135090/ DATA/007	Lead Local Flood Authority update newsletter (November 2010)	23-Nov-10	2	1	Good
D135090/ DATA/009a	Historical Flood Map (HFM) GIS layer	23-Nov-10	1	2	Good
D135090/ DATA/009b	Main River GIS layer	23-Nov-10	1	1	Very good
D135090/ DATA/009c	Digital River Network GIS layer	23-Nov-10	1	1	Very good
D135090/ DATA/009d	Areas Susceptible to Surface Water Flooding (ASTSWF) GIS layer	23-Nov-10	1	2	Good
D135090/ DATA/009e	Flood Zones GIS layer	23-Nov-10	1	1	Very good
D135090/ DATA/009f	Flood Storage Areas GIS layer	23-Nov-10	1	1	Very good
D135090/ DATA/009g	Flood defences GIS layer	23-Nov-10	1	1	Very good
D135090/ DATA/009h	Areas Benefiting from Defences GIS layer	23-Nov-10	1	1	Very good
D135090/ DATA/009i	Historical Landfill GIS layer	23-Nov-10	2	1	Good
D135090/ DATA/009j	National Receptors Database GIS layer	23-Nov-10	1	1	Very good
D135090/ DATA/009k	Social, cultural and environmental (part 2)	23-Nov-10	2	1	Good
D135090/D ATA/010	Watercourse/Drainage infrastructure/asset map – Large Paper copy	23-Nov-10	1	1	Very good
D135090/D ATA/010a	Fire Service Records of Flooded Properties	6-Dec-10	1	1	Very good
D135090/D ATA/019	Spreadsheet of Brook levels for historic events.	19-Jan-11	1	2	Good

Extract from SWMP data register showing data received from the EA

Data ID	Data description	Date received	Relevance	Accuracy	Confidence
D135090/ DATA/006a	Building Trust with Communities Guide, including example of Foxholes Spinney / Lubbesthorpe Brook study.	23-Nov-10	1	1	Very good
D135090/ DATA/006b	National Flooding and Coastal Defence Database Assets and Structures GIS layer	23-Nov-10	1	2	Good
D135090/ DATA/006c	1977 flood event outlines GIS layer	23-Nov-10	1	2	Good
D135090/ DATA/006d	EA Water Management Boundary GIS layer	23-Nov-10	2	1	Good
D135090/ DATA/006e	Flood Warning Areas GIS layer	23-Nov-10	1	1	Very good
D135090/ DATA/006f	Flood Watch Areas GIS layer	23-Nov-10	1	1	Very good
D135090/ DATA/006g	FRM Library Data - model file details	23-Nov-10	1	1	Very good
D135090/ DATA/006h	Surveying services standard technical specifications	23-Nov-10	1	1	Very good
D135090/D ATA/014	Local Flood Warning Plan for the City of Leicester, Leicestershire and Rutland	11-Jan-11	1	1	Very good
D135090/D ATA/015	PFRA Indicative Flood Risk Areas	12-Jan-11	1	1	Very good
D135090/D ATA/016	Draft Trent (Soar) Catchment Flood Management Plan, Final PFRA guidance and annexes, Leicester Leicestershire and Rutland Local Resilience Forum Emergency Plans	16-Jan-11	1	1	Very good
D135090/D ATA/018	Leicester City Strategic Flood Risk Mapping (SFRM) Final Outputs	19-Jan-11	1	1	Very good

Extract from SWMP data register showing data received from STW

Data ID	Data description	Date received	Relevance	Accuracy	Confidence
D135090/D ATA/012	Sewer records (GIS) and supporting documentation	24-Dec-10	1	1	Very Good
D135090/D ATA/013	DG5 sewer flooding register for Leicester City administrative area	07-Jan-11	1	1	Very Good
D135090/D ATA/017	DG5 sewer flooding register for Leicester City administrative area plus Strategic Urban Extensions	18-Jan-11	1	1	Very Good