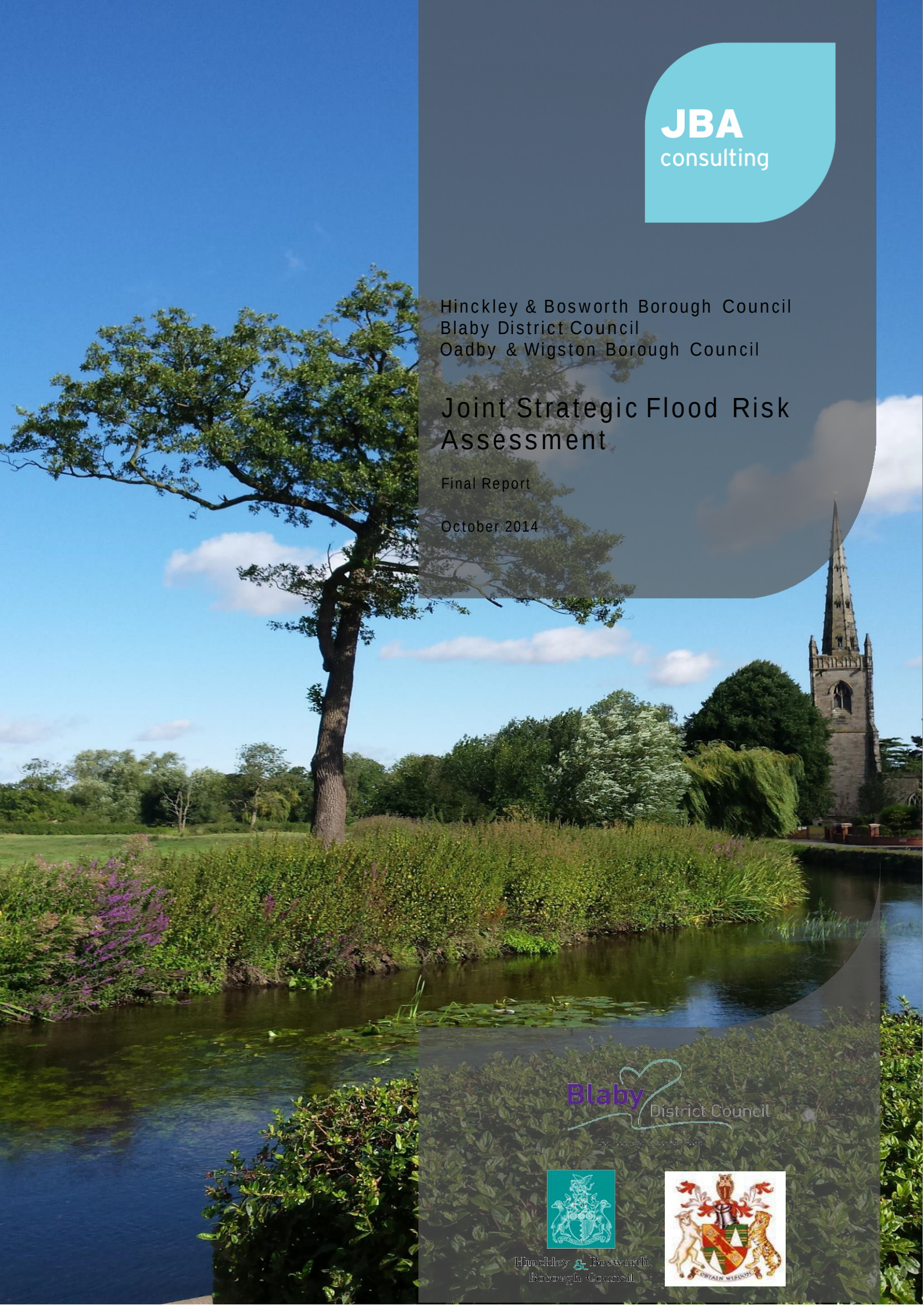

Hinckley & Bosworth Borough Council
Blaby District Council
Oadby & Wigston Borough Council

Joint Strategic Flood Risk Assessment

Final Report

October 2014

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Revision History

Revision Ref / Date Issued	Amendments	Issued to
Draft Report Version 1.0 (August 2014)		• Sally Smith & Rachel Dexter (Hinckley & Bosworth Borough Council • Lucy O'Doherty (Blaby District Council • Kirstie Rea (Oadby & Wigston Borough Council) • Chris Clarke (Environment Agency – Lichfield Office) • Tim Andrews (Environment Agency – Nottingham Office) • Leicestershire County Council
Final Draft Report Version 1.0 (September 2014)	Updated following review by Hinckley & Bosworth Borough Council, Blaby District Council, Oadby & Wigston Borough Council, Leicestershire County Council and the Environment Agency	• Sally Smith & Rachel Dexter (Hinckley & Bosworth Borough Council • Lucy O'Doherty (Blaby District Council • Kirstie Rea (Oadby & Wigston Borough Council)
Final Report Version 1.0 (October 2014)	Small text amendments based upon Hinckley & Bosworth Borough Council and Environment Agency comments	• Sally Smith & Rachel Dexter (Hinckley & Bosworth Borough Council • Lucy O'Doherty (Blaby District Council • Kirstie Rea (Oadby & Wigston Borough Council)

Contract

This report describes work commissioned by Hinckley & Bosworth Borough Council, Blaby District Council, and Oadby & Wigston Borough Council. The Councils' representative for the contract was Sally Smith of Hinckley & Bosworth Borough Council. Natasha Todd-Burley, Jaroslav Petrovskij and Claire Gardner of JBA Consulting carried out this work.

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Purpose

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JBA Consulting has no liability regarding the use of this report except to Hinckley & Bosworth Borough Council, Blaby District Council, and Oadby & Wigston Borough Council.

Acknowledgements

We would like to acknowledge the assistance of Sally Smith and Rachel Dexter (Hinckley & Bosworth Borough Council), Lucy O'Doherty (Blaby District Council), Kirstie Rea and Jamie Carr (Oadby & Wigston Borough Council), Tim Andrews, Chris Clarke and Andrew Nickolls (Environment Agency), Dorothy Barratt (North Warwickshire Borough Council), Fabian D'Costa (Leicester City Council), Lesley Aspinall (Harborough District Council) and Lizzie Beresford (Rugby Borough Council).

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Executive Summary

Introduction

This updated version of the Joint Strategic Flood Risk Assessment (SFRA) 2014 replaces the document "Joint Strategic Flood Risk Assessment Final Report, November 2007"[1] for the Councils of Hinckley & Bosworth Borough, Blaby District and Oadby & Wigston Borough (hereafter referred to as the joint SFRA area). The updated report has been prepared to replace the work that was included in the previous SFRA and provide appropriate supporting evidence for each Council's Local Plan. The SFRA update will be used in decision making and to inform decisions on the location of future development and the preparation of sustainable policies for the long-term management of flood risk.

Since the previous SFRA there have been a number of changes to the planning system, including the Localism Act (2011) and the National Planning Policy Framework (NPPF) (2012) with accompanying Planning Practice Guidance (March 2014). In addition, the provisions of the Flood and Water Management Act (2010) have been substantially commenced under a programme that was initiated by Defra in April 2010 and the Flood Risk Regulations came into force in December 2009 (these regulations transposed the EU 'Floods Directive' into UK law).

The purpose of this SFRA update is to

- provide information on the changes to planning, policy and guidance since the previous SFRA;
- provide a detailed assessment of any flood hazard within the Flood Zones;
- provide information on existing defences and flood risk management measures;
- allow a sequential approach to site allocation to be undertaken within a flood zone; and
- allow development of the policies and practices required to ensure that development in Flood Zones 2 and 3 satisfies the requirements of the Exception Test.

SFRA objectives

The Planning Practice Guidance advocates a tiered approach to risk assessment and identifies the following two levels of SFRA

1. Level One: where flooding is not a major issue and where development pressures are low. The Assessment should be sufficiently detailed to allow application of the Sequential Test
2. Level Two: where land outside Flood Zones 2 and 3 cannot appropriately accommodate all the necessary development creating the need to apply the NPPF's Exception Test. In these circumstances the Assessment should consider the detailed nature of the flood characteristics within a flood zone.

The objectives of this SFRA update are a hybrid of level one and level two.

SFRA outputs

This version of the SFRA delivers:

Level one outputs

- Maps showing the local planning authority area, Main Rivers, ordinary watercourses, and Flood Zones
- An assessment of the implications of climate change for flood risk at assessment sites
- Areas at risk from other sources of flooding, for example surface water or reservoir
- Flood risk management measures, including location and standard of flood defences, flood warning coverage and emergency plans
- Recommendations about the identification of critical drainage areas and the potential need for surface water management plans
- Advice on the likely applicability of sustainable drainage systems for managing surface water runoff at key development sites

[1] Joint Strategic Flood Risk Assessment (JBA Consulting, November 2007)

- Advice on the preparation of flood risk assessments for development sites

Level two outputs

- An appraisal of current conditions of flood defence infrastructure
- An appraisal of the probability and consequences of overtopping or failure of flood risk management infrastructure, including an allowance for climate change
- Definition and mapping of the functional floodplain
- Definition and mapping of
    - Flood depth
    - Flood velocity
    - Flood hazard
- Maps showing the distribution of flood risk across all Flood Zones from all sources of flooding
- Advice on appropriate policies for sites which could satisfy the first part of the Exception Test and on the requirements that would be necessary for a site-specific flood risk assessment supporting a planning application to pass the second part of the Exception Test
- Advice on the preparation of site-specific flood risk assessments for sites of varying risk across the Flood Zones, including information about the use of sustainable drainage techniques
- Recommendations to inform policy, development control and technical issues

Summary

- The Joint SFRA update has considered all sources of flooding, including fluvial, pluvial, groundwater, canal, reservoir and sewer flooding, within Hinckley & Bosworth Borough, Blaby District and Oadby & Wigston Borough.
- An assessment of the flood defences in the joint SFRA area has been undertaken, including defence condition and standard and the residual risk.
- Flood risk has been assessed for all supplied development options.
- Guidance for the requirements for a site specific Flood Risk Assessment for these sites is provided (Appendix A), as well as general guidance on flood risk assessment for any development proposals within the joint SFRA area.
- The updated Flood Map for Surface Water is provided, indicating the likelihood of surface water flooding in the joint SFRA area.
- Surface water flooding is a risk in many of the areas. Advice has been provided regarding suitable SuDS options.
- A broad scale assessment of the cumulative impact of development and cross-boundary issues has been undertaken.
- Green Infrastructure within the joint SFRA area has been assessed and the Water Framework Directive (WFD) status of the joint SFRA area's watercourses assessed.

Recommendations

Key recommendations

- It is recommended that the mapping produced for this SFRA update is used in preference to the previous SFRA published in 2007.
- It is recommended that developers refer to the FRA recommendations provided in the proposed development site summary tables in Appendix A as well as the general guidance on flood risk assessment in Section 11.
- The key requirements for future development are summarised below:
    - All sites within Zones 2 and 3 will require a detailed Flood Risk Assessment in accordance with NPPF, making reference to Appendix A and Section 11, and

associated maps of this report. Consultation with Hinckley & Bosworth Borough Council, Blaby District Council, Oadby & Wigston Borough Council Leicestershire County Council and the Environment Agency is strongly recommended at an early stage in the FRA process.

  - The layout of buildings and access routes should adopt a sequential approach, steering buildings (and hence people) towards areas of lowest risk within the boundaries of the site. This will also ensure that the risk of flooding is not worsened by, for example, blocked flood flow routes.
  - The FRA requirements defined in Section 11 of this Level 2 SFRA must be considered for all future development brought forward.

- Any development adjacent to the canals should take account of residual risk from breach or failure and it is recommended the development incorporates a buffer zone next to the canal to allow access for maintenance and repair, should it be required.

Development and Flood Risk

All development should adhere to the advice in the Joint Strategic Flood Risk Assessment Update and the guidance provided on Flood Risk Assessment requirements in order to:

- protect floodplains from inappropriate development;
- ensure no increase in flood risk;
- where possible provide flood risk betterment; and
- ensure development is safe.

Protection and Enhancement of Watercourses

Planning permission for development should only be granted where:

- the natural watercourse system which provides drainage of land is not adversely affected;
- a minimum of 8 metres width access strip is provided adjacent to the top of both banks of any watercourses for maintenance purposes and is appropriately landscaped for open space and Biodiversity benefits, this width may be reduced in particular circumstances with agreement from the Environment Agency and LPA;
- it would not result in the loss of open water features through draining, culverting or enclosure by other means and culverts are opened up where ever possible;
- surface water drainage is delivered by sustainable drainage systems (SuDS); and
- betterment in the surface water runoff regime is ensured; with any residual risk of flooding, from drainage features either on or off site not placing people and property at unacceptable risk.

Use of SFRA data

It is important to recognise that the SFRA has been developed using the best available information at the time of writing. This relates both to the current risk of flooding from rivers, and the potential impacts of future climate change.

The Environment Agency regularly reviews their flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a detailed Flood Risk Assessment.

The SFRA update should be periodically updated when new information on flood risk, flood warning or new planning guidance or legislation becomes available. New information on flood risk may be provided by the Borough / District Councils, Leicestershire County Council (in its role as Lead Local Flood Authority), the Highways Authority, Severn Trent Water and the Environment Agency.

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Abbreviations and Glossary of Terms

Term	Definition
1D model	One-dimensional hydraulic model
2D model	Two-dimensional hydraulic model
AEP	Annual Exceedance Probability
AIMS	Asset Information Management System
BDC	Blaby District Council
CC	Climate change - Long term variations in global temperature and weather patterns caused by natural and human actions.
CDA	Critical Drainage Area - A discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure.
CFMP	Catchment Flood Management Plan- A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
CIRIA	Construction Industry Research and Information Association
Cumecs	The cumec is a measure of flow rate. One cumec is shorthand for cubic metre per second; also m^3/s.
Defra	Department for Environment, Food and Rural Affairs
Designated Feature	A form of legal protection or status reserved for certain key structures or features that are privately owned and maintained, but which make a contribution to the flood or coastal erosion risk management of people and property at a particular location.
DG5 Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years.
DPD	Development Plan Documents
DTM	Digital Terrain Model
EA	Environment Agency
EU	European Union
FEH	Flood Estimation Handbook
FMfSW	Flood Map for Surface Water
Flood cell	A part of the floodplain that might be inundated in case of floods (in protected floodplains if the defences fail) but where the inundation cannot spread to the adjacent parts of the floodplain.
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG (Welsh Assembly Government).
Flood Risk Regulations	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Floods and Water Management Act	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing surface water flood risk in England.
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a main river
FRA	Flood Risk Assessment - A site specific assessment of all forms of flood risk to the site and the impact of development of the site to flood risk in the area.
FRM	Flood Risk Management
FWMA	Flood and Water Management Act
FZ	Flood Zones
GI	Green Infrastructure – a network of natural environmental components and green spaces that intersperse and connect the urban centres, suburbs and urban fringe
Ha	Hectare
HBBC	Hinckley and Bosworth Borough Council

Term	Definition
Indicative Flood Risk Area	Nationally identified flood risk areas, based on the definition of 'significant' flood risk described by Defra and WAG.
JBA	Jeremy Benn Associates
LDF	Local Development Framework
LFRMS	Local Food Risk Management Strategy
LIDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority - Local Authority responsible for taking the lead on local flood risk management
LPA	Local Planning Authority
mAOD	metres Above Ordnance Datum
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers
NPPF	National Planning Policy Framework
Ordinary Watercourse	All watercourses that are not designated Main River. Local Authorities or, where they exist, IDBs have similar permissive powers as the Environment Agency in relation to flood defence work. However, the riparian owner has the responsibility of maintenance.
OS NGR	Ordnance Survey National Grid Reference
OWBC	Oadby and Wigston Borough Council
PFRA	Preliminary Flood Risk Assessment
Pitt Review	Comprehensive independent review of the 2007 summer floods by Sir Michael Pitt, which provided recommendations to improve flood risk management in England.
Pluvial flooding	Flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (surface runoff) before it enters the underground drainage network or watercourse, or cannot enter it because the network is full to capacity.
Pound length	Distance of level water impounded between two canal locks.
PPG	Planning Policy Guidance – superseded by the NPPF
PPS25	Planning and Policy Statement 25: Development and Flood Risk
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Resistance Measures	Measures designed to keep flood water out of properties and businesses; could include flood guards for example.
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
Return Period	Is an estimate of the interval of time between events of a certain intensity or size, in this instance it refers to flood events. It is a statistical measurement denoting the average recurrence interval over an extended period of time.
SAB	SuDS Approval Body - responsible for approving, adopting and maintaining drainage plans and SuDS schemes that meet the National Standards
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
SHLAA	Strategic Housing Land Availability Assessment - The Strategic Housing Land Availability Assessment (SHLAA) is a technical piece of evidence to support local plans and Sites & Policies Development Plan Documents (DPDs). Its purpose is to demonstrate that there is a supply of housing land in the District which is suitable and deliverable.
SFRA	Strategic Flood Risk Assessment
SFRM	Strategic Flood Risk Mapping
SoP	Standard of Protection - Defences are provided to reduce the risk of flooding from a river and within the flood and defence field standards are usually described in terms of a flood event return period. For example, a flood embankment could be described as providing a 1 in 100 year standard of protection.
Stakeholder	A person or organisation affected by the problem or solution, or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.
SuDS	Sustainable Drainage Systems - Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques
SUE	Sustainable Urban Extension
Surface water flooding	Flooding as a result of surface water runoff as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse, or cannot enter it

Term	Definition
	because the network is full to capacity, thus causing what is known as pluvial flooding.
SWMP	Surface Water Management Plan - The SWMP plan should outline the preferred surface water management strategy and identify the actions, timescales and responsibilities of each partner. It is the principal output from the SWMP study.
uFMfSW	Updated Flood Map for Surface Water
WFD	Water Framework Directive

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1 Introduction

1.1 Purpose of the Strategic Flood Risk Assessment

This Joint Strategic Flood Risk Assessment (SFRA) 2014 document replaces the "Joint Strategic Flood Risk Assessment Final Report, November 2007"[2] for the Councils of Hinckley & Bosworth Borough, Blaby District and Oadby & Wigston Borough (hereafter referred to as the joint SFRA area). This report has been prepared to replace the work that was included in the previous SFRA and provide appropriate supporting evidence for each Councils' Local Plan. The SFRA update will be used in decision making and to inform decisions on the location of future development and the preparation of sustainable policies for the long-term management of flood risk.

The key objectives of the review are:

1. **To critically review the 2007 SFRA and to provide an update, taking into account the latest flood risk information and any updates to policy including:**
   - Changes to legislation relating to both flood risk and planning policy, including the Climate Change Act (2008), the Localism Act (2011), the Flood and Water Management Act (2010) and the National Planning Policy Framework (NPPF)[3] (2012) with accompanying Planning Practice Guidance (2014)[4]; and new powers and responsibilities bestowed on Leicestershire County Council as the Lead Local Flood Authority under the Flood and Water Management Act (2010) and their dependencies therefore with the Councils' local development management and forward planning roles.
   - Changes to technical guidance, for example the Consultation on SuDS Regulations and Standards (2011), National SuDS Guidance (DEFRA, pending), and NPPF Planning Practice Guidance replacing PPS25 Technical Note.
   - Improved knowledge of flood risk through modelling and other studies e.g. River Trent Catchment Flood Management Plan (2010), Leicestershire Preliminary Flood Risk Assessment (March 2011) featuring historic flooding information, the Lower River Soar and tributaries fluvial modelling study undertaken in 2010 by JBA Consulting for the Environment Agency, the River Sence fluvial modelling study undertaken in 2013 by JBA Consulting for the Environment Agency, the availability of the Updated Flood Map for Surface Water (UFMfSW) and the availability of Hazard Mapping.
2. **To provide individual flood risk analysis for any assessment areas identified by each district as part of their local plan preparation.**
   - Local plans set out each Council's spatial strategy to help guide and manage future development in the most sustainable way. Assessment areas have been provided by each authority depending on what stage they are at in the preparation of their local plan.
3. **To provide a comprehensive set of maps including:**
   - Fluvial flood risk, including functional floodplain and climate change
   - Surface water risk
   - Ground water risk
   - Flood warning coverage
   - WFD and green infrastructure
   - Flood defences
   - Depth, hazard and velocity mapping, where available

The SFRA will form an integral part of each of the Councils' evidence base in terms of identifying locations for development and preparation of flood risk policies in the Local Plan. The primary objective of the SFRA is to be part of the evidence base supporting the Local Plans to inform site

[2] Joint Strategic Flood Risk Assessment (JBA Consulting, November 2007)

[3] National Planning Policy Framework (Department for Communities and Local Government, March 2012)

[4] National Planning Policy Framework Planning Practice Guidance: Flood Risk and Coastal Change (Department for Communities and Local Government, March 2014)

allocations so they are in accordance with the NPPF. A number of sites have been provided by each authority to be assessed in the SFRA which will inform Local Plan Production.

In order to achieve this, the Planning Practice Guidance states that SFRAs need to provide sufficient detail on all types of flood risk to enable the Local Planning Authority (LPA) to:

- Determine the variations in risk from all sources of flooding across their areas, and also the risks to and from surrounding areas in the same flood catchment
- Inform the sustainability appraisal of the Local Plan, so that flood risk is fully taken into account when considering allocation options and in the preparation of plan policies, including policies for flood risk management to ensure that flood risk is not increased
- Apply the Sequential and, where necessary, Exception Tests in determining land use allocations
- Identify the requirements for site specific flood risk assessments in particular locations, including those at risk from sources other than river and sea flooding
- Determine the acceptability of flood risk in relation to emergency planning capability
- Consider opportunities to reduce flood risk to existing communities and developments through better management of surface water, provision for conveyance and storage of flood water

This document has been prepared under the requirements of the National Planning Policy Framework (NPPF) and accompanying Flood Risk and Coast Change Planning Practice Guidance to the National Planning Policy Framework published in March 2014, as well as the Environment Agency's Strategic Flood Risk Assessments guidance[5].

The extent of the study area is shown in Figure 1-2.

1.2 SFRA objectives

The Planning Practice Guidance advocates a tiered approach to risk assessment and identifies the following two levels of SFRA

1. Level One: where flooding is not a major issue and where development pressures are low. The assessment should be sufficiently detailed to allow application of the Sequential Test
2. Level Two: where land outside Flood Zones 2 and 3 cannot appropriately accommodate all the necessary development creating the need to apply the NPPF's Exception Test. In these circumstances the assessment should consider the detailed nature of the flood characteristics within a flood zone.

The objectives of this SFRA update are a hybrid of level one and level two.

1.3 SFRA outputs

This version of the SFRA delivers:

1.3.1 Level one outputs

- Maps showing the local planning authority area, Main Rivers, ordinary watercourses, and Flood Zones
- An assessment of the implications of climate change for flood risk at assessment areas
- Areas at risk from other sources of flooding, for example surface water or reservoir
- Flood risk management measures, including location and standard of flood defences, flood warning coverage and emergency plans
- Advice on the likely applicability of sustainable drainage systems for managing surface water runoff at key assessment areas
- Advice of the preparation of flood risk assessments for assessment areas

[5] Strategic Flood Risk Assessments: Guidance to support the National Planning Policy Framework (Environment Agency, July 2013)

1.3.2 Level two outputs

- An appraisal of current conditions of flood defence infrastructure
- An appraisal of the probability and consequences of overtopping or failure of flood risk management infrastructure, including an allowance for climate change
- Definition and mapping of the functional floodplain
- Definition and mapping of
    - Flood depth
    - Flood velocity
    - Flood hazard
- Maps showing the distribution of flood risk across all Flood Zones from all sources of flooding
- Advice on appropriate policies for sites which could satisfy the first part of the Exception Test and on the requirements that would be necessary for a site-specific flood risk assessment supporting a planning application to pass the second part of the Exception Test
- Advice on the preparation of site-specific flood risk assessments for sites of varying risk across the Flood Zones, including information about the use of sustainable drainage techniques
- Recommendations to inform policy, development control and technical issues

The Councils provided GIS layers of assessments areas to be assessed as part of the SFRA.

Stage 2 sites:

These are strategic and/or urban capacity assessment areas identified by each Council as part of their local plan preparation.

Stage 3 sites:

As part of their plan making, each Council will be identifying individual locations for specific future development. Hinckley & Bosworth Borough Council (HBBC) consulted upon the Pre-Submission Site Allocations and Development Management Policies (DPD) in February - March 2014. As a result of this and previous consultations, HBBC have derived a number of sites that have been considered as part of this SFRA. Stage 3 sites had not been identified by Blaby District Council (BDC) and Oadby & Wigston Borough Council (OWBC) at the time of publication of this SFRA.

A summary of flood risk to all assessment areas is given in the following tables:

- Table 10-2: Hinckley & Bosworth
-
-
- Table 10-3: Blaby
- Table 10-4: Oadby & Wigston

Where sites are shown to be in Flood Zones, flood risk to the assessment areas has been assessed and summarised in more detail in a series of summary tables provided in the following appendices:

- A.1: Hinckley & Bosworth Stage 2
- A.2: Hinckley & Bosworth Stage 3

1.4 SFRA user guide

Table 1-1: SFRA report contents

Section	Contents
1. Introduction	Provides a background to the study, defines objectives, outlines the approach adopted and the consultation performed
2 The Planning Framework and Flood Risk Policy	Includes information on the implications of recent changes to planning and flood risk policies and legislation.
Level One Strategic Flood Risk Assessment	
3. How flood risk is assessed	Provides an overview of flooding and risk and Flood Zones
4. Understanding flood risk in the joint SFRA area	Gives an introduction to the assessment of flood risk and provides an overview of the characteristics of flooding affecting the joint SFRA area. Provides a summary of responses that can be made to flood risk, together with policy and institutional issues that should be considered.
5. Flood risk from canals and reservoirs	Summarises flood risk from canals and reservoirs.
6. Mapping and risk-based approach	Summary of the modelling used for the assessment. Description of mapping that should be used for Sequential and Exception testing. Application of the Sequential Approach and Sequential/Exception Test process.
7. Cumulative impact of development and cross boundary issues	Broad scale assessment of areas where the cumulative impact of development may be detrimental to flood risk. An assessment of potential cross boundary flood risk issues as a result of future large scale developments.
8. Managing surface water runoff	Advice on managing surface water run-off and flooding
Level Two Strategic Flood Risk Assessment	
9. Flood defences and 'critical structures'	Assessment of residual risk from flood defences, including future protection from climate change. Identification of possible 'designated features' that affect flood risk.
10. Assessment areas summary	Summary of risk to assessment areas brought forward in the Local Plan.
11. FRA requirements	Identifies the scope of the assessments that must be submitted in FRAs supporting applications for new development.
12. Green Infrastructure and Water Framework Directive	Summarises the importance and role of Green Infrastructure. Describes the purpose and objectives of the Water Framework Directive and provides an assessment of the current ecological status of watercourses within the joint SFRA area and implications for development.
13. Summary and recommendations	Reviews SFRA and its implications.

1.5 Approach

1.5.1 General assessment of flood risk

The flood risk management hierarchy underpins the risk based approach and is the basis for making all decisions involving development and flood risk. When using the hierarchy, account should be taken of

- The nature of the flood risk (the ***source*** of the flooding)
- The spatial distribution of the flood risk (the ***pathways*** and areas affected by flooding)

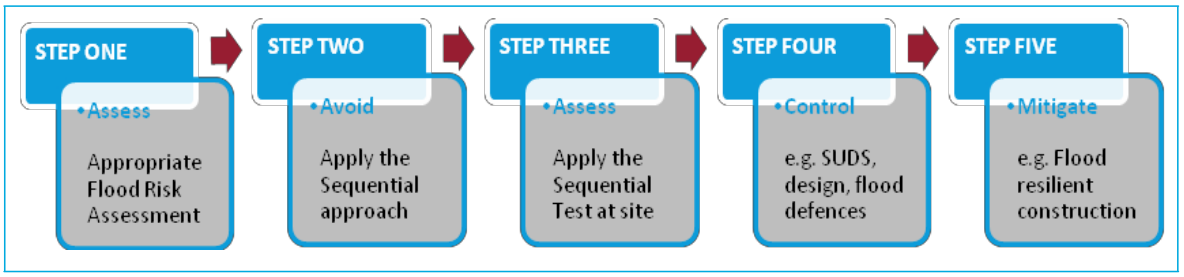
- Climate change impacts, and
- The degree of vulnerability of different types of development (the ***receptors***)

Developments should reflect the application of the Sequential Test using the maps produced for this SFRA. The information in this SFRA should be used as evidence and, where necessary, reference should also be made to relevant evidence in other documents referenced in this report. The Flood Zone maps and flood risk information on other sources of flooding contained in this SFRA should be used where appropriate to apply the Sequential Test.

Where other sustainability criteria outweigh flood risk issues, the decision making process should be transparent. Information from this SFRA should be used to justify decisions to allocate land in areas at high risk of flooding.

The flood risk management hierarchy is summarised in Figure 1-1.

Figure 1-1: Flood Risk Management Hierarchy



1.5.2 Technical assessment of flood hazards

Flood risk within the joint SFRA area has been assessed using results from computer models supplied by the Environment Agency and existing Environment Agency Flood Zone mapping.

In particular:

- 1D-2D modelling of the River Soar and its tributaries as part of the Leicester Strategic Flood Risk Mapping (SFRM) study, including 1D modelling of the River Sence (Soar tributary)
- 1D modelling of the Broughton Astley Brook
- 1D modelling of the Lubbesthorpe Brook
- 1D modelling of the Whetstone Brook
- 1D-2D modelling of the River Sence (Anker tributary)
- Modelled outlines using Jflow have been developed to determine Flood Zone 3a, Flood Zone 3b and Flood Zone 2, as well as the effects of climate change, for a number of ordinary watercourses flowing through or adjacent to sites. (Note, only the sections of the watercourse that flow through/adjacent to the site have been modelled). These watercourses included, but were not limited to:
    - Cosby Brook
    - Harrow Brook
    - Upper reaches of the Lubbesthorpe Brook
    - Upper reaches of the River Soar
    - Upper reaches of the Rothley Brook
    - Sketchley Brook
    - Slate Brook
    - Tweed River
    - Wash Brook
    - Unnamed watercourse from Coombe Park Recreation Ground to Kilby Bridge
    - Unnamed watercourse from Wigston South Junction to Crow Mill Bridge

1.6 Consultation

The following parties (external to the Project Steering Group) have been consulted during the preparation of this version of the SFRA:

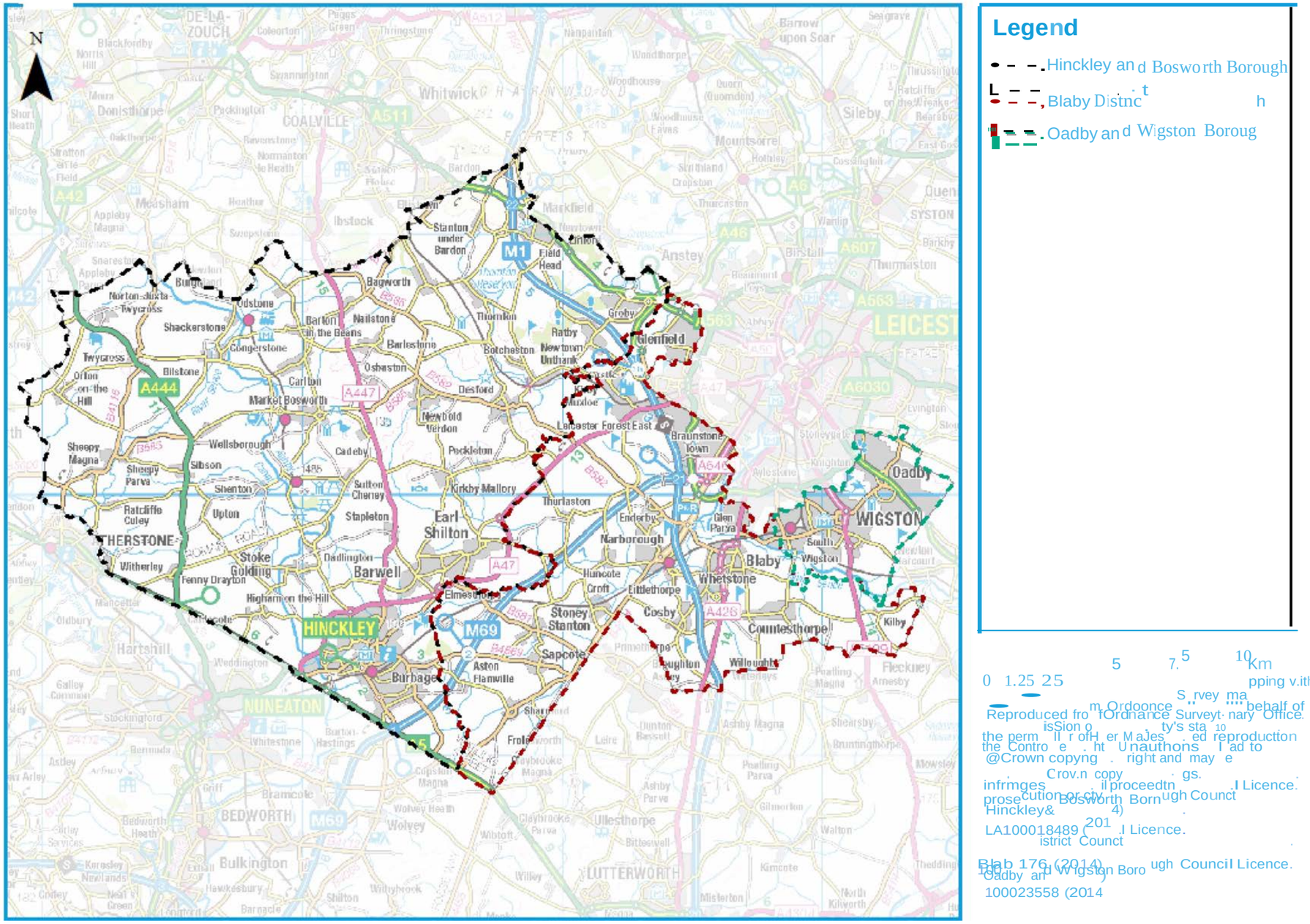
- Environment Agency
- Leicestershire County Council
- Severn Trent Water
- Neighbouring authorities including:
    - Charnwood Borough Council
    - Nuneaton & Bedworth Borough Council
    - North Warwickshire Borough
    - Rugby Borough
    - Harborough District
    - Leicester City Council
    - North West Leicestershire District*

* no response received

The Project Steering Group consists of:

- Hinckley & Bosworth Borough Council
- Blaby District Council
- Oadby & Wigston Borough Council

Figure 1-2: Study area



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2 The Planning Framework and Flood Risk Policy

2.1 Introduction

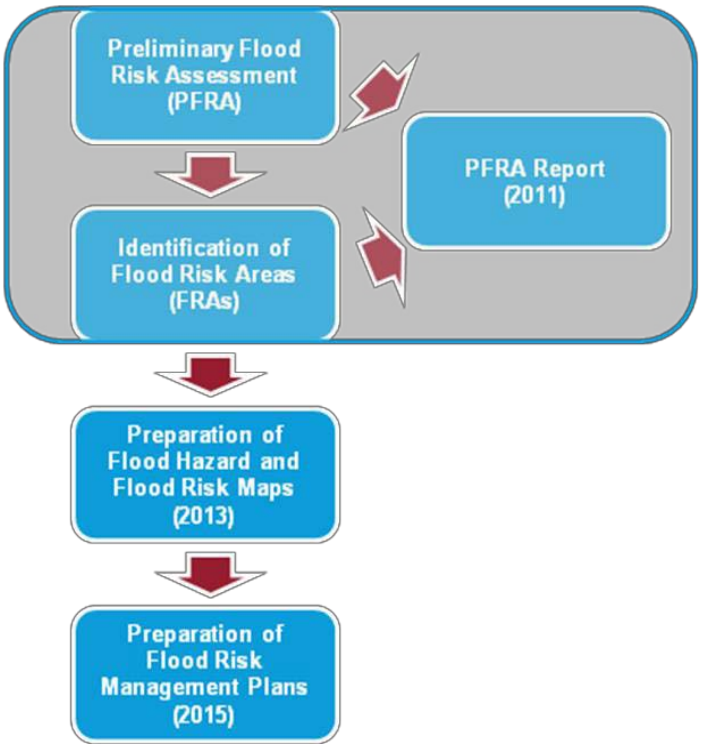
The overarching aim of planning policy on development and flood risk is to ensure that flood risk is taken into account at all stages of the planning process. The purpose of this section of the report is to provide information on the main changes to the planning framework, flood risk responsibilities and flood risk policy since the 2007 SFRA was published. These changes have been taken into account in preparing this SFRA update.

2.2 Flood Risk Regulations (2009) and Flood and Water Management Act (2010)

The Flood Risk Regulations transpose the EU Floods Directive into UK law and place responsibility upon all Lead Local Flood Authorities (LLFAs) to manage local flood risk. Under the Regulations the Environment Agency is responsible for flooding from rivers, the sea and reservoirs with Lead Local Flood Authorities (in this instance Leicestershire County Council) being responsible for local and all other sources of flooding.

Figure 2-1 sets out the requirements and timescales for implementing the requirements of the Directive.

Figure 2-1: Flood Risk Regulation Requirements



Lead Local Flood Authorities prepared the (Preliminary Flood Risk Assessment) PFRA reports in accordance with the regulations and Leicestershire County Council has published the document that covers the local authority area.

The Environment Agency did not prepare a PFRA as they exercised an 'exception' that was permitted under the Regulations. Having exercised this exception the Environment Agency will have to prepare Flood Hazard and Flood Risk Maps and Flood Risk Management Plans for rivers, the sea and reservoirs.

The Flood and Water Management Act (FWMA) received Royal Assent in April 2010. The FWMA aims to create a simpler and more effective means of managing the risk of flood and coastal erosion and implements Sir Michael Pitt's recommendations following his review of the 2007 floods.

The FWMA also calls for the establishment of a SuDS Approving Body (SAB) to be set up in county, county borough or unitary local authorities. This requires SAB approval of drainage

systems for new and redeveloped sites to be obtained before construction can commence. Additionally the proposed drainage system must meet the new National Standards for design, construction, operation and maintenance. The SAB will be responsible for approving, adopting and maintaining drainage plans and SuDS schemes that meet the National Standards. The responsibilities of the SAB are likely to rest with the LLFA (in this case, Leicestershire County Council), although there is flexibility in the FWMA if it is considered more effective for another body to take on the role.

2.2.1 Leicestershire Preliminary Flood Risk Assessment

In the first instance, the regulations required Leicestershire County Council (as the LLFA) to prepare and publish a Preliminary Flood Risk Assessment (PFRA) on past and future flood risk from local sources of flooding. The PFRA reports on significant past and future flooding from all sources except Main River and Reservoir (covered by Environment Agency) and sub-standard performance of the adopted sewer network (under the remit of Severn Trent Water and Anglian Water). The Regulations also require the LLFA to identify significant Flood Risk Areas. Of the ten indicative Flood Risk Areas that were identified by the Environment Agency nationally, one covers the administrative area of Leicester City Council. This indicative Flood Risk Area also covered some parts of Oadby & Wigston due to hydrological links.

Key outputs of the Leicestershire PFRA include:

- Three past flooding events in Leicestershire were noted as having nationally significant harmful consequences; however, none of these events were within the joint SFRA area.
- After a review of the Indicative Flood Risk Area, in collaboration with Leicester City Council, it was proposed that the Indicative Flood Risk Area was extended in the south west to include parts of Blaby.

2.3 Localism Act

The Localism Act was given Royal Assent on 15 November 2011 with the purpose of moving the balance of decision making from central government back to councils, communities and individuals.

In addition, Provision 110 of the Act places a duty to cooperate on local authorities in relation to planning of sustainable development. This duty to cooperate requires local authorities to "engage constructively, actively and on an ongoing basis in any process by means of which development plan documents are prepared so far as relating to a strategic matter"[6].

The Localism Act also provides new rights to allow local communities to shape new development by coming together to prepare neighbourhood plans. This means local people can decide where new homes and businesses should go and what they should look like. Local planning authorities will be required to provide technical advice and support as neighbourhoods draw up their proposals.

2.4 National Planning Policy Framework

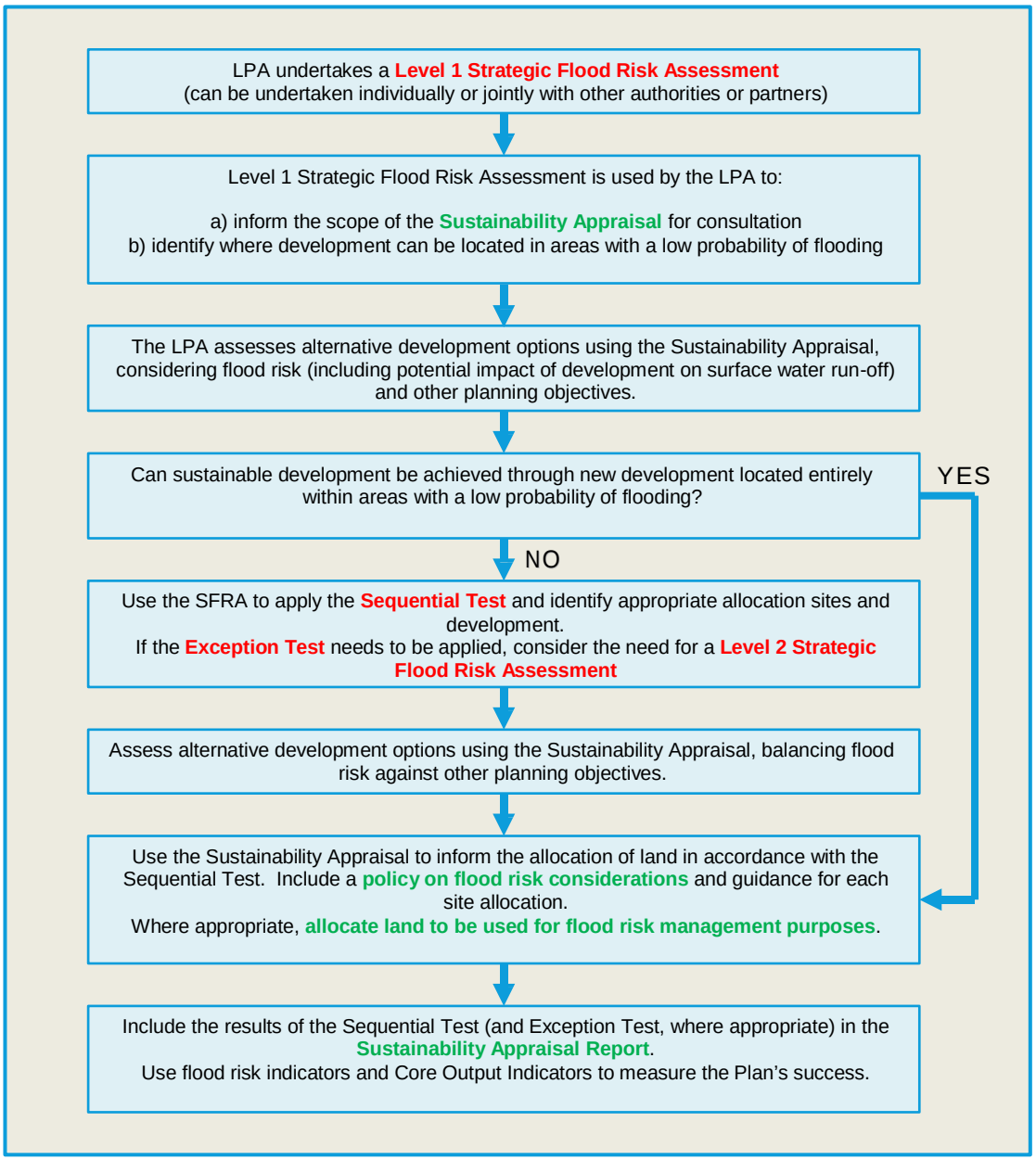
The National Planning Policy Framework (NPPF) was issued on 27 March 2012 to replace the previous documentation, as part of reforms to make the planning system less complex and more accessible, to protect the environment and to promote sustainable growth. It replaces the Planning Policy Guidance Notes (PPGs) and Planning Policy Statements (PPSs).

The NPPF is a source of guidance for local planning authorities to help them prepare Local Plans and for applicants preparing planning submissions. Paragraph 100 of the NPPF states "Local Plans should be supported by a strategic flood risk assessment and develop policies to manage flood risk from all sources, taking account of advice from the Environment Agency and other relevant flood risk management bodies, such as Lead Local Flood Authorities and Internal Drainage Boards. Local Plans should apply a sequential, risk-based approach to the location of development to avoid, where possible, flood risk to people and property and manage any residual risk, taking account of the impacts of climate change"[3].

[6] Localism Act 2011: Section 110. http://www.legislation.gov.uk/ukpga/2011/20/section/110

In March 2014 Planning Practice Guidance on flood risk was published alongside the NPPF[7] and sets out how the policy should be implemented. Diagram 1 in the Planning Practice Guidance also sets out how flood risk should be taken into account in the preparation of Local Plans

Figure 2-2: Flood risk and the preparation of Local Plans†



† Based on Diagram 1 of NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 004, Reference ID: 7-021-20140306) March 2014

2.5 Water Cycle Studies

A large number of homes may cause existing infrastructure to be overwhelmed and can adversely affect the environment. Climate change brings with it new challenges such as increased rainfall that can put greater pressure on the existing infrastructure, planning for water has to take this into account.

Water Cycle Studies assist local authorities to select and develop sustainable development allocations where there is minimal impact on the environment, water quality, water resources, infrastructure and flood risk. This can be achieved by identifying areas where there may be

[7] Planning Practice Guidance: Flood Risk and Coastal Change (2014)
http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/

conflict between any proposed development and the requirements of the environment and by recommending potential solutions.

There are currently no Water Cycle Studies covering the joint SFRA area. However, a Water Cycle Scoping Report was published by Oadby & Wigston Borough Council in October 2009. Where future development is proposed, the sewerage and water supply infrastructure may require upgrading to provide sufficient capacity for the increase in development, and to ensure increased loads will not have a detrimental impact on water quality. It is recommended that planners consider undertaking water cycle studies as a focus for collaborative planning between local authorities, water and sewerage companies and the Environment Agency.

2.6 Surface Water Management Plans

Surface Water Management Plans (SWMPs) outline the preferred surface water management strategy in a given location and are undertaken, when required, by LLFAs in consultation with key local partners who are responsible for surface water management and drainage in their area. SWMPs establish a long-term action plan to manage surface water in an area and should influence future capital investment, drainage maintenance, public engagement and understanding, land-use planning, emergency planning and future developments. The Leicester City Council SWMP covers parts of neighbouring, hydrologically linked authorities, which includes parts of the Blaby District and Oadby & Wigston Borough. At the time of the publication of this SFRA update, no SWMP has been published that covers the Hinckley & Bosworth Borough.

2.7 Association of British Insurers Guidance on Insurance and Planning in Flood Risk Areas for Local Planning Authorities in England

The Association of British Insurers (ABI) and the National Flood Forum have published guidance for local authorities on planning in flood risk areas. The guidance aims to help local authorities in England when producing local plans and dealing with planning applications in flood risk areas. The guidance complements the National Planning Policy Framework. The key recommendations from the guidance are[8]:

- Ensure strong relationships with technical experts on flood risk
- Consider flooding from all sources, taking account of climate change
- Take potential impacts on drainage infrastructure seriously
- Ensure that flood risk is mitigated to acceptable levels for proposed developments
- Make sure Local Plans take account of all relevant costs and are regularly reviewed

2.8 Implications for the joint SFRA area

The new and emerging responsibilities under the Flood and Water Management Act and the Flood Risk Regulations are summarised in Table 2-1.

[8] Guidance on Insurance and Planning in Flood Risk Areas for Local Planning Authorities in England (Association of British Insurers and National Flood Forum, April 2012)

Table 2-1: Roles and responsibilities in Leicestershire

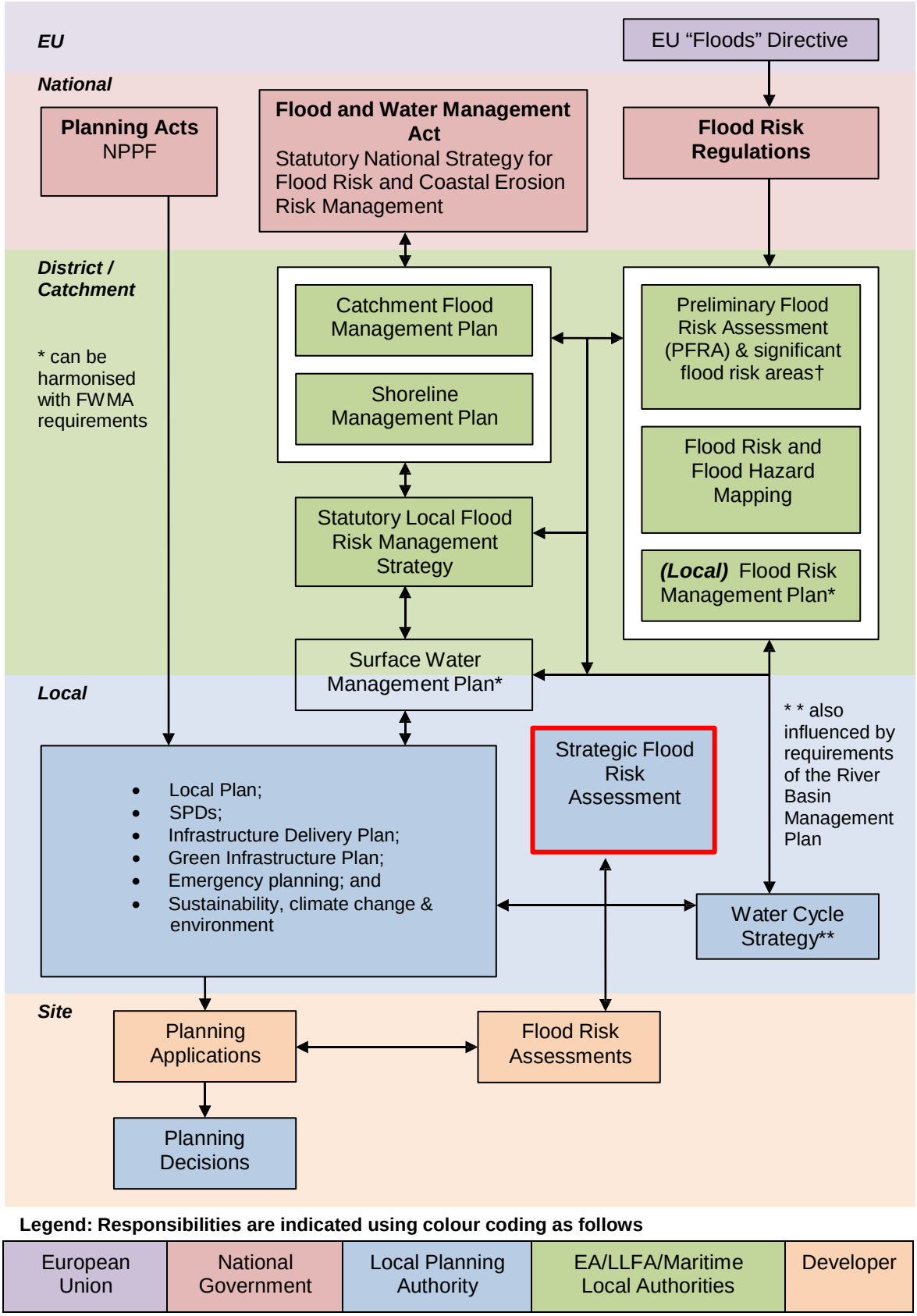
Risk Management Authority (RMA)	Strategic Level	Operational Level
Environment Agency	National Statutory Strategy Reporting and supervision (overview role)	Main rivers, reservoirs • Preliminary Flood Risk Assessment (per River Basin District)[1] • Identify Significant Flood Risk Area[1] • Flood Risk and Hazard Maps • Flood Risk Management Plan Enforcement authority for Reservoirs Act 1975
Lead Local Flood Authority (Leicestershire County Council)	Input to national strategy. Formulate and implement local flood risk management strategy.	Ordinary watercourse • Enforce and consent works Surface water, groundwater, other sources of flooding • Prepare and publish a PFRA • Identify Flood Risk Areas • Prepare Flood Hazard and Flood Risk Maps • Prepare Flood Risk Management Plans SuDS Approval Body
Lower Tier authorities (Hinckley & Bosworth Borough Council, Blaby District Council, Oadby & Wigston Borough Council)	Input to National and Local Authority Plans and Strategy (e.g. Local Plan Documents) • Hinckley & Bosworth Local Plan • Blaby Local Plan • Oadby & Wigston Local Plan	• Ordinary watercourse • Designating authority for essential flood infrastructure

[1] Environment Agency did not prepare a PFRA; instead they submitted an exception permitted under the Regulations

Figure 2-3 shows the key strategic planning links for flood risk and associated documents. It shows how the Flood Risk Regulations and Flood and Water Management Act, in conjunction with the Localism Act's "duty to cooperate", introduce a wider requirement for the exchange of information and the preparation of strategies and management plans.

SFRAs contain information that should be referred to in responding to the Flood Risk Regulations and the formulation of local flood risk management strategies and plans. SFRAs are also linked to the preparation of Catchment Flood Management Plans (CFMPs), Shoreline Management Plans (SMPs), Surface Water Management Plans (SWMPs) and Water Cycle Strategies (WCSs).

Figure 2-3: Strategic planning links and key documents for flood risk



Legend: Responsibilities are indicated using colour coding as follows

European Union	National Government	Local Planning Authority	EA/LLFA/Maritime Local Authorities	Developer

† See Table 2-1 for roles and responsibilities for preparation of information

Level One Strategic Flood Risk Assessment

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3 How flood risk is assessed

3.1 Definitions

3.1.1 Flood

Section1 (subsection 1) of the Flood and Water Management Act (FWMA) (2010) defines a flood as:

'any case where land not normally covered by water becomes covered by water'.

Section1 (subsection 2) states 'it does not matter for the purposes of subsection (1) whether a flood is caused by:

(a) Heavy rainfall

(b) A river overflowing or its banks being breached

(c) A dam overflowing or being breached

(d) Tidal waters

(e) Groundwater, or

(f) Anything else (including any combination of factors).

Note: Source does not include the following – flood from any part of a sewerage system, unless caused by an increase in the volume of rainwater, entering or affecting the system, or a flood caused by a burst water main.

3.1.2 Flood Risk

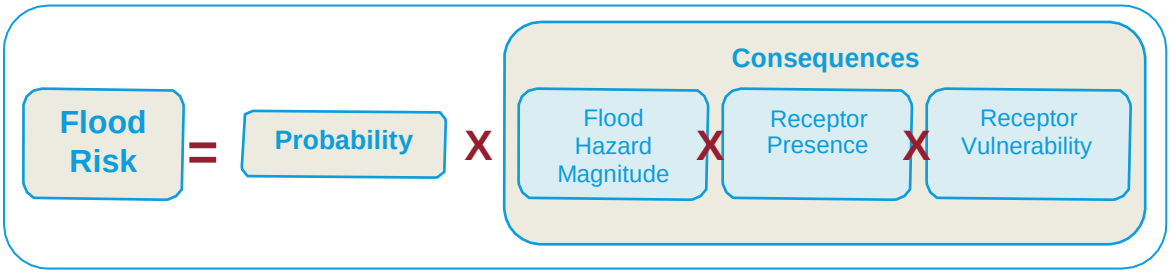
Section 3 (subsection 1) of the FWMA defined flood risk as:

'a risk in respect of an occurrence assessed and expressed (as for insurance and scientific purposes) as a combination of the probability of the occurrence with its potential consequences.'

Thus it is possible to define flood risk as:

Flood Risk = (Probability of a flood) x (Scale of the Consequences)

On that basis it is useful to express the definition as follows:



Using this definition it can be seen that

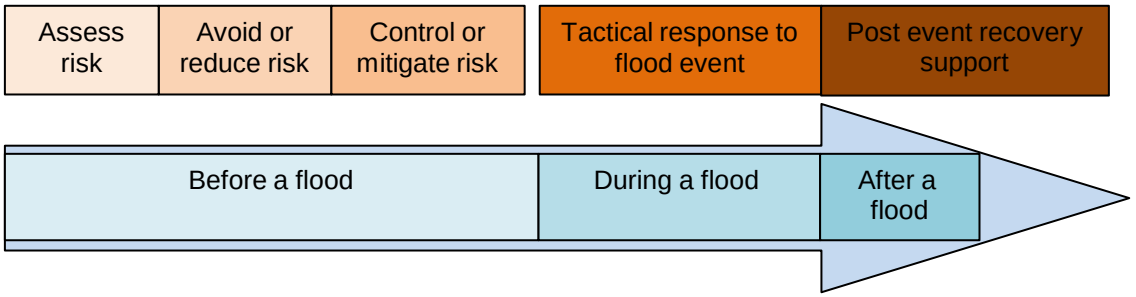
- Increasing the probability or chance of a flood being experienced increases the flood risk. In situations where the probability of a flood being experienced increases gradually over time, for example due to the effects of climate change, then the severity of the flood risk will increase (flooding becomes more frequent or has increased effect).
- The scale of the consequences can increase the flood risk.
    - Flood Hazard Magnitude: If the direct hazard posed by the depth of flooding, velocity of flow, the speed of onset, rate of risk in flood water or duration of inundation is increased, then the consequences of flooding, and therefore risk, is increased.

- Receptor presence: The consequences of a flood will be increased if there are more receptors affected, for example with an increase in extent or frequency of flooding. Additionally, if there is new development that increases the probability of flooding (for example, increase in volume of runoff due to increased impermeable surfaces) or increased density of infrastructure then consequences will also be increased.
- Receptor vulnerability: If the vulnerability of the people, property or infrastructure is increased then the consequences are increased. For example, old or young people are more vulnerable if there is a flood.

3.2 Using SFRA risk information

This SFRA contains information that can be used at strategic, operational and tactical levels as shown by Figure 3-1.

Figure 3-1: Uses of SFRA information



The SFRA will aid in the preparation of the Local Flood Risk Management Strategy prepared by the Lead Local Flood Authority (Leicestershire County Council).

The assessment of flood risk in the SFRA is primarily based on the following three types of information

3.2.1 Flood Zones

The SFRA includes maps that show the Flood Zones. These zones describe the land that would flood if there were no defences present. The NPPF Guidance identifies the following Flood Zones, see Table 3-1.

Table 3-1: Flood Zone descriptions

Probability		Description
Zone 1	Low	This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
Zone 2	Medium	This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (0.1% - 1%) or between 1 in 200 and 1 in 1000 annual probability of sea flooding (0.1% – 0.5%) in any year.
Zone 3a	High	This zone comprises land assessed as having a greater than 1 in 100 annual probability of river flooding (>1.0%) or a greater than 1 in 200 annual probability of flooding from the sea (>0.5%) in any year.
Zone 3b	Function Floodplain	This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone in discussion with the LPA and the Environment Agency. The identification of function floodplain should take account of local circumstances.

The preference when allocating land is, whenever possible, to place all new development on land in Zone 1. Since the Flood Zones identify locations that are not reliant on flood defences, placing development on Zone 1 land means there is no future commitment to spending money on flood banks or flood alleviation measures. It also does not commit future generations to costly long term expenditure that would become increasingly unsustainable as the effects of climate change increase.

3.2.2 Actual Flood Risk

If it has not been possible for all future development to be situated in Zone 1 then a more detailed assessment is needed to understand the implications of locating proposed development in Zones 2 or 3. This is accomplished by considering information on the "actual risk" of flooding. The assessment of actual risk takes account of the presence of flood defences and provides a picture of the safety of existing and proposed development. It should be understood that the standard of protection afforded by flood defences is not constant and it is presumed that the required minimum standards for new development are:

- Residential development should be protected against flooding with an annual probability of river flooding of 1% (1 in 100 year chance of flooding) in any year; and
- Residential development should be protected against flooding with an annual probability of tidal (sea) flooding of 0.5% (1 in 200 year chance of flooding) in any year.

The assessment of the actual risk should take the following issues into account:

- The level of protection afforded by existing defences might be less than the appropriate standards and hence may need to be improved if further growth is contemplated;
- The flood risk management policy for the defences will provide information on the level of future commitment to maintain existing standards of protection. If there is a conflict between the proposed level of commitment and the future needs to support growth then it will be a priority for the Flood Risk Management Strategy to be reviewed;
- The standard of safety must be maintained for the intended lifetime of the development (assumed to be 100 years for residential development). Over time the effects of climate change will erode the present day standard of protection afforded by defences and so commitment is needed to invest in the maintenance and upgrade of defences if the present day levels of protection are to be maintained; and
- The assessment of actual risk can include consideration of the magnitude of the hazard posed by flooding. By understanding the depth, velocity, speed of onset and rate of rise of floodwater it is possible to assess the level of hazard posed by flood events from the respective sources. This assessment will be needed in circumstances where consideration is given to the mitigation of the consequences of flooding or where it is proposed to place lower vulnerability development in areas that are at risk from inundation.

For information on defences reference should be made to the Environment Agency's Asset Information Management System (AIMS) which contains details on the standard of protection of defences.

3.2.3 Residual Risk

The residual risk refers to the risks that remain in circumstances where measures have been taken to alleviate flooding. It is important that these risks are quantified to confirm that the consequences can be safely managed. The residual risk can be:

- The effects of a flood with a magnitude greater than that for which the defences or management measures have been designed to alleviate (the 'design flood'). This can result in over topping of flood banks, failure of flood gates to cope with the level of flow or failure of pumping systems to cope with the incoming discharges; or
- Failure of the defences or flood risk management measures to perform their intended duty. This could be breach failure of flood embankments, failure of flood gates to operate in the intended manner or failure of pumping stations.

The assessment of residual risk demands that attention be given to the vulnerability of the receptors and the response to managing the resultant flood emergency. In this instance attention should be paid to the characteristics of flood emergencies and the roles and responsibilities during such events. Additionally for breach and overtopping events consideration

should be given to the structural safety of the dwellings or structures that could be adversely affected by significant flood flows or flood depths.

3.3 Possible responses to flooding

3.3.1 Assess

The first response to flooding must be to understand the nature and frequency of the risk. The assessment of risk is not just performed as a "one off" during the process, but rather the assessment of risk should be performed during all subsequent stages of responding to flooding.

3.3.2 Avoid

The sequential approach requires that the first requirement is to avoid the hazard. If it is possible to place all new growth in areas at a low probability of flooding then the flood risk management considerations will relate solely to ensuring that proposed development does not increase the probability of flooding to others. This can be achieved by implementing SuDS systems and other measures to control and manage run-off. In some circumstances it might be possible to include measures within proposed growth areas that reduce the probability of flooding to others and assist existing communities to adapt to the effects of climate change. In such circumstances the growth proposals should include features that can deliver the necessary levels of mitigation so that the standards of protection and probability of flooding are not reduced by the effects of climate change. In the joint SFRA area, consideration should be given not only to the peak flows generated by new development but also to the volumes generated during longer duration storm events.

3.3.3 Substitute, Control and Mitigate

These responses all involve management of the flood risk and thus require an understanding of the consequences (the magnitude of the flood hazard and the vulnerability of the receptor).

There are opportunities to reduce the flood risk by lowering the vulnerability of the proposed development. For instance changing existing residential land to commercial uses will reduce the risk provided that the residential land can then be located on land in a lower risk flood zone.

Flood risk management responses in circumstances where there is a need to consider growth or regeneration in areas that are affected by a medium or high probability will include:

- Strategic measures to maintain or improve the standard of flood protection so that the growth can be implemented safely for the lifetime of the development (must include provisions to invest in infrastructure that can adapt to the increased chance and severity of flooding presented by climate change);
- Design and implement measures so that the proposed development includes features that enables the infrastructure to adapt to the increased probability and severity of flooding whilst ensuring that new communities are safe and that the risk to others is not increased (preferably reduced);
- Flood resilient measures that reduce the consequences of flooding to infrastructure so that the magnitude of the consequences is reduced. Such measures would need to be considered alongside improved flood warning, evacuation and welfare procedures so that occupants affected by flooding could be safe for the duration of a flood event and rapidly return to properties after an event had been experienced.

It should be noted that the Flood and Coastal Risk Management Grant in Aid (FCRMGiA) funding arrangements introduced in 2011 do not make government funds available for any new development implemented after 2012. Accordingly, it is essential that appropriate funding arrangements are established for new development proposed in locations where a long term investment commitment is required to sustain Flood Risk Management (FRM) measures. The strategic investment commitment is required so that in future the FRM measures can be maintained and afforded for the lifetime of the development, since the available funds from FCRMGiA will potentially not reflect the scale of development that is benefitting.

The policy statement Flood and Coastal Resilience Partnership Funding (2013) sets out the arrangements that will apply for the allocation of capital Flood Defence Grant-in-Aid (FDGiA) to

flood and coastal erosion risk management projects. Flood and Coastal Resilience Partnership Funding will form part of the Environment Agency's overall capital allocation projects until the end of the 2014/2015 financial year. Under this system, central government contributions will cover the full cost of a scheme if it has high benefits – such as if many houses are protected. However, where the benefits are not high enough for central government contributions to cover the costs, local contributions can top up the funding.

The National Flood and Coastal Erosion Management Strategy summarises the new system:

In essence, instead of meeting the full cost of a limited number of schemes, a new partnership approach to funding could make government money available to pay a share of any worthwhile scheme. The amount in each case will depend on the level of benefits the scheme provides. For example, the number of households protected, or the amount of damage that can be prevented. The level of government funding potentially available towards each scheme can be easily calculated. Local authorities and communities can then decide on priorities and what to do if full funding isn't available. Projects can still go ahead if costs can be reduced or other funding can be found locally.[9]

There are a number of potential impacts of this change in funding. The Government stated that its proposals will help to:

- Encourage total investment in Flood and Coastal Erosion Risk Management by operating authorities to increase beyond what is affordable to national budgets alone.
- Enable more local choice within the system and encourage innovative, cost-effective options to come forward in which civil society may play a greater role; and
- Maintain widespread uptake of flood insurance[10].

[9] National Flood and Coastal Erosion Risk Management Strategy for England: Summary Strategy, Environment Agency, July 2011

[10] Future Funding for Flood and Coastal Erosion Risk Management, Impact Assessment, Defra, November 2010.

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4 Understanding flood risk in the Joint SFRA area

4.1 Historic flooding

The Joint SFRA Area has a history of flood events, with the main source of flooding being from fluvial sources.

Significant historic flood events include:

- January 2014: Fluvial flooding of the Rivers Anker and Sence affecting Witherley, Sheepy Magna and Shenton[11]
- January 2013: South Wigston Flood[12]
- December 2012: River Sence floods Great Glen[13]
- November 2012: River Soar floods in Narborough, Littlethorpe and Sharnford[14]
- July 2012: Rothley Brook[15]
- June 2012: Hailstorm and flash flooding in Leicestershire[16]
- Summer 2007: Flooding through Coventry and Warwickshire[17].
- Christmas 2000: flooding of an under capacity culverted watercourse in Sibson. Amelioration works to the culvert have been carried out since this event

4.2 Topography, geology, soils and hydrology

The Hinckley & Bosworth Borough, the Blaby District and the Oadby & Wigston Borough encompasses an area of approximately 451km^2. The largest urban area in the study area is the town of Hinckley. There are also a number of service centres (including Oadby, Wigston, Earl Shilton, Blaby, Burbage, Barwell and Braunstone Town), villages and hamlets.

4.2.1 Topography

There are three distinct topographic regions within the Joint SFRA area; the low-lying area of the Sence River and Sence Brook in the west, the northern / central raised area of Charnwood Forest and the eastern low-lying south-north floodplain of the River Soar and the Rothley Brook. Elevations range from 65m AOD in the Sence River floodplain in the west to 233m AOD in Charnwood Forest to 59m AOD in the River Soar floodplain to the east.

4.2.2 Geology and soils

The geology of a catchment can be an important influencing factor on the way that a catchment responds to rainfall due to variations in permeability of the strata.

The geology in the Joint SFRA Area is predominantly the Triassic Mudstone, Siltstone and Sandstone bedrock. Areas to the west are underlain by the Triassic Mercia Mudstone and areas to the East are underlain by the Triassic Lias Group. The study area is also underlain with intermittent layers of diorite, mudstone, limestone and Lias Clays. Superficial deposits are a mixture of alluvium, glaciofluvial, river terrace and sand, gravel and clay deposits which tend to be found along the valley sides. Small, isolated areas, largely found in the Blaby District have drift deposits.

The moderate to slowly permeable geology of the study area is likely to produce high percentage runoff.

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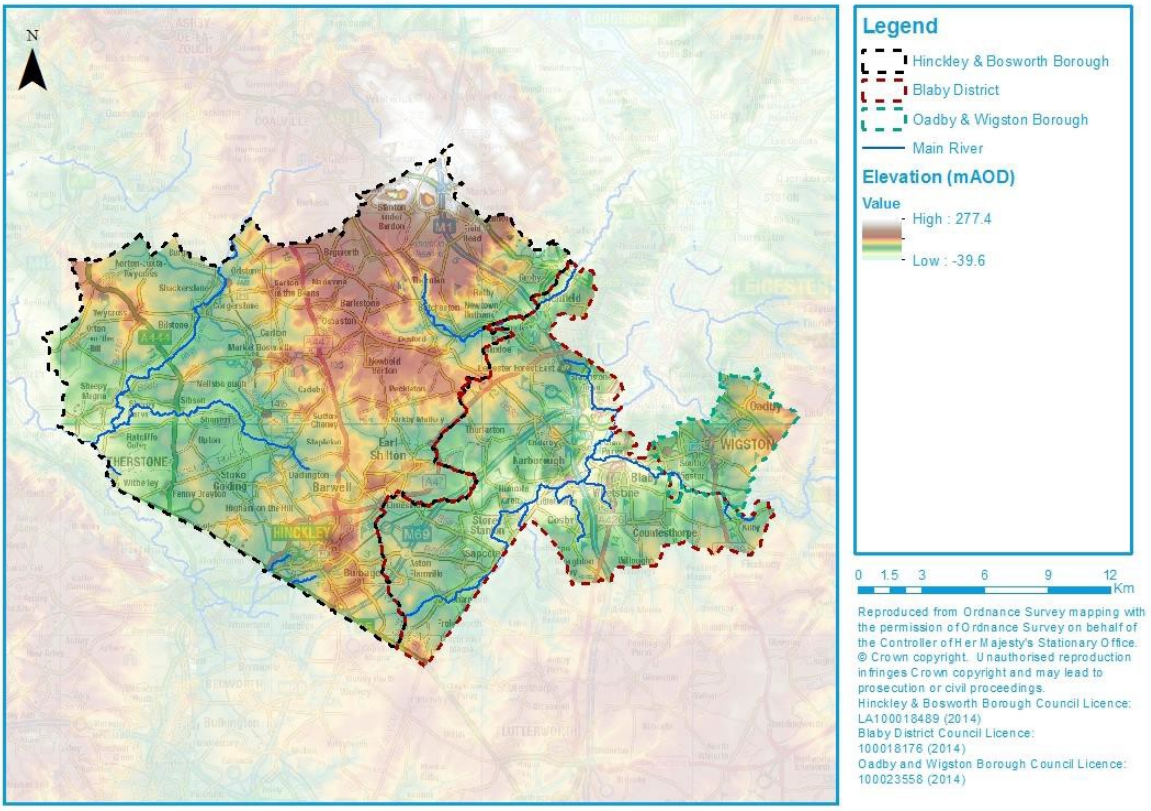
[11] http://www.hinckleytimes.net/news/local-news/torrential-rain-soaks-the-borough-6513000
[12] https://www.youtube.com/watch?v=rasUFG9xSEs
[13] https://www.youtube.com/watch?v=uvbh_cRte7s
[14] http://www.bbc.co.uk/news/uk-england-leicestershire-20492493,

http://www.narboroughandlittlethorpe.co.uk/2012/11/27/floods-in-narborough-littlethorpe/

[15] http://www.bbc.co.uk/news/uk-england-leicestershire-18746637

[17] http://www.bbc.co.uk/coventry/content/image_galleries/floods_july07_general_gallery.shtml?14

Figure 4-1: Joint SFRA Area: topography



4.2.3 Hydrology

The Joint SFRA Area receives between 638 and 666mm of rain on average a year.

The principal watercourse flowing through the joint SFRA area is the River Soar, with a number of smaller tributaries including the River Sence, Whetstone Brook, Lubbesthorpe Brook, Broughton Astley Brook, Wash Brook and Cosby Brook. The River Sence (Soar tributary) has a number of tributaries including an unnamed watercourse which runs from Coombe Park Recreation Ground to Kilby Bridge and another unnamed watercourse which runs from Wigston South Junction to Crow Mill Bridge. Another principal watercourse in the area is the River Sence (Anker tributary) and its smaller tributary, the Sence Brook. The Ashby de la Zouch Canal, the Coventry Canal and the Grand Union Canal, also run through the joint SFRA area. A summary of the principal watercourses in the joint SFRA area are provided in Table 4-1 and their locations, as well as smaller drains and watercourses, are provided in Appendix B.

There are a number of reservoirs in the joint SFRA area including Thornton Reservoir and Bosworth Water Trust Amenity Lake Reservoir. Further details of reservoirs within the joint SFRA area as well as the flood risk posed by reservoirs located outside the joint SFRA area are provided in Section 5.7.

Table 4-1: Watercourses in the study area

KEY											
MR	Main River	OW	Ordinary Watercourse	EA	Environment Agency	HBBC	Hinckley & Bosworth Borough Council	BCD	Blaby District Council	OWBC	Oadby & Wigston Borough Council

River	Classification	Responsibility	Description
Broughton Astley Brook	MR	EA	Flows northwards from its source in south Leicestershire to its confluence with the River Soar, upstream of Leicester. Its flows through an urban catchment, passing through Broughton Astley and Croft, where it receives urban runoff.
Cosby Brook	MR	EA	Flows north-westwards from its source in south Leicestershire to its confluence with the River Soar, downstream of Littlethorpe. Its flows through an urban catchment, passing through Cosby and Littlethorpe, where it receives urban runoff.
Harrow Brook	MR	EA	Flows southwards from its source in south Leicestershire / north Warwickshire to its confluence with the River Anker, upstream of Nuneaton. Its flows through an urban catchment, passing through Hinckley, where it receives urban runoff.
Lubbesthorpe Brook	MR	EA	Flows south-eastwards from its source in south Leicestershire to its confluence with the River Soar, at Aylestone, Leicester. Its flows through an urban catchment, passing through Braunstone Town, where it receives urban runoff.
River Anker	MR	EA	Flows north-westwards from its source in south Leicestershire / north Warwickshire to its confluence with the River Tame, south of Tamworth. Its flows through an urban catchment, passing through Nuneaton, Atherstone, Polesworth and Tamworth, where it receives urban runoff. It has a number of major tributaries including the Harrow Brook and Sketchley Brook that join upstream of Nuneaton and the River Sence (Anker) that join downstream of Atherstone.
River Sence (Anker)	MR	EA	Flows south-westwards from its source in Leicestershire to its confluence with the River Anker, downstream of Atherstone. It flows through a predominantly rural catchment before passing through urban Leicester where is receives urban runoff. It has a number of major tributaries including the River Wreake and Rothley Brook that join the River Soar at Charnwood.

River	Classification	Responsibility	Description
River Sence (Soar)	MR	EA	Flows westwards from its source in Leicestershire to its confluence with the River Soar, downstream of Narborough. It flows through a predominantly urban catchment, passing through Great Glen, South Wigston and Blaby where is receives urban runoff.
River Soar	MR	EA	Flows northwards from its source in north Warwickshire to its confluence with the River Trent. It flows through Coalville where it receives urban runoff, and then through a predominantly rural catchment until its confluence with the River Trent. It has a major tributary, the Sence Brook that joins the River Soar at Ratcliffe Culey.
Rothley Brook	MR	EA	Flows eastwards from its source in south Leicestershire / around Thornton Reservoir to its confluence with the River Soar, downstream of Rothley. Its flows through a mixture of rural and urban catchments, passing through the west Leicester, Anstey, Thurcaston and Rothley where it receives urban runoff.
Sence Brook	MR	EA	Flows westwards from its source in south Leicestershire to its confluence with the River Sence (Anker), around Ratcliffe Culey, north of Atherstone. It flows through a predominantly rural catchment.
Sketchley Brook	MR / OW	EA / HBBC	Flows south-westwards from its source in south Leicestershire / north Warwickshire to its confluence with the Harrow Brook. Its flows through an urban catchment, passing through Hinckley, where it receives urban runoff.
Unnamed tributary of the Lubbesthorpe Brook	MR	EA	Flows eastwards from its source in south Leicestershire to its confluence with the Lubbesthorpe Brook, at Braunstone Town. Its flows through an urban catchment, passing through Thorpe Astley, where it receives urban runoff.
Whetstone Brook	MR / OW	EA / BDC	Flows north-westwards from its source in south Leicestershire to its confluence with the River Soar, at Whetstone. It flows through an urban catchment, passing through Whetstone, where it receives urban runoff.
Witherley Brook	MR	EA	Flows north-westwards from its source in north Warwickshire to its confluence with the River Anker, at Atherstone. It flows through an urban catchment, passing through Atherstone, where it receives urban runoff.
Grand Union Canal	Canal	Canal and River Trust	The canal is interlinked with the River Soar and passes through OWBC and BDC, south of Wigston, north of Blaby and through Leicester.
Feeding Brook	OW	BDC	Flows southwards from its source in south Leicestershire, to its confluence with the Thurlaston Brook. It flows through a predominantly rural catchment.

River	Classification	Responsibility	Description
Thurlaston Brook	OW	BDC	Flows south-eastwards from its source in south Leicestershire, to its confluence with the River Soar. It flows through a predominantly rural catchment, passing through Thurlaston where it receives urban runoff.
Battling Brook	OW	HBBC	Flows westwards from its source in south Leicestershire, to the edge of Hinckley, where it forms the Harrow Brook. It flows through a predominantly rural catchment, passing through Hinckley where it receives urban runoff.
Ashby de la Zouch Canal	Canal	Canal and River Trust	The canal starts at Moira, south of Ashby de la Zouch and flows in a south-easterly direction before joining the Coventry Canal at Bedworth.
River Mease	OW	HBBC	Flows westwards from its source in south Leicestershire, to its confluence with the River Trent in Staffordshire. It flows through a predominantly rural catchment.
Slate Brook	OW	HBBC	Flows eastwards from its source in south Leicestershire, to its confluence with the Rothley Brook, downstream of Groby. It flows through a predominantly urban catchment, passing through Groby where it receives urban runoff.
Kilby Brook	MR	OWBC	Flows northwards from its source in south Leicestershire to its confluence with the River Sence (Soar) to the east of Kilby Bridge. It flows through a predominantly rural catchment.
Wash Brook	OW	OWBC	Flows westwards from its source east of Oadby to its confluence with the River Soar in Leicester. It flows through a predominantly urban catchment, passing through Oadby where it receives urban runoff.
Unnamed tributary of the River Sence (Soar)	OW	OWBC	Flows south-westwards from its source at Coombe Park Recreation Ground to its confluence with the River Sence (Soar) to the west of Kilby Bridge. It flows through a predominantly rural catchment in its upper reaches before passing through Wigston Harcourt in its lower reaches where it receives urban runoff.
Unnamed tributary of the River Sence (Soar)	OW	OWBC	Flows southwards from its source at Wigston South Junction to its confluence with the River Sence (Soar) to the east of Crow Mill Bridge. It flows through a predominantly urban catchment, passing through South Wigston where it receives urban runoff.

4.3 Fluvial flood risk

The watercourses in the joint SFRA area pose a potential risk to development, particularly near the extensive flood plain of the River Soar and River Anker. Flooding may not be from one watercourse alone; there are a number of interactions, particularly between the Broughton Astley Brook, Whetstone Brook, the River Sence (Soar) and the River Soar around the urban areas of Croft, Blaby, Whetstone and Narborough.

In addition to the flood risk shown in the flood risk mapping, there are a number of small watercourses and field drains which may pose a risk to development. The extent of these smaller watercourses can be seen in Appendix B. Flood Zone mapping is only available for watercourses with a catchment area greater than 3km^2. Whilst these smaller watercourses may not be shown as having flood risk on any flood risk mapping, it does not necessarily mean there is no flood risk. Developers will have to assess the risk from these smaller watercourses as part of a detailed, site specific, flood risk assessment.

4.4 Flood defences, assets and structures

4.4.1 Flood Alleviation Schemes

A number of flood alleviation schemes (FAS) have been investigated and commissioned in flood risk hotspots within the study area. Flood alleviation schemes within the joint SFRA area include, but are not limited to the following.

Lubbesthorpe Brook FAS

The Lubbesthorpe Brook Flood Alleviation Scheme re-aligned and widened approximately 500m of the watercourse channel. The left bank of the watercourse runs along the rear boundary of the Lubbesthorpe Road properties which had suffered flooding in August 2005 and 8 July 2007. A bypass culvert has been built at Watergate Lane Bridge as part of the FAS.

Additionally, £200,000 of sewer improvements have been undertaken by Severn Trent Water to help prevent sewer flooding on Lubbesthorpe Road and Watergate Lane. New sewers have been constructed to help manage the storage and flow of storm water as well as new water pipes that will help to prevent burst pipes.

Coventry Road, Hinckley FAS

The Coventry Road, Hinckley, Flood Alleviation Scheme was a £1.8m project undertaken by Severn Trent Water to address internal flooding to a number of residential properties and solve surface water flooding issues.

The scheme involved the installation of approximately 1,600m of new sewer pipework, as well as on line storage pipework.

Broughton Astley FAS

The Broughton Astley FAS was a £19,000 project which included the construction of 'leaky barriers' to delay the flow of storm water, as well as the creation of ponds and tree-planting to provide new habitats for wildlife. The scheme was funded by Leicestershire County Council and the Environment Agency.

Witherley

4.4.2 Summary

A high level review of formal flood defences was carried out for this SFRA including an assessment of their condition. Details of the flood defences, their standard of protection and condition were provided by the Environment Agency for the purpose of preparing this assessment.

A summary of the grading system used by the Environment Agency is provided in Table 4-2. This information supplements a summary of the formal flood defences in the joint SFRA area as shown in the following sections.

Table 4-2: Defence asset condition rating

Grade	Rating	Description
1	Very Good	Cosmetic defects that will have no effect on performance.
2	Good	Minor defects that will not reduce the overall performance of the assets.
3	Fair	Defects that could reduce performance of assets.
4	Poor	Defects that would significantly reduce the performance of the asset. Further investigation required
5	Very Poor	Severe defects resulting in complete performance failure.

Source: Condition Assessment Manual – Environment Agency 2006

The majority of flood defences are located around three main locations. These locations are the following:

- Whetstone
- Cosby
- Croft

In addition to formal flood defences, the Environment Agency, Hinckley & Bosworth Borough Council, Blaby District Council and Oadby & Wigston Borough Council undertake maintenance of main rivers and ordinary watercourses, respectively, to ensure the efficient conveyance of flood flows. Further details of the flood defences at the three locations listed above are summarised on the following pages.

There are no formal flood defences within the Oadby & Wigston Borough Council administrative area.

4.4.3 Witherley Brook Flood Defence

Figure 4-2: Witherley Flood Defences

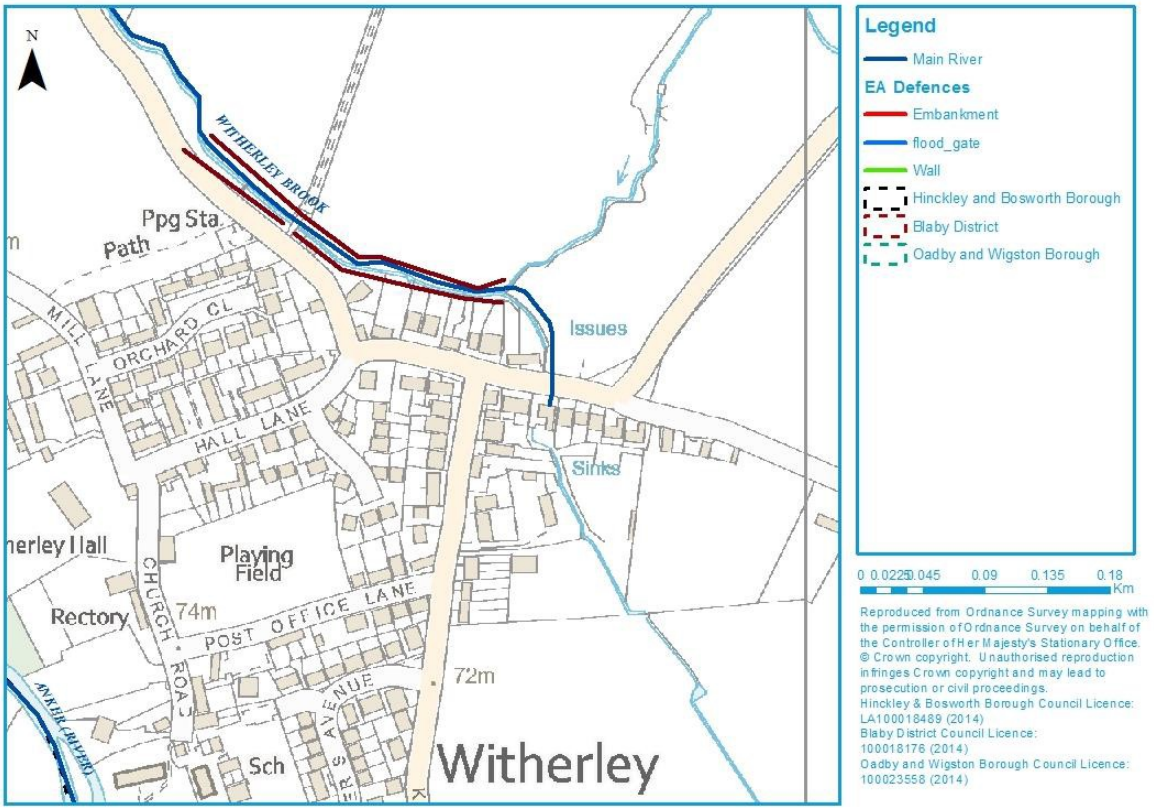


Figure 4-2 shows the flood defence in Witherley is located to the north of the village, in the form of a bund running along the Witherley Brook and behind houses on Mythe Lane. If the level in the Witherley Brook are too high then highway drains from Mythe Lane and Atterton Lane are prone to backing up and flooding in this location.

4.4.4 Whetstone Flood Defences

Figure 4-3: Whetstone Flood Defences

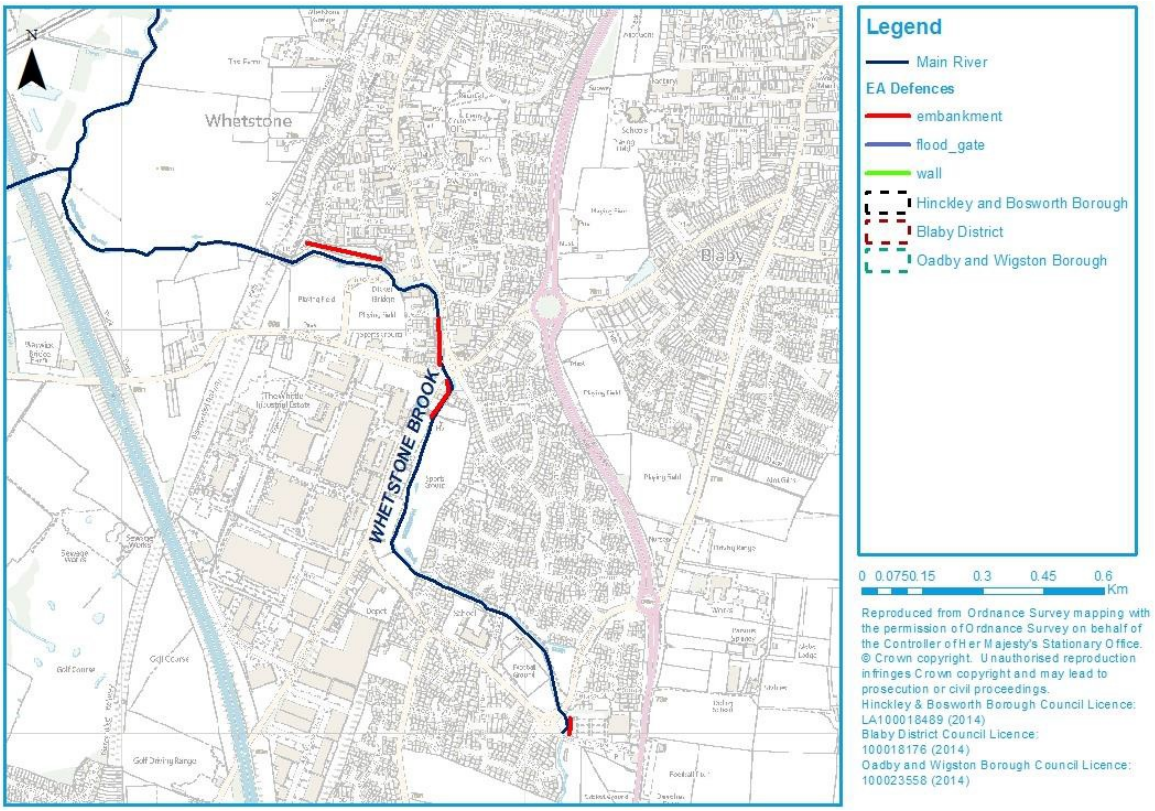


Figure 4-3 shows that the majority of flood defences in Whetstone are situated along the Whetstone Brook. The embankments through the urban areas of Whetstone are maintained by the Environment Agency and are classed as either “good” or “fair” condition. These embankments protect houses and commercial units along the back of Avon Drive / Elizabeth Gardens, Bridge Way, Cambridge Road and between the Dog and Gun Lane and Wychwood Road.

4.4.5 Cosby Flood Defences

Figure 4-4: Cosby Flood Defences

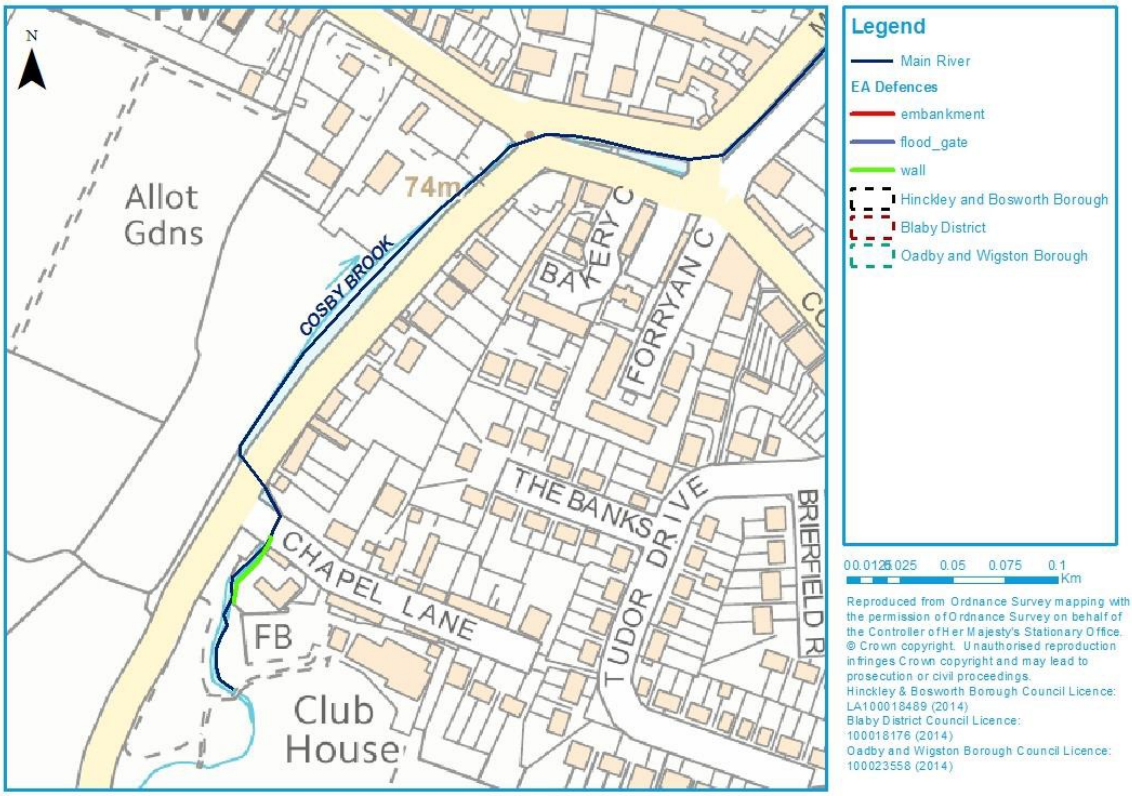
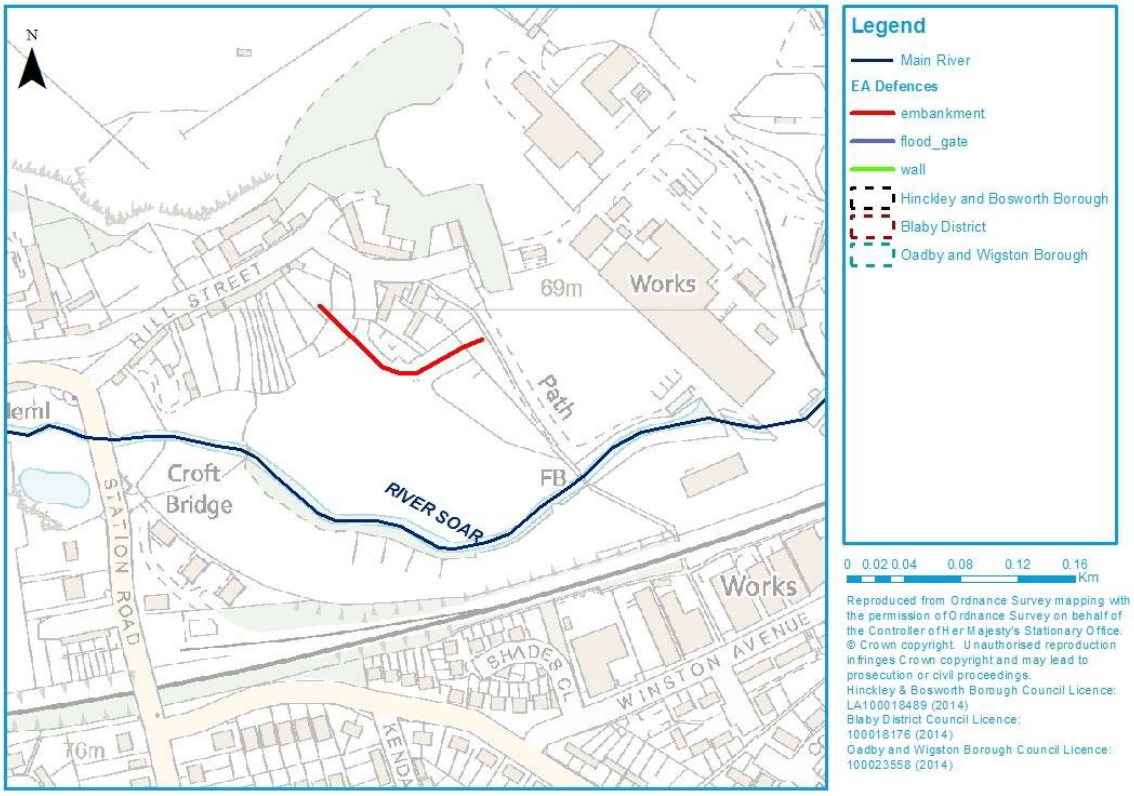


Figure 4-4 shows that a single flood defence is located in Cosby, situated along the Cosby Brook. The flood wall through the urban area of Cosby is maintained by the Environment Agency and is classed as “good” condition. These embankments protect houses adjacent to Chapel Lane.

4.4.6 Croft Flood Defences

A single embankment near the River Soar is located within Croft and has a Standard of Protection (SoP) of 50-years (i.e. provide protection for floods of magnitude of 2% AEP). The condition of the embankment is ranked as ‘Good’.

Figure 4-5: Croft Flood Defences



4.5 Surface water flooding

Flooding from surface water runoff is usually caused by intense rainfall that may only last a few hours and usually occurs in lower lying areas, often where the drainage system is unable to cope with the volume of water. Surface water flooding problems are inextricably linked to issues of poor drainage, or drainage blockage by debris, and sewer flooding.

The updated Flood Map for Surface Water (uFMfSW) predominantly follows topographical flow paths of existing watercourses or dry valleys with some isolated ponding located in low lying areas. If the uFMfSW indicates a risk to a site allocation or settlement this has been discussed in further detail in Section 10 and Appendix A It should be noted that, because of its broad-scale nature, wherever possible these mapped outlines should be used in conjunction with other sources of local flooding information to confirm the presence of a surface water risk.

The geology of the study area has large areas underlain with clay deposits. Extensive areas of clay and undulating topography results in the study area responding quickly to rainfall events and therefore increases the risk of surface water flooding. In addition, areas with an abundance of impervious surfaces may also be at risk of surface water flooding, especially when local intense rainstorms occur. Any site-specific FRA would need to adequately assess the risk from surface water flooding; not only at the site but to also ensure there is not an increased risk of flooding to areas downstream.

Thorpe Astley has a history of surface water flooding, mostly via surface water runoff from the high ground to the rear of Priestman Road, Tuffleys Way and Murby Way. Although flood risk from surface water is not deemed to be a constraint to future development, mitigation measures should be implemented especially with new developments. Further guidance for planners and developers is provided in Section 11.

The uFMfSW is provided in Appendix F. The uFMfSW shows the flooding that takes place from the 'surface runoff' generated by rainwater (including snow and other precipitation) which:

a. is on the surface of the ground (whether or not it is moving), and
b. has not yet entered a watercourse, drainage system or public sewer.

The updated Flood Map for Surface Water will pick out natural drainage channels, low areas in the floodplain, and flow paths between buildings, but it will only indicate flooding caused by local rainfall.

4.6 Groundwater flooding

In comparison to fluvial flooding, current understanding of the risks posed by groundwater flooding is limited and mapping of flood risk from groundwater sources is in its infancy. There is currently no one organisation with responsibility to respond to groundwater flooding, therefore the risks and mechanisms of groundwater flooding are poorly reported. However, under the Flood and Water management Act (2010), LLFAs have powers to undertake risk management functions in relation to groundwater flood risk. Groundwater level monitoring records are available for areas on Major Aquifers. However, for lower lying valley areas, which can be susceptible to groundwater flooding caused by a high water table in mudstones, clays and superficial alluvial deposits, very few records are available.

Due to the moderate or slowly permeable geology of the area, it is more likely that there will be higher percentages of runoff and therefore limited potential for ground water flood risk problems.

The Areas Susceptible to Ground Water Flooding (AStGWf) map is provided in Appendix G. The AStGWf is a strategic scale map showing groundwater flood areas on a 1km square grid. The data was produced to annotate indicative Flood Risk Areas for PRFA studies and allow the LLFAs to determine whether there may be a risk of flooding from groundwater.

The map indicates the proportion of each 1km grid square which geological and hydrogeological condition show that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring. The dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding.

The AStGWf data should be used only in combination with other information, for example local data or historic data. It should not be used as sole evidence for any specific flood risk management, land use planning or other decisions at any scale. The data can however help to identify areas for assessment at a local scale where finer resolution datasets exist

4.7 Flooding from sewers

Sewer flooding occurs when intense rainfall overloads the sewer system capacity (surface water, foul or combined), and/or when sewers cannot discharge properly to watercourses due to high water levels. Sewer flooding can also be caused when problems such as blockages, collapses or equipment failure occur in the sewerage system. Infiltration, entry of soil or groundwater into the sewer system via faults within the fabric of the sewerage system, is another cause of sewer flooding. Infiltration is often related to shallow groundwater, and may cause high flows for prolonged periods of time.

Since 1980, the Sewers for Adoption guidelines have meant that most new surface water sewers have been designed to have capacity for a rainfall event with a 1 in 30 chance of occurring in any given year, although until recently this did not apply to smaller private systems. This means that, even where sewers are built to current specification, they are likely to be overwhelmed by larger events of the magnitude often considered when looking at river or surface water flooding (e.g. a 1 in 100 chance of occurring in a given year). Existing sewers can also become overloaded as new development adds to their catchment, or due to incremental increases in roofed and paved surfaces at the individual property scale (urban creep). Sewer flooding is therefore a problem that could occur in many locations across the study area.

4.8 The impact of climate change

4.8.1 Fluvial flooding

Climate change mapping has been provided for all watercourses in the study currently shown at risk in the Environment Agency's Flood Zones. The effect tends to be a noticeable increase in the mapped flood extent. Smaller watercourses in study area (e.g. Witherley Brook) tend to be in areas of steeper topography with quite confined floodplains, and in these cases increases in flow do not result in a significant increase in flood extent.

However, climate change does not just affect the extent of flooding. It is important to remember that even where extent does not significantly increase; flooding is likely to become more frequent under a climate change scenario. For example, what is currently an event with a 2% probability of occurring in any one year, may increase to say a 5% probability under climate change.

The impact of an event with a given probability is also likely to become more severe. For example depths, velocities, hazard and therefore risk to people will increase. Although qualitative statements can be made as to whether extreme events are likely to increase or decrease over the UK in the future, there is still considerable uncertainty regarding the magnitude of these changes locally. Further details regarding the uncertainties in predicting the impacts of climate change can be found in

- Environment Agency (2011) Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities. September 2011
- UK Climate Projections (UKCP09)

4.8.2 Surface Water

Climate change is predicted to increase rainfall intensity in the future by up to 30%. This will increase the likelihood and frequency of surface water flooding, particularly in impermeable urban areas, and areas that are already susceptible such as Hinckley.

4.8.3 Groundwater

The effect of climate change on groundwater flooding problems, and those watercourses where groundwater has a large influence on winter flood flows is more uncertain. Milder wetter winters may increase the frequency of groundwater flooding incidents in areas that are already susceptible, but warmer drier summers may counteract this effect by drawing down groundwater levels more during the summer months.

4.9 Catchment Flood Management Plans

Catchment Flood Management Plans (CFMPs) are a high-level strategic plan providing an overview of flood risk across each river catchment. The Environment Agency use CFMPs to work with other key-decision makers to identify and agree long-term policies for sustainable flood risk management.

There are six pre-defined national policies provided in the CFMP guidance and these are applied to specific locations through the identification of 'Policy Units'. These policies are intended to cover the full range of long term flood risk management options in the catchment that can be applied to different locations.

The six national policies are:

1. No active intervention (including flood warning and maintenance). Continue to monitor and advise
2. Reducing existing flood risk management actions (accepting that flood risk will increase over time).
3. Continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from this baseline).
4. Take further action to sustain the current level of flood risk (responding to the potential increases in risk from urban development, land use change and climate change).
5. Take action to reduce flood risk (now and/or in the future)
6. Take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits, locally or elsewhere in the catchment.

4.9.1 River Trent CFMP

The study area is covered by the River Trent CFMP. The Policy Units of importance to study area are Policy Units 6, 8 and 9.

Policy Unit 6 (Mid Staffs and Lower Tame): within this policy unit the CFMP states that Policy 6 applies. As part of this SFRA update, an assessment of green infrastructure has been undertaken which will help support this policy.

Policy Unit 8 (Rural Leicestershire): within this policy unit the CFMP states that Policy 6 applies. As part of this SFRA update, an assessment of green infrastructure has been undertaken which will help support this policy.

Policy Unit 9 (Upper Soar and Upper Anker): within this policy unit the CFMP states that Policy 4 applies. The SFRA will help support this policy by aiding the Council to make informed decisions about the location of future development, as well as identifying where future flood risk management measures may be required.

4.10 Emergency planning in the District

4.10.1 Flood Warning Areas

Flood Alerts are used to warn people of the possibility of flooding and encourage them to be alert, stay vigilant and make early preparations. It is issued earlier than a flood warning, to give customers advice notice of the possibility of flooding, but before we are fully confident that flooding in Flood Warning Areas is expected.

Flood Warnings warn people of expected flooding and encourage them to take action to protect themselves and their property.

Severe Flood Warnings warn people of expected severe flooding where there is a significant threat to life.

Warnings no longer in force

Informs people that river or sea conditions begin to return to normal and no further flooding is expected in the area. People should remain careful as flood water may still be around for several days.

There are currently three Flood Alert Areas and ten Flood Warning Areas (FWAs) covering all, or part of, the study area. These are summarised in Table 4-3 and Table 4-4. Maps showing the coverage of each FWA are provided in Appendix H.

4.10.2 Multi-agency Flood Response Plan

The 2012 Leicester, Leicestershire & Rutland Local Resilience Forum (LLR LRF) Multi-agency Flood Plan[18] covers the Hinckley & Bosworth Borough Council, Blaby District Council and Oadby & Wigston Borough Council. The flood response plan is an 'over-arching' plan based on the identified risk of flooding within the LLR LRF area'. It sets out arrangements and provides information for a multi-agency response to a flood or potential flooding incidents affecting the LLR LRF area. It aims to facilitate effective response to the threat of flooding by initiating a multi-agency response at the earliest possible stage. It sets out the roles and responsibilities of Category 1 and 2 responders but does not detail the operational responses of individual organisations.

The response plan also informs the public by providing information on what to do before, during and after a flood, and how to prepare property for flooding.

The following 'At Risk' communities and community response plans in the Hinckley & Bosworth Borough Council, Blaby District and Oadby & Wigston Borough have been identified in the Response Plan.

Hinckley & Bosworth:

- Sheepy Magna and Sheepy Parva
- Shenton
- Witherley

[18] LRF Multi-agency Flood Plan (Leicester, Leicestershire & Rutland Local Resilience Forum, August 2012)

Blaby:

- Blaby
- Croft
- Enderby
- Glen Parva
- Glenfield
- Littlethorpe
- Lubbesthorpe Brook
- Narborough
- Sharnford
- Whetstone

Oadby & Wigston:

- Oadby

The information provided is based on the August 2012 LLR LRF Flood Plan. The next scheduled update of the plan is due in August 2014.

Table 4-3: Flood Alert coverage

Flood Alert Code	Flood Alert Name	Watercourse	Coverage
034WAF401	River Sence and tributaries from Billesdon to the River Soar at Glen Parva	River Sence	Billesdon, Charlton Curlieu, Great Glen, Peatling Magna, South Wigston, Blaby and Glen Parva
034WAF402	River Soar in Leicestershire including tributaries from Sharnford to the River Wreake confluence at Syston	River Soar	Sharnford, Sapcote, Primethorpe, Stoney Stanton, Cosby, Huncote, Narborough, Glen Parva, Aylestone, Braunstone Town and Leicester.
033WAF307	Low-lying land and roads between Nuneaton and Tamworth on the River Anker and between Temple Mill and Ratcliffe Culey on the River Sence	River Anker and River Sence	Wolvey, Bedworth, Nuneaton, Atherstone, Sheepy Magna, Polesworth and Tamworth.

Table 4-4: Flood Warning Coverage

Flood Warning Code	Flood Warning Name	Watercourse	Coverage
034FWFSEBLABPAR	River Sence at Blaby and Glen Parva	River Sence	Blaby and Glen Parva
034FWFWBWHETSTNE	Whetstone Brook at Whetstone	Whetstone Brook	Whetstone
034FWFSOSHRNFRD	River Soar at Sharnford including Croft Mill	River Soar	Sharnford
034FWFSOCROFT	River Soar at Croft	River Soar	Croft
034FWFSOLITLTHRP	River Soar at Littlethorpe and Narborough	River Soar	Littlethorpe and Narborough
034FWFSOENDERBY	River Soar at Enderby	River Soar	Enderby
034FWFSOBRUNSTNE	River Soar at Braunstone	River Soar	Braunstone
033FWF3SENCE001	River Sence from Temple Mill to Sheepy Magna	River Sence	Temple Mill to Sheepy Magna including Sibson Mill, Lovetts Bridge and Sheepy Parva
033FWF3ANKR005	River Anker at Mancetter, Witherley and Atherstone	River Anker	Mancetter, Witherley and Atherstone including Lodge Close in Mancetter, Bridge Lane and Riverside in Witherley, Royal Meadow Drive, Ratcliffe Road and Aldermill Business Park in Atherstone

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5 Flood risk from canals and reservoirs

5.1 Introduction

Two canals, the Ashby de la Zouch Canal and the Grand Union Canal, are located within the joint SFRA area. Primary flood risk from canal breach for the assessment areas is from the Ashby de la Zouch and the Grand Union Canal. The Ashby de la Zouch Canal starts at a junction with the Coventry Canal just outside of Bedworth and travels northeast for approximately 35.4km in one continuous pound (a stretch of canal between two locks) before reaching its terminus at Snarestone. The canal flows through Hinckley and is adjacent to a number of the proposed development sites. The Leicester Line of the Grand Union Canal runs from Norton Junction on the main line of the Grand Union Canal to the River Soar Navigation at West Bridge in Leicester. The Canal is 66.5km long and has 41 locks. The canal flows through Leicester and is adjacent to a number of the proposed development sites. Along the courses of both the Ashby de la Zouch Canal and Grand Union Canal there are numerous sections where watercourses run either adjacent or underneath the canal. Therefore, understanding the interactions of the canal and main rivers are integral to understanding of flood risk in the area.

As part of assessing flood risk from the canals, worst case canal inundation assessments have been identified based on areas of raised embankments in close proximity to assessment areas. These assessments do not take the structural integrity of the embankment into account or quantify a risk of failure. Breach may occur at any location along the canal system where there is a raised embankment. Canal inundation analysis is therefore indicative and digital plans only have been submitted as part of this SFRA. At locations that could be affected by inundation from canal breach more detailed assessments should be included in site-specific FRAs. This should be based on a more detailed appreciation of the hazard and the implications during a flood emergency.

5.2 Flood risk from canals

Canals do not generally pose a direct flood risk as they are a regulated waterbody. The residual risk from canals tends to be associated with lower probability events such as overtopping and embankment failure.

The residual risk associated with canals is more difficult to determine as it depends on a number of factors including, for example, the source and magnitude of surface water runoff into the canal, the size of the canal, construction materials and level of maintenance. The probability of a breach is managed by continued maintenance.

No attempt is made in this SFRA to assess the probability of failure other than noting that such events are very rare. However, in accordance with NPPF, all sources of flooding need to be considered. If a breach event were to occur then the consequences, to people and property, could be high. In order to understand the possible impacts, a series of inundation models have been generated for this SFRA. It should be noted that the canal breach locations have been identified based on areas of the canal that includes raised embankments. The mapping is intended to provide an indication of the likely impact of selected failure scenarios. It is not intended that inundation mapping provides a comprehensive analysis of all failure scenarios and further, site specific analysis, will need to be considered at all sites located within the vicinity of a canal system. Developers should be aware that any site that is at or below canal bank level may be subject to canal flooding and this should be taken into account when building resilience into low level properties.

According to the Leicestershire PFRA there are no known records of flooding events that relate to the Ashby de la Zouch Canal and Grand Union Canal within the joint SFRA area.

A "Canal Hazard Zone" has been created for assessment areas, where applicable, to show areas that could potentially be affected by flooding in the event of breach of selected raised canal embankments. These are based on broad scale modelling techniques and should only be taken as an indication of the extent of flooding at potential risk. The methodologies used to derive the risk from canal inundation are outlined in the next section. Canal breaches can be caused by overtopping and erosion of canal embankments. In general, failure is more commonly caused by degradation of the canal lining and erosion within the embankment slope until failure occurs.

5.3 Canal Inundation Methodology

Flooding from a breach of a canal embankment is largely dictated by canal and ground levels, canal embankment construction, breach characteristics and the volume of water within the canal that can discharge into the lower lying areas behind the embankment. For this study, the potential maximum flood extent is limited by the maximum volume of water within a pound length. However, during a joint probability flood event or if there is an interaction between a canal and watercourse then the volume and extent of flooding may increase.

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

There are a number of uncertainties associated with the simulation of flooding from canals in either overtopping or breach conditions. A number of assumptions have been used in the simulation of flooding for the joint SFRA area:

- Canal widths were estimated at a number of locations along each pound length and an average taken.
- A minimum depth of approximately 1.2 metres
- The canal is typically shallow but variability in depth along the course has not been taken into account.
- An impounded length of water (between locks or areas where stop boards could be placed) was calculated for each breach location.

These assumptions should be considered when using and reviewing the mapping produced from the modelling.

A breach hydrograph was developed using a 1-D HECRAS model to represent the three stage mechanism with the starting water level as bank full. The respective pound lengths were applied to the model. The breach hydrographs obtained from HECRAS were fed into a two dimensional JFlow model to assess potential flood inundation extents along the length of the canal. Inflows were applied to the JFlow model along the canal at potential breach locations. The breach locations have been chosen to assess the *possible* implications of a breach along the canal and *do not* indicate an increased likelihood of a breach in that specific area - the locations were chosen based on proximity to the assessment areas alone, where assessment areas are located on ground lower than the level of the canal. Developers should be aware that any site that is at or below canal bank level may be subject to canal flooding and this should be taken into account when building resilience into low level properties.

5.4 Data Availability

A series of worst case canal inundation appraisals have been undertaken at selected locations along the canal system in the joint SFRA area. Due to the potentially numerous locations for failure scenarios, the canal mapping is considered indicative only and will need to be reviewed and updated as part of any detailed site specific FRA. The location of inundation scenarios were based on the location of elevated canal systems and vulnerable infrastructure. The actual probability of failure, at any location, has not been assessed in this SFRA.

5.5 Flooding from the Ashby de la Zouch Canal and the Grand Union Canal: inundation results

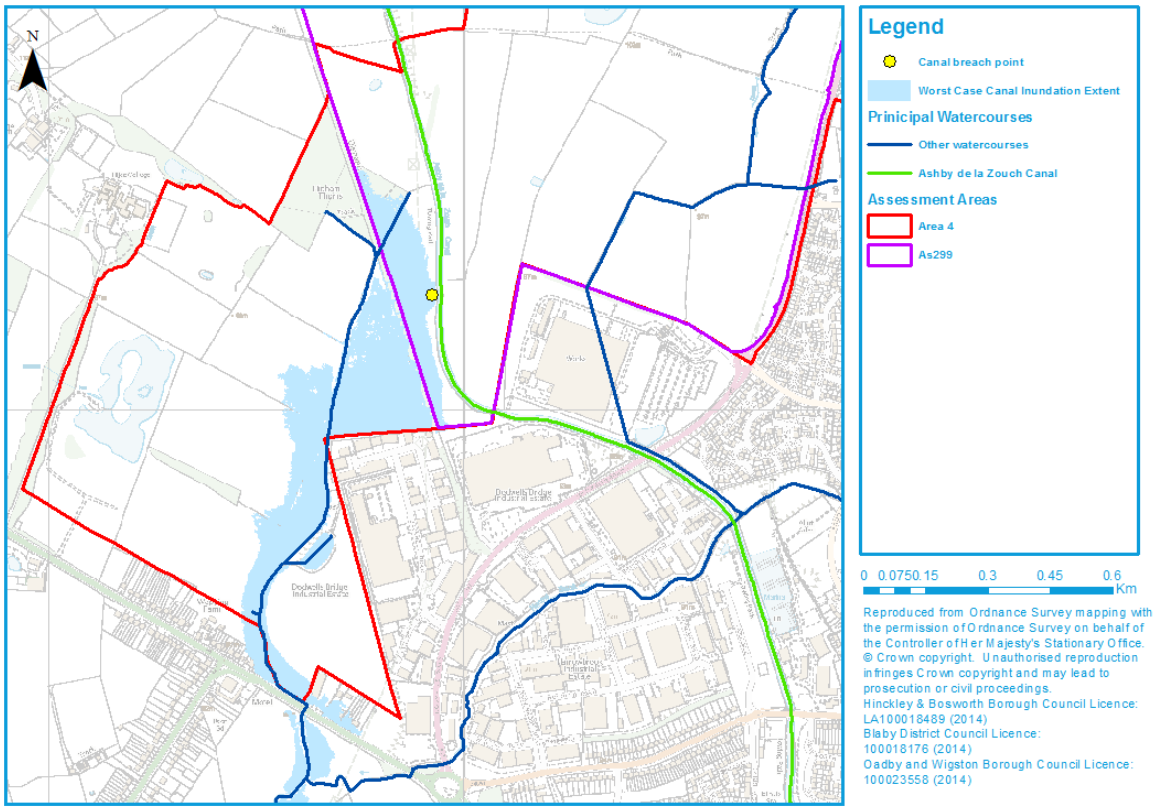
Canal flooding is an unlikely occurrence and so should be considered to be a residual risk. The following sections examine how simulated inundation from breach points on the Ashby de la Zouch and Grand Union Canal could potentially affect the assessment sites.

5.5.1 Canal Breach Point 1

Canal Breach Point 1 is located on the left bank of Ashby de la Zouch Canal (SP 39923 94278) to the north of Dodwells Bridge Industrial Estate, Hinckley. Stop boards are assumed to have been placed at Dodwells Road Bridge and the Hinkley Lane road bridge, creating an impounded canal reach of 1,844m. Land situated in the assessment areas As299 (land to rear of Wykin Hall Farm House, adjacent to Normandy Way, Hinckley) and Area 4 (West of the Northern Perimeter Road, Hinckley) is significantly lower than the canal channel and would therefore be at risk should canal inundation occur.

Figure 5-1 shows the inundation from Canal Breach Point 1. The canal breach is located within the boundaries of assessment areas Area 4 and As299. Flood water flows predominantly south from the breach location, following the course of a drain and low points in the topography. Flood water is shown to affect the south-western section of both assessment areas Area 4 and As299.

Figure 5-1: Inundation at Canal Breach Point 1

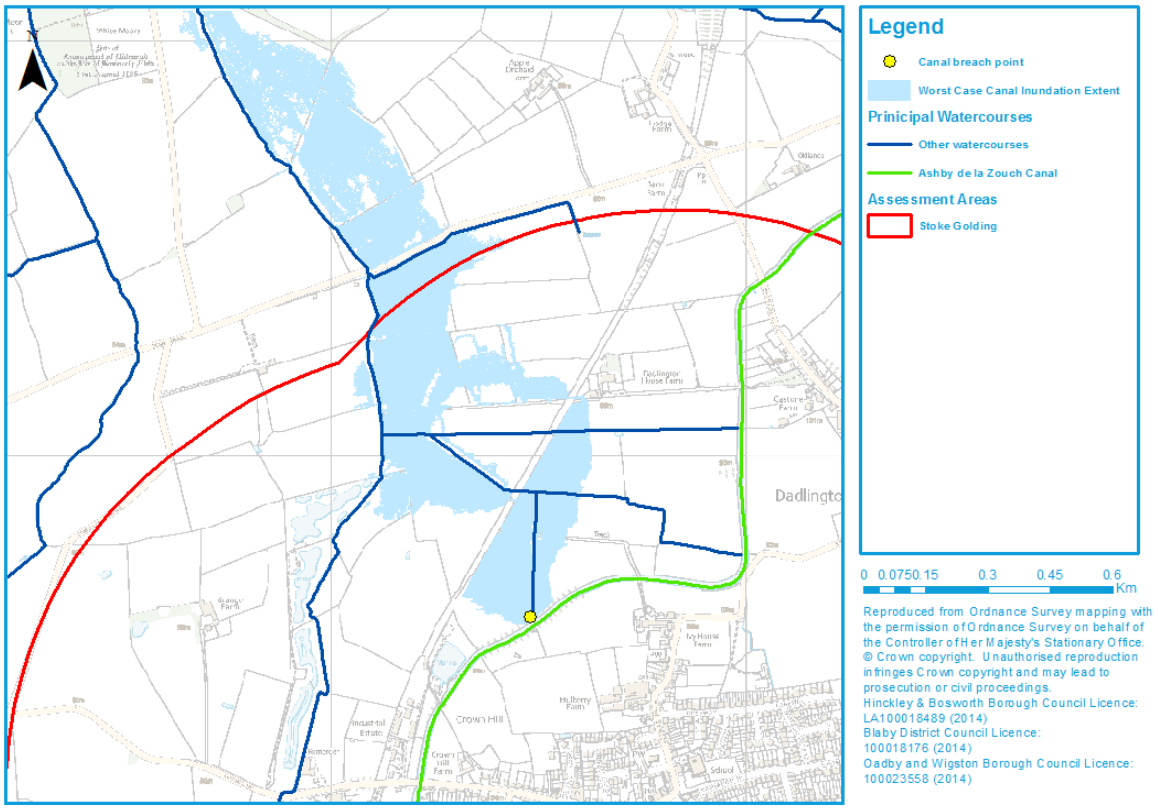


5.5.2 Canal Breach Point 2

Canal Breach Point 2 is located on the left bank of the Ashby de la Zouch canal (SP 39480 97610) to the north of Stoke Golding. Stop boards are assumed to have been placed at the Upton Lane road bridge and Shenton Lane road bridge, creating an impounded canal reach of 1,790m. Ground level in the western portion of the Stoke Golding assessment area is significantly lower than the canal channel and would therefore be at risk should canal inundation occur.

Figure 5-2 shows the inundation from Canal Breach Point 2. The canal breach is located within the boundary of the Stoke Golding assessment area. Flood water flows predominantly northwest away from the breach location, following the topography. Water is shown to back up behind the embankment of a dismantled railway that runs directly through the site. Flood water is shown to affect the north-western section of the Stoke Golding assessment area.

Figure 5-2: Inundation at Canal Breach Point 2

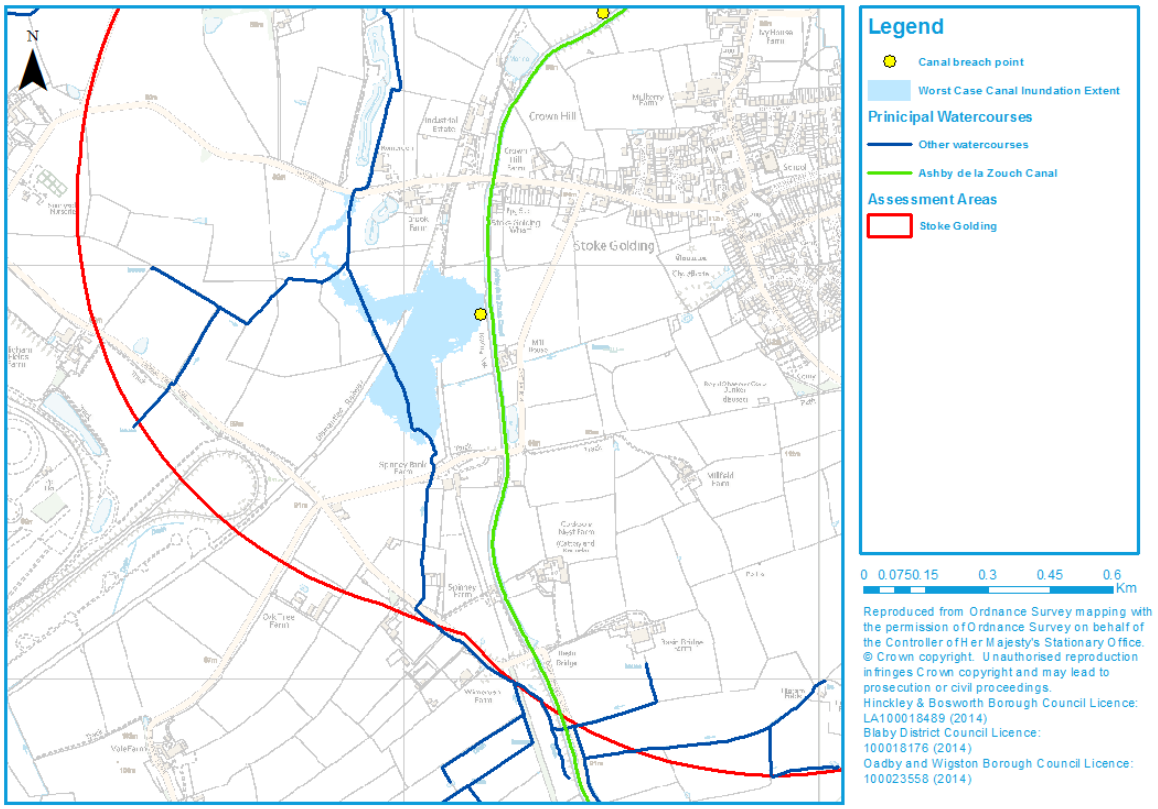


5.5.3 Canal Breach Point 3

Canal Breach Point 3 is located on the left bank of the Ashby de la Zouch canal (SP 39183 96883) to the south of Stoke Golding. Stop boards are assumed to have been placed at the Upton Lane road bridge and the Higham Lane road bridge, creating an impounded canal reach of 650m. Land situated in the western portion of the Stoke Golding assessment area is significantly lower than the canal channel and would therefore be at risk should canal inundation occur.

Figure 5-3 shows the inundation from Canal Breach Point 3. The canal breach is located within the boundary of the Stoke Golding assessment area. Flood water flows predominantly west away from the breach location, following the topography. Water is shown to back up behind the embankment of a dismantled railway that runs directly through the site. Flood water is shown to affect the western section of the Stoke Golding assessment area.

Figure 5-3: Inundation at Canal Breach Point 3

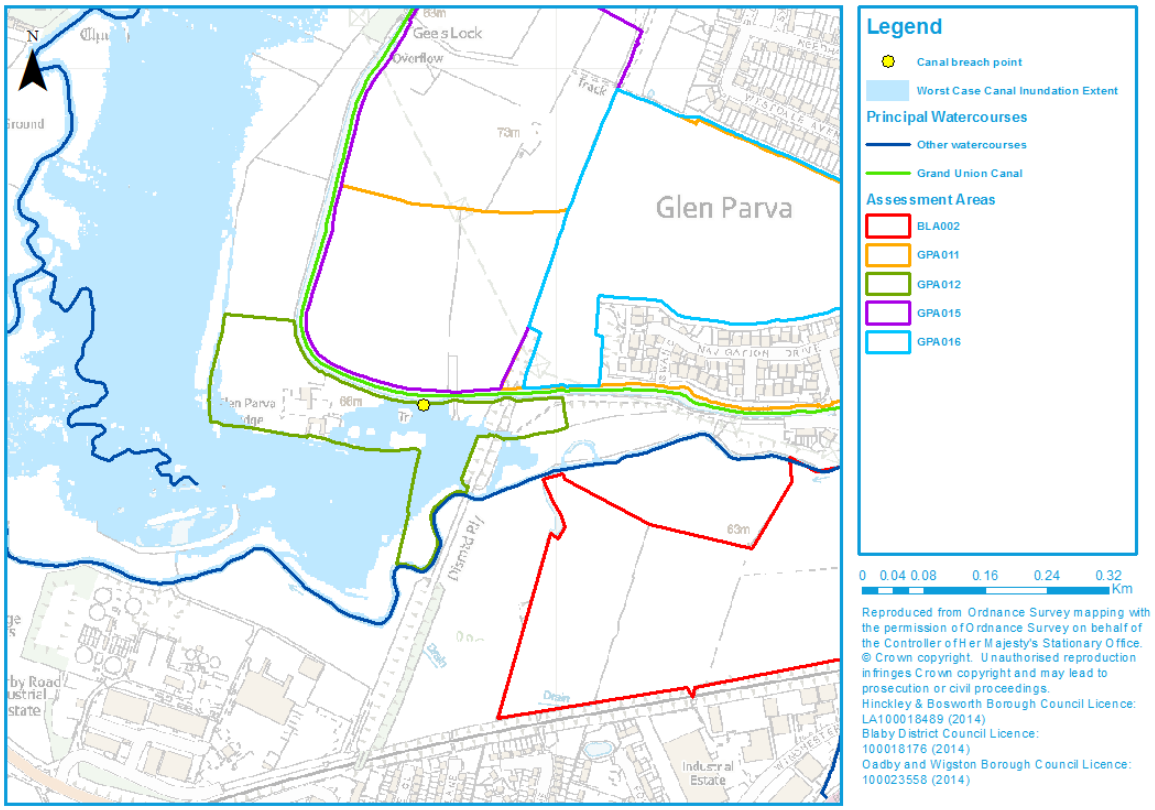


5.5.4 Canal Breach Point 4

Canal Breach Point 4 is located on the left bank of the Grand Union Canal (SP 55827 98563) to the east of Glen Parva. The impounded reach runs from Gee's Lock to the lock north of New Bridge Road, a total distance of 1,340m. Land situated in the assessment areas BLA002 and GPA012 is significantly lower than the canal channel and would therefore be at risk should canal inundation occur. Although three other assessment areas (GPA011, GPA015 and GPA016) border the canal at the breach point, elevation data shows that these are on higher ground and are therefore not at significant risk.

Figure 5-4 shows the inundation from Canal Breach Point 4. The canal breach is located adjacent to assessment area GPA012. Flood water flows away from the breach location directly through the central section assessment area GPA012 in a southerly direction, before flowing away to the west (following the course of the River Sence) and then north (following the course of the River Soar).

Figure 5-4: Inundation at Canal Breach Point 4

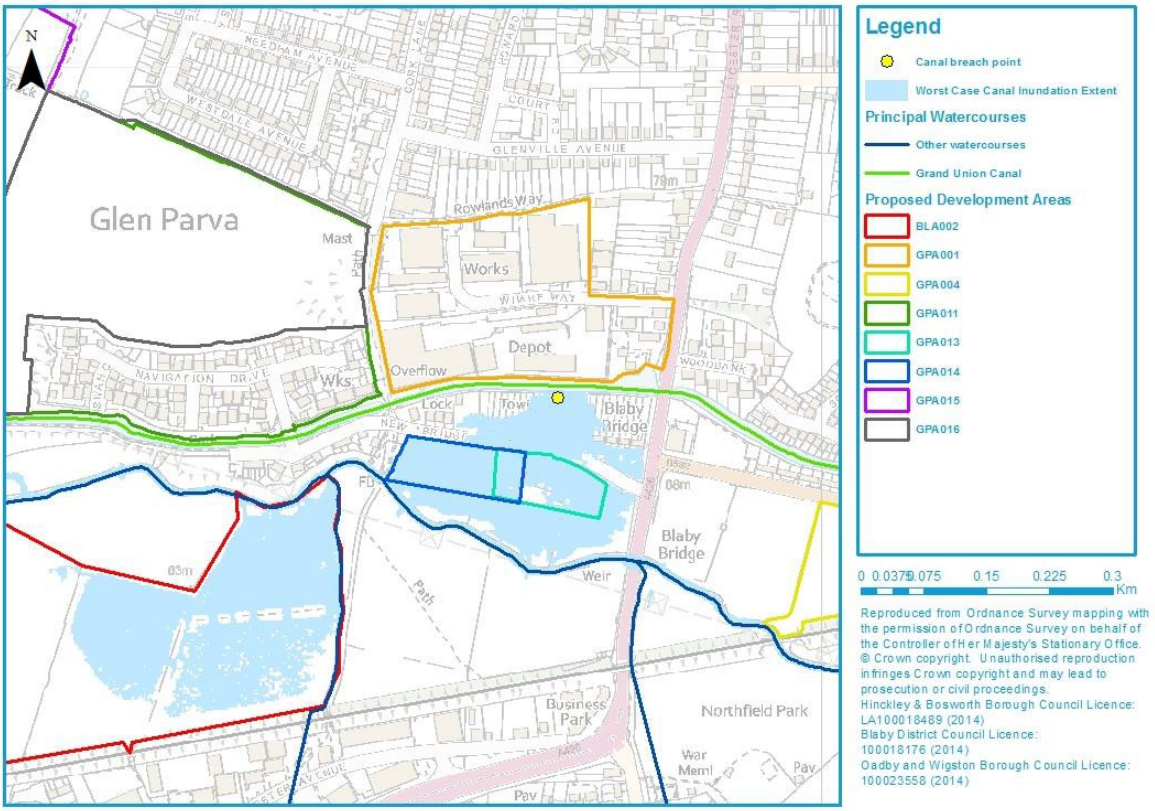


5.5.5 Canal Breach Point 5

Canal Breach Point 5 is located on the left bank of the Grand Union Canal (SP 56686 98607) to the west of Blaby Bridge, Glen Parva. The impounded reach runs from the lock north of New Bridge Road to Dunn's Lock, a total distance of 680m. Land situated in the assessment areas BLA002, GPA013 and GPA014 is significantly lower than the canal channel and would therefore be at risk should canal inundation occur. Although another assessment area (GPA001) borders the canal at the breach point, elevation data shows that this is on higher ground and is therefore not at significant risk.

Figure 5-5 shows the inundation from Canal Breach Point 5. The canal breach is located adjacent to assessment areas GPA013 and GPA014. Flood water flows away from the breach location directly through the central section of assessment areas GPA013 and GPA014 in a southerly direction, before flowing away to the west (following the course of the River Sence) where the water enters assessment area BLA002, inundating the eastern section of the site.

Figure 5-5: Inundation at Canal Breach Point 5

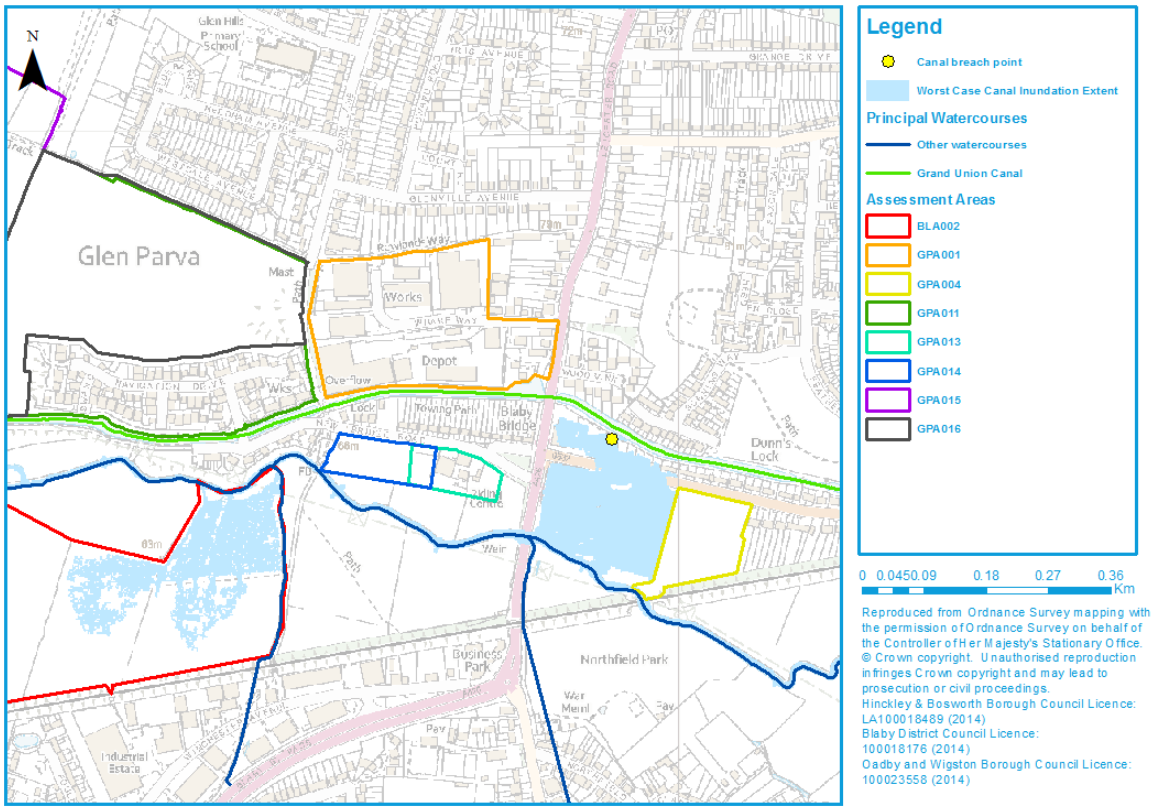


5.5.6 Canal Breach Point 6

Canal Breach Point 6 is located on the left bank of the Grand Union Canal (SP 56903 98555) to the east of Blaby Bridge, Glen Parva. The impounded reach runs from the lock north of New Bridge Road to Dunn's Lock, a total distance of 680m. Land situated in the assessment areas BLA002, GPA013 and GPA014 is significantly lower than the canal channel and would therefore be at risk should canal inundation occur. Although another assessment area (GPA004) borders the canal at the breach point, elevation data shows that this is on higher ground and is therefore not at significant risk.

Figure 5-6 shows the inundation from Canal Breach Point 6. The canal breach is located adjacent to assessment areas GPA013 and GPA014. Flood water flows south from the breach location between the A426 road and the higher ground of assessment area GPA004, before flowing away to the west (following the course of the River Sence) where the water enters assessment area BLA002, inundating the eastern section of the site.

Figure 5-6: Inundation at Canal Breach Point 6

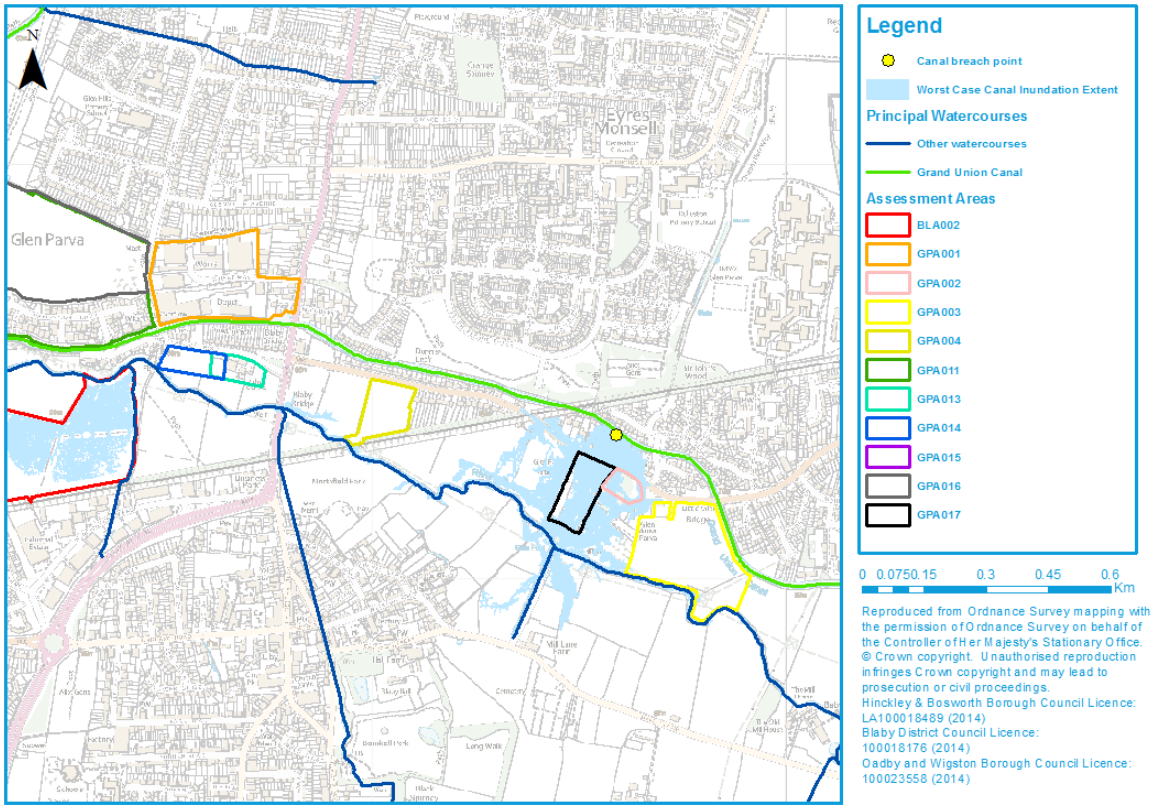


5.5.7 Canal Breach Point 7

Canal Breach Point 7 is located on the left bank of the Grand Union Canal (SP 57589 98346) to the west of Knight's Bridge. The impounded reach runs from Dunn's Lock to Bush Lock, a total distance of 1,410m. Land situated in the assessment areas GPA002 and GPA017 is significantly lower than the canal channel and would therefore be at risk should canal inundation occur.

Figure 5-7 shows the inundation from Canal Breach Point 7. The canal breach is located adjacent to assessment areas GPA002 and GPA017. Flood water flows south away from the breach location directly through assessment areas GPA002 and GPA017. The flood water interacts with the River Sence, flowing mainly in a westerly direction, following the topography where it eventually enters assessment area BLA002, and inundates the eastern section of the site.

Figure 5-7: Inundation at Canal Breach Point 7

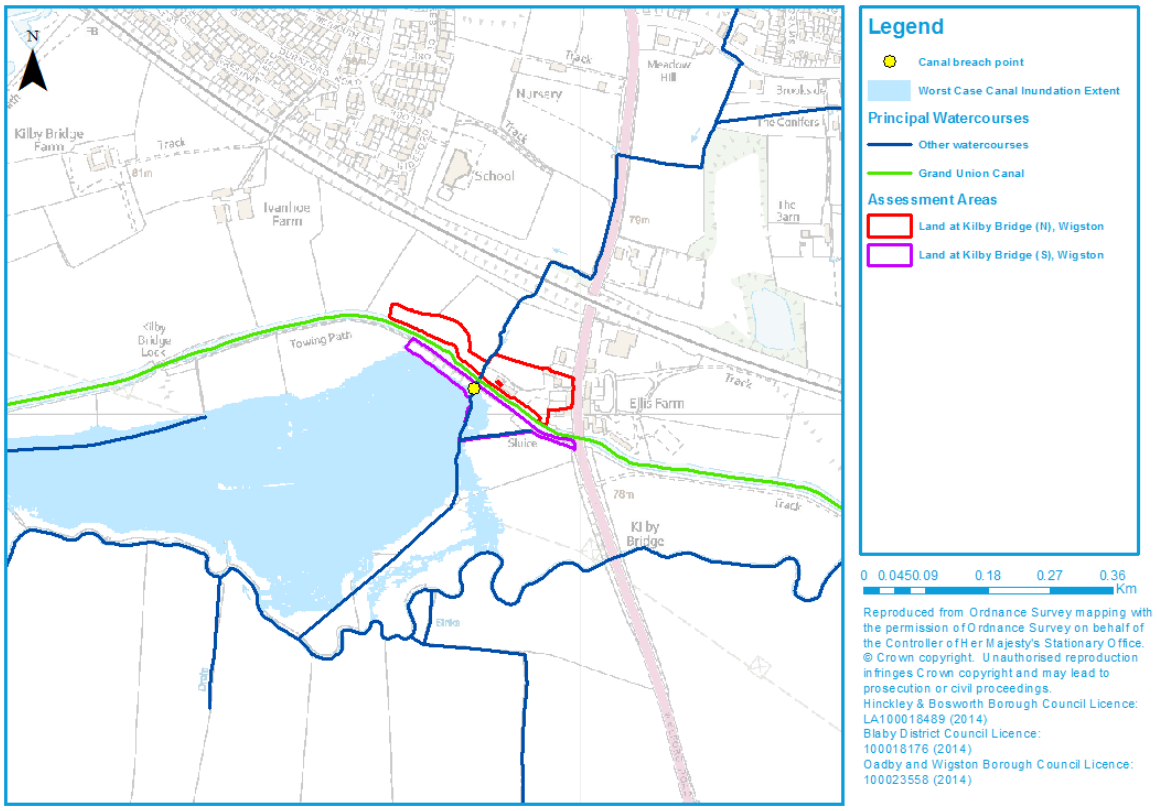


5.5.8 Canal Breach Point 8

Canal Breach Point 8 is located on the left bank of the Grand Union Canal (SP 60847 97038) to the south of Wigston Harcourt. The impounded reach runs from Kilby Bridge Lock to the Welford Road bridge, a total distance of 680m. Land situated in the assessment areas 'Land at Kilby Bridge (S), Wigston' and 'Land at Kilby Bridge (N), Wigston' is significantly lower than the canal channel and would therefore be at risk should canal inundation occur.

Figure 5-8 shows the inundation from Canal Breach Point 8. Flood water flows away from the breach location directly through assessment area 'Land at Kilby Bridge (S), Wigston', following the topography as it drops away to the southwest.

Figure 5-8: Inundation at Canal Breach Point 8

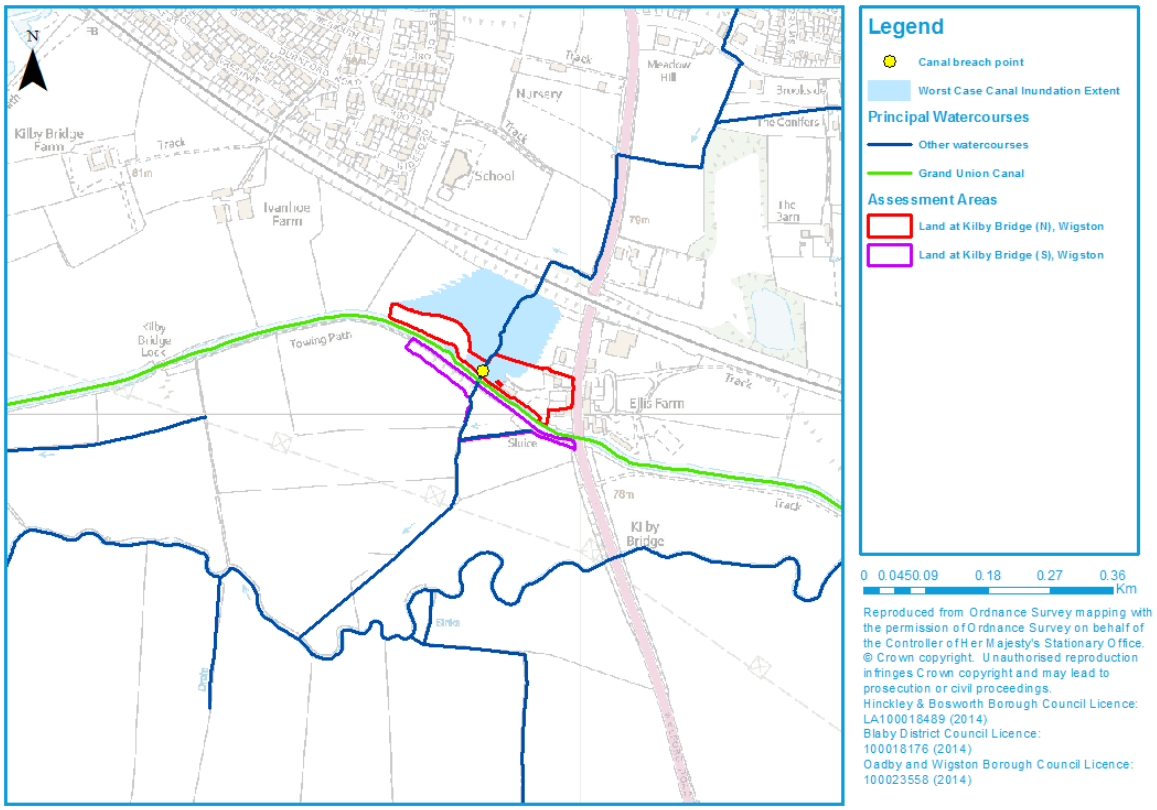


5.5.9 Canal Breach Point 9

Canal Breach Point 9 is located on the right bank of the Grand Union Canal (SP 60859 97602) to the south of Wigston Harcourt. The impounded reach runs from Kilby Bridge Lock to the Welford Road bridge, a total distance of 680m. Land situated in the assessment areas 'Land at Kilby Bridge (S), Wigston' and 'Land at Kilby Bridge (N), Wigston' is significantly lower than the canal channel and would therefore be at risk should canal inundation occur.

Figure 5-9 shows the inundation from Canal Breach Point 9. Flood water flows away from the breach location directly through the assessment area 'Land at Kilby Bridge (N), Wigston', following the topography as it drops away to the northeast where it backs up behind the railway embankment to the north of the site.

Figure 5-9: Inundation at Canal Breach Point 9



5.6 Implications

The modelled scenarios show a credible situation should canal inundation occur but does not assess the probability of failure. The mapping shows the residual risk as the canal should be well maintained.

However, development at locations adjacent to the canal will need to consider this residual risk as part of a detailed FRA. Any development should be set back eight metres from the canal, providing a buffer strip to 'make space for water' and to allow access for maintenance or repair should it be required.

5.7 Flood risk from reservoirs

The risk of inundation to the joint SFRA area as a result of reservoir breach or failure of a number of reservoirs within the area was assessed as part of the National Inundation Reservoir Maps (NRIM) study. Reservoirs whose inundation mapping is shown to affect the joint SFRA area are detailed in Table 5-1 (reservoirs located within the joint SFRA area are highlighted in blue).

Reservoir flooding is very different from other forms of flooding. It may happen with little or no warning and evacuation will need to happen immediately. The likelihood of such flooding is very difficult to estimate, but it is less likely than flooding from rivers or surface water. It may not be

possible to seek refuge from floodwaters upstairs as buildings could be unsafe or unstable due to the force of water from the reservoir breach or failure. The Environment Agency maps represent a credible worst case scenario. In these circumstances it is the time to inundation, the depth of inundation, the duration of flooding and the velocity of flood flows that will be most influential. This information is not made available to the public.

The risk to development from reservoirs is residual but developers should consider reservoir flooding during the planning stage.

- Developers should seek to contact the reservoir owner to obtain information which may include
  - Reservoir characteristics: type, dam height at outlet, area/volume, overflow location
  - Operation: discharge rates / maximum discharge
  - Discharge during emergency drawdown
  - Inspection / maintenance regime
- Developers should apply the sequential approach to locating development within the site. The following questions should be considered:
  - Can risk be avoided through substituting less vulnerable uses or by amending the site lay-out?
  - Can it be demonstrated that less vulnerable uses for the site have been considered and reasonably discounted?
  - Can layout be varied to reduce the number of people or flood risk vulnerability or building units located in higher risk parts of the site?
- Consult with relevant authorities regarding emergency plans in case of reservoir breach

Table 5-1: Reservoirs in the vicinity of the joint SFRA area

Reservoir	Location (grid reference)	Reservoir owner	Environment Agency area	Local authority
Mallory Park Large Lake Reservoir	444888,299824	Mallory Park Motor Sport Ltd	Derbyshire, Nottinghamshire & Leicestershire	Leicestershire County Council
Thornton Reservoir	447316,307258	Severn Trent Water		
Groby Pool Reservoir	452393,307911	Hanson Plc		
Bosworth Water Trust Amenity Lake Reservoir	438169,303008	Bosworth Water Trust		
Seeswood Pool Reservoir	433086,290386	Warwickshire County Council	Staffordshire, Warwickshire & West Midlands	Warwickshire County Council
Oldbury No.1 Reservoir	431210,294769	Severn Trent Water		
Merevale Park Estate Reservoir	430080,297160	Dugdale		

6 Mapping and risk based approach

6.1 Summary of mapping for all sources of flood risk

6.1.1 Fluvial

The data used to prepare mapping is based on the results from hydraulic models either provided by the Environment Agency or prepared for the purposes of this SFRA.

- 1D-2D modelling of the River Soar and its tributaries (part of the Leicester SFRM study).
- 1D modelling of the Broughton Astley Brook
- 1D modelling of the Lubbesthorpe Brook
- 1D modelling of the River Sence (Soar tributary)
- 1D modelling of the Whetstone Brook
- 1D-2D modelling of the River Sence (Anker tributary)
- Environment Agency's Flood Map for Planning. Note: these outlines are based on generalised modelling to provide only an indication of flood risk. Whilst they are generally accurate on a large scale, they are not provided for specific sites or land where the catchment of the watercourse falls below 3km^2. For this reason, the Flood Map for Planning is not sufficiently accurate to resolve the details of possible flooding for individual properties or sites and for any sites with watercourses on, or adjacent to the site, would require further, more detailed assessment.

  The Flood Map for Planning is updated quarterly; therefore the Flood Map on the Environment Agency/Defra website will supersede the version of the Flood Map shown in Appendix C.
- Modelled outlines using JFlow have been developed to provide an indication of Flood Zone 3a, Flood Zone 3b and Flood Zone 2, as well as the effects of climate change, for a number of ordinary watercourses flowing through or adjacent to sites. The modelling also provides an indication of depth, velocity and hazard associated with a 100-year event (Flood Zone 3a). Note, only the sections of the watercourse that flow through/adjacent to the site have been modelled. These watercourses included, but were not limited to:
  - Cosby Brook
  - Harrow Brook
  - Upper reaches of the Lubbesthorpe Brook
  - Upper reaches of the River Soar
  - Upper reaches of the Rothley Brook
  - Sketchley Brook
  - Slate Brook
  - Tweed River
  - Wash Brook
  - Unnamed watercourse from Combe Park Recreation Ground to Kilby Bridge
  - Unnamed watercourse from Wigston South Junction to Crow Mill Bridge

6.1.2 Surface Water

Mapping of surface water flood risk has been taken from updated Flood Maps for Surface Water (UFMfSW) published online by the Environment Agency in December 2013. This information is based on a national scale map identifying those areas where surface water flooding poses a risk. Flooding is separated into the following four categories:

- **High** – An area has a chance of flooding greater than 1 in 30 (3.3%) each year.
- **Medium** – An area has a chance of flooding between 1 in 100 (0.1%) and 1in 30 (3.3%) each year.
- **Low** – An area has a chance of flooding between 1 in 1000 (0.1%) and 1in 100 (1%) each year.

- **Very Low** – An area has a chance of flooding of less than 1 in 1000 (0.1%) each year.

6.1.3 Hazard Maps

Hazard mapping has also been produced for the assessment areas. The hazard rating is calculated directly within 1D-2D models and utilises the classifications of hazard presented in DEFRA R&D Technical Note FD2320: Flood Risk Assessment. The hazard mapping output from JFlow does not include a debris factor. In order for the hazard mapping across the joint SFRA area to be consistent, the debris factor has been added to the JFlow hazard mapping outputs.

It should be noted that the hazard mapping prepared for the SFRA will need to be refined when more detailed consideration is given to preparing development proposals at the respective sites where development is not currently proposed. This should be done at the detailed Flood Risk Assessment (FRA) stage. At that time it is likely that more detailed 1D-2D modelling will have to be prepared to enable results with an appropriate level of detail and resolution.

6.1.4 Suite of Maps

All of the mapping can be found in the appendices and is presented in the following structure:

- **Appendix B: Watercourses.** Map showing the Main River within the Joint SFRA area as well as the location of ordinary watercourses and canals
- **Appendix C: Flood Zones.** These are based on the Environment Agency's published Flood Zones, and where available, detailed models have been used to define Flood Zone 3b. In the absence of detailed models a precautionary approach can be adopted with the assumption that the extent of Flood Zone 3b would be equal to Flood Zone 3a. These maps do not include the results from the Jflow modelling undertaken to assess flood risk to the assessment sites shown in the assessment site summary tables in Appendix A.
- **Appendix D: Climate change outlines.** Where available, climate change results from detailed modelling have been used. In the absence of detailed models, a precautionary approach has been adopted where Flood Zone 2 has been used as a guide to provide an indication of the likely increase in extent of Flood Zone 3 with climate change. These maps do not include the results from the Jflow modelling undertaken to assess flood risk to the assessment sites shown in the assessment site summary tables in Appendix A.
- **Appendix E: WFD status of watercourses.** Map showing the 2013 overall status of the main water bodies in the joint SFRA.
- **Appendix F: Surface water flood risk mapping.** These maps are based on the Environment Agency's updated Flood Map for Surface Water (uFMfSW)
- **Appendix G: Ground water flooding.** These maps are based on the Environment Agency's Areas Susceptible to Groundwater Flood (AStGWf) map
- **Appendix H: Flood warning coverage.** These maps show the coverage of the various flood warning areas in the Joint SFRA area.
- **Appendix I: Assessment Areas overview.** Overview maps showing all of the assessment areas for HBBC, BDC and OWBC.

6.2 Other relevant flood risk information

The mapping prepared for this SFRA provides information on:

- The extent of flooding
- The depth of flooding
- Flood water velocity
- Hazard from flood water

Note: depth, velocity and hazard mapping is only available in areas of proposed developments.

Other relevant information on flood risk should be referred to by users of this SFRA, where available and appropriate. This information includes:

- River Trent Catchment Flood Management Plan (2010) – Environment Agency

- Leicestershire Preliminary Flood Risk Assessment (2011) – Leicestershire County Council
- Surface Water Management Plan (2012) – Leicester City Council
- Flood Risk Management Plan in accordance with the Flood Risk Regulations (available in 2015) – Environment Agency and Lead Local Flood Authority
- Environment Agency's Asset Information Management System (AIMS) – users should note that recently completed schemes may not yet be included in this dataset.

6.3 The Sequential, risk-based approach

This approach is designed to ensure areas with little or no risk of flooding (from any source) are developed in preference to areas at higher risk, with the aim of keeping development outside of medium and high flood risk areas (Flood Zones 2 and 3) and other sources of flooding, where possible.

It is often the case that it is not possible for all new development to be allocated on land that is not at risk from flooding. In these circumstances the Flood Zone maps (that show the extent of inundation assuming that there are no defences) are too simplistic. A greater understanding of the scale and nature of the flood risks is required.

When deciding on the ability to manage flood risk for new development located in Zones 2 and 3 consideration must be given to a wide range of issues. The issues to be addressed include how any evacuation of the occupants would be handled, how the new development fits in with the existing flood management provision and, in circumstances where flooding is experienced how quickly the wider area would recover and return to normal. At some of the locations it could be found that Flood Risk Management measures are more easily integrated alongside proposed new development to address the flood risk issues, usually as a consequence of the prevailing natural or artificial topography. In these circumstances the Flood Risk Management proposals could be deployed without causing a significant alteration to the design and its place setting. However, even in these circumstances it should be recognised that Flood Risk Management Measures at one location can have the potential to cause an alteration to the flood risk to adjacent property or in flood cells on the opposite bank.

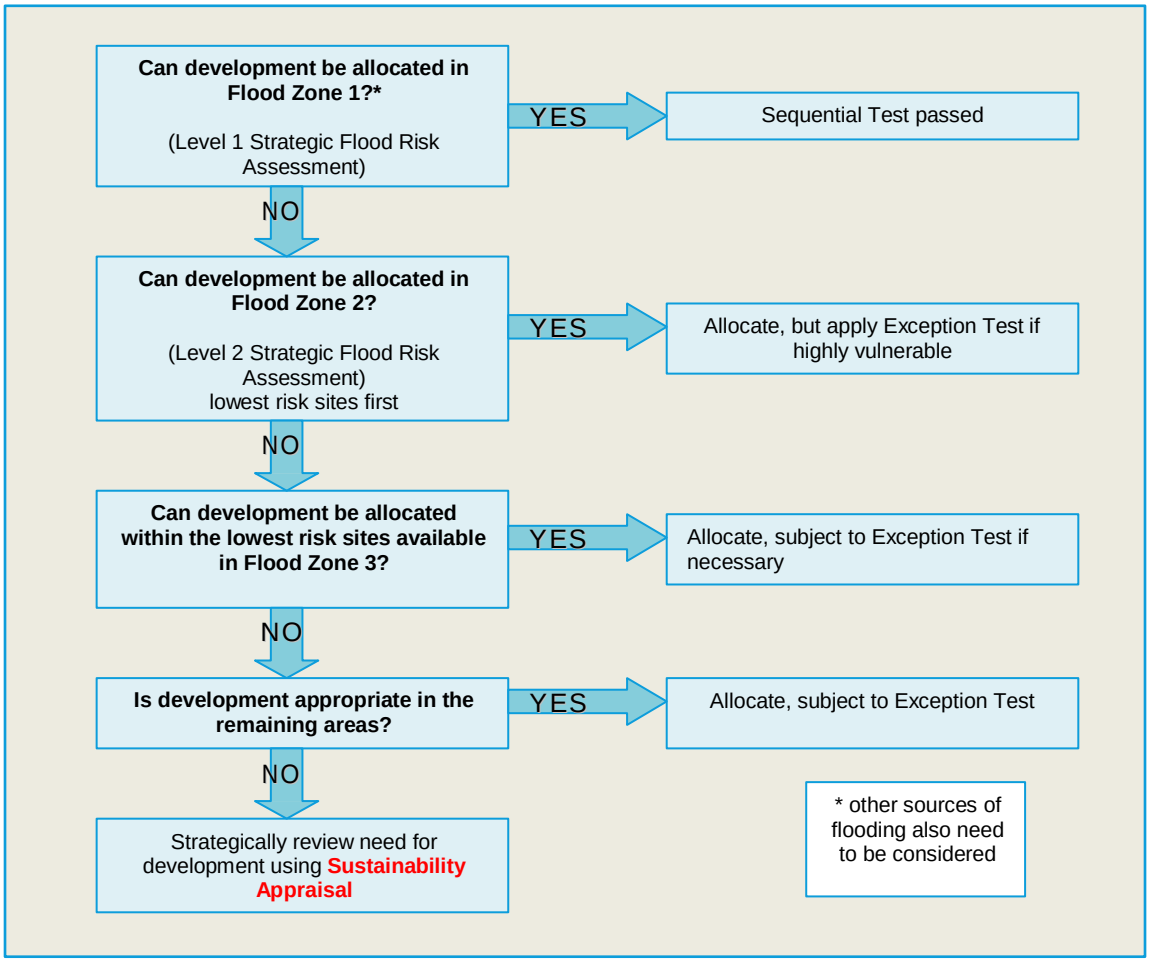
6.4 Applying the Sequential Test and Exception Test in the preparation of a Local Plan

When preparing a local plan, the Local Planning Authority should demonstrate it has considered a range of site allocations, using Strategic Flood Risk Assessments to apply the Sequential and Exception Tests where necessary.

The Sequential Test should be applied to the whole local planning authority area to increase the likelihood of allocating development in areas not at risk of flooding. The Sequential Test can be undertaken as part of a local plan sustainability appraisal. Alternatively, it can be demonstrated through a free-standing document, or as part of strategic housing land or employment land availability assessments. NPPF Planning Practice Guidance for Flood Risk and Coastal Change describes how the Sequential Test should be applied in the preparation of a Local Plan (Figure 6-1).

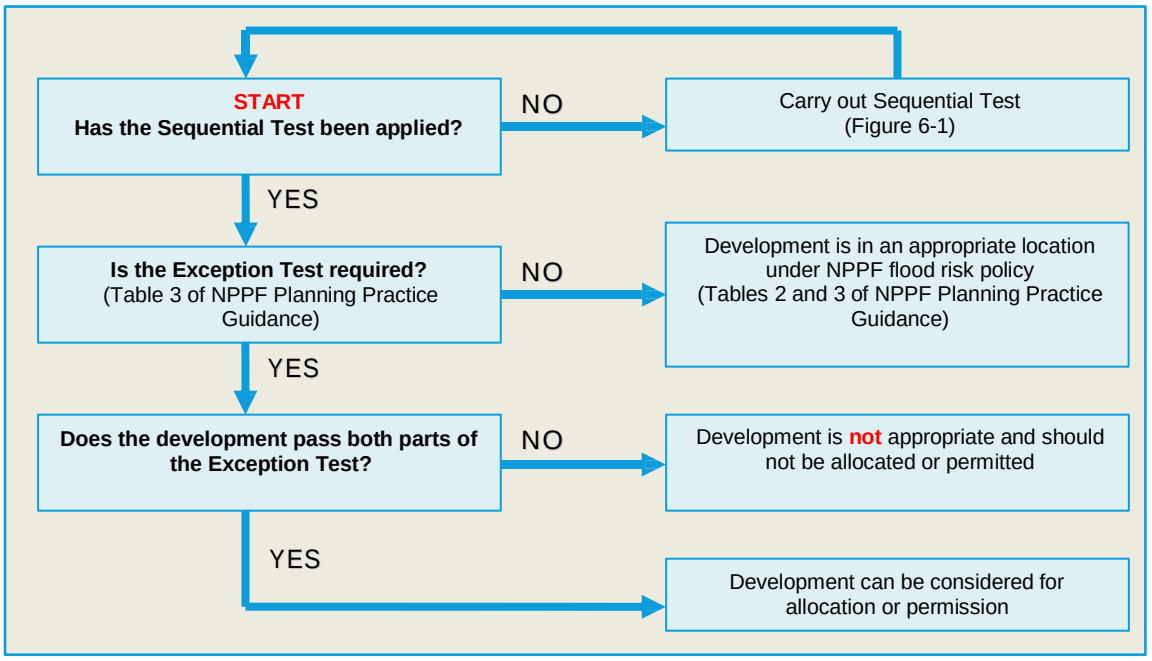
The Exception Test should <u>only</u> be applied *following* the Sequential Test and as set out in Table 3 of the NPPF Planning Practice Guidance: Flood Risk and Coastal Change. NPPF Planning Practice Guidance for Flood Risk and Coastal Change describes how the Exception Test should be applied in the preparation of a Local Plan (Figure 6-2).

Figure 6-1: Applying the Sequential Test in the preparation of a Local Plan†



† Based on Diagram 2 of NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 020, Reference ID: 7-021-20140306) March 2014

Figure 6-2: Applying the Exception Test in the preparation of a Local Plan†



† Based on Diagram 3 of NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 028, Reference ID: 7-021-20140306) March 2014

6.5 Applying the Sequential Test and Exception Test to individual planning applications

The NPPF Planning Practice Guidance[19] sets out how developers and planners need to consider flood risk to, and from, the development site, following the broad approach of assessing, avoiding, managing and mitigating flood risk. A checklist for Site Specific Flood Risk Assessments is provided in Paragraph 68 of the Guidance.

A site-specific flood risk assessment should be carried out to assess flood risk to, and from a development. The assessment should demonstrate how flood risk will be managed over a development's lifetime, taking climate change and the user vulnerability into account.

The NPPF Planning Practice Guidance sets out the following objectives for a site specific Flood Risk Assessment (FRA). An FRA should establish:

- Whether a proposed development is likely to be affected by current or future flooding from any source
- Whether it will increase flood risk elsewhere
- Whether the measures proposed to deal with these effects and risks are appropriate
- The evidence for the local planning authority to apply (if required) the Sequential Test
- Whether the development will be safe and pass the Exception Test (where applicable)

6.5.1 Sequential Test

The Sequential Test must be performed when considering the placement of future development and for planning application proposals. The sequential approach to locating development should be followed for all sources of flooding. The Flooding and Coastal Change Planning Practice Guidance to the NPPF gives detailed instructions on how to perform the test.

The Sequential Test does not need to be applied for individual developments under the following circumstances:

- The site has been identified in development plans through the Sequential Test
- Applications for minor development or change of use (except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site)

The Sequential Test does not normally need to be applied for individual developments under the following circumstances

- Development proposals in Flood Zone 1 (unless the SFRA for the area, or any other recent information, indicates there may be flooding issues now or in the future)

For developments that do not fall under the above categories, local circumstances must be used to define the area of application of the Sequential Test (within which it is appropriate to identify reasonably available alternatives). The criteria used to determine the appropriate search area relate to the catchment area for the type of development being proposed. For some sites this may be clear, in other cases it may be identified by other Local Plan policies[19]. A pragmatic approach should be taken when applying the Sequential Test.

Local planning authorities, with advice from the Environment Agency, are responsible for considering the extent to which Sequential Test considerations have been satisfied, and will need to be satisfied that the proposed development would be safe and not lead to increased flood risk elsewhere.

The information provided in this SFRA can be used to:

- Identify the area to be assessed (including alternatives) on the Flood Zone Maps that are provided with this assessment;
- Establish the risk of flooding from other sources
- Follow the instructions given in the Planning Practice Guidance.

19 NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 033, Reference ID: 7-056-20140306) March 2014

6.5.2 Exception Text

If, following application of the Sequential Test, it is not possible for the development to be located in areas with a lower probability of flooding then the Exception Test must be applied, if appropriate. The aim of the Exception Test is to ensure that more vulnerable property types, such as residential development can be implemented safely and are not located in areas where the hazards and consequences of flooding are inappropriate. For the Test to be satisfied, both of the following elements have to be accepted for development to be allocated or permitted:

1. It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared

   Local planning authorities will need to consider what criteria they will use to assess whether this part of the Exception Test has been satisfied, and provide advice to enable applicants to provide evidence to demonstrate that it has been passed. If the application fails to prove this, the local planning authority should consider whether the use of planning conditions and/or planning obligations could allow it to pass. If this is not possible, this part of the Exception Test has not been passed and planning permission should be refused[20].

2. A site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime, taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

   The site specific flood risk assessment should demonstrate that the site will be safe and the people will not be exposed to hazardous flooding from any source. The following should be considered[21]

   - The design of any flood defence infrastructure
   - Access and egress
   - Operation and maintenance
   - Design of the development to manage and reduce flood risk wherever possible
   - Resident awareness
   - Flood warning and evacuation procedures
   - Any funding arrangements required for implementing measures

The NPPF and Technical Guidance provide detailed information on how the Test can be applied.

[20] NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 037, Reference ID: 7-056-20140306) March 2014

[21] NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 038, Reference ID: 7-056-20140306) March 2014

7 Cumulative impact of development and cross-boundary issues

7.1 Cumulative impact of development

When allocating land for development, consideration must be given to the potential cumulative impact of the loss of floodplain or flood cell storage volume. The effect of the loss of volume should be assessed, at both the development and elsewhere within the catchment or cell and, if required, the scale and scope of appropriate mitigation should be identified[3]. Whilst the loss of storage for individual developments may only have a minimal impact on flood risk the cumulative effect of multiple developments may be more severe.

Application of the flood risk management hierarchy should be used before measures such as land raising or new defences are considered[3]. Developers should also consider how development can be used to provide flood risk benefits downstream or within a flood cell.

An assessment has been undertaken of the potential cumulative impact of development in the joint SFRA area. The location of the assessment areas, along with sites that have already received planning permission but have not been built/completed, has been assessed against the Environment Agency's Flood Zones and the Updated Flood Map for Surface Water (uFMfSW) to undertake a broad scale assessment of areas where there may be a potential cumulative impact of development on flood risk.

The following examples outlined in sections 7.1.1 to 7.1.3 are intended to illustrate the potential ways in which the cumulative impact of development could potential affect flood risk.

7.1.1 Hinckley & Bosworth Borough

Figure 7-1: Example cumulative impact of development – Hinckley & Bosworth Borough

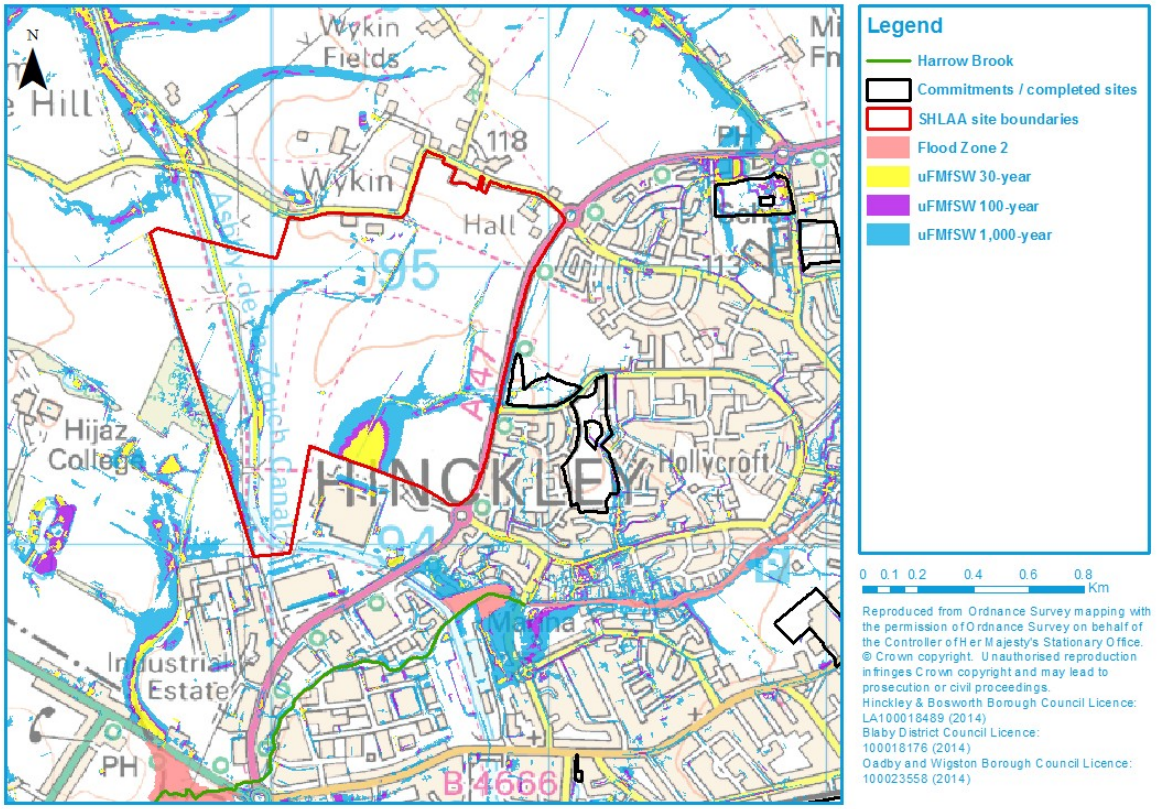


Figure 7-1 shows an example of where there is a potential for the cumulative impact of development to affect flood risk. To the west of Hinckley there are two sites that already have planning permission and there is a proposed larger site to the west of these off the A47. The uFMfSW shows that parts of the area are already at risk from surface water flooding and from fluvial flooding from the Harrow Brook. An increase in impermeable surfaces as a result of these

developments being built could potentially increase the amount of overland flow and increase the chances of fluvial and surface water flooding.

Development should implement appropriate SuDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff, testing any onsite attenuation schemes against the hydrograph of the receiving watercourse to ensure flows are not exacerbated further downstream on the Harrow Brook.

7.1.2 Blaby District

Figure 7-2: Example cumulative impact of development – Blaby District

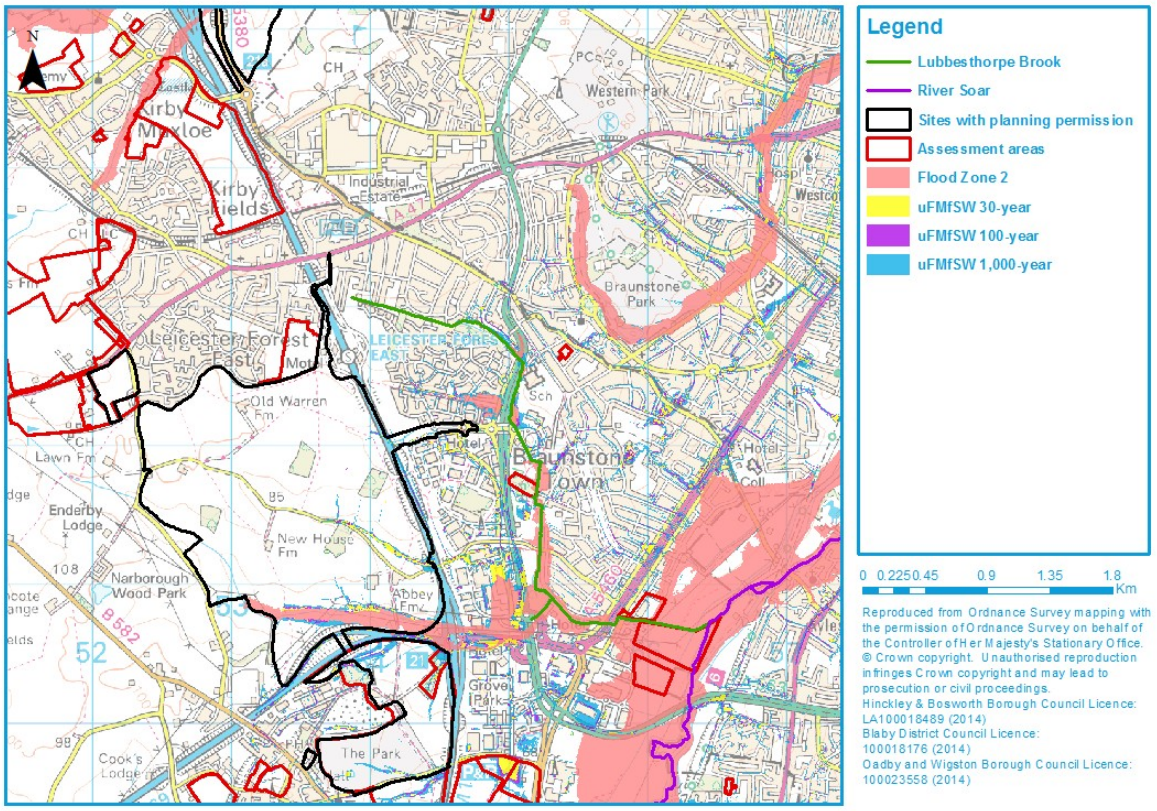


Figure 7-2 shows an example of where there is a potential for the cumulative impact of development to affect flood risk. West of Braunstone Town there are a number of sites that have already received planning permission, as well as a number of assessment areas. The uFMfSW suggests there are areas on the outskirts of Braunstone Town which are at risk from surface water flooding. The increase in impermeable surfaces if the planned and proposed development in this area is built could potentially result in an increase in overland flow. There are also a number of small tributaries of the Lubbesthorpe Brook that flow through these sites. Increase in flow in these watercourses could increase the risk of fluvial flooding, both from the watercourses themselves and from the Lubbesthorpe Brook further downstream.

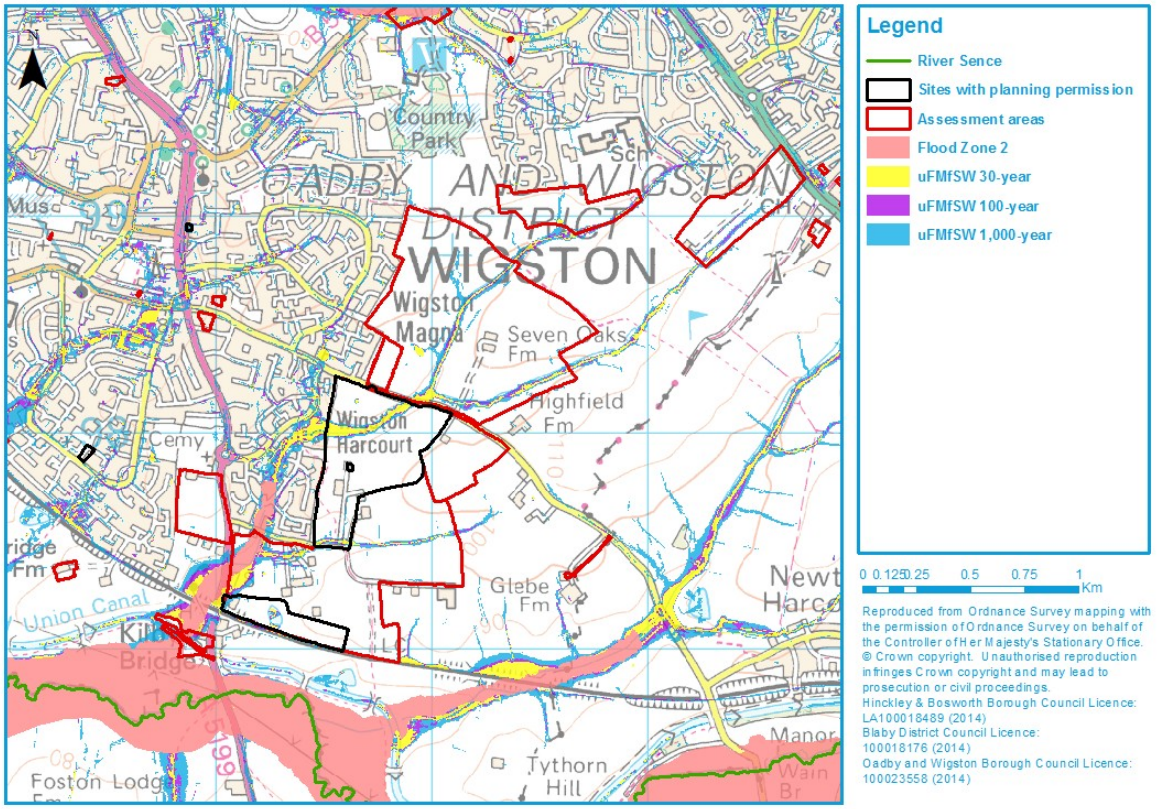
Development should implement appropriate SuDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff, testing any onsite attenuation schemes against the hydrograph of the receiving watercourses (the Lubbesthorpe Brook tributaries) to ensure flows are not exacerbated further downstream on the Lubbesthorpe Brook.

7.1.3 Oadby & Wigston Borough

Figure 7-3 shows an example of where there is a potential for the cumulative impact of development to affect flood risk. To the south of Wigston there are a number of sites that have already received planning permission, as well as a number of assessment areas. The increase in impermeable surfaces if these developments are built could potentially result in an increase in overland flow. There are also a number of ordinary watercourses and drains that flow through this area. An increase in flow in these watercourses could increase the risk of fluvial flooding, both from the watercourses themselves and from the River Sence further downstream.

Development should implement appropriate SuDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff, testing any onsite attenuation schemes against the hydrograph of the receiving watercourses (the ordinary watercourses and drains) to ensure flows are not exacerbated further downstream on the River Sence.

Figure 7-3: Example cumulative impact of development – Oadby & Wigston Borough



7.2 Cross-boundary issues

Future large-scale development, both within and outside the joint SFRA area can have the potential to effect flood risk to existing development and surrounding areas. The joint SFRA area has boundaries with the following local authorities:

- Charnwood Borough Council
- Nuneaton and Bedworth Borough Council
- North Warwickshire Borough
- Rugby Borough
- Harborough District
- Leicester City Council
- North West Leicestershire District

Neighbouring authorities were contacted and, where possible, local plans and SFRAs reviewed to assess whether there are any proposed large-scale developments that may affect flood risk in the joint SFRA area. Evidence, at this stage, suggests there are no large-scale developments proposed in neighbouring authorities that would impact the level of flood risk in the joint SFRA area.

The topography of the joint SFRA means all the major watercourses flow out of the study area into neighbouring authority areas which suggests that it is more likely that a large scale development in the joint SFRA area has the potential to affect flood risk in neighbouring authorities.

There are numerous smaller scale developments proposed for the joint SFRA area, whose cumulative influence, may have the potential to affect flood risk in neighbouring authorities if suitable SuDS and drainage is not implemented. This is particularly the case for developments

near watercourses that flow out of the SFRA area such as the River Soar and Harrow and Sketchley Brooks (see Section 7.1).

There are also a number of larger scale developments proposed for the joint SFRA area, whose cumulative influence may have the potential to affect flood risk in neighbouring authorities if suitable SuDS and drainage is not implemented. The Lubbesthorpe Sustainable Urban Extension (SUE) to the west of the M1 motorway at Lubbesthorpe has planning permission for 4,250 residential properties, as well as 21 ha of employment land and additional infrastructure and facilities. Two major SUEs are planned to the northeast of Hinckley at Earl Shilton and Barwell. At Earl Shilton, the SUE includes 1,500 new homes and 4.5 ha of employment development. At Barwell, the SUE includes 2,500 new homes and 6.2 ha of employment development.

8 Managing Surface Water Runoff

8.1 What is meant by Surface Water Flooding?

In the context of this SFRA, the definition of surface water flooding is set out in the Defra SWMP Guidance. Surface water flooding describes flooding from sewers, drains, small watercourses and ditches that occurs during heavy rainfall in urban areas.

Surface water flooding includes the following:

- Pluvial flooding: flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (surface runoff) before it enters the underground drainage network or watercourse, or cannot enter it because the network is full to capacity.
- Sewer flooding: flooding which occurs when the capacity of underground systems is exceeded, resulting in flooding inside and outside of buildings. Normal discharge of sewers and drains through outfalls may be impeded by high water levels in receiving waters.
- Overland flows from the urban/rural fringe entering the built-up area, including overland flows from groundwater springs.

Flow interactions between surface water and larger main rivers can be important mechanisms that significantly influence the extent and frequency of surface water flooding. It is therefore important to consider the impact that surface water flows from a development might have on any receiving watercourse.

8.2 Assessment of Surface Water Flood Risk

In order to assess surface water flood risk across the Joint SFRA Area the Environment Agency updated Flood Map for Surface Water (uFMfSW) has been utilised. These maps are designed to help the LLFA (Leicestershire County Council), the Environment Agency and developers view surface water flood risk consistently across all of England and Wales and to help focus the management of surface water flood risk.

The updated Flood Map for Surface Water (uFMfSW) predominantly follows topographical flow paths of existing watercourses or dry valleys with some isolated ponding located in low lying areas. They provide a map which is separated into a number of categories which depict different levels of surface water flood risk. This is defined below in Table 8-1.

Table 8-1: uFMfSW categories

Category	Definition
High	Flooding occurring as a results of rainfall with a greater than 1in 30 chance in any given year (annual probability of flooding 3.3%)
Medium	Flooding occurring as a results of rainfall of between 1in 100 (1%) and 1 in 30 (3.3%) chance in any given year.
Low	Flooding occurring as a results of rainfall of between 1in 1000 (0.1%) and 1 in 100 (1%) chance in any given year.
Very Low	Flooding occurring as a result of rainfall with less than 1 in 1000 (0.1%) chance in any given year.

Although the uFMfSW offers improvements on previously available datasets the results should not be used to understand flood risk for individual properties but, rather, used for high level assessments such as SFRAs. If a particular site is shown to be at risk from surface water flooding, a more detailed assessment should be considered which can more accurately represent the flood risk on a site specific scale. This should use the uFMfSW in conjunction with other sources of local flooding information to confirm the presence of a surface water risk.

8.3 Sustainable Drainage Systems (SuDS)

Sustainable Drainage Systems (SuDS) are management practices which enable surface water to be drained in a way which mimics, as closely as possible, the run-off prior to site development. The choice of flow management facilities within a single site is heavily influenced by constraints including (but not limited to):

- Topography
- Geology (soil permeability)
- Available area
- Former site use
- Proposed site use
- Groundwater conditions
- Future adoption and maintenance possibilities

The design, construction and ongoing maintenance regime of such a scheme must be carefully defined, and a clear and comprehensive understanding of the existing catchment hydrological processes and existing drainage arrangements is essential.

For infiltration SuDS techniques it is imperative that the water table is low enough and a site-specific infiltration test is undertaken. Where sites lie within or close to groundwater protection zones or aquifers further restrictions may be applicable, and guidance should be sought from the Environment Agency.

There are many different SuDS techniques which can be implemented. The suitability of the techniques will be dictated in part by the development proposal and site conditions. Advice on best practice is available from the Environment Agency and the Construction Industry Research and Information Association (CIRIA).

The inclusion of SuDS within developments should be seen as an opportunity to enhance ecological and amenity value, and promote Green Infrastructure, incorporating above ground facilities into the development landscape strategy. SuDS must be considered at the outset, during preparation of the initial site conceptual layout to ensure that enough land is given to design spaces that will be an asset to the development rather than an after-thought.

Under the Flood and Water Management Act, the SuDS Approval Body (SAB) will be responsible for approving, adopting and maintaining drainage plans and SuDS schemes that meet the National Standards for sustainable drainage.

All new developments will require planning approval from both the SAB and the local planning authority. The Environment Agency will be a statutory consultee when delivering SuDS for any proposed discharge of surface water into a watercourse. Leicestershire County Council is expected to become the SAB when Schedule 3 of the FWMA 2010 is implemented.

Local planning bodies should:

- Promote the use of SuDS for the management of run off
- Ensure their policies and decisions on applications support and compliment the building regulations on sustainable rainwater drainage, giving priority to infiltration over watercourses, then sewers
- Incorporate favourable policies within development plans
- Adopt policies for incorporating SuDS requirements into Local Plans
- Encourage developers to utilise SuDS wherever practicable, if necessary, through the use of appropriate planning conditions
- Develop joint strategies with sewerage undertakers and the Environment Agency to further encourage the use of SuDS

Table 8-2: Example of SuDS Techniques

SuDS Technique	Flood Reduction	Water Quality Treatment & Enhancement	Landscape and Wildlife Benefit
Living roofs	✓	✓	✓
Basins and ponds	✓	✓	✓
Constructed wetlands	✓	✓	✓
Balancing ponds	✓	✓	✓
Detention basins	✓	✓	✓
Retention ponds	✓	✓	✓
Filter strips and swales	✓	✓	✓
Infiltration devices	✓	✓	✓
Soakaways	✓	✓	✓
Infiltration trenches and basins	✓	✓	✓
Permeable surfaces and filter drains	✓	✓	
	✓	✓	
Gravelled areas	✓	✓	
Solid paving blocks	✓	✓	
Porous pavements	✓	✓	
Tanked systems	✓		
Over-sized pipes/tanks	✓		
Storm cells	✓		

8.4 SuDS Approving Body

8.4.1 Leicestershire County Council's interim position on SuDS for new development

The FWMA establishes a SAB at county or unitary local authority levels. Leicestershire County Council as LLFA is currently not a statutory consultee to the planning process for drainage matters. When Schedule 3 of the FWMA 2010 is implemented, Leicestershire County Council is expected to become the SAB, as well as a statutory consultee to the planning process, in respect of combined applications only[22], for matters that relate to surface water drainage. The existing Defra consultation has stated that the SAB role will apply initially to major developments, delivered through the planning process from the implementation date, with other thresholds for smaller developments being introduced, in time, on a phased basis. Schedule 3 of the FWMA 2010 is currently anticipated to be implemented in October 2014.

In advance of the establishment of the formal SAB role Leicestershire County Council is willing to engage with developers and other partners in respect of the adoption of SuDS subject to:

- Proposals being compliant with best practice and in the vision of the Schedule 3 of the FWMA 2010.
- An appreciation that applications will be considered on an individual basis and that Leicestershire County Council has no formal statutory requirement to adopt SuDs in advance of the implementation date.
- Inclusion of SuDs features in a suitable legal agreement that will include commuted sums.

It is essential that the consideration of sustainable drainage takes place at an early stage of the development process ideally at the master-planning stage. This will assist with the delivery of well-designed SuDS. Leicestershire County Council encourage early pre-application discussions

[22] Combined Applications are combined planning and drainage applications that are made directly to the LPA. Standalone Applications are applications submitted directly to either the LPA or SAB.

between all the relevant stakeholders. Proposals should comply with the key SuDS principles of solutions that deliver multiple benefits:

- Quantity – should be able to cope with the quantity of water generated by the development at the agreed rate with due consideration for climate change via a micro-catchment based approach.
- Quality – should utilise SuDS features in a "treatment train" that will have the effect of treating the water before infiltration or passing it on to a subsequent water body.
- Amenity / Biodiversity – should be incorporated within "open space" or "green corridors" within the site and designed with a view to performing a multifunctional purpose.

In the absence of National Standards and Guidance, developers and their consultants should base designs around current best practice in the form of CIRIA C697 and other leading local authority and water authority guidance available from Cambridge City, Anglian Water, and Oxfordshire County Council.[23]

Enquiries regarding SuDS or the SAB can be addressed to the Leicestershire County Council SuDS team suds@leics.gov.uk.

8.5 SFRA assessment of potential SuDS

As part of this SFRA, an indication of potential SuDS which can be used for each of the assessment areas has been undertaken. This is based on catchment characteristics and additional datasets such as the AStGWf map and Soil maps of England and Wales which allow for a basic assessment of the soil characteristics on a site by site basis. The OS Opendata Terrain_50 dataset was used as a basis for determining the topography and average slope across each development site. This data was then collated to provide an indication of particular groups of SuDS system which might be suitable at a site. This should not be used as a definitive guide to which SuDS would be suitable but used as an indicative guide of suitability. Further site specific investigation should be conducted to determine what SuDS techniques could be utilised on a development.

For further details on the SuDS suitability summary please refer to Section 10.2.

[23] Interim policy supplied by Leicestershire County Council, September 2014

Level Two Strategic Flood Risk Assessment

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9 Flood defences and critical structures

9.1 Flood defences

The Joint SFRA presents the risk of flooding from watercourses across the joint SFRA area. It focuses on those areas at greater risk, where strategic development sites have been proposed by the council. The river modelling that has been developed for the SFRA is of a strategic nature. Detailed studies should seek to refine the understanding of flood risk from all sources where a specific site risk assessment is required.

Consideration of residual risk behind flood defences has been undertaken as part of this study. The residual risk of flooding in an extreme flood event or from failure of defences should also be considered carefully.

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

Developers should consider the standard of protection provided by defences and residual risk as part of a detailed flood risk assessment.

A review of key defences across the Joint SFRA area and their condition has been discussed in Section 9.3.

The following locations have been assessed as part of this SFRA.

- Flood defences on the Whetstone Brook at Whetstone (central and south)
- Flood defences on the Cosby Brook at Cosby
- Flood defences on the River Soar at Croft

The results of these assessments are discussed section 9.3.

9.2 National Flood Risk Assessment (NaFRA) mapping

Flood defences reduce, but do not completely remove, the risk of flooding. They are built to withstand a flood of a certain magnitude but can be overtopped or fail either in extreme weather conditions or due to poor condition.

The National Flood Risk Assessment (NaFRA) gives an indication, at a national level, of the likelihood, and consequences, of areas of land flooding from fluvial sources. The likelihood of flooding has been calculated using predicted water levels and taking the location, type and condition of any flood defences into account.

The NaFRA maps do not include other forms of flooding such as from highway drains, sewers, overland flow or rising groundwater.

The mapping is classified into four different classes for likelihood of flooding. These classes are shown in Table 9-1.

Table 9-1: NaFRA classifications

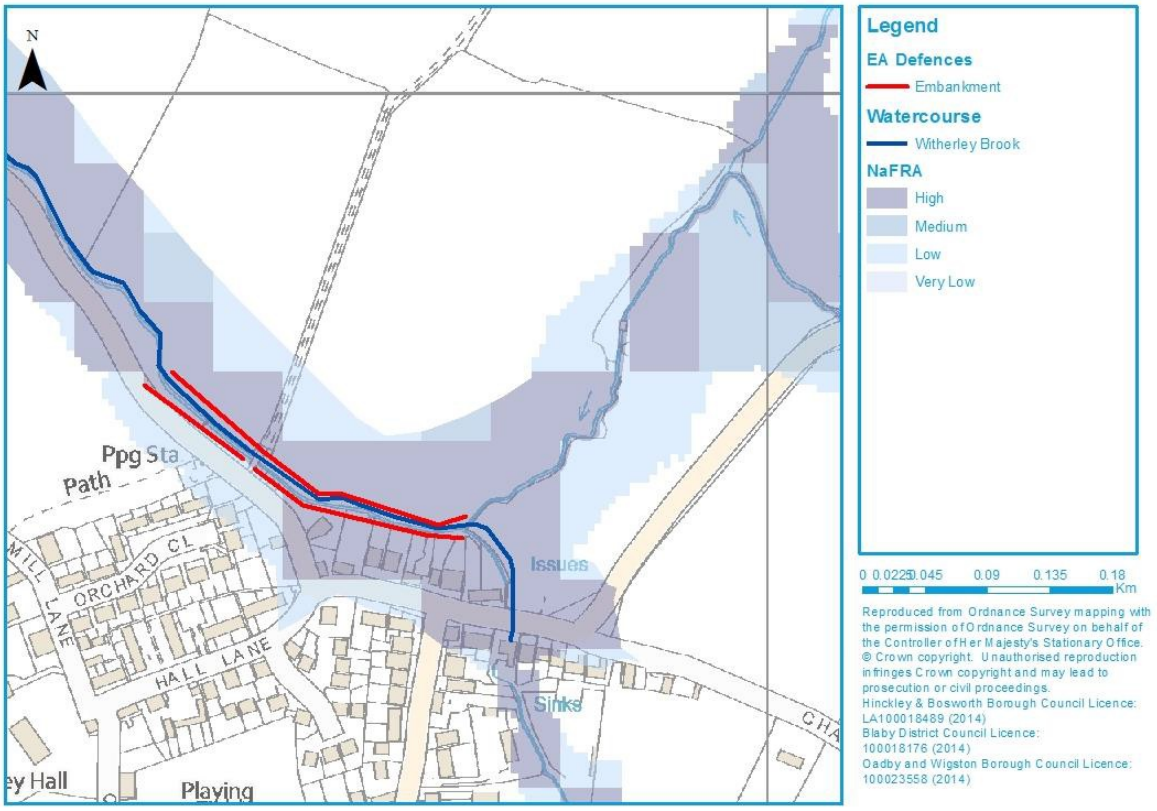
NaFRA Class	Description
Very Low	These areas have a chance of flooding of less than 1 in 1,000 (0.1%).
Low	These areas have a chance of flooding of between 1 in 1,000 (0.1%) and 1 in 100 (1%).
Medium	These areas have a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%).
High	These areas have a chance of flooding of greater than 1 in 30 (3.3%).

The following section shows the NaFRA mapping for the key areas of the joint SFRA area protected by flood defences.

9.3 Flood defences in the joint SFRA area

NaFRA mapping in Witherley (Figure 9-1) shows that flood risk is generally high behind the flood defence, particularly along the houses at Mythe Lane.

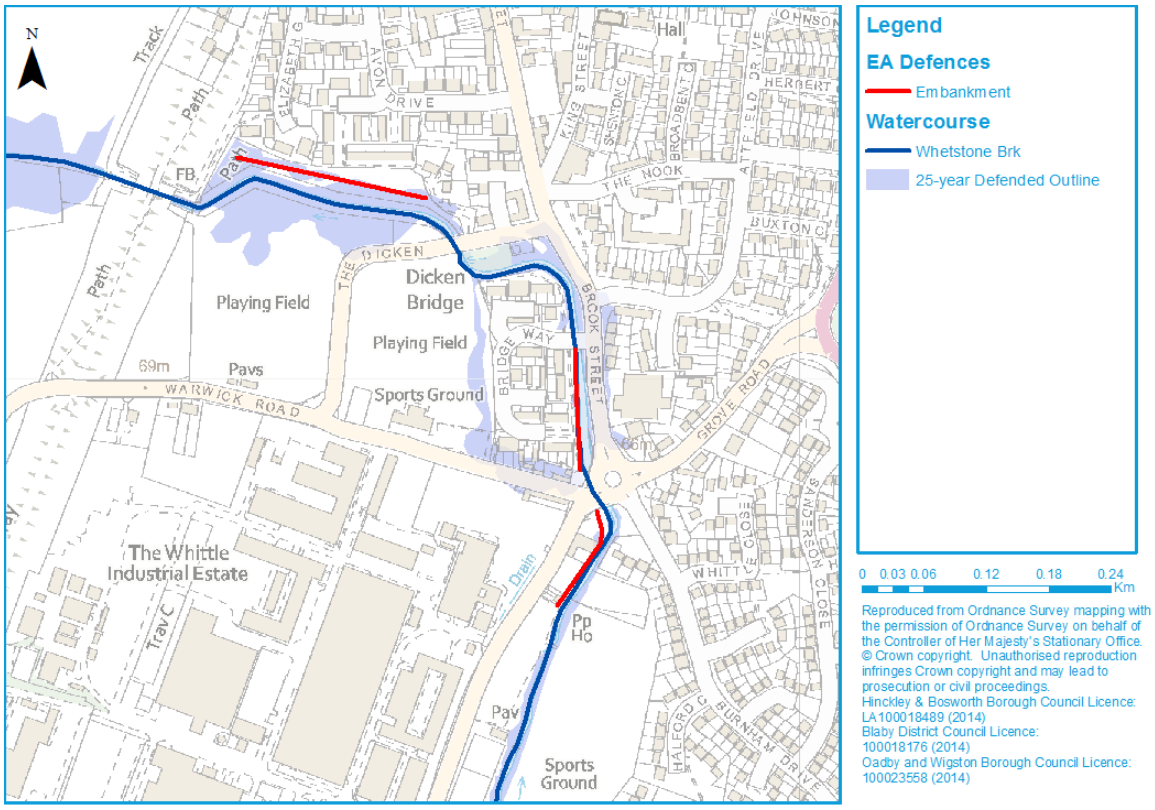
Figure 9-1: NaFRA mapping in Witherley



9.3.1 Flood Defence in central Whetstone

Figure 9-2 shows the flood defences to the west of Brook Street and Cambridge Road and to the south of Avon Drive / Elizabeth Gardens in the central area of Whetstone. The flood defences in this location are embankments which have a SoP of 1 in 25-years. The modelled 25-year defended flood event is shown to be contained behind the flood defences protecting properties on Cambridge Road, Bridge Way and Avon Drive / Elizabeth Gardens. The flooding shown to the west and south of Bridge Way may be a result of water getting out of bank to the south of Dicken Bridge, rather than overtopping of the defences.

Figure 9-2: 25-year Defended Flood Outlines in Central Whetstone



In regards to future flood risk, Figure 9-3 shows the 75-year flood outline which is used in this instance to give an indication of future flood risk, taking into account climate change. The flood defences to the east of Bridge Way and to the south of Avon Drive / Elizabeth Gardens are shown not to overtop during this scenario with no significant increase in flood extent compared to the 25-year (defended) return period. The flood defences to the east of Cambridge Road are shown to overtop during this scenario with a small increase in flood extent compared to the 25-year return period.

NaFRA mapping in central Whetstone (Figure 9-4) shows that flood risk is generally low behind the flood defences. Areas of high risk that occur to the south of Avon Drive / Elizabeth Gardens could possibly be attributable to the resolution of the NaFRA data, and may not represent overtopping of the defences.

Figure 9-3: 75-year Defended Flood Outline in central Whetstone

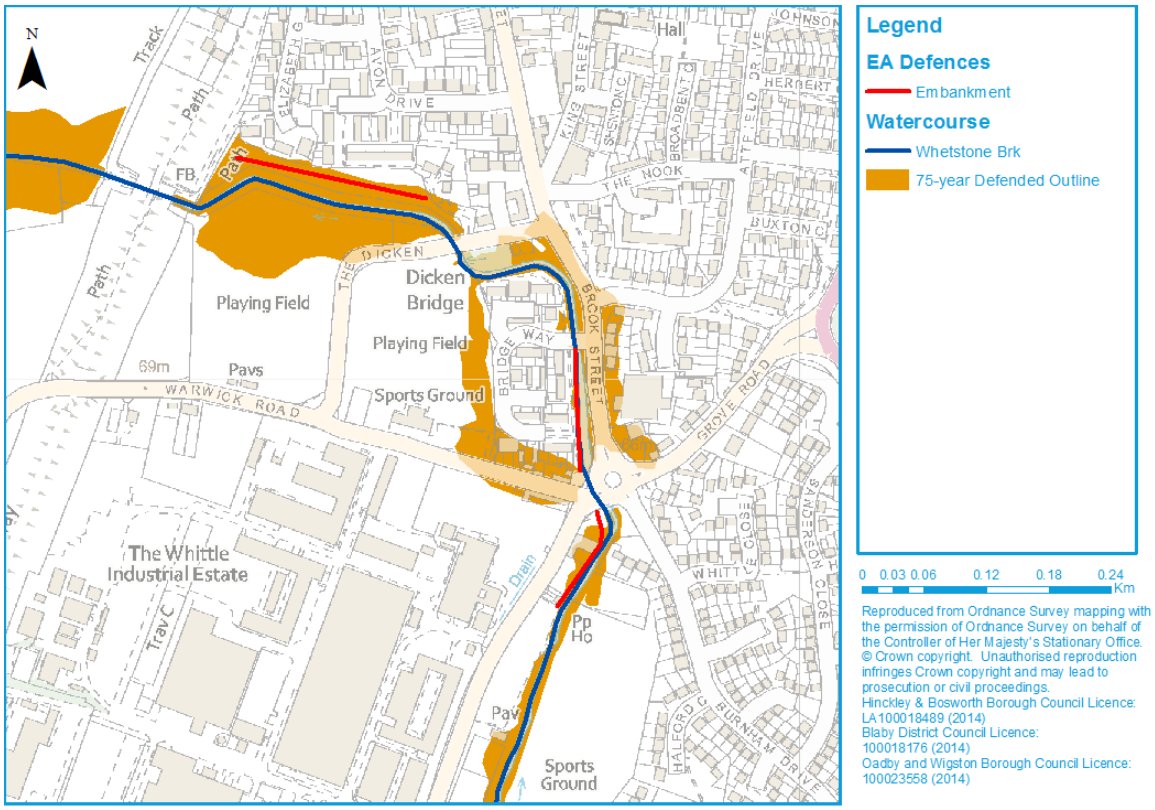
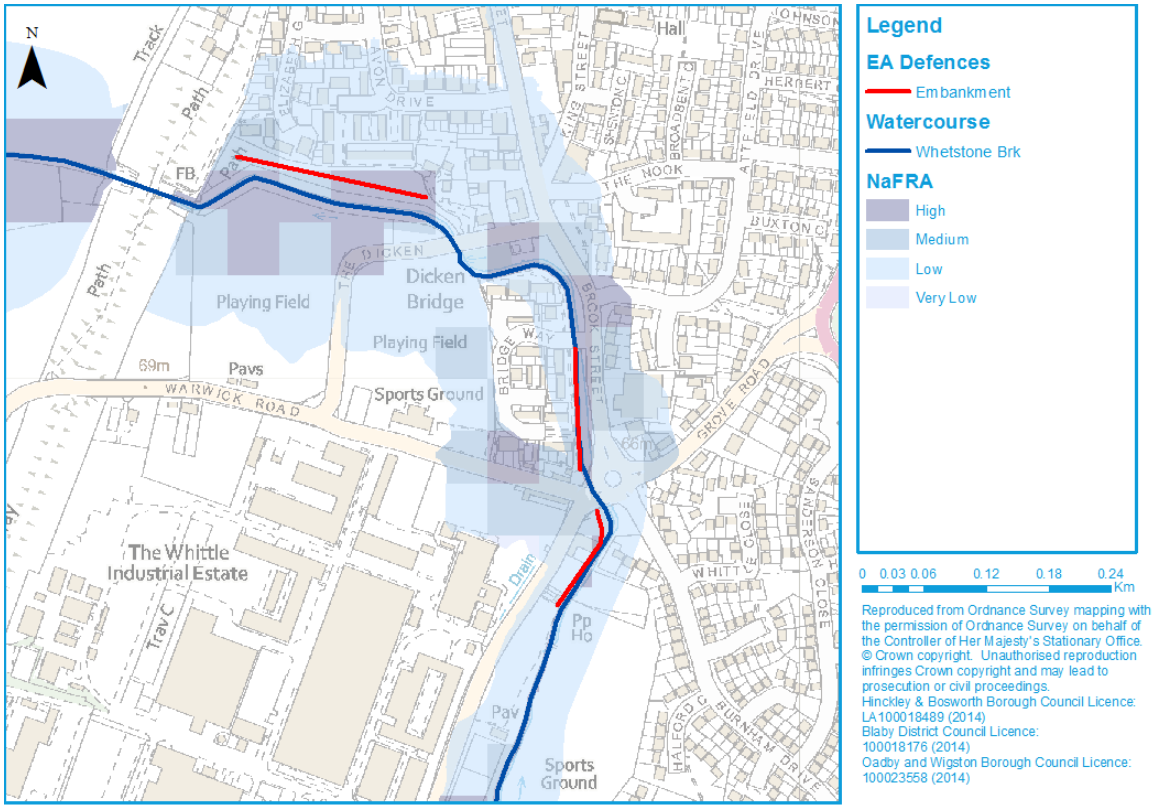


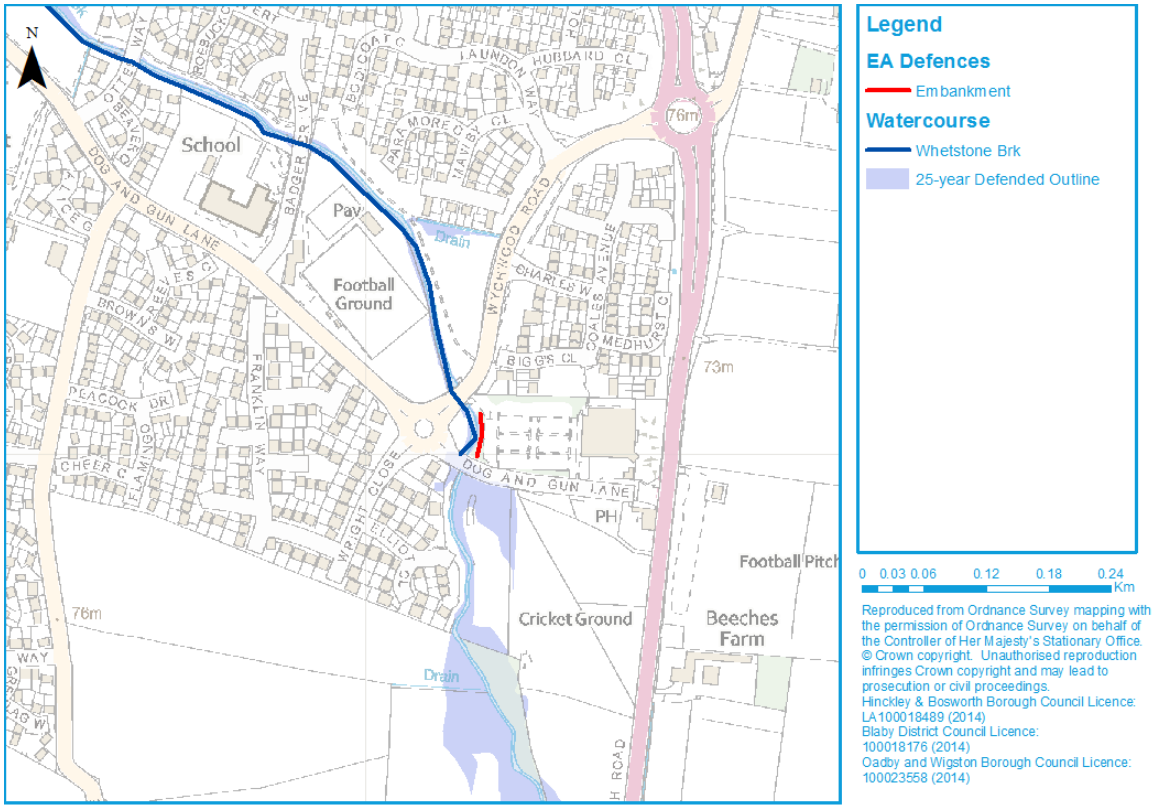
Figure 9-4: NaFRA mapping in central Whetstone



9.3.2 Flood Defence in south Whetstone

Figure 9-5 shows the flood defences between Wychwood Road and Dog and Gun Lane in south Whetstone. The flood defence in this location consists of an embankment which has a SoP of 1 in 25-years. The modelled 25-year flood event is shown to be contained behind the flood defences, preventing water from flooding the car park to the north of Dog and Gun Lane.

Figure 9-5: 25-year Defended Flood Outlines in south Whetstone



In regards to future flood risk, Figure 9-6 shows the 75-year flood outline which is used in this instance to give an indication of future flood risk, taking into account climate change. The flood defence between Wychwood Road and Dog and Gun Lane is shown not to overtop during this scenario with no significant increase in flood extent compared to the 25-year return period.

NaFRA mapping in south Whetstone (Figure 9-7) shows that flood risk is generally low behind the flood defences.

Figure 9-6: 75-year Defended Flood Outline in south Whetstone

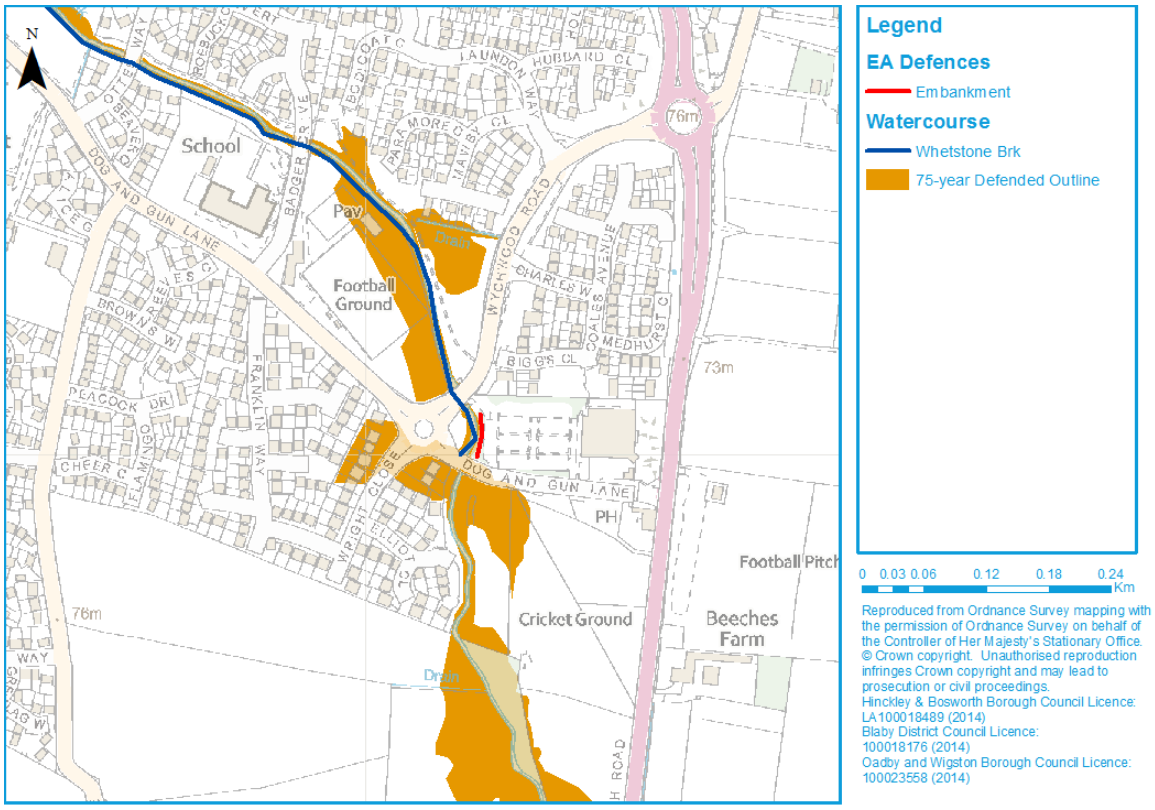
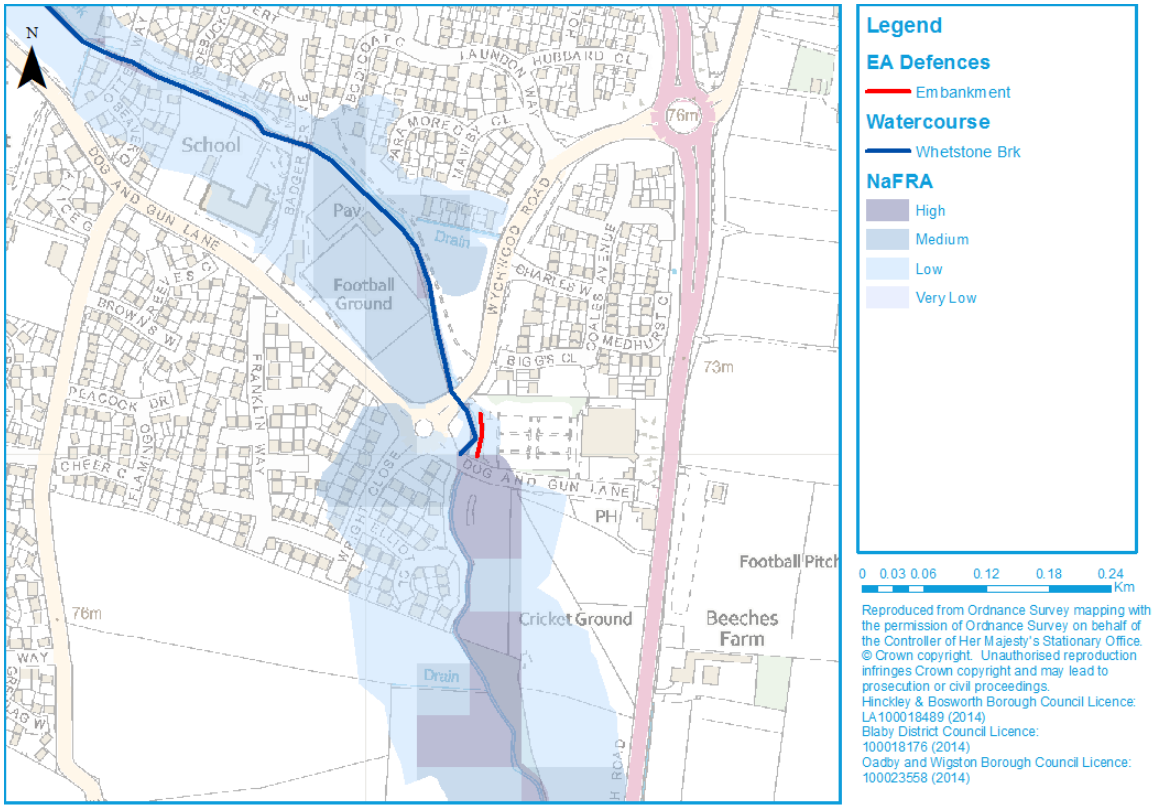


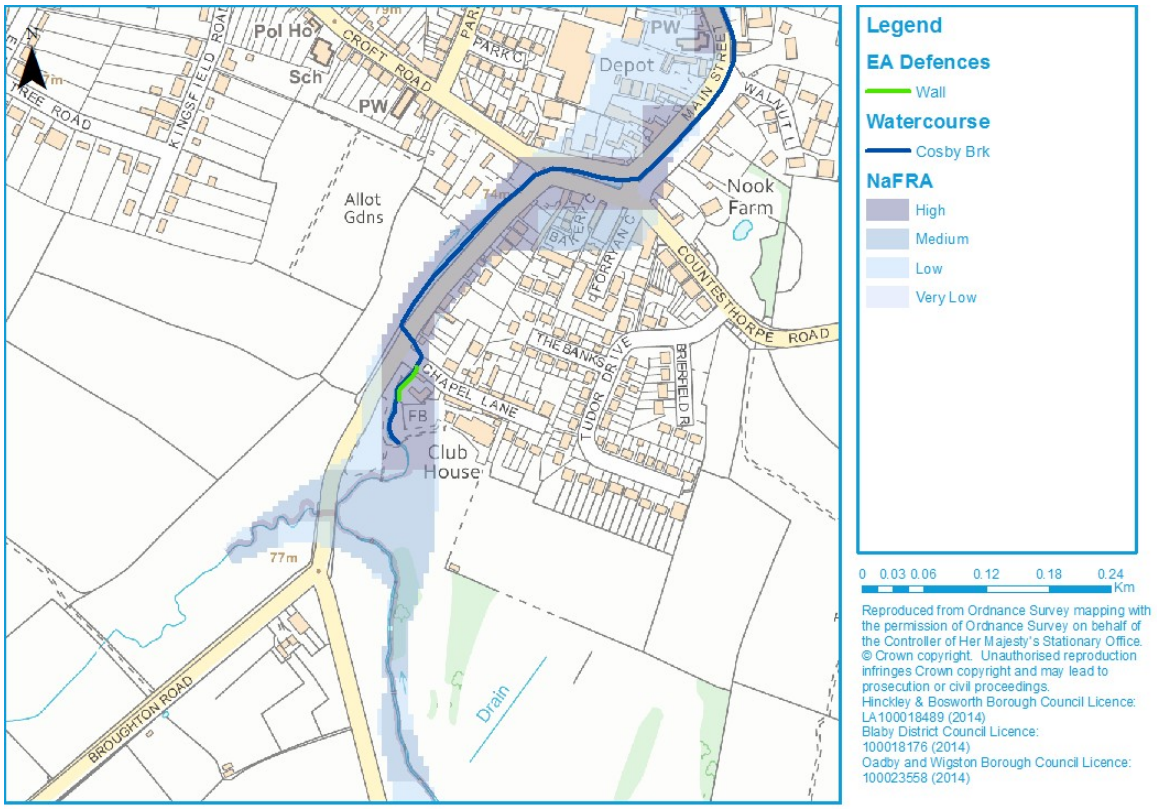
Figure 9-7: NaFRA mapping in south Whetstone



9.3.3 Flood Defence at Cosby

Figure 9-8 shows the flood defences to the south of Chapel Lane, Cosby. The flood defence in this location consists of a wall. The lack of detailed modelling in this area prevents an accurate assessment of the performance of the flood wall. The NaFRA mapping shows that the flood risk is generally high behind the flood defence, which suggests that it is not protecting properties on Chapel Lane from flooding, although this could possibly be attributable to the resolution of the NaFRA data, and may not represent overtopping of the defence.

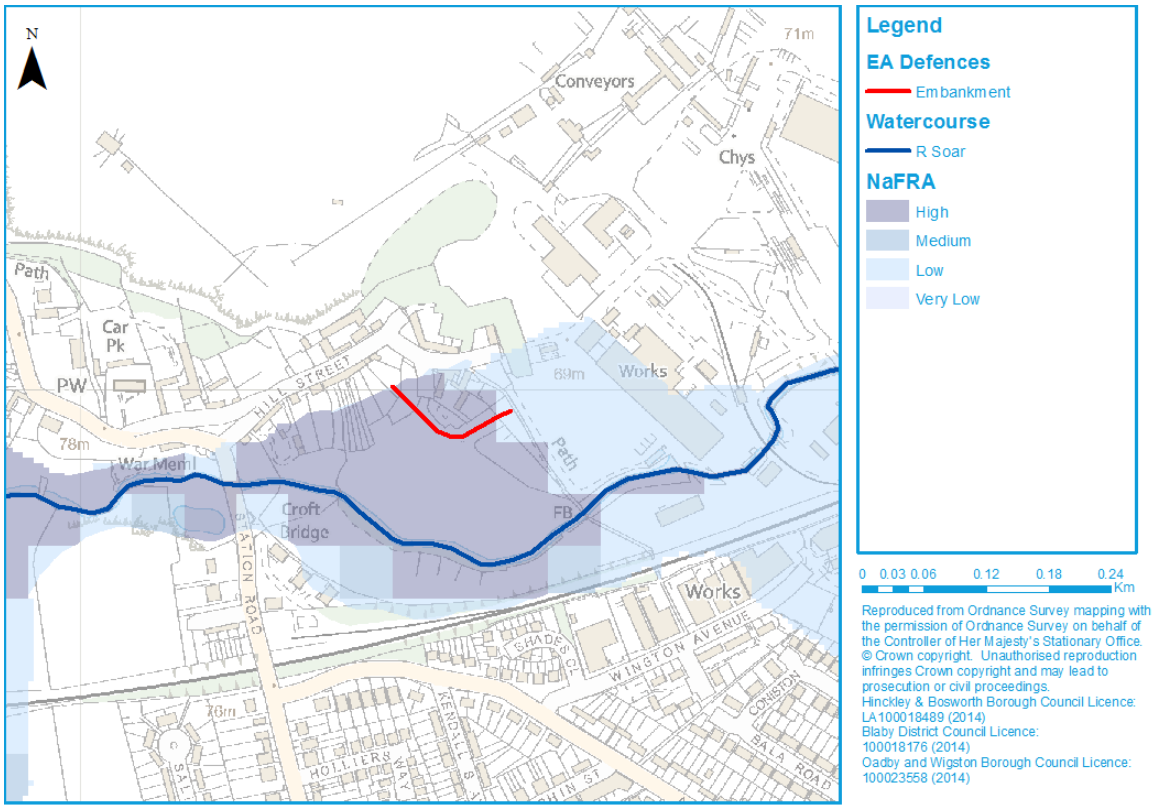
Figure 9-8: NaFRA mapping at Cosby



9.3.4 Flood Defence at Croft

Figure 9-9 shows the flood defences to the south of Hill Street, Croft. The flood defence in this location consists of an embankment which has a SoP of 1 in 50-year. The lack of detailed modelling in this area prevents an accurate assessment of the performance of the embankment. The NaFRA mapping shows that the flood risk is generally high behind the flood defence, which suggests that it is not protecting properties on The Green / Dovecote Road from flooding, although this could possibly be attributable to the resolution of the NaFRA data, and may not represent overtopping of the defence.

Figure 9-9: NaFRA mapping at Croft



9.4 'Critical Structures'

In addition to the Environment Agency's formal flood defence assets, there are other flood risk management (FRM) measures in place in the joint SFRA area. These include:

- Council owned assets
- Environment Agency Flood Warning Areas (FWAs)
- Critical structures such as bridges, weirs, culverts and trash screens which may affect local hydraulics and flood risk.

9.4.1 Designation of features/structures

Under the FWMA 2010 EA, LLFAs, district councils, the EA and internal drainage boards have legal powers to "designate" structures and features that affect flood or coastal erosion risk (whether or not it was originally intended to do so) and are not directly maintained by these organisations.

A designation is a legally binding notice served by the designating authority on the owner of the feature and will automatically apply to anyone dealing with the land and to successive owners or occupiers of a particular property of parcel of land[24]

[24] Information Note: Designation of structures and features for flood and coastal erosion risk management purposes (Defra, July 2012)

Four conditions must be satisfied to enable a structure or feature to be designated. These are outlined in Table 9-2. If any of the four conditions cannot be met than designation is not possible.

Should a feature/structure be designated the owner should be able to continue to use the structure/feature. They may also alter, remove or replace the structure or feature providing they have the prior consent of the designating authority.

Table 9-2: Designation conditions

Condition	
1	The designating authority thinks the existence of the structure or feature affects a flood or coastal erosion (or both) risk.
2	The designating authority has flood or coastal erosion risk management functions in respect of the risk being affected.
3	The structure or feature is not already designated by another designating authority.
4	The owner of the structure or feature is not a designating authority.

The following factors should also be considered[24].

- An assessment of flood or coastal risk associated with the structure/feature in terms of the consequences of its alteration, removal or replacement.
- Consider the general circumstances of the owner of the structure/feature. (A designating authority may reach an agreement with a third party, with respect to flood risk management, without recourse to a designation.)
    - If the designating authority is confident that the owner is aware of the flood or coastal erosion risk management function that their structure/feature serves then designation may not be relevant
    - If the designating authority is confident that the management, use or treatment of the structure/feature does not give rise to adverse risks then designation may not be relevant.
- Assess the vulnerability of the structure/feature to change or damage
- Assess any need for emergency repairs by the owner or intervention by the designating authority.

Further information on the designating of structures and features can be found in the Defra Information Note: Designation of structures and features for flood and coastal erosion risk management purposes (July 2012).

9.4.2 Possible critical structures within the joint SFRA area

As part of the SFRA, we have prepared a broad scale assessment of structures which may possibly affect flood risk.

In additional to railway embankments and culverts under roads within the joint SFRA area, possible critical structures identified in the SFRA include, but are not limited to:

- Embankment of the dismantled railway, north of the Whittle Industrial Estate
- Possible canal bridges over ordinary watercourses near Kilby Bridge

It is recommended that the ownership of these structures is identified to determine whether they are owned by a designating authority. Designation is not possible on any structures owned by a designating authority.

For any of the structures/features not owned by a designating authority it is recommended the factors outlined in Section 9.4.1 above should be considered and a more detailed assessment be prepared, if required. The resolution of the assessment possible for the SFRA is less than that required to identify all appropriate features.

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10 Summary assessment of assessment areas

10.1 Introduction

The assessment areas in the joint SFRA area were screened to identify sites where additional modelling would be required, for example, sites where there is a watercourse with a catchment less than 3km^2 that is not included in the Environment Agency's Flood Zone coverage, or where Flood Zones exist but further modelling was required to identify Flood Zone 3b, climate change as well as depth, velocity and hazard information. Jflow modelling was then undertaken for these sites.

On completion of the modelling, the sites have been screened again to provide a summary of risk to each site (see Table 10-2 to Table 10-4) including

- The proportion of the site in each Flood Zone
- Whether the site is shown at risk in the uFMfSW and, if so, the lowest return period from which the site is at risk
- Whether the site is within 100m of a canal
- Whether the site is within, or partially within, the Environment Agency's Historic Flood Map

Where sites are shown to be in Flood Zones, flood risk to the assessment areas has been assessed and summarised in more detail in a series of summary tables provided in Appendix A. These sites are highlighted in orange in Table 10-2 to Table 10-4.

Site summary tables have been produced for all assessment areas where fluvial flooding is potentially an issue. Each table sets out the following information:

- Site area
- Proportion of the site in each flood zone
- NPPF and Exception Test guidance
- Mapping including Flood Zones, climate change and surface water
- Depth, hazard and velocity mapping
- An broad scale assessment of suitable SuDS techniques and considerations
- The presence of any flood defences
- Whether the site is within 100m of a canal
- Whether the site is covered by a flood warning service
- Whether there are any access and egress issues for the site
- The potential impacts of climate change in the future
- Advice on the preparation of site-specific flood risk assessments and considerations for developers

10.1.1 Sequential Testing

Inclusion of assessment areas in the SFRA does not mean they have passed the Sequential Test. For the assessment areas to be developed it should be demonstrated that there are no suitable alternative sites in order to pass the Sequential Test. This can be undertaken as part of a local plan sustainability appraisal. Alternatively, it can be demonstrated through a free-standing document, or as part of strategic housing land or employment land availability assessments. NPPF Planning Practice Guidance for Flood Risk and Coastal Change describes how the Sequential Test should be applied in the preparation of a Local Plan (Figure 6-1). The assessments undertaken for this SFRA will assist the Councils when they undertake the Sequential Test.

10.2 Note on SuDS suitability

The hydraulic and geological characteristics of each assessment area were assessed to determine the constraining factors for surface water management at the sites. This assessment is designed to inform the early-stage site planning process and is not intended to replace site-specific detailed drainage assessments.

From catchment characteristics and additional datasets (areas susceptible to groundwater flooding map, Soil Map of England and Wales, Environment Agency 'What's in your Backyard' online mapping) a broad criterion for the applicability of SuDS techniques was determined. These criteria were then used to carry out a simple assessment of the likely feasibility of different types of SuDS techniques at each of the assessment areas. SuDS techniques were categorized into five main groups as follows.

Table 10-1: Summary of SuDS Categories

SuDS Type	Technique
Source Controls	Green Roof, Rainwater Harvesting, Pervious Pavements, Rain Gardens
Infiltration	Infiltration Trench, Infiltration Basin, Soakaway
Detention	Pond, Wetland, Subsurface Storage, Shallow Wetland, Extended Detention Wetland, Pocket Wetland, Submerged Gravel Wetland, Wetland Channel, Detention Basin
Filtration	Surface Sand filter, Sub-Surface Sand Filter, Perimeter Sand Filter, Bioretention, Filter Strip, Filter Trench
Conveyance	Dry Swale, Underdrained Swale, Wet Swale

The suitability of each SuDS type for the assessment areas has been displayed using a traffic light colour system in the summary tables. The assessment of suitability is broad scale and indicative only; more detailed assessments should be carried out during the site planning stage to confirm the feasibility of different types of SuDS.

Suitability	Description
	The SuDS Group and its associated techniques are unlikely to be suitable at the development site based on the results of this assessment.
	The SuDS Group and its associated techniques may be suitable at the development but is likely to require additional engineering works. Some techniques from this group may not be suitable for use at the development.
	The SuDS Group and its associated techniques are likely to be suitable at the development site based on the results of this assessment.

Table 10-2: Summary of flood risk to all assessment areas in Hinckley & Bosworth

Stage	Site name	Site area (ha)	Proportion of site in Flood Zone 3b	Proportion of site in Flood Zone 3a	Proportion of site in Flood Zone Two	Proportion of site in Flood Zone One	uFMfSW (lowest return period (yr) of risk)	Site within 100m of a canal? (Y/N)	Site within, or partially within, the EA's Historic Flood Map? (Y/N)
Hinckley & Bosworth Borough Stage 2	Area 1 – North East Burbage	188.84	4.4%	1.3%	1.8%	92.5%	30	N	N
	Area 2 – South of Burbage	139.57	2.1%	0.3%	0.4%	97.2%	30	N	N
	Area 3 – West of Burbage	200.02	3.3%	1.1%	5.1%	90.5%	30	Y	N
	Area 4 – West of the Northern Perimeter Road, Hinckley	526.27	2.4%	1.1%	1.7%	94.8%	30	Y	N
	Area 5 – Land between Hinckley and Barwell	321.36	0.9%	0.4%	0.5%	98.1%	30	N	N
	Area 6 – East of Earl Shilton	87.57	1.0%	0.3%	0.7%	98.0%	30	N	N
	Area 7 – West of Earl Shilton	345.83	3.8%	1.3%	1.4%	93.5%	30	N	N
	Area 8 – West of Barwell	279.24	1.7%	0.5%	1.1%	96.8%	30	N	N
	Bagworth	823.92	1.6%	0.4%	0.5%	97.5%	30	N	N
	Barlestone	842.24	3.2%	0.6%	0.5%	95.7%	30	N	N
	Congerstone	490.31	15.8%	1.3%	1.3%	81.7%	30	Y	N
	Desford	802.52	5.2%	0.6%	0.6%	93.6%	30	N	N
	Groby	1,061.71	8.2%	1.1%	1.6%	89.1%	30	N	N
	Higham On The Hill	544.98	0.9%	0.2%	0.2%	98.7%	30	Y	N
	Market Bosworth	835.82	4.4%	1.0%	1.4%	93.3%	30	YN	N
	Markfield & Field Head	941.93	2.9%	0.3%	0.4%	96.4%	30	N	N
	Nailstone	500.28	3.5%	0.6%	0.6%	95.3%	30	N	N
	Newbold Verdon	840.11	1.6%	0.2%	0.3%	98.0%	30	N	N
	Ratby	853.88	7.4%	0.8%	0.8%	91.0%	30	N	N
	Sheepy Magna	698.24	10.8%	1.0%	1.3%	86.9%	30	N	Y
	Stanton Under Bardon	535.18	1.5%	0.2%	0.3%	98%	30	N	N
	Stoke Golding	711.55	4.1%	1.3%	1.8%	92.7%	30	Y	N
	Thornton	658.93	7.5%	0.6%	0.8%	91.1%	30	N	N
	Twycross	506.61	1.4%	0.3%	0.4%	97.9%	30	N	N
	Witherley	543.91	8.1%	2.8%	3.3%	85.8%	30	N	Y
Hinckley & Bosworth Borough Stage 3	As110 Land south of Sketchley Grange, Burbage	15.37	1.0%	0.2%	0.2%	98.6%	30	N	N
	As120 As121 As122 Land at Bullfurlong Lane, Burbage	4.89	9.8%	0.3%	1.2%	88.6%	30	N	N
	As217 Land at Westfield Farm, Earl Shilton	24.45	0.0%	0.5%	0.7%	98.7%	30	N	N
	As299 Land rear of Wykin Hall Farm House, adj Normandy Way, Hinckley	118.57	2.8%	0.9%	2.1%	94.3%	30	Y	N
	As303 Land bounded by Barwell Lane, Laneside and Leicester Road, Hinckley	10.4	0.2%	0.0%	0.1%	99.7%	30	N	N
	As41 As42 Land to south and east of Brookside, Barlestone	6.02	4.8%	1.8%	2.5%	90.8%	30	N	N
	As455 Land north of Barton Road, Barlestone	3.25	0.0%	0.0%	0.0%	100.0%	100	N	N
	As694 Land west of 2A Main Street, Higham on the Hill	2.08	0.0%	0.0%	0.0%	100.0%	1,000	N	N
	As701 Land at Trout Pond Farm, Twycross Road, Sheepy Magna	0.50	0.0%	0.0%	0.0%	100.0%	1,000	N	N
	As971 Land at Workhouse Lane, Burbage	2.55	0.0%	0.0%	0.0%	100.0%	30	N	N
	BARL02 Land at Garden Farm, Bagworth Road, Barlestone	2.39	0.0%	0.0%	0.0%	100.0%	-	N	N
	GRO02 Land south of Martinshaw Lane, Groby	0.32	0.0%	0.0%	0.0%	100.0%	1,000	N	N
	GRO03 Land to the rear of Daisy Close, Groby	1.56	0.0%	0.0%	0.0%	100.0%	30	N	N
	GRO04 Land at Laurel Farm, Groby	1.80	0.0%	0.0%	0.0%	100.0%	30	N	N
	HIG02 Land to the rear of Oddfellows Arms PH, Main Street, Higham on the Hill	0.77	0.0%	0.0%	0.0%	100.0%	-	N	N
	HIN05 Land west of Nutts Lane and south of the railway line, Hinckley	1.71	0.0%	0.0%	19.2%	80.8%	100	N	N
	MKBOS02 Land south of Station Road and Heath Road, Market Bosworth	6.79	0.0%	0.0%	0.0%	100.0%	100	N	N
	SHE02 Land off Meadow Close and Oakfield Way, Sheepy Magna	0.65	0.0%	0.0%	0.0%	100.0%	30	N	N

Table 10-3: Summary of flood risk to all assessment areas in Blaby District

Site name	Site area (ha)	Proportion of site in Flood Zone 3b	Proportion of site in Flood Zone 3a	Proportion of site in Flood Zone Two	Proportion of site in Flood Zone One	uFMfSW (lowest return period (yr) of risk)	Site within 100m of a canal? (Y/N)	Site within, or partially within, the EA's Historic Flood Map? (Y/N)
BLA001	1.29	0.0%	0.0%	0.0%	100.0%	30	N	N
BLA002	10.85	95.5%	1.5%	1.2%	1.7%	30	Y	Y
BLA004	29.38	0.0%	0.0%	0.0%	100.0%	30	N	N
BLA005	7.35	22.1%	9.5%	8.9%	59.5%	30	N	N
BLA006	3.42	0.0%	0.0%	0.0%	100.0%	30	N	N
BLA007	0.84	0.0%	0.0%	0.0%	100.0%	30	N	N
BLA008	1.08	21.5%	10.5%	24.0%	44.0%	100	N	N
BLA009	0.53	0.0%	0.0%	0.0%	100.0%	30	N	N
BLA014	22.02	1.9%	0.5%	0.4%	97.3%	100	N	N
BLA018	0.87	0.0%	0.0%	0.0%	100.0%	30	N	N
BLA019	15.84	9.9%	4.4%	4.7%	81.0%	30	N	N
BLA020	0.63	0.0%	0.0%	0.0%	100.0%	-	N	N
BLA021	1.02	0.0%	0.0%	0.0%	100.0%	1,000	N	N
BLA024	5.28	0.0%	0.0%	0.0%	100.0%	30	N	N
BLA025	1.48	0.0%	0.0%	0.8%	99.2%	100	N	N
BRA003	0.53	0.0%	0.0%	0.0%	100.0%	100	N	N
BRA008	3.31	0.5%	1.6%	16.8%	81.1%	30	N	Y
BRA009	1.85	4.0%	1.8%	2.7%	91.5%	30	N	N
COS001	3.92	0.0%	0.0%	0.0%	100.0%	30	N	N
COS002	16.39	9.9%	3.8%	3.2%	83.1%	30	N	Y
COS004	1.48	0.0%	0.0%	0.0%	100.0%	1,000	N	N
COS005	0.58	0.0%	0.0%	0.0%	100.0%	30	N	N
COS006	15.31	0.0%	0.0%	0.0%	100.0%	30	N	N
COU002	16.83	0.0%	0.0%	0.0%	100.0%	30	N	N
COU004	1.39	0.0%	0.0%	0.0%	100.0%	-	N	N
COU006	5.05	0.0%	0.0%	0.0%	100.0%	30	N	N
COU008	3.58	5.0%	15.9%	8.0%	71.1%	30	N	N
COU011	20.41	5.5%	0.2%	0.3%	93.9%	30	N	Y
COU012	16.28	0.0%	0.0%	0.0%	100.0%	30	N	N
COU014	0.58	0.0%	0.0%	0.0%	100.0%	30	N	N
COU015	0.89	0.0%	0.0%	0.0%	100.0%	1,000	N	N
COU021	7.10	0.0%	0.0%	0.0%	100.0%	30	N	N
COU022	9.67	0.0%	0.0%	0.0%	100.0%	30	N	N
COU023	3.79	0.0%	0.0%	0.0%	100.0%	30	N	N
COU024	4.16	0.0%	0.0%	0.0%	100.0%	30	N	N
COU025	1.03	0.0%	0.0%	0.0%	100.0%	1,000	N	N
COU026	5.76	45.8%	1.8%	1.0%	51.4%	30	N	Y
COU027	0.20	0.0%	0.0%	0.0%	100.0%	-	N	N
CRO001	6.67	3.4%	1.0%	1.1%	94.5%	30	N	Y
CRO002	0.55	0.0%	0.0%	0.0%	100.0%	1,000	N	N
CRO003	3.00	0.0%	0.0%	0.0%	100.0%	-	N	N
ELM001	26.25	16.1%	5.1%	4.7%	74.1%	30	N	N
ELM003	2.57	0.0%	0.0%	0.0%	100.0%	1,000	N	N
ELM004	1.74	0.0%	0.0%	0.0%	100.0%	30	N	N
ELM004	1.74	0.0%	0.0%	0.0%	100.0%	30	N	N
ELM005	1.45	0.0%	0.0%	0.0%	100.0%	-	N	N
END003	94.58	2.5%	0.4%	0.4%	96.7%	30	N	N
END004	39.57	0.0%	0.0%	0.0%	100.0%	30	N	N
END006	1.47	0.0%	0.0%	0.0%	100.0%	1,000	N	N

Site name	Site area (ha)	Proportion of site in Flood Zone 3b	Proportion of site in Flood Zone 3a	Proportion of site in Flood Zone Two	Proportion of site in Flood Zone One	uFMfSW (lowest return period (yr) of risk)	Site within 100m of a canal? (Y/N)	Site within, or partially within, the EA's Historic Flood Map? (Y/N)
END008	8.40	0.0%	0.0%	0.0%	100.0%	30	N	N
END009	3.56	0.0%	0.0%	0.0%	100.0%	30	N	N
END013	12.63	99.3%	0.7%	0.0%	0.0%	30	Y	Y
END014	5.02	99.9%	0.1%	0.0%	0.0%	30	Y	Y
END015	9.83	0.0%	0.0%	0.0%	100.0%	30	N	N
END016	11.66	0.0%	0.0%	0.0%	100.0%	30	N	N
END017	1.21	1.3%	0.2%	1.7%	96.8%	30	N	N
END018-EMP	21.37	0.0%	0.0%	0.0%	100.0%	30	N	N
GLE008	1.06	0.0%	0.0%	0.0%	100.0%	100	N	N
GLE009	0.41	0.0%	0.0%	0.0%	100.0%	-	N	N
GLE011	0.52	7.7%	1.1%	1.6%	89.7%	30	N	N
GLE013	27.07	2.4%	0.4%	0.9%	96.2%	30	N	N
GLE015	0.42	0.0%	0.0%	0.0%	100.0%	1,000	N	N
GLE018	3.52	2.5%	2.7%	4.7%	90.2%	30	N	N
GLE019	0.62	0.0%	0.0%	0.0%	100.0%	1,000	N	N
GLE020	0.47	0.0%	0.0%	0.0%	100.0%	100	N	N
GPA001	5.77	0.0%	0.0%	0.0%	100.0%	100	Y	N
GPA002	0.49	0.0%	0.1%	2.4%	97.4%	30	Y	N
GPA003	5.08	8.9%	0.7%	1.4%	89.0%	30	Y	Y
GPA004	1.47	7.5%	3.1%	3.2%	86.3%	30	Y	Y
GPA007	0.32	0.0%	0.0%	0.0%	100.0%	-	N	N
GPA009	0.48	0.0%	0.0%	0.0%	100.0%	-	N	N
GPA011	23.82	0.0%	0.0%	0.0%	100.0%	30	Y	Y
GPA012	4.52	21.1%	1.8%	4.0%	73.0%	100	Y	Y
GPA013	0.74	50.8%	5.1%	8.1%	36.0%	30	Y	Y
GPA014	0.88	92.4%	2.0%	2.4%	3.3%	30	Y	Y
GPA015	15.39	0.0%	0.0%	0.0%	100.0%	30	Y	Y
GPA016	10.51	0.0%	0.0%	0.0%	100.0%	30	Y	N
GPA017	1.51	5.5%	3.1%	5.9%	85.5%	30	Y	Y
HUN001	3.45	0.0%	0.0%	0.0%	100.0%	-	N	N
HUN002	9.60	0.0%	0.0%	0.0%	100.0%	30	N	N
HUN004	0.99	0.0%	0.0%	0.0%	100.0%	100	N	Y
KIL001	0.61	0.0%	0.0%	0.0%	100.0%	1,000	N	N
KIL002	1.25	0.0%	0.0%	0.0%	100.0%	1,000	N	N
KIL003	1.09	13.4%	6.2%	7.3%	73.1%	30	N	N
KIL005	0.57	0.0%	0.0%	0.0%	100.0%	1,000	N	N
KIL006	0.80	12.3%	3.1%	2.7%	82.0%	30	N	N
KMU001	1.55	0.0%	0.0%	0.0%	100.0%	-	N	N
KMU002	5.25	3.0%	1.2%	2.0%	93.8%	30	N	N
KMU003	4.71	0.0%	0.0%	0.0%	100.0%	30	N	N
KMU004	0.40	0.0%	0.0%	0.0%	100.0%	100	N	N
KMU005	0.37	0.0%	0.0%	0.0%	100.0%	100	N	N
KMU007	53.44	0.9%	0.1%	0.2%	98.8%	30	N	N
KMU009	8.64	0.0%	0.0%	0.0%	100.0%	1,000	N	N
KMU012	1.27	0.0%	0.0%	0.0%	100.0%	-	N	N
KMU013	8.14	4.1%	1.1%	0.9%	93.8%	30	N	N
LFE002	126.20	1.1%	0.2%	0.2%	98.5%	30	N	N
LFE008	1.45	0.0%	0.0%	0.0%	100.0%	-	N	N
LFE012	4.91	0.0%	0.0%	0.0%	100.0%	30	N	N
LFE013	17.12	0.0%	0.0%	0.0%	100.0%	30	N	N
LFE014	1.77	0.0%	0.0%	0.0%	100.0%	1,000	N	N
LFE015	8.91	0.0%	0.0%	0.0%	100.0%	30	N	N
LFE016	39.89	0.0%	0.0%	0.0%	100.0%	30	N	N

Site name	Site area (ha)	Proportion of site in Flood Zone 3b	Proportion of site in Flood Zone 3a	Proportion of site in Flood Zone Two	Proportion of site in Flood Zone One	uFMfSW (lowest return period (yr) of risk)	Site within 100m of a canal? (Y/N)	Site within, or partially within, the EA's Historic Flood Map? (Y/N)
LIT003	0.92	0.0%	0.0%	0.0%	100.0%	30	N	N
LIT008	0.95	33.4%	0.9%	1.5%	64.2%	30	N	Y
LIT009	1.02	52.2%	1.6%	1.2%	45.0%	30	N	Y
LIT012	17.28	43.5%	1.7%	1.2%	53.6%	30	N	Y
LIT013	1.47	15.2%	5.9%	6.3%	72.5%	30	N	Y
LIT014	0.83	0.0%	0.0%	0.0%	100.0%	100	N	N
LIT016	1.04	71.5%	2.6%	2.4%	23.6%	100	N	Y
LIT018	1.16	0.0%	0.0%	0.0%	100.0%	100	N	N
LIT019	0.98	0.0%	0.0%	0.0%	100.0%	100	N	N
LIT020	15.10	0.0%	0.0%	0.0%	100.0%	30	N	N
LIT021	0.93	56.2%	1.7%	1.4%	40.8%	30	N	Y
NAR002	2.40	0.0%	0.0%	0.0%	100.0%	1,000	N	N
NAR003	1.72	0.0%	5.4%	2.7%	91.9%	30	N	Y
NAR004	0.75	0.1%	0.0%	0.0%	99.9%	100	N	Y
NAR008	3.20	36.7%	0.6%	4.5%	58.3%	30	N	Y
SAP001	4.82	19.7%	7.5%	1.8%	71.0%	30	N	N
SAP004	6.14	0.0%	0.0%	0.0%	100.0%	30	N	N
SAP007	0.80	0.0%	0.0%	0.0%	100.0%	-	N	N
SAP009	7.81	0.0%	0.0%	0.0%	100.0%	30	N	N
SAP010	1.75	0.0%	0.0%	0.0%	100.0%	30	N	N
SAP011	4.80	0.0%	0.0%	0.0%	100.0%	30	N	N
SAP013	8.23	14.2%	5.0%	1.6%	79.3%	30	N	N
SAP014	3.21	6.4%	1.1%	1.2%	91.4%	30	N	N
SAP015	52.53	0.0%	0.0%	0.0%	100.0%	30	N	N
SAP016	0.49	0.0%	0.0%	0.0%	100.0%	30	N	N
SHA002	4.03	0.0%	0.0%	0.0%	100.0%	1,000	N	N
SHA003	4.28	0.0%	0.0%	0.6%	99.4%	30	N	Y
STO002	9.64	0.0%	0.0%	0.0%	100.0%	1,000	N	N
STO006	0.49	0.0%	0.0%	0.0%	100.0%	30	N	N
STO008	2.87	0.0%	0.0%	0.0%	100.0%	30	N	N
STO009	1.54	0.0%	0.0%	0.0%	100.0%	1,000	N	N
STO011	4.16	0.0%	0.0%	0.0%	100.0%	100	N	N
STO012	2.26	0.0%	0.0%	0.0%	100.0%	1,000	N	N
STO013	1.05	0.0%	0.0%	0.0%	100.0%	100	N	N
THU001	2.88	0.0%	0.0%	0.0%	100.0%	30	N	N
THU002	2.28	0.0%	0.0%	0.0%	100.0%	100	N	N
WHE003	23.04	24.2%	5.7%	4.3%	65.9%	30	N	Y
WHE004	0.90	0.0%	0.0%	0.0%	100.0%	100	N	N
WHE005	1.74	0.0%	0.0%	0.0%	100.0%	1,000	N	N
WHE006	1.01	0.0%	0.0%	0.0%	100.0%	100	N	N
WHE009	0.41	0.0%	0.0%	0.0%	100.0%	1,000	N	N
WHE014	2.40	26.0%	30.4%	37.3%	6.3%	30	N	N
WHE015	1.76	0.0%	0.0%	0.0%	100.0%	1,000	N	N
WHE016	1.03	0.0%	0.0%	0.0%	100.0%	100	N	N
WHE017	3.63	0.0%	0.0%	0.0%	100.0%	30	N	N
WHE018	1.93	87.0%	1.3%	10.9%	0.8%	30	N	Y

Table 10-4: Summary of flood risk to all assessment areas in Oadby & Wigston Borough

Site name	Site area (ha)	Proportion of site in Flood Zone 3b	Proportion of site in Flood Zone 3a	Proportion of site in Flood Zone Two	Proportion of site in Flood Zone One	uFMfSW (lowest return period (yr) of risk)	Site within 100m of a canal? (Y/N)	Site within, or partially within, the EA's Historic Flood Map? (Y/N)
20 Queens Drive, Wigston	0.02	0.0%	0.0%	0.0%	100.0%	1,000	N	N
216 Leicester Road, Wigston	0.24	0.0%	0.0%	0.0%	100.0%	1,000	N	N
41 to 41a Manor Street, Wigston	0.01	0.0%	0.0%	0.0%	100.0%	1,000	N	N
7 Wye Dean Drive, Wigston	0.17	0.0%	0.0%	0.0%	100.0%	-	N	N
Former Europa Sports, Wigston	0.41	0.0%	0.0%	0.0%	100.0%	1,000	N	N
Land adjacent 69 Central Avenue, Wigston	0.02	0.0%	0.0%	0.0%	100.0%	-	N	N
Land at Britford Avenue, Wigston	0.61	0.0%	0.0%	0.0%	100.0%	30	N	N
Land at Glebe Farm, Wigston	0.21	0.0%	0.0%	0.0%	100.0%	100	N	N
Land at Kilby Bridge (N), Wigston	1.11	5.4%	3.5%	21.2%	70.0%	30	N	Y
Land at Kilby Bridge (S), Wigston	0.71	10.1%	1.7%	6.9%	81.3%	30	Y	Y
Land at Kilby Bridge Farm, Wigston	0.67	0.0%	0.0%	0.0%	100.0%	1,000	N	N
Land between Newton Lane and Welford Road, Wigston	86.70	1.6%	2.2%	0.5%	95.7%	30	N	Y
Land opposite Highfield Farm, Wigston	9.17	0.0%	0.0%	0.0%	100.0%	-	N	N
Land rear 24 Clarkes Road, Wigston	0.10	0.0%	0.0%	0.0%	100.0%	-	N	N
Land rear 47 Granville Road, Wigston	0.02	0.0%	0.0%	0.0%	100.0%	-	N	N
Land rear 82 Moat Street, Wigston	0.03	0.0%	0.0%	0.0%	100.0%	-	N	N
Land to the north of Newton Lane, Wigston	64.16	1.7%	0.6%	1.1%	96.7%	30	N	Y
North of Newton Lane (with N Ln and W Rd), Wigston	2.19	0.0%	0.0%	0.0%	100.0%	1,000	N	N
South Leicestershire Rugby Club, Wigston	6.76	0.0%	0.0%	0.0%	100.0%	1,000	N	N
West Avenue and Aylestone Lane, Wigston	0.47	0.0%	0.0%	0.0%	100.0%	-	N	N
113 Saffron Road, South Wigston	0.03	0.0%	0.0%	0.0%	100.0%	100	N	N
14 Saffron Road, South Wigston	0.02	0.0%	0.0%	0.0%	100.0%	-	N	N
41 to 43 Canal Street, South Wigston	0.03	0.0%	0.0%	0.0%	100.0%	-	N	N
9 Waverly Road, South Wigston	0.03	0.0%	0.0%	0.0%	100.0%	-	N	N
Former Elequip Factory, South Wigston	0.91	0.0%	0.0%	0.0%	100.0%	100	N	N
Former Shoefayre, Kirkdale Road, South Wigston	1.10	0.0%	0.0%	0.0%	100.0%	100	N	N
Former Wigston Landfill Site, South Wigston	9.17	0.0%	0.0%	0.0%	100.0%	30	N	N
Hindoostan Avenue, South Wigston	0.16	0.0%	0.0%	0.0%	100.0%	-	N	N
Land adjacent 33 Canal Street, South Wigston	0.02	0.0%	0.0%	0.0%	100.0%	-	N	N
Land at Bennett Way, South Wigston	0.13	0.0%	0.0%	0.0%	100.0%	100	N	N
Land at Premier Drum, South Wigston	2.25	3.4%	0.9%	6.4%	89.4%	1,000	N	Y
1 Sibton Lane, Oadby	0.02	0.0%	0.0%	0.0%	100.0%	-	N	N
33 Beaumont Street, Oadby	0.02	0.0%	0.0%	0.0%	100.0%	-	N	N
47 Beaumont Street, Oadby	0.00	0.0%	0.0%	0.0%	100.0%	-	N	N
55-57 London Road, Oadby	0.06	0.0%	0.0%	0.0%	100.0%	-	N	N
6 Woodside Road, Oadby	0.09	0.0%	0.0%	0.0%	100.0%	1,000	N	N
64 Manor Road, Oadby	0.08	0.0%	0.0%	0.0%	100.0%	-	N	N
8 Stoughton Drive South, Oadby	0.08	0.0%	0.0%	0.0%	100.0%	-	N	N
98 Stoughton Road, Oadby	0.22	0.0%	0.0%	0.0%	100.0%	1,000	N	N
Former Fuel Station, Harborough Road, Oadby	0.14	0.0%	0.0%	0.0%	100.0%	1,000	N	N
Land adjacent 23 Church Street, Oadby	0.23	0.0%	0.0%	0.0%	100.0%		N	N
Land adjacent 39 Harborough Road, Oadby	0.20	0.0%	0.0%	0.0%	100.0%	1,000	N	N
Land adjacent 49 Hidcote Road, Oadby	0.02	0.0%	0.0%	0.0%	100.0%	-	N	N
Land adjacent 5 Gorse Lane, Oadby	0.06	0.0%	0.0%	0.0%	100.0%	-	N	N
Land at 50 Stoughton Road, Oadby	0.18	0.0%	0.0%	0.0%	100.0%	1,000	N	N
Land at Cottage Farm, Oadby	12.57	0.0%	0.0%	0.0%	100.0%	30	N	N
Land at Gartree Road-Gaulby Lane, Oadby	2.42	0.0%	0.0%	0.0%	100.0%	1,000	N	N
Land at Oadby Grange, Oadby	14.75	6.3%	0.7%	0.5%	92.5%	30	N	Y
Land at Oadby Lodge Farm, Oadby	62.15	1.9%	0.2%	0.4%	97.5%	30	N	Y
Land at Springhill Farm, Oadby	1.94	0.0%	0.0%	0.0%	100.0%	30	N	N
Land at Stoughton Road, Oadby	48.43	0.0%	0.0%	0.0%	100.0%	30	N	N

Site name	Site area (ha)	Proportion of site in Flood Zone 3b	Proportion of site in Flood Zone 3a	Proportion of site in Flood Zone Two	Proportion of site in Flood Zone One	uFMfSW (lowest return period (yr) of risk)	Site within 100m of a canal? (Y/N)	Site within, or partially within, the EA's Historic Flood Map? (Y/N)
Land at Stretton Hall, Oadby	4.86	0.1%	0.0%	0.0%	99.9%	30	N	Y
Land rear Cottage Farm, Oadby	0.65	0.0%	0.0%	0.0%	100.0%	-	N	N
Land South of Sutton Close, Oadby	9.17	3.5%	0.3%	0.2%	96.0%	30	N	Y
Oadby Town FC, Oadby	2.79	66.6%	6.3%	9.5%	17.6%	30	N	Y
Stoughton House, Harborough Road, Oadby	0.14	0.0%	0.0%	0.0%	100.0%	-	N	N
The Blues, Severn Rd, Oadby	0.20	0.0%	0.0%	0.0%	100.0%	-	N	N

11 FRA requirements

11.1 Over-arching principles

The joint SFRA focuses on delivering a strategic assessment of flood risk within the area. Prior to development, site-specific assessments will need to be undertaken to ensure all forms of flood risk at a site are fully addressed. In addition, following the Sequential Test, some sites may be put forward for the Exception Test. These will require further work in a detailed FRA. Any site that does not pass the Exception Test should not be allocated for development. It is normally the responsibility of the developer to provide a FRA with an application. However, a LPA can decide to commission a detailed, site-specific FRA to help them decide upon allocations in the high risk zone. The SFRA cannot provide this level of site-specific information.

It should be acknowledged that a detailed FRA may show that a site is not appropriate for development of a particular vulnerability, or at all. Where the FRA shows that a site is not appropriate for a particular usage, a lower vulnerability classification may be appropriate.

11.2 Requirements for flood risk assessments

The aim of a FRA is to demonstrate that the development is protected to the 1% annual probability event and is safe during the design flood event, including an allowance for climate change. This includes assessment of mitigation measures required to safely manage flood risk. Development proposals requiring FRAs should:

- Apply the Sequential and, when necessary, Exception, Tests
- Not increase flood risk, either upstream or downstream, of the site, taking into account the impacts of climate change
- Not increase surface water volumes or peak flow rates, which would result in increased flood risk to the receiving catchments
- Use opportunities provided by new development to, where practicable, reduce flood risk within the site and elsewhere
- Ensure that where development is necessary in areas of flood risk (after application of Sequential and Exception Tests), it is made safe from flooding for the lifetime of the development, taking into account the impact of climate change
- All sources of flood risk, including fluvial, surface water and drainage need to be considered.

FRAs for assessment areas in the joint SFRA area should follow the approach recommended by the NPPF and associated guidance, and guidance provided by the Environment Agency.

11.3 Mitigation measures

In accordance with the Flood Risk Management Hierarchy described in Figure 1-1, mitigation measures should be seen as a last resort to address flood risk issues. Consideration should first be given to minimising risk by planning sequentially across a site. Once risk has been minimised, only then should mitigation measures be considered.

Often the determining factor in deciding whether a particular development is appropriate is the practical feasibility, financial viability and long term maintenance implications of flood risk mitigation rather than technical limitations. Detailed technical assessments are required in the FRA to assess the practical feasibility, together with a commercial review by the developer of the cost of the mitigation works and how contributions will be made for their long term maintenance. At the SFRA stage, broad assumptions must be made regarding the feasibility of flood risk mitigation to highlight sites with greater development potential. The formulation of measures that not only provides an appropriate standard of protection to new development, but also reduces the risk to existing communities will be an important consideration.

Attention must also be paid to the provision of safe access and egress during flood events including climate change and how this is linked to flood warning and emergency evacuation where necessary. The Emergency Services and local authority should be consulted on the evacuation and rescue capabilities and any advice or requirements included.

There should be no interruption to flood flows or loss of flood storage as a result of any proposed development. Flood storage compensation may be appropriate for sites on the edge of the existing floodplain or within a flood cell.

Whilst it might be possible to identify appropriate flood mitigation measures for some sites, it is worth noting that in some instances the findings of individual FRAs may determine that the risk of flooding to a proposed development is too great and mitigation measures are not feasible or appropriate. In these instances, the development is likely to be subject to an objection by the Environment Agency.

The minimum acceptable standard of protection against flooding for new residential property within flood risk areas is 1% annual probability for fluvial flooding, 0.5% annual probability of tidal flooding and a breach during a 0.5% annual probability tidal event. An allowance for climate change over the lifetime of the development must be made when assessing all these scenarios. The measures chosen will depend on the nature of the flood risk.

11.4 Reducing flood risk

11.4.1 Sustainable Drainage Systems

Sustainable Drainage Systems (SuDS) aim to mimic the natural processes of Greenfield surface water drainage, allowing water to flow along natural flow routes and reducing the runoff rates and volumes during storm events, while providing some water treatment benefits. SuDS also have the advantage of providing effective Blue and Green infrastructure, ecology and public amenity benefits when designed and maintained properly.

The inclusion of SuDS within developments should be seen as an opportunity to enhance ecological and amenity value, and promote Green Infrastructure, incorporating above ground facilities into the development landscape strategy. SuDS must be considered at the outset, during preparation of the initial site conceptual layout to ensure that enough land is given to design spaces that will be an asset to the development rather than an after-thought. Advice on best practice is available from the Environment Agency and the Construction Industry Research and Information Association (CIRIA).

11.4.2 Reducing flood risk through site layout and design

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

The NPPF states that a sequential, risk-based approach should be applied to try to locate more vulnerable land use to higher ground, while more flood-compatible development (e.g. vehicular parking, recreational space) can be located in higher risk areas. However vehicular parking in floodplains should be based on nature of parking, flood depths and hazard including evacuation procedures and flood warning.

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

11.4.3 Modification of ground levels

Modifying ground levels to raise the land above the required flood level is an effective way of reducing flood risk to a particular site in circumstances where the risk is entirely from tidal flooding and the land does not act as conveyance for flood waters. However, care must be taken at locations where raising ground levels could adversely affect existing communities and property.

In most areas of fluvial flood risk, conveyance or flood storage in flood cells would be reduced by raising land above the floodplain, adversely impacting on flood risk downstream or on neighbouring land. Compensatory flood storage should be provided, and would normally be on a level for level, volume for volume basis on land that does not currently flood but is adjacent to the floodplain (in order for it to fill and drain). It should be in the vicinity of the site and within the red line of the planning application boundary (unless the site is strategically allocated). Raising

ground levels can also deflect flood flows, so analyses should be performed to demonstrate that there are no adverse effects on third party land.

Raising levels can also create areas where surface water might pond during significant rainfall events. Any proposals to raise ground levels should be tested to ensure that it would not cause increased ponding or build-up of surface runoff on third party land.

11.4.4 Raised defences

Construction of localised raised floodwalls or embankments to protect new development is not a preferred option, as a residual risk of flooding will remain. Compensatory storage must be provided where raised defences remove storage from the floodplain or flood cell. It would be preferable for schemes to involve an integrated flood risk management solution.

Temporary or demountable defences are not acceptable forms of flood protection for a new development but might be appropriate to address circumstances where the consequences of residual risk are severe. In addition to the technical measures the proposals must include details of how the temporary measures will be erected and decommissioned, responsibility for maintenance and the cost of replacement when they deteriorate.

11.4.5 Developer contributions

In some cases and following the application of the sequential test, it may be necessary for the developer to make a contribution to the improvement of flood defence provision that would benefit both proposed new development and the existing local community. Developer contributions can also be made to maintenance and provision of flood risk management assets, flood warning and the reduction of surface water flooding (i.e. SuDS).

Defra's Flood and Coastal Risk Management Grant in Aid (FCRMGiA)[25] can be obtained by operating authorities to contribute towards the cost of a range of activities including flood risk management schemes that help reduce the risk of flooding and coastal erosion. Some schemes are only partly funded by FCRMGiA and therefore any shortfall in funds will need to be found from elsewhere when using Resilience Partnership Funding, for example local levy funding, local businesses or other parties benefitting from the scheme.

For new development in locations without existing defences, or where the development is the only beneficiary, the full costs of appropriate risk management measures for the life of the assets proposed must be funded by the developer.

However, the provision of funding by a developer for the cost of the necessary standard of protection from flooding or coastal erosion does not mean the development is appropriate as other policy aims must also be met. Funding from developers should be explored prior to the granting of planning permission and in partnership with the local planning authority and the Environment Agency.

The appropriate route for the consideration of strategic measures to address flood risk issues is the Local flood Risk Management Strategy (LFRMS)prepared by the Lead Local flood Authority. The LFRMS should describe the priorities with respect to local flood risk management, the measures to be taken, the timing and how they will be funded. It will be preferable to be able to demonstrate that strategic provisions are in accordance with the LFRMS, can be afforded and have an appropriate priority.

The Environment Agency is committed to working in partnership with Developers to reduce flood risk. Where assets are in need of improvement or a scheme can be implemented to reduce flood risk, the EA request that Developers contact them to discuss potential solutions. The Partnerships and Strategic Overview Team who manage these partnerships can be contacted by calling **03708 506 506 (Mon-Fri, 9am - 5pm).**

11.4.6 Building design

Internal areas of new development should be designed to be dry during the 1 in 1,000-year flood event.

The raising of floor levels within a development avoids damage occurring to the interior, furnishings and electrics in times of flood. If it has been agreed with the Environment Agency

[25] Principles for implementing flood and coastal resilience funding partnerships (Environment Agency, 2012)

that, in a particular instance, the raising of floor levels is acceptable, they should be raised to 600mm above the maximum water level caused by a 1 in 100-year (1% AEP) event plus climate change. This additional height that the floor level is raised to is referred to as the "freeboard".

Allocating the ground floor of a building for less vulnerable, non-residential, use is an effective way of raising living space above flood levels.

The Environment Agency do not consider that putting a building on stilts is an acceptable means of flood mitigation for new development. However it may be allowed in special circumstances if it replaces an existing solid building, as it can improve flood flow routes. In these cases attention should always be paid to safe access and egress and a legal agreement should be entered into to ensure the ground floor use is not changed.

Two or three storey properties

Single storey buildings such as ground floor flats or bungalows are especially vulnerable to rapid rise of water, such as that experienced during a breach. This risk can be reduced by use of multiple storey construction and raised areas that provide an escape route. Access and egress would still be an issue, particularly when flood duration covers many days.

11.4.7 Resistance and resilience

There may be instances where flood risk remains to a development. For example, where the use is water compatible, where an existing building is being changed, where residual risk remains behind defences, or where floor levels have been raised but there is still a risk at the 0.1% annual probability. In these cases (and for existing development in the floodplain), additional measures can be put in place to reduce damage in a flood and increase the speed of recovery. These measures should not be relied on as the only mitigation method.

Temporary barriers

Temporary barriers consist of moveable flood defences which can be fitted into doorways and/or windows. The permanent fixings required to install these temporary defences should be discrete and keep architectural impact to a minimum. On a smaller scale temporary snap on covers for airbricks and air vents can also be fitted to prevent the entrance of flood water.

Permanent barriers

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

Wet-proofing

Interior design to reduce damage caused by flooding, for example:

- Electrical circuitry installed at a higher level with power cables being carried down from the ceiling rather than up from the floor level.
- Water-resistant materials for floors, walls and fixtures.
- Non-return valves to prevent waste water from being forced up bathrooms, kitchens or lavatories.

If redeveloping existing basements for non-residential purposes, new electrical circuitry installed at a higher level with power cables being carried down from the ceiling rather than up from the floor level to minimise damage if the development floods.

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

11.5 Reducing flood risk from other sources

11.5.1 Surface water and sewer flooding

Where new development is in an area where the public sewerage network does not currently have sufficient spare capacity to accept additional development flows it is recommended that the developer discusses such issues with the water utility company at the earliest possible stage. The development should improve the drainage infrastructure to reduce flood risk on site. It is important however that a drainage impact assessment shows that this will not increase flood risk

elsewhere, and the drainage requirements regarding runoff rates and SuDS for new development are met.

If residual surface water flood risk remains, the likely flow routes and depths across the site should be modelled. The site should be designed so that these flow routes are preserved and building design should provide resilience against this residual risk.

When redeveloping existing buildings, the installation of some permanent or temporary flood-proofing and resilience measures could prevent against both surface water and sewer flooding. Non-return valves prevent water entering the property from drains and sewers. Non-return valves can be installed within gravity sewers or drains, within the property's private sewer upstream of the public sewerage system. These need to be carefully installed and must be regularly maintained. Additionally, manhole covers within the property's grounds could be sealed to prevent surcharging.

11.5.2 Groundwater

Groundwater flooding has a very different flood mechanism to any other and for this reason many conventional flood defence and mitigation methods are not suitable. The only way to fully reduce flood risk would be through building design, ensuring floor levels are raised above the water levels caused by a 1% annual probability fluvial / 0.5% annual probability tidal plus climate change event. Site design would also need to preserve any flow routes followed by the groundwater overland to ensure flood risk is not increased downstream.

When redeveloping existing buildings it may be acceptable to install pumps in basements as a resilience measure. However for new development this is unlikely to be considered an acceptable solution.

11.6 Making development sites safe

11.6.1 Safe access and egress

The NPPF Planning Practice Guidance outlines how developers can ensure safe access and egress to and from development in order to demonstrate that development satisfies the second part of the Exception Test[26]. Access considerations should include the voluntary and free movement of people during a 'design flood' as well as for the potential of evacuation before a more extreme flood. The access and egress must be functional for changing circumstances over the lifetime of the development. The NPPF Planning Practice Guidance sets out that[26]

- Access routes should allow occupants to safely access and exit their dwellings in design flood conditions. In addition, vehicular access for emergency services to safely reach development in design flood conditions is normally required
- Where possible, safe access routes should be located above design flood levels and avoid flow paths. Where this is unavoidable, limited depths of flooding may be acceptable providing the proposed access is designed with appropriate signage etc. to make it safe. The acceptable flood depth for safe access will vary as this will be dependent on flood velocities and risk of debris in the flood water.

The depth, velocity and hazard mapping and visualisations from this SFRA update should help inform the provision of safe access and egress routes.

As part of an FRA, the developer should review the acceptability of the proposed access in consultation with the Environment Agency.

11.6.2 Flood warning and evacuation

A consideration for any new development is how to make it safe from flood risk over the developments lifetime (including the likely impacts of climate change). The NPPF Planning Practice Guidance outlines the main options and considerations for making a development safe; this includes flood warning and evacuation plans (these can also be referred to as flood plans or flood response plans etc.)[27]. Flood warning and evacuation plans should detail actions to assist

[26] NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 039, Reference ID: 7-056-20140306) March 2014

[27] NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 056, Reference ID: 7-056-20140306) March 2014

residents / building users in preparing and responding to the risk of flooding and remaining safe, as well as defining procedures in the event an evacuation is required.

The practicality of safe evacuation from an area will depend on[28]:

- the type of flood risk present, and the extent to which advance warning can be given in a flood event;
- the number of people that would require evacuation from the area potentially at risk;
- the adequacy of both evacuation routes and identified places that people could be evacuated to (and taking into account the length of time that the evacuation may need to last), and;
- sufficiently detailed and up to date evacuation plans being in place for the locality that address these and related issues.

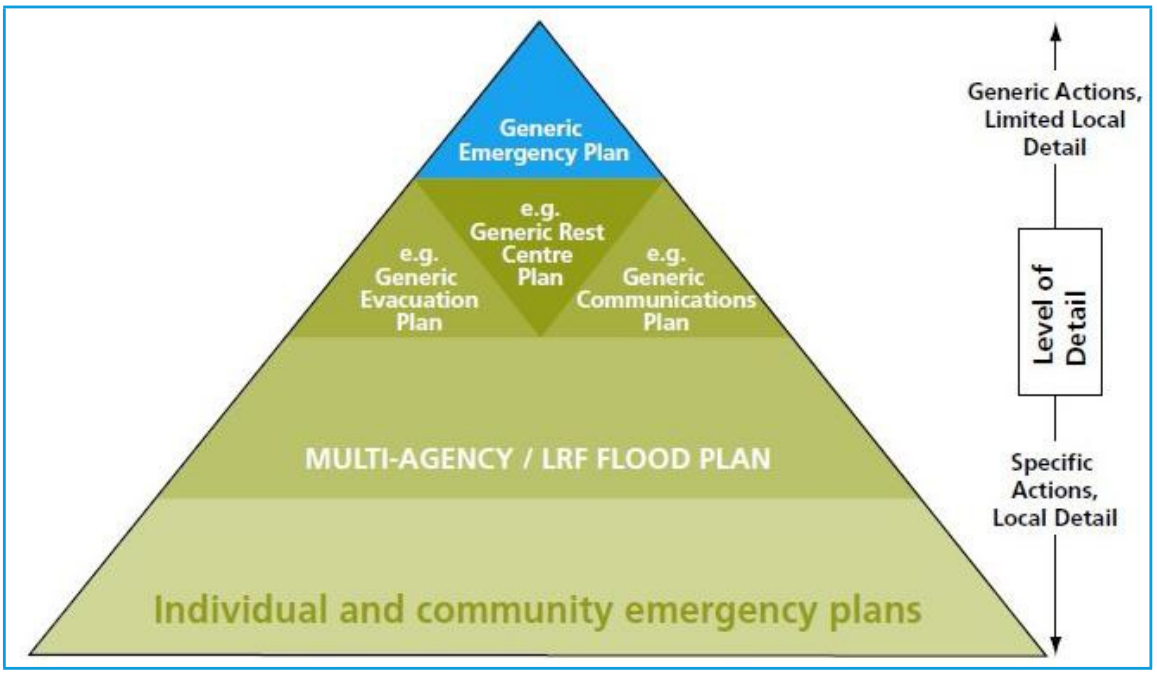
It is a requirement under the NPPF that a flood warning and evacuation plan is prepared for sites at risk of flooding used for holiday or short-let caravans and camping and are important at any site that has transient occupants (e.g. hostels and hotels)[27].

Flood warning and evacuation plans can be prepared at a personal, site specific, community \ group level (see Figure 11-1), in consultation with the local planning authority and emergency services.

Guidance documents for preparation of flood response plans

- Environment Agency (2011) Flooding – minimising the risk, flood plan guidance for communities and groups https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/292939/LIT_5286_b9ff43.pdf
- Environment Agency (2011) Community Flood Plan template
- Environment Agency Personal flood plans http://apps.environment-agency.gov.uk/flood/151256.aspx
- Flood Plan UK 'Dry Run' - A Community Flood Planning Guide

Figure 11-1: Types of emergency plans



Source: DEFRA (2011) Detailed Guidance on Developing Multi-Agency Flood Plans[29]

[28] NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 057, Reference ID: 7-057-20140306) March 2014

[29] DEFRA (2011) Detailed Guidance on Developing Multi-Agency Flood Plans, Figure 12.1 How a MAFP fits with other emergency plans, page 3.

Flood warnings supplied by the Environment Agency's Floodline Warnings Direct service can be provided to homes and businesses within Flood Zones 2 and 3, although the service is not available everywhere. Developers should encourage those owning or occupying developments, where flood warnings can be provided, to sign up to receive them. This applies even if the development is defended to a high standard.

11.7 Making Space for water

The NPPF sets out a clear policy aim in Flood Zone 3 to create space for flooding by restoring functional floodplain.

All new development close to rivers should consider the opportunity presented to improve and enhance the river environment. Developments should look at opportunities for river restoration and enhancement as part of the development. Options include backwater creation, de-silting, in-channel habitat enhancement and removal of structures. When designed properly, such measures can have benefits such as reducing the costs of maintaining hard engineering structures, reducing flood risk, improving water quality and increasing biodiversity. Social benefits are also gained by increasing green space and access to the river.

11.7.1 Buffer strips

As a minimum, developers should set back development eight metres from the landward toe of fluvial defences or top of bank where defences do not exist. This provides a buffer strip to 'make space for water', allow additional capacity to accommodate climate change and ensure access to defences is maintained for maintenance purposes.

For watercourses classed as 'Main River' a minimum eight metre easement from the top of bank is recommended for maintenance purposes to avoid disturbing riverbanks, benefiting ecology and having to construct engineered riverbank protection. Building adjacent to riverbanks can also cause problems to the structural integrity of the riverbanks and the building, making future maintenance of the river much more difficult.

11.7.2 Drainage capacity

The capacity of internal drainage infrastructure is often limited and is at or near capacity under existing conditions. Development that leads to increased peak runoff within the drainage catchments may lead to infrastructure capacity being exceeded, with the potential for increased flood risk. Development locations should be assessed to ensure capacity exists within both the on and off site network.

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12 Green Infrastructure and the Water Framework Directive

12.1 Green Infrastructure

Green Infrastructure (GI) is a planned and managed network of natural environmental components and green spaces that intersperse and connect the urban centres, suburbs and rural fringe and consist of:

- Open spaces – parks, woodland, nature reserves, lakes
- Linkages – River corridors and canals, and pathways, cycle routes and greenways
- Networks of "urban green" – private gardens, street trees, verges and green roofs.

The identification and planning of Green Infrastructure is critical to sustainable growth. It merits forward planning and investment as much as other socio-economic priorities such as health, transport, education and economic development. GI is also central to climate change action and is a recurring theme in planning policy.

With regards to flood risk, green spaces can be used to manage storm flows and free up water storage capacity in existing infrastructure to reduce risk of damage to urban property, particularly in city centres and vulnerable urban regeneration areas. Green infrastructure can also improve accessibility to waterways and improve water quality, supporting regeneration and improving opportunity for leisure, economic activity and biodiversity.

12.1.1 A Green Infrastructure Strategy for Hinckley & Bosworth

A green Infrastructure Strategy for Hinckley & Bosworth was published in 2008, with the aim of informing the development of Hinckley & Bosworth Borough Council's local plans and strategies such as Local Development Framework documents and Area Action Plans, and in addition to assist the implementation of those plans by providing baseline evidence and information for policy formation and project development and delivery. Groupings of features, needs and assets provide an opportunity to address various issues at a sub-borough strategic level in 3 green infrastructure zones within the borough: Southern Zone, Western Zone and North Eastern Zone. The GI Plan sets out the Borough-wide response to green infrastructure, providing a broad strategic approach of special policy initiatives across the Borough within which the more locally focussed GI Zones fit. The following key strategic recommendations were identified[30]

- Tourism – aim to enhance and protect existing assets, as well as encouraging the sustainable use of natural tourism resource and promoting local as well as out of town use
- Access and Recreation – aim to ensure that existing and potential green infrastructure assets are retained and enhanced to provide for population demands and community needs for green and open space
- Biodiversity (Protect, Increase, Enhance) – aim to ensure that natural and semi-natural habitats are given due protection within the planning system
- Potential Strategic Access Routes – aim to improve access to green infrastructure in the Borough (particularly those with a tourist interest)

12.1.2 The 6 'C's Green Infrastructure Strategy (2010)

The 6 'C's sub-region includes the three cities of Derby, Leicester and Nottingham and the three counties of Derbyshire, Leicestershire and Nottinghamshire. A Green Infrastructure Strategy for the sub-region was published in 2010, with the aim to provide a GI Strategy to 'help inspire stakeholder involvement, and focus action on the ground where it is most needed and would achieve most benefit'. Volume 5 of the Green Infrastructure Strategy covers the joint SFRA area; it includes two key sub-regional corridors that were identified and that reflect significant wildlife habitat corridors/areas that link with strategic GI in surrounding areas – the Soar Strategic River Corridor and the Sence Strategic River Corridor and Grand Union Canal.

[30] A Green Infrastructure Strategy for Hinckley & Bosworth (2008)

The following key opportunities for delivering GI benefits were identified for both of these sub-regional corridors[31]

- Access and movement – potential to establish traffic free multi-user greenways, linking communities and Strategic GI assets
- Biodiversity – potential opportunities for river corridor habitat management, creation, restoration and extension
- Natural processes – potential opportunities to manage flood risk through appropriate land management
- Cultural heritage – potential opportunities to enhance the management, presentation, accessibility and interpretation of historic environmental assets
- Landscape – potential opportunities to enhance the character and distinctiveness of the landscape

12.1.3 River Soar and Grand Union Canal Strategy

The emerging River Soar and Grand Union Canal strategy provides an assessment of the current position, issues and future opportunities for River Soar and Grand Union Canal, recommending a series of short to medium term actions to secure a successful long-term future for the Waterway[32].

Chaired by the Leicester City Mayor, the partnership comprises representatives of the public authorities, statutory bodies and charitable and voluntary organisations along the corridor from the confluence of the River Soar with the River Trent, up to Kilby Bridge in Oadby & Wigston Borough, south of Leicester. The running of the River Soar/Grand Union Canal Partnership is jointly between Leicester City and Leicestershire County Council[32].

12.1.4 Re-wilding the River Soar Valley

The Leicestershire and Rutland Wildlife Trust is working to restore wildlife and wild places to the floodplains of the Soar and Wreake as part of a Living Landscape scheme. The Trust's goal is to enable the floodplain to function more naturally, which has huge benefits for nature and for people[33].

The Trust has acquired over 350 acres of land on the Soar floodplain since 2004, offered advice to landowners and carried out extensive habitat restoration work, centred on Cossington Meadows nature reserve[33].

In 2011-12 the Trust surveyed the River Soar through Leicester and its associated green spaces. The survey showed that the river forms a vital link with the river valley to the north and south of the city, facilitating species movement between fragmented habitats within and beyond the urban area[33].

12.1.5 Using SFRA data to support GI Strategies

The evidence base provided in this SFRA should be used to help inform the Green Infrastructure strategy for the joint SFRA area. River corridors identified as functional floodplains are an excellent linkage of GI and can provide storage during a flood event. Areas identified within the urban environment or upstream of a critical surface water flood area should be incorporated into council GI strategies. Opening up land to create flow paths or flood storage areas can help protect current and future property.

In certain circumstances runoff from green space can cause flooding in developed areas. This should be considered through further detailed work in a Surface Water Management Plan.

[31] 6 Cs Green Infrastructure Strategy Volume 5: Strategic GI Network for the Leicester Principal Urban Area and Sub-Regional Centres (2010)

[32] Leicestershire County Council (http://www.leics.gov.uk/index/environment/countryside/environment_management/river_soar_strategy.htm)

[33] Leicestershire and Rutland Wildlife Trust

12.2 The Water Framework Directive

The EU Water Framework Directive (WFD) is a piece of European water legislation that is designed to improve and integrate the way water bodies are managed throughout Europe. The WFD was transposed into law in England and Wales by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003. The Directive requires that Environmental Objectives be set for all surface and ground waters in England and Wales to enable them to achieve Good Status (or Good Ecological Potential for Heavily Modified and Artificial Water Bodies) by a defined date. These Environmental Objectives are listed below:

- Prevent deterioration in the status of aquatic ecosystems, protect them and improve the ecological condition of waters.
- Aim to achieve at least good status/potential for all water bodies by 2015. Where this is not possible and subject to the criteria set out in the Directive, aim to achieve good status/potential by 2021 or 2027.
- Meet the requirements of Water Framework Directive Protected Areas.
- Promote sustainable use of water as a natural resource.
- Conserve habitats and species that depend directly on water.
- Progressively reduce or phase out the release of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment.
- Progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants.
- Contribute to mitigating the effects of floods and droughts.

In England, the Environment Agency (EA) is responsible for the delivery of the WFD objectives. The EA has produced River Basin Management Plans (RBMP) for the whole of England which describe how the WFD will be achieved. RBMPs set out the ecological objectives for each water body and give deadlines by when objectives need to be met. All waterbodies have to achieve Good Ecological Status or Good Ecological Potential (GEP) by a set deadline. GEP is the best ecological improvements that can be achieved for a water body while still enabling Flood and Coastal Erosion Risk Management (FCERM) works to be undertaken to protect people and property from flooding.

The WFD defines the flow, shape and physical characteristics of a watercourse as its 'hydromorphology.' Any in-channel works can impact upon the shape of a watercourse and the natural processes that occur within it, including:

- flow patterns
- width and depth of a channel
- features such as pools, riffles, bars and bank slopes
- sediment availability/transport
- interaction between a channel and its floodplain
- ecology and biology (i.e. habitats which support plants and animals)

Any adverse impacts can cause a water body's ecology to deteriorate and prevent environmental improvements from being undertaken. Nevertheless, in-channel works can also be beneficial if they can be designed to help achieve environmental improvements included in the RBMP, thus enhancing the water environment for plants and animals.

12.3 Preventing Deterioration in Status

Any activity which has the potential to have an impact on the ecology of a waterbody will need consideration in terms of whether it could cause deterioration in its Ecological Status or Potential.

For each waterbody, three different status objectives are identified. These are the overall status objective, the ecological status or potential objective and the chemical status objective. A default objective for all water bodies is to prevent the deterioration in the Ecological Status (or Ecological Potential for Heavily Modified and Artificial Water Bodies) of the waterbody.

The Ecological Status of a waterbody is determined through analysis of its constituent biological Quality Elements (listed below). These elements are in turn supported by a series of physio-chemical and hydromorphological Quality Elements. These Quality Elements are taken from Annex V of the Directive and are listed below. The overall Ecological Status is determined by the lowest element status.

Biological Quality Elements

- Fish
- Invertebrates
- Macrophytes
- Phytobenthos

Any activity that has the potential to have an impact upon any of the Quality Elements will need consideration in terms of whether it could cause a deterioration in the status of a waterbody. The activity will also need to be considered in terms of whether it will compromise the ability of the waterbody to reach Good Ecological Status or Good Ecological Potential by the date specified in the RBMP.

12.4 Artificial or Heavily Modified Water Bodies

Whilst good ecological status is defined as a slight variation from undisturbed natural conditions in natural water bodies, artificial and heavily modified water bodies are unable to achieve natural conditions. Instead, artificial and heavily modified water bodies have a target to achieve Good Ecological Potential, which recognises their important uses, whilst making sure ecology is protected as far as possible. Ecological potential is also measured on the scale high, good, moderate, poor and bad. The chemical status of these water bodies is measured in the same way as for natural water bodies.

Specific mitigation measures have been identified for each Artificial and Heavily Modified Waterbody and are listed in the RBMP. These mitigation measures are necessary to reduce the existing hydromorphological impacts on the waterbody and all measures need to be in place in order for the waterbody to achieve Good Ecological Status or Potential.

12.5 WFD Assessments

A detailed assessment should be undertaken to determine the effects that any proposed works within or adjacent to a watercourse could have upon Quality Elements. Any impacts identified should then be considered in relation to the Ecological, Hydromorphological and Chemical Status of the waterbody and the status objectives.

The following assessment objectives should then be used to determine whether the proposed works comply with the overarching objectives of the WFD. These objectives were therefore derived from the Environmental Objectives of the Directive

- Objective 1: The proposed scheme does not cause deterioration in the Status of the Biological Elements of the waterbody.
- Objective 2: The proposed scheme does not compromise the ability of the waterbody to achieve its WFD status objectives.
- Objective 3: The proposed scheme does not cause a permanent exclusion or compromised achievement of the WFD objectives in other bodies of water within the same RBD.
- Objective 4: The proposed scheme contributes to the delivery of the WFD objectives.

In order to establish whether the strategy complies with the WFD it is necessary to ascertain whether the preferred options have the potential to result in:

- Failure of a water body to achieve good ecological status or potential; or
- Failure to prevent a deterioration in the ecological status or potential of a water body

If the answer to these questions is ‘no’ the strategy can be considered WFD compliant. If either of these failures is identified, further assessment may be required to identify if the strategy meets all of the conditions set out by the WFD Legislation.

A map showing the 2013 overall status of the main water bodies in the joint SFRA area is provided in Appendix E. Note, not all the watercourses in the joint SFRA area are shown on this map. The majority of the surface water bodies in the joint SFRA are classified as 'poor'. Five waterbodies in the joint SFRA area fall into the 'bad' category – the Countesthorpe Brook (from source to River Sence), the River Soar (from Soar Brook to Thurlaston Brook), the River Sence (from Source to Ibstock Brook), the Whetstone Brook (tributary of the River Soar) and the Thurlaston Brook (from source to River Soar). Future development should ensure there is no adverse impact on the quality of watercourses within the joint SFRA area.

12.6 Example Restoration Options and assessments

12.6.1 Structure Removal and / or modification (e.g. Weirs)

Structures, both within watercourses and adjacent to them can have significant impacts upon rivers including, alterations to the geomorphology and hydraulics of the channel through water impoundment and altering sediment transfer regime, which over time can significantly impact the channel profile including bed and bank levels, alterations to flow regime and interruption of biological connectivity, including the passage of fish and invertebrates.

Many artificial in-channel structures (examples include weirs and culverts) are often redundant and / or serve little purpose and opportunities exist to remove them where feasible. The need to do this is heightened by climate change, for which restoring natural river processes, habitats and connectivity are vital adaptation measures. However, it also must be recognised that some artificial structures may have important functions or historic/cultural associations, which need to be considered carefully when planning and designing restoration work.

In the case of weirs, whilst weir removal should be investigated in the first instance, in some cases it may be necessary to modify a weir rather than remove it. For example by lowering the weir crest level or adding a fish pass. This will allow more natural water level variations upstream of the weir and remove a barrier to fish migration.

A detailed assessment would need to be undertaken to gain a greater understanding of the restoration response, including erosion and flood risk analysis to ensure that the post removal and / or modification scenario does not increase flood risk at the site and up and downstream of the site.

12.6.2 Bank removal, set back and / or increased easement

The removal or realignment of flood embankments and walls can allow the natural interrelationship between the river channel and the floodplain to be reinstated. This can be achieved at a small scale within urban areas providing pockets of attractive green spaces along rivers, whilst also improving floodplain storage within confined urban environments at times of flooding.

A detailed assessment would need to be undertaken to gain a greater understanding of the response to the channel modification, including flood risk analysis to investigate flood risk impacts.

12.6.3 Re-naturalisation and bank removal, set back and / or increased easement

There is potential to re-naturalise a watercourse by re-profiling the channel, removing hard defences, re-connecting the channel with its floodplain and introducing a more natural morphology (particularly in instances where a watercourse has historically been modified through hard bed modification). Detailed assessments and planning would need to be undertaken to gain a greater understanding of the response to any proposed channel modification.

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13 Strategic Flood Risk Solutions

13.1 Flood defences

There are a number of formal flood defences present within the joint SFRA area. However, none of the assessment areas are afforded protection by these defences.

Flood mitigation measures should only be considered if, after application of the Sequential Approach, development sites cannot be located away from higher risk areas. If defences are constructed to protect a development site, it will need be demonstrated that the defences will not have a resulting negative impact on flood risk elsewhere, and that there is no net loss in floodplain storage.

13.2 Flood storage schemes

Flood storage schemes aim to reduce the flows passed downriver to mitigate downstream flooding. Development increases the impermeable area within a catchment, creating additional and faster runoff into watercourses. Flood storage schemes aim to detain this additional runoff, releasing it downstream at a slower rate, to avoid any increase in flood depths and/or frequency downstream. Methods to provide these schemes include[34]

- Enlarging the river channel
- Raising the riverbanks
- Constructing flood banks set back from the river

Flood storage schemes have the advantage that they generally benefit areas downstream, not just the local area.

Upstream attenuation schemes already exist on the Battling Brook/Sketchley Brook in Hinckley & Bosworth and on the Wash Brook in Oadby & Wigston.

The construction of new upstream storage schemes on a number of watercourses within the joint SFRA area would provide one potential strategic solution to flood risk. Watercourses which are rural in their upper reaches but have high levels of flood risk to urban areas in the downstream reaches are potential candidates, as the open land in the upper reaches can potentially provide the space for an attenuation area, providing benefit to the urban area downstream. Potential examples include the Whetstone Brook in Blaby District and the River Sence in Oadby & Wigston Borough / Blaby District.

13.3 Floodplain restoration

Compared to flood defences and flood storage, floodplain restoration represents the most sustainable form of strategic flood risk solution, by allowing watercourses to return to a more naturalised state.

Although the restoration of floodplain is difficult in previously developed areas where development cannot be rolled back, the following measures should be adopted:

- Return existing and future brownfield sites that are adjacent to watercourses back to floodplain, rather than allowing new development
- Removal of redundant structures to reconnect the river and the floodplain
- Apply the Sequential Approach to avoid new development within currently undefended floodplain.

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14 Summary and recommendations

14.1 Summary

- The joint SFRA area is at risk from a variety of sources. The SFRA has considered all sources of flooding including fluvial, pluvial, groundwater, sewers, canal and reservoir, within the study area.
- An assessment of the flood defences has been undertaken, including defence condition, the standard of protection and the residual risk.
- For each assessment area shown to be at risk from fluvial flooding, a detailed summary table has been completed (Appendix A). These tables set out the flood risk to the site, including maps of Flood Zones, Flood Zone 3a with the effect of climate change, surface water flood risk, and depth, hazard and velocity mapping. Each table also sets out the NPPF requirements for the site as well as guidance for site-specific flood risk assessments. A broad scale assessment of suitable SuDS options has also been provided.
- The cumulative impact of development has been considered and an assessment of any cross-boundary issues as a result of any proposed large-scale development has been undertaken.
- Green infrastructure within the joint SFRA area has been assessed. The current WFD status of the watercourses within the study area has been reviewed and the potential for restoration of natural floodplains considered.

14.2 Recommendations

14.2.1 Key recommendations

- It is recommended that the mapping produced for this SFRA update is used in preference to the previous SFRA published in 2007.
- It is recommended that developers refer to the FRA recommendations provided in the assessment area summary tables in Appendix A as well as the general guidance on flood risk assessment in Section 11.
- The key requirements for future development are summarised below:
    - All sites within Zones 2 and 3, and all sites over 1ha in flood zone 1, will require a detailed Flood Risk Assessment in accordance with NPPF, making reference to Section 11, Appendix A and associated maps of this report. Consultation with the relevant local authority, Leicestershire County Council and the Environment Agency is strongly recommended at an early stage in the FRA process.
    - The layout of buildings and access routes should adopt a sequential approach, steering buildings (and hence people) towards areas of lowest risk within the boundaries of the site. This will also ensure that the risk of flooding is not worsened by, for example, blocked flood flow routes.
    - The FRA requirements defined in Section 11 of this Level 2 SFRA must be considered for all future development brought forward.
- Suitable and adequate SuDS techniques are required for development to manage post-development surface water runoff rates and volumes. Advice on SuDS is provided in Sections 8 and 11.4.1, as well as in the summary tables in Appendix A.
- It is recommended that development is set back at least eight metres from watercourses, in accordance with the bylaw distance for Main Rivers in the Midlands Region Land Drainage Bylaws, to allow for flood risk and maintenance.

  This has the additional benefit of providing open space, contributing to the GI network within the joint SFRA area.
- Consideration should be given to ‘rolling back’ development allowing restoration of the floodplain.
- Any development adjacent to the canals should take account of residual risk from breach or failure and it is recommended the development incorporates a buffer zone next to the canal to allow access for maintenance and repair, should it be required.

14.2.2 Development and Flood Risk

All development should adhere to the advice in the Joint Strategic Flood Risk Assessment and the guidance provided on Flood Risk Assessment requirements in order to:

- protect floodplains from inappropriate development;
- ensure no increase in flood risk;
- where possible provide flood risk betterment; and
- ensure development is safe.

14.2.3 Windfall sites

These are sites which have not been specifically identified as available in the Local Plan process. They normally comprise previously developed sites that have unexpectedly become available.

The Environment Agency recommend that the acceptability of windfall applications in flood risk areas should be considered at the strategic level through a policy setting out broad locations and quantities of windfall development that would be acceptable or not in Sequential Test terms.

In the absence of a flood risk windfall policy, it may be possible (where the data is sufficiently robust) for the LPA to apply the Sequential Test taking into account historic windfall rates and their distribution across the district relative to Flood Zones. Where historic and future trends evidence indicate that housing need in the district through windfall can be met largely/entirely by development outside high flood risk areas, this may provide grounds for factoring this into the consideration of `reasonably available' alternative sites at the planning application stage.

14.2.4 Protection and Enhancement of Watercourses

Planning permission for development should only be granted where:

- the natural watercourse system which provides drainage of land is not adversely affected;
- a minimum 8m width access strip is provided adjacent to the top of both banks of any watercourses for maintenance purposes and is appropriately landscaped for open space and Biodiversity benefits, this width may be reduced in particular circumstances with agreement from the Environment Agency and LPA;
- it would not result in the loss of open water features through draining, culverting or enclosure by other means and culverts are opened up where ever possible;
- surface water drainage is delivered by sustainable drainage systems (SuDS); and
- betterment in the surface water runoff regime is ensured; with any residual risk of flooding, from drainage features either on or off site not placing people and property at unacceptable risk.

14.3 Use of SFRA data

It is important to recognise that the SFRA has been developed using the best available information at the time of writing. This relates both to the current risk of flooding from rivers, and the potential impacts of future climate change.

The Environment Agency regularly reviews their flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a detailed Flood Risk Assessment.

The SFRA should be periodically updated when new information on flood risk, flood warning or new planning guidance or legislation becomes available. New information on flood risk may be provided by the relevant local authority, Leicestershire County Council (in its role as Lead Local Flood Authority), the Highways Authority, Severn Trent Water and the Environment Agency.

Note on the Flood Map for Planning: these outlines are based on generalised modelling to provide only an indication of flood risk. Whilst they are generally accurate on a large scale, they are not provided for specific sites or land where the catchment of the watercourse falls below 3km^2. For this reason, the Flood Map for Planning is not sufficiently accurate to resolve the details of possible flooding for individual properties or sites and for any sites with watercourses on, or adjacent to the site, would require further, more detailed assessment.

The Flood Map for Planning is updated quarterly; therefore the Flood Map on the Environment Agency/Defra website will supersede the version of the Flood Map shown in Appendix C.

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Appendices

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A Detailed assessment area summary tables

Summary table structure

Summary tables have been produced for all assessment areas where fluvial flooding is potentially an issue. Each table sets out the following information:

- Site area
- Proportion of the site in each flood zone
- NPPF and Exception Test guidance
- Mapping including Flood Zones, climate change and surface water
- Depth, hazard and velocity mapping
- An broad scale assessment of suitable SuDS techniques and considerations (see below)
- The presence of any flood defences
- Whether the site is within 100m of a canal
- Whether the site is covered by a flood warning service
- Whether there are any access and egress issues for the site
- The potential impacts of climate change in the future
- Advice on the preparation of site-specific flood risk assessments and considerations for developers

SuDs suitability

The hydraulic and geological characteristics of each development site were assessed to determine the constraining factors for surface water management at the proposed development sites. This assessment is designed to inform the early-stage site planning process and is not intended to replace site-specific detailed drainage assessments.

From catchment characteristics and additional datasets (areas susceptible to groundwater flooding map, Soil map of England and Wales, Environment Agency 'What's in your Backyard' online mapping) a broad criterion for the applicability of SuDS techniques was determined. These criteria were then used to carry out a simple assessment of the likely feasibility of different types of SuDS techniques at each of the proposed development sites. SuDS techniques were categorized into 5 main groups as follows.

Table A-1: Summary of SuDS Categories

SuDS Type	Technique
Source Controls	Green Roof, Rainwater Harvesting, Pervious Pavements, Rain Gardens
Infiltration	Infiltration Trench, Infiltration Basin, Soakaway
Detention	Pond, Wetland, Subsurface Storage, Shallow Wetland, Extended Detention Wetland, Pocket Wetland, Submerged Gravel Wetland, Wetland Channel, Detention Basin
Filtration	Surface Sand filter, Sub-Surface Sand Filter, Perimeter Sand Filter, Bioretention, Filter Strip, Filter Trench
Conveyance	Dry Swale, Underdrained Swale, Wet Swale

The suitability of each SuDS type for the proposed developments has been displayed using a traffic light colour system in the summary tables. The assessment of suitability is broad scale and indicative only; more detailed assessments should be carried out during the site planning stage to confirm the feasibility of different types of SuDS.

Suitability	Description
	The SuDS Group and its associated techniques are unlikely to be suitable at the development site based on the results of this assessment.
	The SuDS Group and its associated techniques may be suitable at the development but is likely to require additional engineering works. Some techniques from this group may not be suitable for use at the development.
	The SuDS Group and its associated techniques are likely to be suitable at the development site based on the results of this assessment.

A.1 HBBC Stage 2 Sites

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A.2 HBBC Stage 3 Sites

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A.3 BDC Stage 2 Sites

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A.4 OWBC Stage 2 Sites

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B Joint SFRA watercourses

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C Flood Zone mapping

The flood zone maps show the extents of Flood Zones 1, 2 3a and 3b in the joint SFRA area. The flood zones are defined as follows:

Zone 1: Comprised of land having a less than 1 in 1,000 annual probability of river or sea flooding in any year.

Zone 2: Comprised of land having between a 1 in 100 and a 1 in 1,000 annual probability of river flooding or 1 in 200 and 1 in 1,000 annual probability of sea flooding in any year.

Zone 3a: Comprised of land assessed as having a greater than 1 in 100 annual probability of river flooding or a greater than 1 in 200 annual probability of flooding from the sea in any year.

Zone 3b: Comprised of land where water has to flow or be stored in times of flood (the functional floodplain). The SFRA identified this Flood Zone as land which would flood with an annual probability of 1 in 20 years, where detailed hydraulic modelling exists. In the absence of detailed hydraulic model information, a precautionary approach can be adopted with the assumption that the extent of Flood Zone 3b would be equal to Flood Zone 3a. If development is shown to be in Flood Zone 3a, further work should be undertaken as part of a detailed site specific flood risk assessment to define the extent of Flood Zone 3b.

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D Climate change mapping

The climate change maps show the potential impacts that climate change may have on river flows and, subsequently, on flood events. Where models exist in the study area, a change factor has been applied to the 1 in 100 year flows.

Where modelling output is not available, the Environment Agency's flood zones can provide some indication of areas where rare, more extreme flows might affect the floodplain extents, by comparing Flood Zone 3a with Flood Zone 2. For the purposes of this study, a precautionary approach has been adopted where Flood Zone 2 has been used as a guide to provide an indication of the likely increase in extent of Flood Zone 3 with climate change (hatched area).

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E Current WFD status of watercourses

The current WFD status of watercourses in the joint SFRA area is shown in Appendix E. The watercourses are colour-coded according to their current overall status.

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F Surface water mapping

The updated Flood Map for Surface Water (uFMfSW) maps show the flooding that takes place from the 'surface runoff' generated by rainwater (including snow and other precipitation) which: (a) is on the surface of the ground (whether or not it is moving), and (b) has not yet entered a watercourse, drainage system or public sewer.

The uFMfSW will pick out natural drainage channels, rivers, low areas in the floodplain and flow paths between buildings but it will only indicate flooding caused by local rainfall.

The uFMfSW shows predictions of flooded area but does not show whether individual properties will be affected by surface water flooding or have been affected in the past. The uFMfSW should not be used to predict if individual properties will flood.

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G Groundwater mapping

The Areas Susceptible to Groundwater Flooding (AStGWF) maps are a set of strategic maps which show groundwater flood areas on a 1km square grid. The data was produced to annotate indicative Flood Risk Areas for Preliminary Flood Risk Assessment (PFRA) studies and allow the Lead Local Flood Authorities (LLFAs) to determine whether there may be a risk of flooding from groundwater.

This data shows the proportion of each 1km grid square where geological and hydrogeological condition show that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring. It does not take account of the chance of flooding from groundwater rebound. This dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of ground water flooding.

The AStGWF data should only be used in combination with other information, for example local data or historic data. It should not be used as sole evidence for any specific flood risk management, land use planning or other decisions at any scale. However, the data can help to identify areas for assessment at a local scale where finer resolution datasets exist.

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H Flood warning coverage

Flood Warning and Flood Alert coverage maps are shown in Appendix H for the joint SFRA area. Flood Alerts are used to warn people of the possibility of flooding and encourage them to be alert, stay vigilant and make early preparations. It is issued earlier than a flood warning, to give customers advance notice of the possibility of flooding, but before we are fully confident that flooding in Flood Warning Areas is expected.

Flood Warnings warn people of expected flooding and encourage them to take action to protect themselves and their property.

Some areas may be covered by more than one flood warning area as they may be at risk of flooding from more than one watercourse.

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Assessment areas overview

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Offices at

Coleshill
Doncaster
Edinburgh
Exeter
Haywards Heath
Limerick
Newcastle upon Tyne
Newport
Saltaire
Skipton
Tadcaster
Thirsk
Wallingford
Warrington

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