2018s0553 – Strategic Flood Risk Assessment for Bassetlaw District Council

FINAL Report

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Bassetlaw District Council

JBA Project Manager

Hannah Coogan
The Library
St Philips Courtyard
Church Hill
Coleshill
Warwickshire
B46 3AD

Revision history

Revision Ref/Date	Amendments	Issued to
25/05/2018	Skeleton Report	Debbie Broad and Tom Bannister Planning Policy Officer at Bassetlaw District Council
22/08/2018	Draft Report	Debbie Broad and Tom Bannister - Bassetlaw District Council Ross Marshall – Nottinghamshire County Council Rob Millbank and Alison C Beaumont – Environment Agency Alice Johns – Severn Trent Water
07/01/2019	Final Report	Debbie Broad and Tom Bannister - Bassetlaw District Council

Contract

This report describes work commissioned by Debbie Broad, on behalf of Bassetlaw District Council, by an email dated 26th April 2018. Hannah Coogan, Freyja Scarborough, and Joe Esgate of JBA Consulting carried out this work.

Prepared by ..... Freyja Scarborough BSc MSc

Assistant Analyst

Reviewed by ..... Hannah Coogan BSc MCIWEM C.WEM
Technical Director

Hannah Hogan BA MA MCIWEM C.WEM CENV
Chartered Senior Analyst

Purpose

This document has been prepared as a Final Report for Bassetlaw District Council. JBA Consulting accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

JBA Consulting has no liability regarding the use of this report except to Bassetlaw District Council.

Acknowledgements

We would like to acknowledge the assistance of:

- Nottinghamshire County Council;
- Environment Agency;
- Internal Drainage Boards;
- Severn Trent Water;
- Anglian Water;
- The Canal and Rivers Trust; and,
- Planners at the neighbouring authorities

Carbon footprint

JBA is aiming to reduce its per capita carbon emissions.

Executive summary

About this report

This report is a strategic assessment of flood risk to inform planning allocations and policies in Bassetlaw. If you are concerned about flooding and it is an emergency, please visit:

https://www.nottinghamshire.gov.uk/planning-and-environment/flooding/during-a-flood

If life is in danger, call 999.

Introduction

This Strategic Flood Risk Assessment (SFRA) document replaces the 2009 Level 1 SFRA. The study provides a comprehensive and robust evidence base to support the Bassetlaw District Council Local Plan. The key objectives are:

1. To replace the Council's 2009 Level 1 SFRA, taking into account the most recent policy and legislation in the National Planning Policy Framework (2018).
2. To collate and analyse the latest available information and data for current and future (i.e. climate change) flood risk from all sources, and how these may be mitigated.
3. To inform decisions in the emerging Local Plan, including the selection of development sites and planning policies.
4. To provide evidence to support the application of the Sequential Test for the allocation of new development sites, to support the Council's preparation of the Local Plan.
5. To provide a comprehensive set of maps presenting flood risk from all sources that can be used as evidence base for use in the emerging Local Plan.
6. To provide advice for applicants carrying out site-specific flood risk assessments and outline specific measures or objectives that are required to manage flood risk.

SFRA outputs

To meet the objectives, the following outputs have been prepared:

- Identification of policy and technical updates from the previous Level 1 Strategic Flood Risk Assessment.
- Identification of any strategic flooding issues which may have cross-boundary implications.
- Identification of any flood modelling and data gaps.

- Appraisal of all potential sources of flooding, including Main River, ordinary watercourse, surface water, sewers, groundwater, reservoirs and canals.
- Mapping showing the distribution of flood risk across all flood zones from all sources of flooding, including climate change allowances, including the addition of new and amended data sources.
- Review of historic flooding incidents.
- Reporting on the standard of protection provided by defences.
- Assessment of surface water management issues and Sustainable Drainage Systems guidance.
- Flood Risk Assessment guidance for developers.
- Sequential Test guidance and sequential approach to flood risk.

Summary of flood risk in Bassetlaw

- Flood history shows that Bassetlaw has been subject to flooding from several sources of flood risk, with the principal risk being fluvial from watercourses within the district. Additionally, there are recorded incidents of surface water flooding, particularly in the main urban areas of the district.
- The primary fluvial flood risk for the majority of Bassetlaw is associated with the River Trent and its tributary, the River Idle. In the west area of the district, the River Ryton and its tributaries are the primary sources of fluvial risk. There are also other small tributaries that influence the fluvial flood risk in Worksop and Retford.
- Bassetlaw has experienced a number of historic surface water flooding incidents. The Risk of Flooding from Surface Water map further shows a number of prominent overland flow routes in the district; these predominantly follow topographical flow paths of existing watercourses or road networks in urban areas, with some isolated flow-routes through properties by virtue of run-off.
- The majority of the district is classified as <25% in the AStGWF map with areas of increased groundwater flooding susceptibility in the East along the River Trent and to the West over the Carlton Beck. There is increased risk of groundwater flooding throughout the district due to an history of mining in Bassetlaw.
- There are 20 reservoirs located within Bassetlaw and a number located outside of the area whose inundation mapping is shown to affect Bassetlaw. There are no records of flooding from reservoirs impacting properties inside the study area. The level and standard of inspection and maintenance required under the Act means that the risk of flooding from reservoirs is relatively low.
- The Severn Trent Water HFRR register indicates a total of 208 recorded incidents of sewer flooding in Bassetlaw District administrative area. Anglian water had no recorded incidents in Bassetlaw. The settlements with the most recorded incidents include Retford, Worksop and Costhorpe.
- There are records of historic canal overtopping and breach along the Chesterfield Canal.

How to use this report

Planners

The SFRA provides recommendations regarding all sources of flood risk in Bassetlaw District which can be used to inform policy on flood risk within the Local Plan. This includes how the cumulative impact of development should be considered.

It provides the latest flood risk data and guidance to inform the Sequential Test and provides guidance on how to apply the Exception Test. The District Council will use this information to apply the Sequential Test to strategic allocations and identify where the Exception Test will also be needed.

The SFRA provides guidance for developers, which can be used by Development Management staff to assess whether site specific Flood Risk Assessments meet the required quality standard.

Developers

For sites that are not strategic allocations, developers will need to use this SFRA to help apply the Sequential Test. For all sites, whether strategic allocations or windfall sites, developers will need to apply the Exception Test and use information in a site-specific Flood Risk Assessment to inform this test at planning application stage.

When assessing sites not identified in the Local Plan (windfall sites), developers should use evidence provided in this SFRA to apply the Sequential Test as well as providing evidence to show that they have adequately considered other reasonably available sites.

This SFRA provides guidance for the application of the Sequential and Exception Tests at a site level and for detailed site-specific Flood Risk Assessments.

This is a strategic assessment and does not replace the need for site specific Flood Risk Assessments where a development is either within Flood Zones 2 or 3 or greater than a hectare in Flood Zone 1. In addition, a surface water drainage strategy will be needed for all major developments in any Flood Zone to satisfy Nottinghamshire County Council (the Lead Local Flood Authority (LLFA) for the area).

Developers can use the information in this SFRA, alongside site specific research to help to scope out what additional work will be needed in a detailed Flood Risk Assessment. To do this they should refer to the Chapter 6 Sources of flooding in Bassetlaw and the flood maps in the appendices.

At the planning application stage, developers may need to undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent (including latest climate change allowances, due to be updated by the Environment Agency in 2019), inform master planning and prove, if required, whether the Exception Test can be passed. As part of the Environment Agency's updated guidance on climate change, which must be considered for all new developments and planning applications, developers will need to

undertake a detailed assessment of climate change as part of the planning application process when preparing FRAs.

Developers need to ensure that new development does not increase surface water runoff from a site. Chapter 11 provides information on the surface water drainage requirements of Nottinghamshire County Council as LLFA. Sustainable Drainage Systems should be considered at the earliest stages that a site is developed which will help to minimise costs and overcome any site-specific constraints.

Flood risk assessments will need to identify how flood risk will be mitigated to ensure the development is safe from flooding. In high risk areas the Flood Risk Assessment will also need to consider emergency arrangements, including how there will be safe access and egress from the site.

Any developments located within an area protected by flood defences, where the condition of those defences is 'fair' or 'poor', where the future maintenance is uncertain and where the standard of protection is not of the required standard (either now or in the future) should be identified and the use of developer contributions considered to fund improvements.

Neighbourhood plans

The SFRA provides information on the sources of flooding and the variation in the risk across the District, which organisations are involved in flood risk management and their latest strategic plans, current plans for major flood defences the requirements for detailed Flood Risk Assessments.

Neighbourhood planners can use this information to assess the risk of flooding to sites within their community, using the Chapter 6, the sources of flooding in Bassetlaw and the flood mapping in the appendices. The SFRA will also be helpful for developing community level flood risk policies in high flood risk areas.

These maps highlight on a broad scale where flood risk from fluvial, surface water, ground water and the effects of climate change are most likely. These maps are useful to provide a community level view of flood risk but may not identify if an individual property is at risk of flooding or model small scale changes in flood risk. Local knowledge of flood mechanisms will need to be included to complement this broadscale mapping. Similarly, all known recorded historical flood events for the district are listed in Section 6.1 and this can be used to supplement local knowledge regarding areas worst hit by flooding. Ongoing and proposed flood alleviation schemes planned by Bassetlaw District council are outlined in Section 7.2 and Section 10.6 discusses mitigations, resistance and resilience measures which can be applied to alleviate flood risk to an area.

A cumulative impact assessment has been carried out which has identified which Parishes in Bassetlaw are more sensitive to the cumulative impact of development and where more stringent policy regarding flood risk is recommended. Any development in these areas should mitigate against existing flooding problems and any potential future flooding.

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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 – The probability (expressed as a percentage) of a flood event occurring in any given year.
AStGWf	Areas Susceptible to Groundwater flooding
Brownfield	Previously developed parcel of land
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.
Design flood	This is a flood event of a given annual flood probability, which is generally taken as: fluvial (river) flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year), or; tidal flooding with a 0.5% annual probability (1 in 200 chance each year), against which the suitability

	of a proposed development is assessed and mitigation measures, if any, are designed.
DTM	Digital Terrain Model
EA	Environment Agency
EU	European Union
Exception Test	Set out in the NPPF, the Exception Test is a method used to demonstrate that flood risk to people and property will be managed appropriately, where alternative sites at a lower flood risk are not available. The Exception Test is applied following the Sequential Test.
FCERM	Flood and Coastal Erosion Risk Management
FEH	Flood Estimation Handbook
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 Map for Planning	The Environment Agency Flood Map for Planning (Rivers and Sea) is an online mapping portal which shows the Flood Zones in England. The Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences and do not account for the possible impacts of climate change.
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.
FWA	Flood Warning Area
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a 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
FRMP	Flood Risk Management Plan

FSA	Flood Storage Area
FWMA	Flood and Water Management Act
FWS	Flood Warning System
GI	Green Infrastructure – a network of natural environmental components and green spaces that intersperse and connect the urban centres, suburbs and urban fringe
Greenfield	Undeveloped parcel of land
Ha	Hectare
IDB	Internal Drainage Board
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
Jflow	2D generalised hydrodynamic modelling software.
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
m AOD	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
NFM	Natural Flood Management
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
NRD	National Receptor Database
NRIM	National Reservoir Inundation Mapping
NVZs	Nitrate Vulnerability Zones
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.
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.
PPS25	Planning Policy Statement 25: Development and Flood Risk – superseded by the NPPF and PPG
RBMP	River Basin Management Plan
RFCC's	Regional Flood and Coastal Committee
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.
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.
Riparian owner	A riparian landowner, in a water context, owns land or property, next to a river, stream or ditch.
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.
Risk Management Authority	Operating authorities who's remit and responsibilities concern flood and / or coastal risk management.
RoFfSW	Risk of Flooding from Surface Water (formerly known as the Updated Flood Map for Surface Water (uFMfSW))
Sequential Test	Set out in the NPPF, the Sequential Test is a method used to steer new development to areas with the lowest probability of flooding.
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
SFRA	Strategic Flood Risk Assessment
SMP	Shoreline Management Plan
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.
SPD	Supplementary Planning Document
SPZ	(Groundwater) Source Protection Zone
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
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 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.
WFD	Water Framework Directive – Under the WFD, all waterbodies have a target to achieve Good Ecological Status (GES) or Good Ecological Potential (GEP) by a set deadline. River Basin Management Plans (RBMPs) set out the ecological objectives for each water body and give deadlines by when objectives need to be met.

1 Introduction

This Strategic Flood Risk Assessment 2018 document replaces the Level 1 Strategic Flood Risk Assessment originally published by Bassetlaw District Council in July 2009. The purpose of this study is to support the production of the council's Local Plan, provide an understanding of the risks from all types of flooding across the council areas, and to present clear and robust evidence.

1.1 SFRA Objectives

The key objectives of Level 1 Strategic Flood Risk Assessment are:

1. To replace the Council's 2009 Level 1 SFRA, taking into account the most recent policy and legislation in the National Planning Policy Framework (2018).
2. To collate and analyse the latest available information and data for current and future (i.e. climate change) flood risk from all sources, and how these may be mitigated.
3. To inform decisions in the emerging Local Plan, including the selection of development sites and planning policies.
4. To provide evidence to support the application of the Sequential Test for the allocation of new development sites, to support the Council's preparation of the Local Plan.
5. To provide a comprehensive set of maps presenting flood risk from all sources that can be used as evidence base for use in the emerging Local Plan.
6. To provide advice for applicants carrying out site-specific flood risk assessments and outline specific measures or objectives that are required to manage flood risk.

1.2 Levels of SFRA

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

- Level 1: where flooding is not a major issue in relation to potential site allocations and where development pressures are low. The assessment should be of sufficient detail to enable application of the Sequential Test.
- Level 2: where land outside Flood Zones 2 and 3 cannot appropriately accommodate all necessary development, creating the need to apply the NPPF Exception Test. In these circumstances, the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

This update provides a Level 1 SFRA assessment. Should the Councils be unable to place development outside of flood zones, a Level 2 assessment may be required in the future.

1.3 SFRA outputs

To meet the objectives, the following outputs have been prepared:

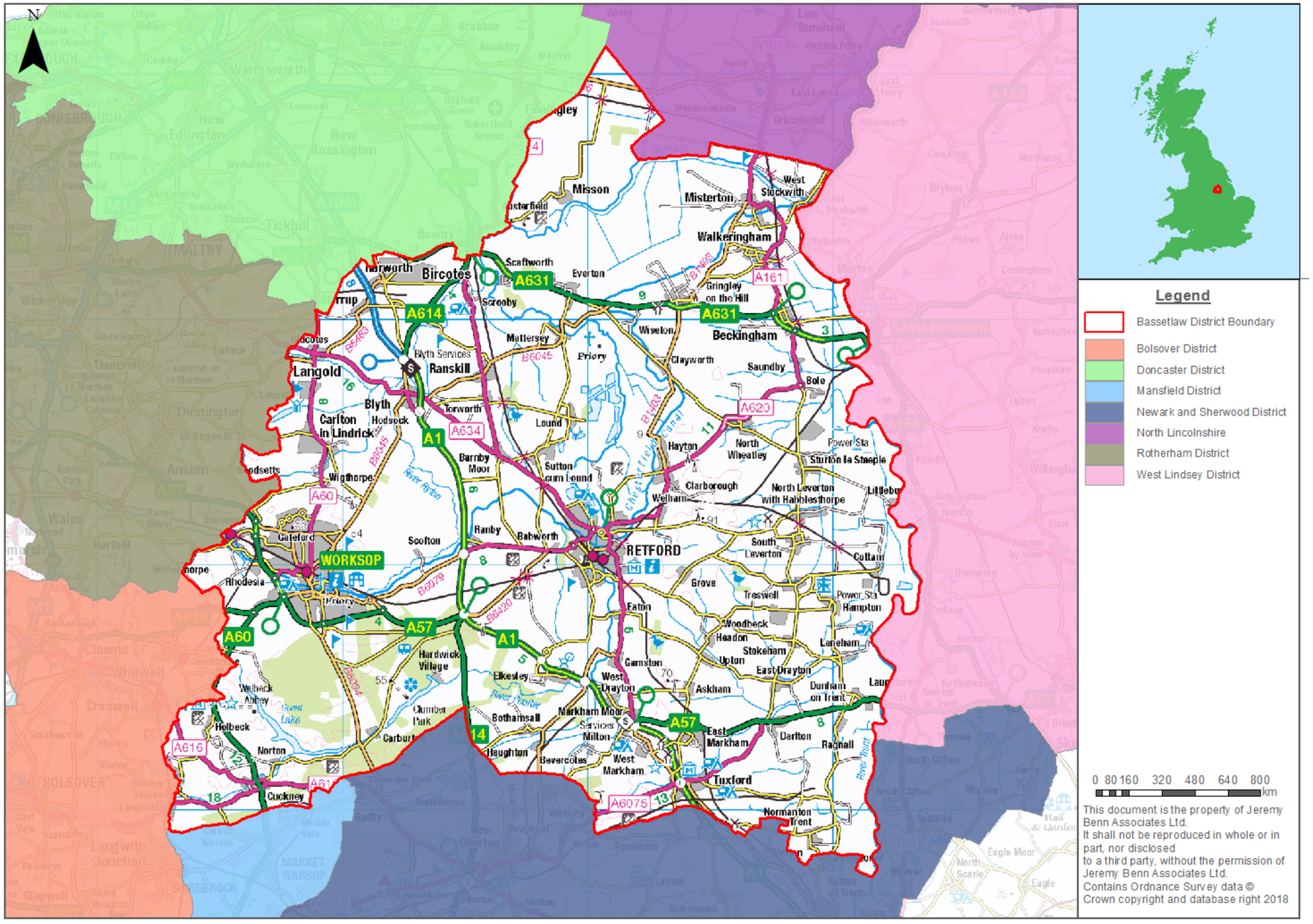
- Identification of policy and technical updates from the previous Level 1 Strategic Flood Risk Assessment.
- Identification of any strategic flooding issues which may have cross-boundary implications.
- Identification of any flood modelling and data gaps.
- Appraisal of all potential sources of flooding, including Main River, ordinary watercourse, surface water, sewers, groundwater, reservoirs and canals.
- Mapping showing the distribution of flood risk across all flood zones from all sources of flooding, including climate change allowances, including the addition of new and amended data sources.
- Review of historic flooding incidents.
- Reporting on the standard of protection provided by defences.
- Assessment of surface water management issues and Sustainable Drainage Systems guidance.
- Flood Risk Assessment guidance for developers.
- Sequential Test guidance and sequential approach to flood risk.

1.4 SFRA Study Area

The Bassetlaw District Council administrative area covers an area of approximately 639km^2 and has a population of approximately 116,304 (2017). As the northernmost District of Nottinghamshire, Bassetlaw is a predominately rural district with two main urban centres; Worksop and Retford.

Bassetlaw is the northernmost District in Nottinghamshire with over 10,000 hectares of woodland (including parts of the old Sherwood forest) and over 300 protected local wildlife sites. To the north of Bassetlaw, the Idle lowlands are characterised by gently undulating arable landscape, with areas to the east of Retford having a rich coal mining heritage. The Trent and Idle Washlands offer fertile farming and Bassetlaw has generous historic parklands such as Clumber Park and Welbeck Estate. An overview of the study area is shown in Figure 1-1.

Figure 1-1:Study Area



1.5 Consultation

SFRA's should be prepared in consultation with other risk management authorities. The following parties (external to Bassetlaw District council) have been consulted during the preparation of this version of the SFRA:

- Environment Agency
- Canal & River Trust
- Nottinghamshire County Council, including the Lead Local Flood Authority and Highways
- Severn Trent Water
- Anglian Water
- Internal Drainage Boards (IDBs)
- Neighbouring authorities including:
    - Bolsover District Council
    - Doncaster District Council
    - Mansfield District Council
    - Newark and Sherwood District Council
    - North Lincolnshire Council
    - Rotherham District Council
    - West Lindsey District Council

1.6 Use of SFRA data

It is important to recognise that Level 1 SFRAs are high-level strategic documents and, as such, do not go into detail on an individual site-specific basis. The primary purpose of this SFRA data is to provide an evidence base to inform Bassetlaw's Local Plan and any future flood risk policies, as detailed in the objectives listed in Section 1.1. This SFRA is intended to aid Bassetlaw District Council in applying the Sequential Test for their site allocations and identify where the application of the Exception Test may be required via a Level 2 SFRA.

The data contained in this SFRA also has a number of other uses, in addition to that which is noted above. Table 1-1 sets out the structure and content of the SFRA report and associated mapping, alongside how the data can be used, primarily by Bassetlaw District Council or private developers.

Hyperlinks to external guidance documents/ websites are provided in green throughout the SFRA.

2 The Planning Framework and Flood Risk Policy

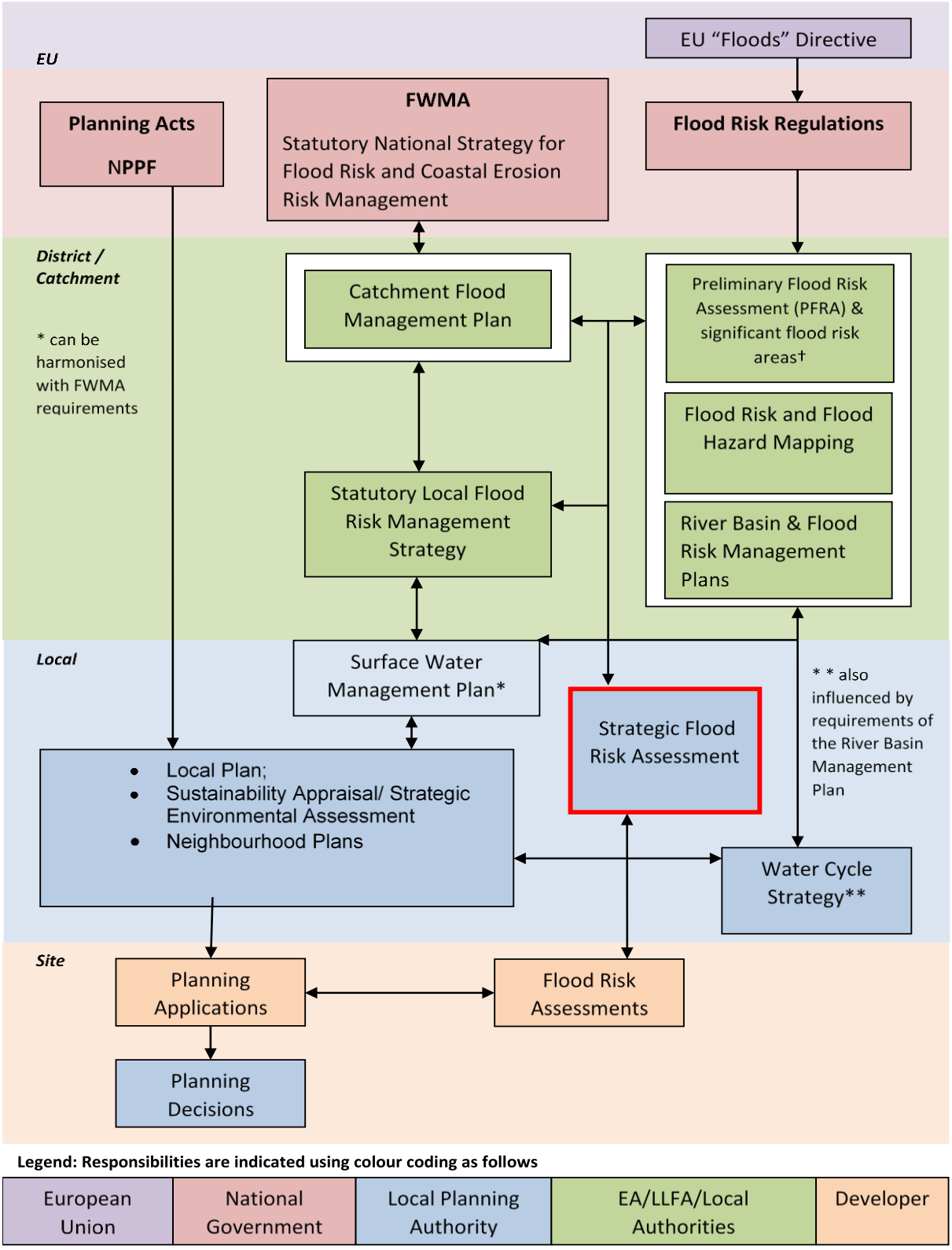
2.1 Introduction

The overarching aim of development and flood risk planning policy in the UK is to ensure that the potential risk of flooding is taken into account at every stage of the planning process. This section of the SFRA provides an overview of the planning framework, flood risk policy and flood risk responsibilities. In preparing the subsequent sections of this SFRA, appropriate planning and policy amendments have been acknowledged and taken into account.

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), Surface Water Management Plans (SWMPs) and Water Cycle Studies (WCSs).

Figure 2-1 outlines the key strategic planning links for flood risk management 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 mutual exchange of information and the preparation of strategies and management plans.

Figure 2-1: Strategic planning links and key documents for flood risk



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

2.2 Roles and responsibilities for Flood Risk Management in Bassetlaw District

There are a number of different organisations in and around Bassetlaw that have responsibilities for flood risk management, known as Risk Management Authorities (RMAs). These are shown on Table 2-1, with a summary of their responsibilities.

It is important to note that land and property owners are responsible for the maintenance of watercourses either on or next to their properties. Property owners are also responsible for the protection of their properties from flooding as well as other management activities, for example by maintaining river beds/ banks, controlling invasive species and allowing the flow of water to pass without obstruction. More information can be found in the Environment Agency publication 'Owning a Watercourse' (2018).

When it comes to undertaking works to reduce flood risk, the Environment Agency, IDBs, Nottinghamshire County Council as LLFAs and Bassetlaw District Council do have powers, but limited resources must be prioritised and targeted to where they can have the greatest effect.

Table 2-1: Risk Management Authorities

Risk Management Authority	Strategic Level	Operational Level
Environment Agency	• Strategic overview for all sources of flooding • National Strategy • Reporting and general supervision	• Main rivers (e.g. river Idle, River Trent, River Poulter, River Ryton) • Reservoirs
Nottinghamshire County Council as Lead Local Flood Authority (LLFA)	• Preliminary Flood Risk Assessment • Local Flood Risk Management Strategy	• Surface Water • Groundwater • Ordinary Watercourses (consenting and enforcement) • Ordinary watercourses (works)
Bassetlaw District Council as Local Planning Authority	• Local Plans as Local Planning Authorities	• Determination of Planning Applications as Local Planning Authorities • Managing open spaces under District Council ownership
Internal Drainage Boards: • *Trent Valley* • *Isle of Axholme and North Nottinghamshire* • *Doncaster East*	• Water Level Management Plans	• Ordinary Watercourses within Internal Drainage Districts
Water Companies: • *Severn Trent Water* • *Anglian Water*	• Asset Management Plans, supported by Periodic Reviews (business cases) • Develop Drainage and Wastewater management plans	• Public sewers
Highways Authorities • *Highways Agency (motorways and trunk roads)* • *Nottinghamshire County Council (other adopted roads)*	• Highway drainage policy and planning	• Highway drainage

2.3 Relevant flood risk policy documents

This section summarises relevant national and local flood risk and water management documents and policies. Some of these are required by EU legislation. The UK is due to leave the EU in March 2019. However, both the Floods Directive and Water Framework Directive have been applied into English law using secondary legislation. Until this secondary legislation is reviewed, these requirements will remain.

2.3.1 Flood Risk Regulations

The Flood Risk Regulations (2009) translate the EU Floods Directive into UK law. The EU requires Member States to complete an assessment of flood risk (known as a Preliminary Flood Risk Assessment (PFRA)) and then use this information to identify areas where there is a significant risk of flooding. For these Flood Risk Areas, States must then undertake Flood Risk and Hazard Mapping and produce Flood Risk Management Plans.

The Flood Risk Regulations direct the Environment Agency to do this work for river, sea and reservoir flooding. LLFAs must do this work for surface water, Ordinary Watercourse and Groundwater flooding. This is a six-year cycle of work and the second cycle started in 2017.

The Bassetlaw PFRA (2011) provides information on significant past and future flood risk from localised flooding in the. This was updated in 2017, and no nationally significant Flood Risk Areas for localised flooding have been identified in Bassetlaw.

The Environment Agency recently undertook a PFRA for river, sea and reservoir flooding and identified new nationally significant Flood Risk Areas for these sources. This was published in December 2019. There are 40 Flood Risk Areas in the Humber catchment for which more detailed flood risk and hazard maps and a Flood Risk Management Plan will be produced. Information on the exact location of these is available from the Environment Agency.

2.3.2 Flood risk management plans (FRMP)

The FRMP draws on previous policies and actions identified in Catchment Flood Management Plans (CFMPs) and also incorporates information from Local Flood Risk Management Strategies (LFRMs). Bassetlaw District falls within the Humber River Basin District FRMP (March 2015). The FRMP summarises flooding affecting the catchments and describe the measures to be taken to address the risk in accordance with the Flood Risk Regulations. The Humber River Basin District is split into 15 management catchments; Bassetlaw District Council lies within the Idle and Torne and Lower Trent and Erewash catchment.

In the Idle and Torne catchment identifies six prevention measures associated with the prevention of damage caused by floods:

- investigate ways of working with the environment to reconnect the floodplain with rivers, in areas of mineral workings, especially sand and gravel sites, to assist in improving flood risk management;
- deliver priority habitat and help to deliver flood risk management improvements by ensuring that appropriate designs are in place at the onset of a project;
- identify the potential for rehabilitating watercourses and developing plans for implementing land management improvements, all of which can have positive impacts upon flood risk;
- consider opportunities for storing water in areas upstream of urban centres;
- review the Trent hydraulic model to enable us to consider flood risk within the Idle and Torne, and help us to deliver multi-benefit environmental outcomes with respect to the Isle of Axholme Strategy;
- develop specific Torne and Idle hydraulic models to consider optimising maintenance and biodiversity options.

The Lower Trent and Erewash Catchment identifies several measures to inform protection, prevention, preparedness and recovery and review. The measures which Bassetlaw District need to consider are:

- Protection of property from flooding, needs to consider the importance of both the design life and the design standard. Defences can never 100% guarantee against all flooding occurrences.
- It is important to investigate ways of working with the environment to reconnect the floodplain with rivers, in areas of mineral workings, especially sand and gravel sites, to assist in improving flood risk management. Alternatively, consider opportunities for storing water in areas upstream of urban centres
- Trent hydraulic model, for the tidal reaches of the watercourse, are currently being reviewed to consider how the tidal Trent area can contribute to the wider Humber estuary in terms of delivering compensatory habitat and wider flood risk management in and around the estuary.
- Investigate flood resilience for infrastructure, such as transportation links, energy services and telecommunications, by first understanding what key infrastructure is at risk of flooding, then determining how damages can be limited and what measures can be undertaken to prepare for flooding.

- The Environment Agency proposes to work with communities to develop flood warden schemes, improve the uptake of FWD, whilst looking to improve flood forecasting through better warning and expansion of the service. The Environment Agency is looking at reviewing the hydrometric network and looking to improve flood warning.

2.3.3 Flood and Water Management Act, 2010

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

The FWMA gives Nottinghamshire County Council as Lead Local Flood Authority various duties and powers for flood risk management and these are set out in Table 2-2 below.

Table 2-2: Roles and responsibilities as Lead Local Flood Authority Strategic

Roles and responsibilities	Operational
Develop, maintain, apply and monitor a Local Flood Risk Management Strategy. Co-ordinate partnership working between relevant organisations. Represent Nottinghamshire on the River Trent Regional Flood and Coastal Committee. To comply with the European Floods Directive, produce a Preliminary Flood Risk Assessment and for nationally significant Flood Risk Areas, surface water mapping and a Flood Risk Management Plan (on a six-year cycle).	Investigate flooding incidents and set out who has responsibilities and what actions can be taken. Hold a register of significant drainage/ flood alleviation assets. Power to designate third party assets acting as flood defences so they cannot be altered or removed. Powers to enforce land drainage legislation to ensure ordinary watercourses flow properly and a duty to consent to certain works on these watercourses. Powers to build new flood alleviation schemes for local sources of flooding. Statutory Consultee for Planning Applications for surface water drainage on major developments

2.3.4 Nottinghamshire Local Flood Risk Management Strategy (LFRMS) 2016

Nottinghamshire County Council as a LLFA is responsible for developing, maintaining, applying and monitoring a Local Flood Risk Management Strategy for Nottinghamshire. The Strategy is used as a means by which the LLFA co-ordinates Flood Risk Management on a day to day basis. The Strategy also sets measures to manage local flood risk. The high-level objectives proposed in the Strategy for managing flood risk include:

- To pursue new solutions, partnerships and alleviation schemes to manage future flood risks and adapt to climate change in Nottinghamshire.
- To increase levels of awareness and cooperation within local organisations and communities so they can become more resilient to flooding and understand their land drainage responsibilities.
- To improve delivery of flood risk management by working in partnership across functions and organisations, taking a catchment-based approach.
- To integrate local flood risk management into the planning process and support sustainable growth.

- To consider the environmental impact of proposed flood risk management measures, maximise opportunities to contribute to the sustainable management of our cultural heritage and landscape and deliver environmental benefits.

2.3.5 LLFAs, surface water and SuDS

The revised 2018 NPPF states that: 'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate' (Para 165). When considering planning applications, local planning authorities should consult the LLFA on the management of surface water in order to satisfy that:

- the proposed minimum standards of operation are appropriate
- through the use of planning conditions or planning obligations, there are clear arrangements for on-going maintenance over the development's lifetime.

2.3.6 Water Cycle Studies

Water Cycle Studies assist local authorities to select and develop growth proposals that minimise impacts on the environment, water quality, water resources, infrastructure and flood risk and help to identify ways of mitigating such impacts. This can be achieved in areas where there may be conflict between any proposed development and the requirements of the environment through the recommendation of potential sustainable solutions.

A Scoping and Outline Water Cycle Study covering Bassetlaw District was completed in January 2010. The Study sets out recommendations in relations to housing growth, Infrastructure, water quality and water resources for each of the main urban areas.

For developers there is Water Cycle Developers Checklist which should be used as part of the planning application process and has been developed by building on previous examples used in previous WCS and the Environment Agency's national standards checklist.

2.3.7 Surface Water Management Plans

Surface Water Management Plans (SWMPs) outline the preferred surface water management strategy in a given location. SWMPs 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 a particular area and are intended to influence future capital investment, drainage maintenance, public engagement and understanding, land-use

planning, emergency planning and future developments. There are no known SWMPs in the Bassetlaw area.

2.3.8 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 that can be applied to different locations in the catchment.

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.

Bassetlaw District is covered by the River Trent CFMP and provides proposed 'actions' to manage risk for each sub-area. The policy options and sub-areas applicable to Bassetlaw are as follows:

- Policy option 3 in Sherwood
- Policy option 4 in Shelford to Gainsborough and Axholme and NW Lincolnshire

The 2019 SFRA will help support the above policies in the CFMPs by aiding LPAs to make informed decisions about the location of future development, as well as identifying where future flood risk management measures may

be required. The specific 'actions' relevant to Bassetlaw in relation to strategic flood risk management can be found in Section 12.1

2.3.9 The Water Framework Directive

The EU Water Framework Directive (WFD) seeks to integrate and enhance the way in which water bodies are managed throughout Europe by the preservation, restoration and improvement of the water environment. On 23 October 2000 the European Commission established the WFD Directive (WFD) requiring each Member State of the European Union to satisfy the environmental objectives set by the Directive and implement the legislation. This was transposed into law in England and Wales in 2003. In England, the Environment Agency is responsible for the delivery of the WFD objectives.

The Directive requires that Environmental Objectives be set for all surface and ground waters in England and Wales to enable them to achieve Good Ecological Status (or Good Ecological Potential for Heavily Modified and Artificial Water Bodies) by a defined date.

It is important that developments aim to take positive measures to conform to the WFD, which can be impacted as a result of development, for example in terms of 'deterioration' in ecological status or potential.

2.3.10 Humber River Basin Management Plan (Updated 2015)

The WFD requires the production of Management Plans for each River Basin District. River Basin Management Plans (RBMPs) aims to ensure that all aquatic ecosystems, riparian ecosystems and wetlands reach 'good status'. To achieve 'good status', a waterbody must be observed to be at a particular level of ecological and chemical quality.

The Bassetlaw District Council area falls within the Humber River Basin District. The Humber RBMP13 identified a number of pressures that has significantly altered and damaged the environment over the last few hundred years and major challenges to deal with. Key issues include pollution, biodiversity, climate change and communication and engagement. A number of actions have been proposed to manage these issues. Further information can be found in the RBMP and the Catchment Based Approach (CaBA) website.

2.3.11 Drainage and Wastewater Management Plan (DWMP)

As part of a new direction developed by central government, with the support of a number of water utility companies and private business, Severn Trent will be looking to develop a Drainage and Wastewater Management Plan (DWMP). The DWMP for Severn Trent will contain a number of Strategic Planning Areas (SPA), these will be based on the water basin catchments. Bassetlaw is covered by two SPA's the Lower Trent SPA

and the North Notts SPA. Severn Trent will be utilising these boundaries to look at the impact of our operations and the water cycle in a more holistic way. This should enable schemes to be delivered that provide wider benefits to the whole water cycle. Delivery of a successful DWMP is likely to require partnership working and good communication with key stakeholder such as Bassetlaw District Council. Developers and planners should consult the emerging DWMP and Sever Trent water when considering flood risk in Bassetlaw District.

2.3.12 National Planning Policy Framework

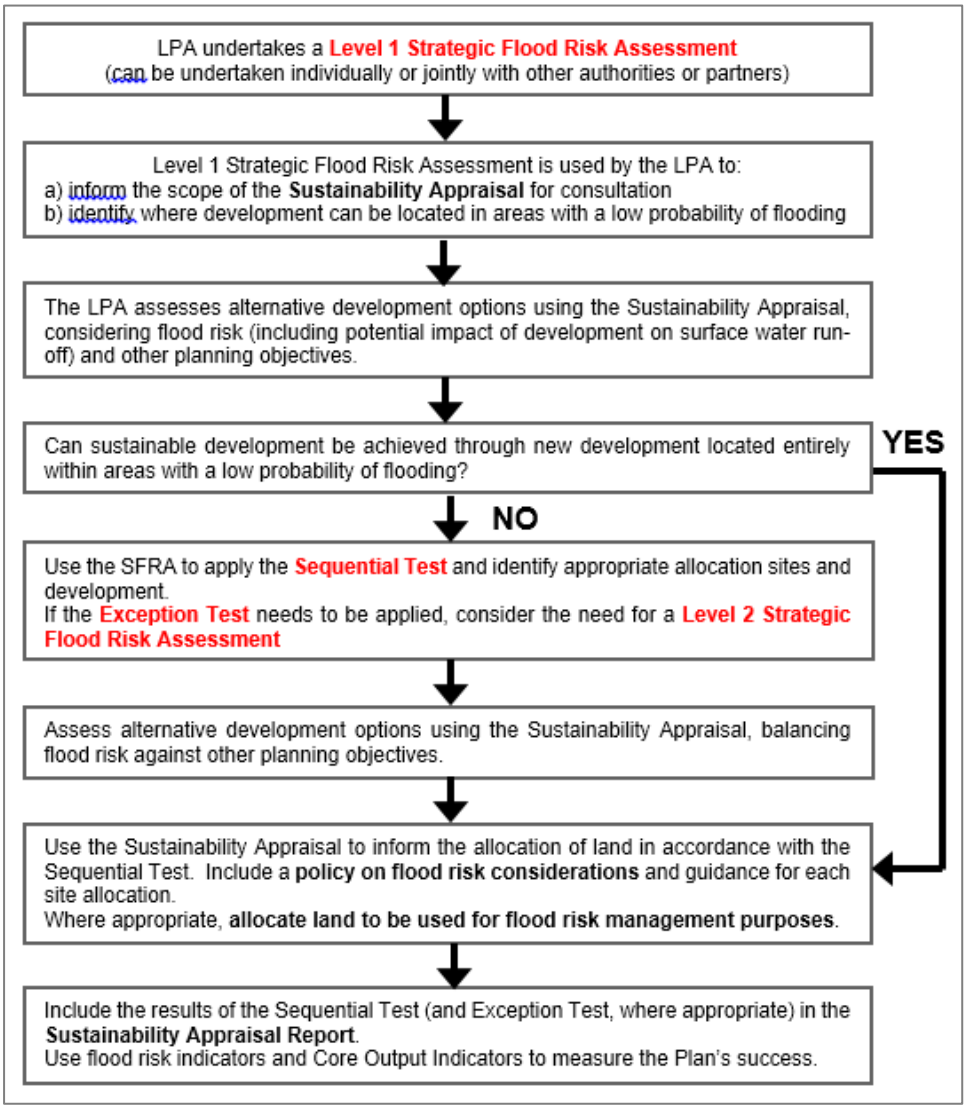
The revised NPPF was published in July 2018, replacing the previous version published in March 2012. The NPPF sets out Government's planning policies for England and how these are expected to be applied. The Framework is based on core principles of sustainability and forms the national policy framework in England, also accompanied by a number of Planning Practice Guidance (PPG) notes. It must be taken into account in the preparation of local plans and is a material consideration in planning decisions.

The PPG documents will, where necessary, be updated in due course to reflect the changes in the revised NPPF. The NPPF states that:

"Strategic policies should be informed by a strategic flood risk assessment and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards"

Planning Practice Guidance on flood risk was published in March 2014 and sets out how the policy should be implemented. NPPF defines the Flood Zones, the appropriate land uses for each zone, flood risk assessment requirements and the policy aims for developers and authorities regarding each Flood Zone. Further details on Flood Zones and associated policy is provided in Chapter 3 and throughout this report. A description of how flood risk should be taken into account in the preparation of Local Plans is outlined in Diagram 1 contained within the Planning Practice Guidance (see Figure 2-2).

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: 7-005-20140306) March 2014

3 The sequential, risk-based approach

3.1 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.

The sequential approach can be applied both between and within Flood Zones.

When drawing up a Local Plan, 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 and a greater understanding of the scale and nature of the flood risks is required.

3.1.1 Flood Zones

Table 1 of NPPG Flood Risk and Coastal Change identifies the following Flood Zones. These apply to both Main River and Ordinary Watercourses. Flood risk vulnerability and Flood Zone compatibility is set out in Table 3 of the NPPG. Table 3-1 summarises this information and also provides information on when an FRA would be required.

Table 3-1: Flood Zone descriptions

Zone	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%).
		All land uses are appropriate in this zone.
		For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a flood risk assessment.
Zone 2	Medium	This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (0.1% - 1%) or between 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.1% – 0.5%) in any year.
		Essential infrastructure, water compatible infrastructure, less vulnerable and more vulnerable land uses (as set out by NPPF) as appropriate in this zone. Highly vulnerable land uses are allowed as long as they pass the Exception Test.
		All developments in this zone require an FRA.
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 Developers and the local authorities should seek to reduce the overall level flood risk, relocating development sequentially to areas of lower flood risk and attempting to restore the floodplain and make open space available for flood storage.
		Water compatible and less vulnerable land uses are permitted in this zone. Highly vulnerable land uses are not permitted. More vulnerable and essential infrastructure are only permitted if they pass the Exception Test.
		All developments in this zone require an FRA.
Zone 3b	Functional 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 functional floodplain should take account of local circumstances.
		Only water compatible and essential infrastructure are permitted in this zone and should be designed to remain operational in times of flood, resulting in no loss of floodplain or blocking of water flow routes. Infrastructure must also not increase flood risk elsewhere.
		All developments in this zone require an FRA.

Further definition of Zone 3b:

This Flood Zone comprises land where water has to flow or be stored in times of flood (the functional floodplain). The mapping in the SFRA identifies this Flood Zone as land which would flood with a 5% chance in each and every year (a 1 in 20-year annual exceedance probability), where modelling exists for both river and sea flooding. Where the 5% AEP model outputs are not available, the 4% AEP (a 1 in 25-year annual probability)

results were used as an alternative. In Appendix B, Flood Zone 3b is identified in the Flood Zone mapping.

The presence of defences is considered when mapping Flood Zone 3b, but if these defences are overtopped during a flood with a 5% chance in each and every year then the mapping will show that the Zone affects land behind defences. Under climate change conditions, this effect can result in the extent of the Zone increasing substantially and, in such circumstances, decisions on land allocation or planning applications should review and take account of the implications of this effect and whether such land should be regarded as functional floodplain.

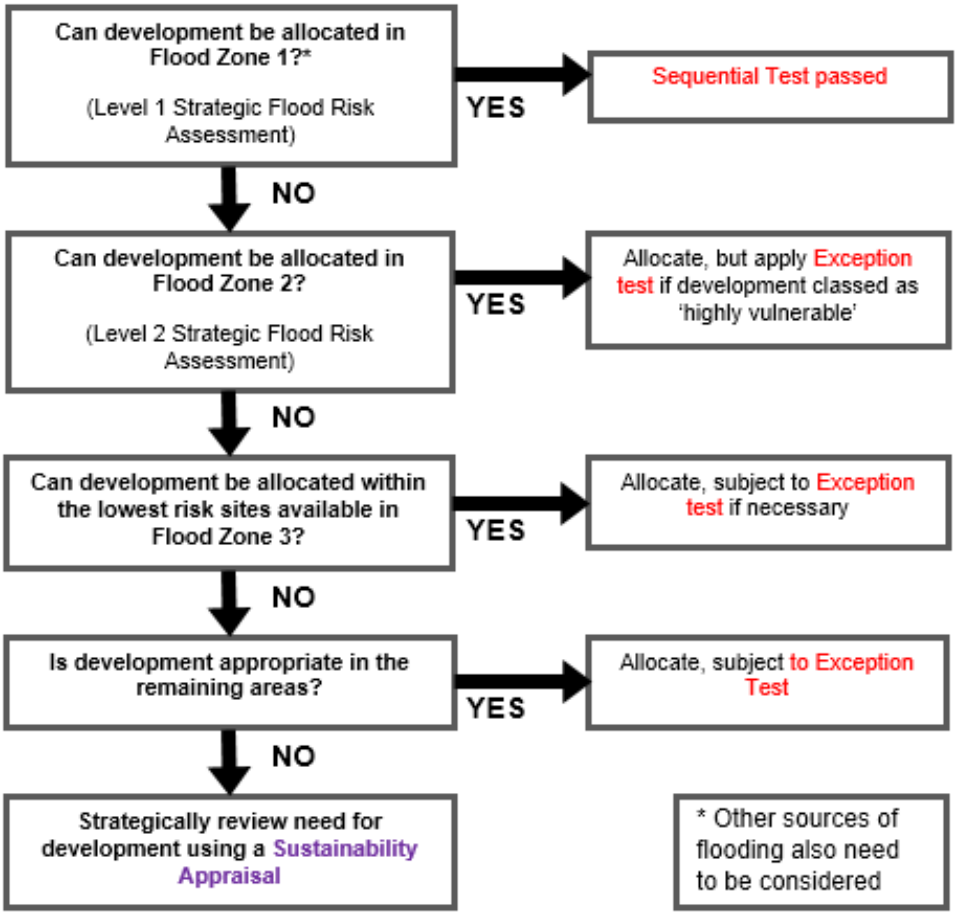
In circumstances where existing development or infrastructure is shown in Flood Zone 3b, where the flooding is a consequence of overtopping of existing defences or where the flooding is a consequence of sea water levels, additional consideration should be given to whether the specific location is appropriate for designation as 'Functional' with respect to the storage or flow of water in time of flood.

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

When preparing a Local Plan, the LPA should demonstrate it has considered a range of site allocations, using SFRAs to apply the Sequential and Exception Tests where necessary.

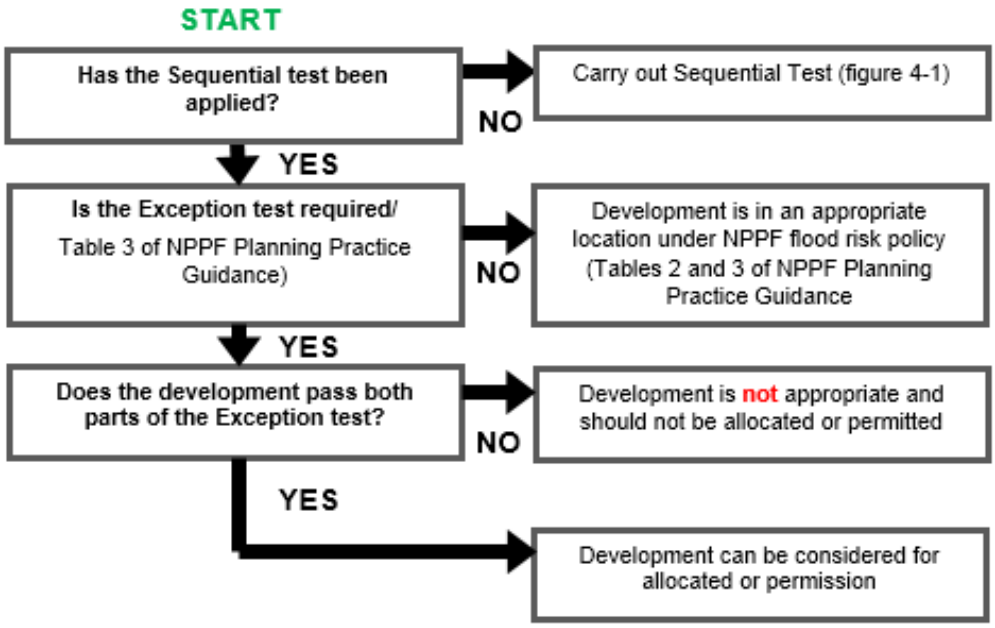
The Sequential Test should be applied to the whole LPA area to increase the likelihood of allocating development in areas not at risk of flooding. The Sequential Test can be undertaken as part of a Local Plan Sustainability Appraisal. Alternatively, it can be demonstrated through a free-standing document, or as part of strategic housing land or employment land availability assessments. NPPG for Flood Risk and Coastal Change describes how the Sequential Test should be applied in the preparation of a Local Plan (Figure 3-1).

Figure 3-1: Applying the Sequential Test in the preparation of a Local Plan



The Exception Test should only be applied following the application of the Sequential Test and as set out in Table 3 of the NPPF Planning Practice Guidance: Flood Risk and Coastal Change. The NPPF PPG describes how the Exception Test should be applied in the preparation of a Local Plan.

Figure 3-2: Applying the Exception Test in the preparation of a Local Plan



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

3.3.1 Sequential Test

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. A pragmatic approach should be taken when applying the Sequential Test.

Bassetlaw District Council, 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 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).
- It is normally reasonable to presume and state that individual sites that lie in Zone 1 satisfy the requirements of the Sequential Test; however, consideration should be given to risks from all sources, areas with critical drainage problems and critical drainage areas.

3.3.2 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 the Exception Test must then be applied if deemed 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 give 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 .

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:

- 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 PPG provide detailed information on how the Test can be applied.

3.4 Actual and residual flood risk

3.4.1 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. 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. 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 where necessary land secured that is required for affordable future flood risk management measures.
- 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.

3.4.2 Residual flood risk

Residual risk refers to the risks that remain in circumstances after measures have been taken to alleviate flooding (such as flood defences). It is important that these risks are quantified to confirm that the consequences can be safely managed. For example, if flood defences were to overtop or fail, what emergency arrangements are in place?

Chapter 7 considers this risk in more detail.

4 Impact of Climate Change

4.1 Climate change and the NPPF

The NPPF sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. NPPF and NPPG describe how FRAs should demonstrate how flood risk will be managed over the lifetime of the development, taking climate change into account.

The Environment Agency has published guidance to local planning authorities in the application of appropriate climate change allowances when considering climate change effects (Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities). This guidance adopts a risk-based approach to the selection of appropriate allowances based on the consequences of flooding, as described by the flood risk vulnerability of the proposed development (see Section 3.3.1).

4.2 Revised Climate Change Guidance

The Environment Agency published updated climate change guidance on 19 February 2016 (and updated on 3 February 2017), which supports the NPPF and must now be considered in all new developments and planning applications. The document contains guidance on how climate change should be taken into account when considering development, specifically how allowances for climate change should be included with FRAs.

In 2018, the government published new UK Climate Projections. The Environment Agency are currently using these to update their climate change guidance for new developments. Developers should check on the government website for the latest guidance before undertaking a detailed Flood Risk Assessment.

4.3 Climate change allowances

By making an allowance for climate change, it will help reduce the vulnerability of the development and provide resilience to flooding in the future. The 2016 climate change guidance includes climate change predictions of anticipated change for peak river flow and peak rainfall intensity. These allowances are based on climate change projections and different scenarios of carbon dioxide emissions to the atmosphere. Due to the complexity of projecting climate change, there are uncertainties attributed to the magnitude of the climate change allowances. As a result, the guidance presents a range of possibilities to reflect the level of uncertainty in the predicted climate change impacts over three periods (epochs).

4.4 Peak river flows

Climate change is expected to increase the frequency, extent and impact of flooding, reflected in peak river flows. Wetter winters and more intense rainfall may increase fluvial flooding and surface water runoff and there may be increased storm intensity in summer. Increased river levels may also increase flood risk.

The peak river flow allowances provided in the guidance show the anticipated changes to peak flow for the river basin district within which the subject watercourse is located. Once the river basin district has been identified, guidance on uplift in peak flows are provided for three allowance categories, Central, Higher Central and Upper End which are based on the 50th, 70th and 90th percentiles respectively. A percentile is a measure used in statistics to describe the proportion of possible scenarios that fall below an allowance level (i.e. the 50th percentile is the point at which half of the possible scenarios for peak flows fall below it and half fall above it.) The allowance category to be used is based on the vulnerability classification of the proposed development and the Flood Zones within which it is to be located.

These allowances are provided in the form of figures for the total potential change anticipated, for three climate change periods:

- The '2020s' (2015 to 2039)
- The '2050s' (2040 to 2069)
- The '2080s' (2070 to 2115)

The time-period used in the assessment depends upon the expected lifetime of the proposed development. Residential development should be considered for a minimum of 100 years, whilst the lifetime of a non-residential development depends upon the characteristics of that development. Further information on what is considered to be the lifetime of development is provided in the NPPG.

The Bassetlaw District area falls within the Humber Basin District. The allowances for the Humber River Basin District are provided in Table 4-1.

Table 4-1: Peak river flow allowances for the Humber river basin district

Allowance Category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	20%	30%	50%
Higher central	15%	20%	30%
Central	10%	15%	20%

4.4.1 High++ allowances

High++ allowances only apply in assessments for developments that are very sensitive to flood risk, for example large scale energy generating infrastructure, and that have lifetimes beyond the end of the century. H++ estimates represent the upper limit of plausible climate projections and would not normally be expected for schemes or plans to be designed to or incorporate resilience for the H++ estimate. Further information is provided in the Environment Agency publication, Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities.

4.4.2 Which peak river flow allowance to use?

The Flood Zone and flood risk vulnerability classification should be considered when deciding which allowances apply to the development or the plan. Vulnerability classifications are found in the NPPG. The guidance states the following:

Flood Zone 2

Vulnerability classification	Central	Higher Central	Upper end
Essential infrastructure		✓	✓
Highly vulnerable		✓	✓
More vulnerable	✓	✓	
Less vulnerable	✓		
Water compatible	None		

Flood Zone 3a

Vulnerability classification	Central	Higher Central	Upper end
Essential infrastructure			✓
Highly vulnerable	Development not permitted		
More vulnerable		✓	✓
Less vulnerable	✓	✓	
Water compatible	✓		

Flood Zone 3b

Vulnerability classification	Central	Higher Central	Upper end
Essential infrastructure			✓
Highly vulnerable		Development not permitted	
More vulnerable			
Less vulnerable			
Water compatible	✓		

4.5 Peak rainfall intensity allowance

Climate change is predicted to result in wetter winters and increased summer storm intensity in the future. This increased rainfall intensity will affect drainage systems, resulting in increased risk of surface water flooding, due to the increased volume of water entering the systems. The table below shows anticipated changes in extreme rainfall intensity in small and urban catchments. These allowances should be used for small catchments and urban drainage sites. For catchments, larger than 5km^2, the guidance suggests the peak river flow allowances should be used.

For Flood Risk Assessments, both the Central and Upper end allowances should be assessed to understand the range of impact.

Table 4-2: Peak rainfall intensity allowance in small and urban catchments

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper end	10%	20%	40%
Central	5%	10%	20%

4.6 Using climate chance allowances

To help decide which allowances to use to inform the selection of flood levels for flood risk management measures at a development or development plan allocation, the following should be considered:

- likely depth, speed and extent of flooding for each allowance of climate change over time considering the allowances for the relevant epoch (2020s, 2050s and 2080s)
- vulnerability of the proposed development types or land use allocations to flooding
- 'built in' resilience measures used, for example, raised floor levels
- capacity or space in the development to include additional resilience measures in the future, using a 'managed adaptive' approach

The Environment Agency have produced guidance on when and how to use climate change allowances and published it online. Aspects the guidance covers includes:

- What climate change allowances are
- When they should be used
- Types of allowance
- How to use a range of allowances for peak flow and rainfall intensity, and
- Exceptions – when other data or climate change allowances may be more appropriate

The epoch selected, i.e. the total potential change anticipated for the '2080s' (2070 to 2115), generally reflects the anticipated lifetime for residential development (i.e. 100 years), as stated in Paragraph 026 of the NPPG.

4.7 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 to a greater extent during the summer months. The effect of climate change on groundwater levels for sites in areas where groundwater is known to be an issue should be considered at the planning application stage.

4.8 Impact of climate change in Bassetlaw District

Bassetlaw District Council are committed to tackling climate change which is demonstrated in the signing of the Nottingham Declaration on Climate Change in 2006. This declaration commits Bassetlaw to tackling the causes and effects of climate change within the Districts. Bassetlaw's response to climate change is outlined in its Climate Change Strategy. The strategy identifies the following key areas which are essential in mitigating the impacts of climate change: -

- Energy
- Transport
- Resource Efficiency
- Adaptation and Flooding
- Communication and Education
- Planning and Regulation
- Green Spaces

Each key area has priority actions identified which are essential for improving the council's response to climate change.

4.8.1 Previous studies

The UK Climate Projection 2009 (UKCP09) predict the following climatic changes in the East Midlands (medium emissions scenario):

- Increased summer temperatures of 3.3°C by 2050
- Increased winter temperatures of 2.4°C by 2050
- Reduced summer rainfall of 16% by 2050
- Increased winter rainfall of 14% by 2050.

The East Midlands Councils: The Changing Nature of Flooding in the East Midlands (2015) report explores the effects climate change is predicted to have on flood risk in the East Midlands region. The report included a number of recommendations for councils including:

- Local Resilience Forums make consistent usage of the Severe Weather Impacts Monitoring System (SWIMS) to monitor extreme weather and impacts.
- LLFAs should look to create additional posts with the aim of securing third party contributions towards priority flood risk management schemes.
- Local authorities should help inform support and enable local decision making, using local indicators to determine if areas are becoming more or less resilient to flooding and climate changes.
- Local authorities are also recommended to use the "Climate just" tool to examine the causes of flood disadvantage in their local area and identify appropriate responses.
- Local politicians should work to raise the awareness in communities most at risk and ensure the work across different services is joining up in its approach.
- The Met office published a report titled: Climate change and flood risk – Climate East Midlands that reviews the existing research and literature across the field in relation to the East Midlands. The report includes the following findings:
- The East Midlands is identified as being acutely sensitive to changes in River peak flow with just a 10% increase in peak flows doubling the number of properties at 'significant risk' across the region from 30,000 to 60,000.
- The cost from damage to properties in the region would increase by between 70% and 400% by the 2080s.
- Potential for four-fold (2 to 5x) increases of heavy rainfall events in summer by the end of the century under high emissions scenario.
- A significant increase in average winter groundwater levels in the Lincolnshire Limestone by the 2050s with implications of an increased frequency of groundwater flooding.

4.8.2 SFRA climate change modelling

Climate change mapping has been provided in Appendix C as part of the SFRA.

The climate change mapping in the SFRA uses the results from the existing Environment Agency hydraulic models (100-year +20%) and where no hydraulic models exist, Flood Zone 2 has been used as a conservative indication.

This conservative approach has been taken because Bassetlaw District Council are proposing to allocate development in the lowest flood risk

areas, the Environment Agency are currently updating several of the models in the district and because new guidance on climate change for Flood Risk Assessments is due imminently.

When undertaking a site-specific Flood Risk Assessment, developers should:

1. Confirm which national guidance on climate change and new development applies by visiting GOV.uk

2. Apply this guidance when deciding the allowances to be made for climate change, having considered the potential sources of flood risk to the site (using this SFRA), the vulnerability of the development to flooding and the proposed lifetime of the development. If the site is just outside the indicative climate change extents in this SFRA, the impact of climate change should still be considered because these may get affected should the more extreme climate change scenarios materialise.

3. Contact the Environment Agency to confirm which is the most up to date model available for the area. Table 5-2 has a list of the current models in the Bassetlaw District and timescales (that are subject to change) for the new updated modelling to be complete.

Chapter 11 provides further details on climate change for developers, as part of the FRA Guidance.

4.8.3 Adapting to climate change

The NPPG sections on climate change contain information and guidance for how to identify suitable mitigation and adaptation measure in the planning process to address the impacts of climate change. Examples of adapting to climate change include:

- Considering future climate risks when allocating development sites to ensure risks are understood over the development's lifetime
- Considering the impact of and promoting design responses to flood risk and coastal change for the lifetime of the development
- Considering availability of water and water infrastructure for the lifetime of the development and design responses to promote water efficiency and protect water quality
- Promoting adaptation approaches in design policies for developments and the public realm for example by building in flexibility to allow future adaptation if needed, such as setting new development back from watercourses

- Identifying no or low-cost responses to climate risks that also deliver other benefits, such as green infrastructure that improves adaptation, biodiversity and amenity, for example by leaving areas shown to be at risk of flooding as public open space.

5 Sources of information used in preparing the SFRA

5.1 Fluvial flooding

5.1.1 Flood Zones 2 and 3a

Flood Zones 2 and 3a, as shown in Appendix B, show the same extent as the online Environment Agency's Flood Map for Planning (at the time of preparing this SFRA). Over time, the online mapping is likely to be updated more often than the SFRA, so SFRA users should check there are no major changes in their area.

5.1.2 Flood Zone 3b (the Functional Floodplain)

Flood Zone 3b, as shown in Appendix B, has been compiled for the study area as part of this SFRA and is based on the 5% AEP (1 in 20-year chance of flooding in any given year) or 4% AEP (1 in 25-year chance of flooding in any given year) extents produced from Environment Agency detailed hydraulic models, where outputs were available. This information is only available in the SFRA and not shown on the online map.

For areas not covered by detailed models, a precautionary approach should be adopted for Flood Zone 3b 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.

If the area of interest is in an area that has seen some major changes to the extent of the Flood Zones, having checked the online mapping, Developers will also need to remap Flood Zone 3b as part of a detailed site-specific Flood Risk Assessment

5.1.3 Climate change

Please refer to Chapter 4 for information on the approach to climate change in this SFRA.

5.1.4 Surface water

Mapping of surface water flood risk in study area has been taken from the Risk of Flooding from Surface Water (RoFfSW) maps published online by the Environment Agency. These maps are intended to provide a consistent standard of assessment for surface water flood risk across England and Wales in order to help LLFAs, the Environment Agency and any potential developers to focus their management of surface water flood risk.

The RoFfSW is derived primarily from identifying topographical flow paths of existing watercourses or dry valleys that contain some isolated ponding locations in low lying areas. They provide a map which displays different

levels of surface water flood risk depending on the annual probability of the land in question being inundated by surface water (Table 5-1).

Table 5-1: RoFfSW risk categories

Category	Definition
High	Flooding occurring as a result of rainfall with a greater than 1 in 30 chance in any given year (annual probability of flooding 3.3%)
Medium	Flooding occurring as a result of rainfall of between 1 in 100 (1%) and 1 in 30 (3.3%) chance in any given year.
Low	Flooding occurring as a result of rainfall of between 1 in 1,000 (0.1%) and 1 in 100 (1%) chance in any given year.

Although the RoFfSW offers improvement on previously available datasets, the results should not be used to understand flood risk for individual properties. The results should be used for high level assessments such as SFRAs for local authorities. If a site is indicated in the Environment Agency mapping to be at risk from surface water flooding, a more detailed assessment should be considered to more accurately illustrate the flood risk at a site-specific scale.

5.1.5 Groundwater

Mapping of groundwater flood risk has been based on the Areas Susceptible to Groundwater (AStGW) dataset.

The AStGW dataset is a strategic-scale map showing groundwater flood areas on a 1km square grid. It shows the proportion of each 1km grid square, where geological and hydrogeological conditions indicate that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring and does not take account of the chance of flooding from groundwater rebound (e.g. following cessation of mining or industrial activity). This dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding.

The AStGW data should be used only in combination with other information, for example local data or historical 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.

5.1.6 Sewers

Historical incidents of flooding are detailed by Severn Trent Water and Anglian Water through their Historic Flood Risk Register (HFRR). The HFRR databases records incidents of flooding relating to public foul, combined or surface water sewers and displays which properties suffered flooding. The risk registers have been considered in the assessment of flood risk from sewers (see Section 6.6).

5.1.7 Reservoirs

The risk of inundation because of reservoir breach or failure of reservoirs within the area has been mapped using the outlines produced as part of the National Inundation Reservoir Mapping (NIRIM) study. These outlines were the same as those on the Long-Term Risk of Flooding website at the time of publication. The Environment Agency are currently updating their national reservoir flood maps and SFRA users should check there are no major changes to the reservoir maps before relying on the mapping in the SFRA.

5.2 Modelling and data gaps

5.2.1 Hydraulic models used in this SFRA

Table 5-2 lists the hydraulic models supplied by the Environment Agency and Bassetlaw District Council used to inform this SFRA.

Table 5-2: Hydraulic models used to inform the SFRA

Hydraulic model	Date	Software	Watercourse	Estimate update finish date
River Idle 2009 SFRA model	2009	1D-ONLY ISIS Model	River Idle	2019
River Maun 2009 SFRA model	2009	1D-ONLY ISIS Model	River Maun	2020
River Meden 2009 SFRA model	2009	1D-ONLY ISIS Model	River Meden	2020
River Ryton 2009 SFRA model	2009	1D-ONLY ISIS Model	River Ryton	2020
Tidal Trent SFRM Study	2014	1D-2D ISIS TUFLOW	Tidal Trent	2019

5.2.2 Summary

This SFRA is a high-level strategic document. The datasets used to inform this SFRA may periodically be updated and following the publication of this SFRA, new information on flood risk may be provided by Risk Management Authorities.

At a site level, Developers will need to check before commencing on a more detailed Flood Risk Assessment that they are using the latest available datasets. Those that are most likely to be updated not long after this SFRA is published include the Flood Map for Planning and the Flood Risk from Reservoirs maps.

6 Understanding flood risk in Bassetlaw District

6.1 Historical flooding

Severe flooding affected the district in 1922, 1932, 1964 and 2007. Several rural settlements were also affected in 1958, 2002, 2004, 2006, Summer 2007, 2008, November 2012 and March 2016. Prominent sources of flooding are fluvial, surface water, sewer and flood incidents associated with culvert blockages and/ or insufficient capacity in the sewer network.

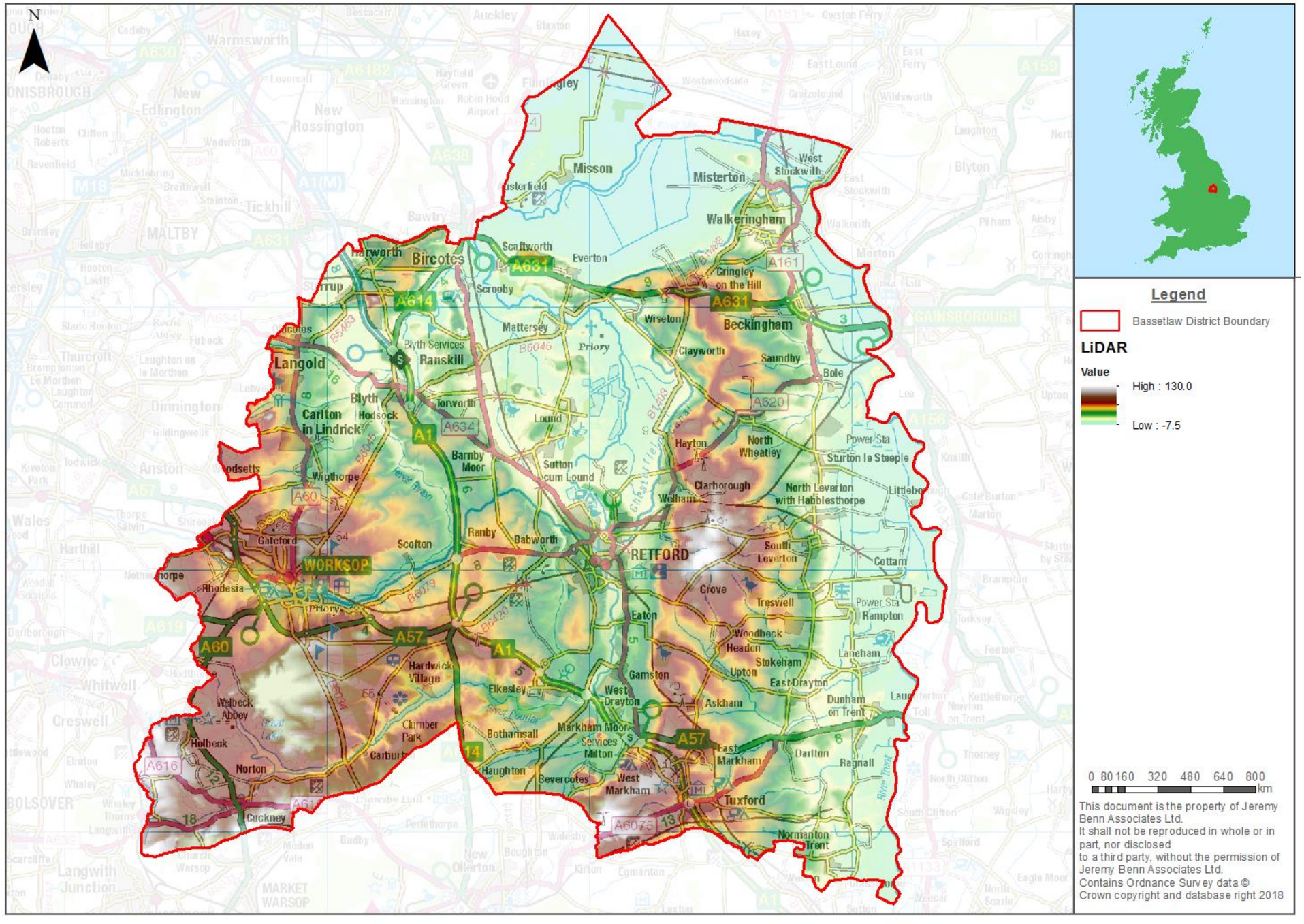
6.2 Topography, geology, soils and hydrology

6.2.1 Topography

The topography, geology and soils are all important in influencing the way the catchment responds to rainfall. The degree to which a material allows water to percolate through it, the permeability, affects the extent of overland flow and therefore the amount of run-off reaching the watercourse. Steep slopes or clay rich (low permeability) soils will promote a rapid surface run-off, whereas more permeable rock for example limestone and sandstone may result in a more subdued response.

The topography of Bassetlaw District is primarily characterised by low lying ground. High ground is sporadic throughout the catchment and confided to hills in the south of the catchment at Retford, Worksop, Wellbeck Abbey, Hollbeck, Cuckney and Markham. Elevations in this area containing the previously named rural settlements, reach approximately 94m above ordnance datum (AOD). The topography within the rest of the area is dominated by low lying land of elevations of approximately 24m AOD. The topography of the study area is shown in Figure 6-1.

Figure 6-1: Bassetlaw topography



6.2.2 Geology and soils

The geology of the catchment can be an important influencing factor on the way that water runs off the ground surface. This is primarily due to variations in the permeability of the surface material and bedrock stratigraphy.

Figure 6-2 shows the bedrock (solid permeable) formations in the study area and Figure 6-3 shows the superficial (permeable, unconsolidated (loose) deposits). These are classified as the following:

- Principal: layers of rock or drift deposits with high permeability which, therefore, provide a high level of water storage
- Secondary A: rock layers or drift deposits capable of supporting water supplies at a local level and, in some cases, forming an important source of base flow to rivers
- Secondary B: lower permeability layers of rock or drift deposits which may store and yield limited amounts of groundwater
- Secondary undifferentiated: rock types where it is not possible to attribute either category a or b
- Unproductive Strata: rock layers and drift deposits with low permeability and therefore have negligible significance for water supply or river base flow.

The bedrock in Bassetlaw District is predominantly Principal; layers of rock or drift deposits with a high permeability which, therefore, provides a high level of water storage. Outcrops of Secondary B; lower permeability layers of rock or drift deposits which may store and yield limited amounts of groundwater, can be identified in the south, around the hills near the settlements of Retford, Worksop, Wellbeck Abbey, Holbeck, Cuckney and Markham. A band of Secondary A; rock layers or drift deposits capable of supporting water supplies at a local level, and in some cases, forming an important source of base flow to rivers, is located within the central areas of the study area. The majority of the study area is not overlain by superficial deposits, in the areas that are, however, are overlain by Secondary A superficial deposits, within the centre and the east of the catchment in low lying areas.

The majority of the bedrock and superficial deposits are permeable and therefore capable at providing a level of water storage. In particular, areas underlain by Principle bedrock geology, and may be vulnerable to groundwater flooding. The bedrock geology is predominately sedimentary and therefore the type of groundwater flooding is probable to be associated with consolidated sedimentary aquifers.

The British Geological Survey provides further information on the nature of groundwater flooding on their website.

Figure 6-2: Aquifer designated bedrock in Bassetlaw

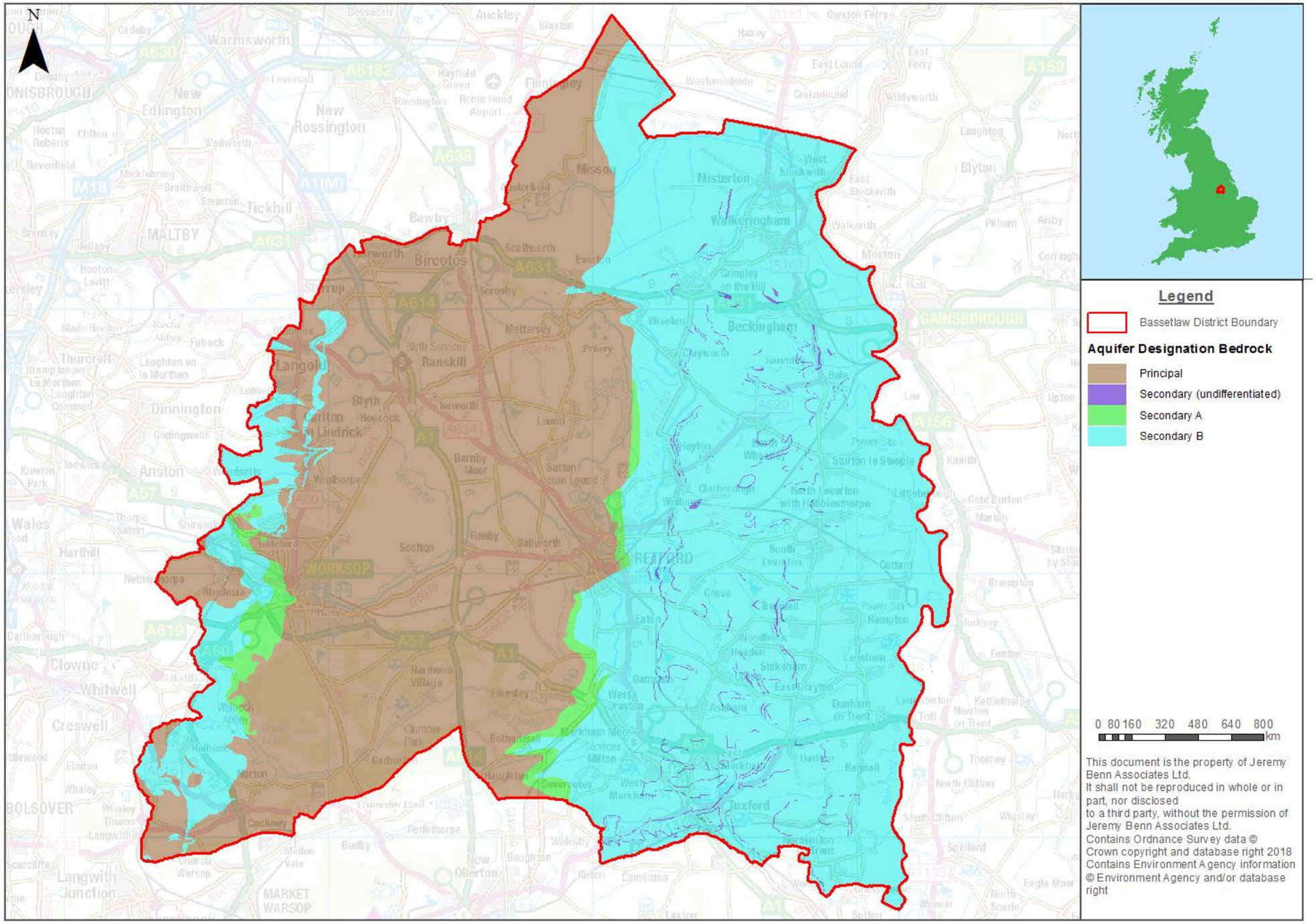
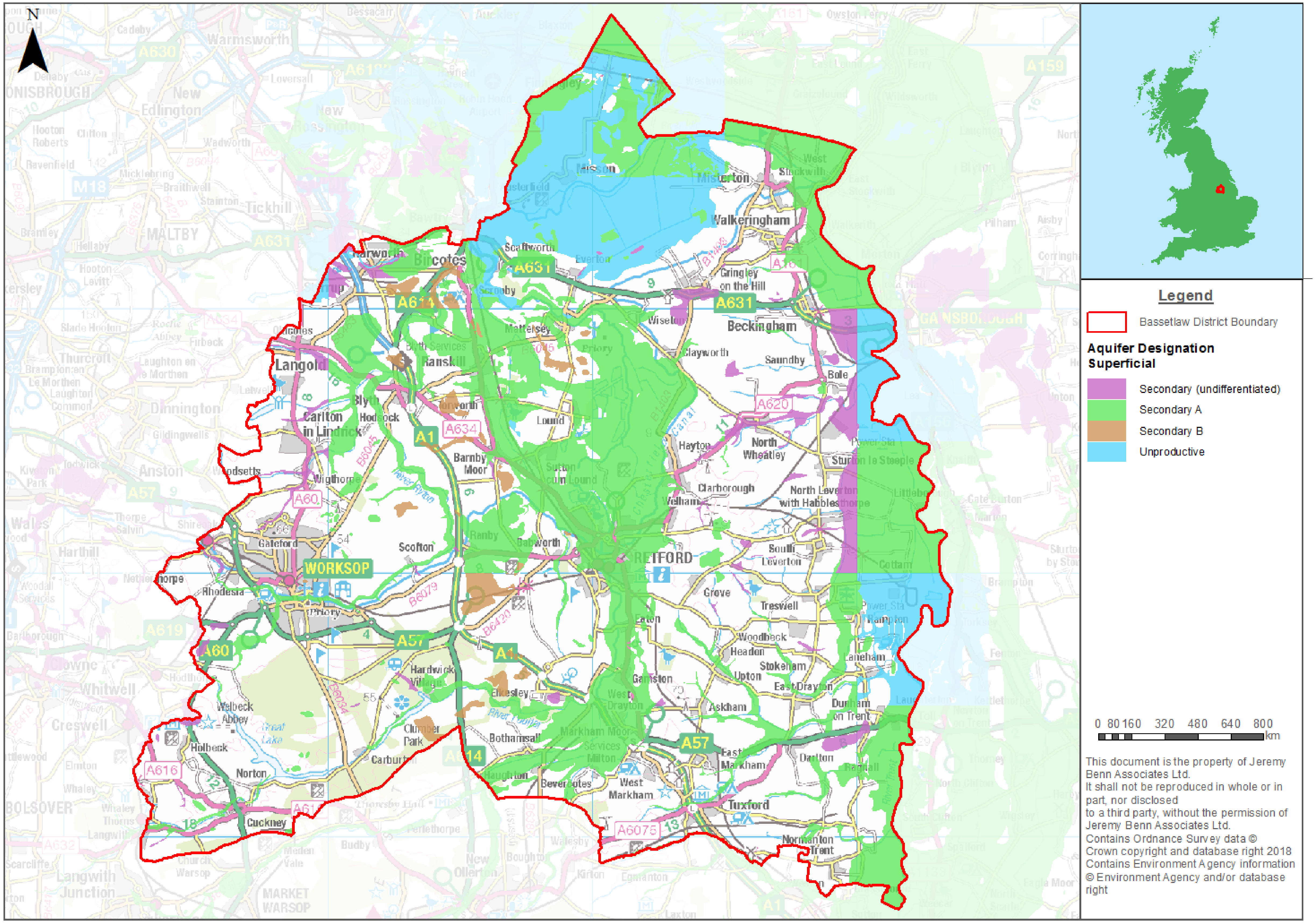


Figure 6-3: Superficial deposits in Bassetlaw



6.2.3 Hydrology

The principal watercourses flowing through the SFRA area include:

- River Idle
- River Ryton
- River Poulter
- River Trent
- Chesterfield Canal
- North Beck
- Wheatley Beck
- Redborough Beck

Tributaries of these watercourses include smaller ordinary watercourses and some unnamed and named drains including Catchwater Drain and Seymour Drain. There are also a number of ponds and lakes within the study area. Mapping indicating the locations of key watercourses can be found in Appendix A.

6.3 Fluvial flood risk

The primary fluvial flood risk is along the River Trent with numerous smaller rivers within Bassetlaw include the River Ryton, River Poulter, River Idle. Fluvial flooding poses a risk to both rural and urban locations within Bassetlaw.

The Bassetlaw District can receive high flows from the River Idle and the River Trent. The flood zones within the study area are predominately Flood Zones 3 near Retford and Beckingham. The flood zones are wide within the study area due to the flat topography and geology. There are no flood storage areas within the study area according to the Environment Agency's Flood Risk mapping.

Appendix B contains the Flood Zone maps for the Bassetlaw District.

6.4 Surface water flooding

Flooding from surface water runoff (or 'pluvial' flooding) is usually caused by intense rainfall that may only last for a few hours, and typically occurs in low lying areas, often where the natural (or artificial) 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. This can be made worse by local insufficient capacity. Where discharge is directly into a watercourse, locally high-water levels can cause back-up and prevent drainage taking place.

The Risk of Flooding from Surface Water (RoFSW) provided by Bassetlaw District Council shows that several communities are at risk of surface water flooding. Communities at risk of surface water flooding include Clayworth, Beckingham, North Wheatley, Bole, North Leverton with Habblesthorpe, Retford, Dadton, Ragnall, West Drayton, Markham Moor and Worksop.

Overall the RoFSW shows that the surface water predominately follows the topographical flow paths of existing watercourses. In some low-lying areas within the study area there is notable prominent run-off flow routes around properties for example to the north of the study area. The RoFSW mapping for Bassetlaw District can be found in Appendix C.

6.5 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. Groundwater level monitoring records are available for areas on Major aquifers; however, for lower lying valleys areas, which can be susceptible to groundwater flooding caused by high water tables for example in mudstone areas. Additionally, there is an increased risk of groundwater levels not be able to naturally pass into watercourses and be conveyed to less susceptible areas.

Mapping of groundwater flood risk has been based on the Areas Susceptible to Groundwater (AStGWF) dataset. The AStGWF dataset is a strategic scale map showing groundwater flood areas on a 1km square grid. It shows the proportion of each 1km grid square, where geological and hydrogeological conditions indicate where groundwater might emerge. However, it does not show the likelihood of groundwater flooding occurring and does not take into account of the chance of flooding from groundwater rebound. This dataset covers a large area of land, and only isolated locations within the susceptible area are actually likely to suffer the consequences of groundwater flooding.

The AStGWF data is indicative and should only be used in combination with other information, for example, local or historical 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.

Mapping of the district has been provided showing the risk from ground water flooding dataset and is shown in Appendix E.

6.6 Sewer Flooding

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 or 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 the newest 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 the discharge 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. Further, sewer flooding is more likely to occur along the routes of main trunk sewers and in particular, if these sewers interact with fluvial systems.

Historical incidents of flooding are detailed by Severn Trent Water through their HFRR registers (see Table 6-1). This database records incidents of flooding relating to public foul, combined or surface water sewers and displays which properties suffered flooding. For confidentiality reasons this data has been supplied on a postcode basis. The dataset was supplied on 14/08/2018.

Table 6-1: Hydraulic Flood Risk Register (HFRR) Register recorded flood incidents

Post Code	Locality	Recorded Flood Incidents
DN10 4	Misterton	17
DN10 5	Everton	1
DN11 8	Styrrup	12
DN17 4	Eastoft	1
DN22 0	North Leverton	2
DN22 6	Retford	13
DN22 7	Retford	36
DN22 8	Lound	17
DN22 9	North Wheatley	18
NG20 9	Cuckney	1
NG22 0	Dunham on Trent	14
NG22 7	Retford	1
NG23 6	Normanton on Trent	3
S80 1	Worksop	8
S80 2	Worksop	6
S80 2LY	Worksop	1
S81 0	Worksop	2
S81 7	Worksop	21
S81 8	Oldcotes	8
S81 9	Costhorpe	21

6.7 Flooding from canals

Canals do not generally pose a direct flood risk as they are a regulated waterbody. There is however a rare but residual risk from canals from overtopping and embankment failure (breach and sudden escape of the water retained in the canal channel).

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 the risk of a breach is managed by continued maintenance.

For development applications located in the vicinity of a canal, it is recommended that overtopping and / or breach of the structure is considered as part of a site-specific FRA to establish the residual risk to the development.

6.7.1 Overtopping and breach

The level of water in canals is normally controlled by the level and size of weirs. When surface water enters a canal, the level of water rises. The water level may then reach a point in which it discharges from the canal through control structures such as weirs. If the capacity of these control structures be exceeded, or should they become blocked, overtopping may occur.

Breaches or embankment failure may be caused by a number of factors including:

- Culvert collapse.
- Overtopping.
- Animal burrowing.

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. The volume of water released during a breach is dependent on the upstream pound length (i.e. the distance between locks) and how quickly the operating authorities can react to prevent further water loss, for example by the fitting of stop boards to restrict the length of the canal that can empty through the breach, or repair of the breach.

6.7.2 Canals in Bassetlaw District

There is one canal within Bassetlaw District, the Chesterfield Canal which starts from the River Trent, west of Stockwith, travelling approximately north east to south west through the district, through Retford and Worksop before leaving the study area at Shireoaks. The 2011 Nottinghamshire Preliminary Flood Risk Assessment shows that have been historic incidences of breach and overtopping on the Chesterfield Canal in Bassetlaw District.

Many of the canals in Nottinghamshire interact with watercourses to some extent, including the River Ryton and Chesterfield Canal in Retford. Canals that are in cut or follow natural contours are likely to act as conduits for flood waters and may divert floodwaters from one place to another. Hence the Environment Agency Flood Maps and surface water maps are likely to show the effect of flooding to or from canals in places.

Specific breaches in the Canal at Retford and Worksop were modelled for the 2009 SFRA, using a strategic 2D modelling approach. The outputs of these models are shown in Figure 6-4 and Figure 6-5. The 2009 SFRA noted that a "breach could occur at any location where the canal is higher than the surrounding land; these results should be taken as examples of the flood risk if breaches should occur". The results therefore do not provide a complete picture of areas that could be affected by a breach in the

Chesterfield Canal across the District and the volume of water is related to the capacity of the canal in those locations.

Figure 6-4: Worksop Canal Breach

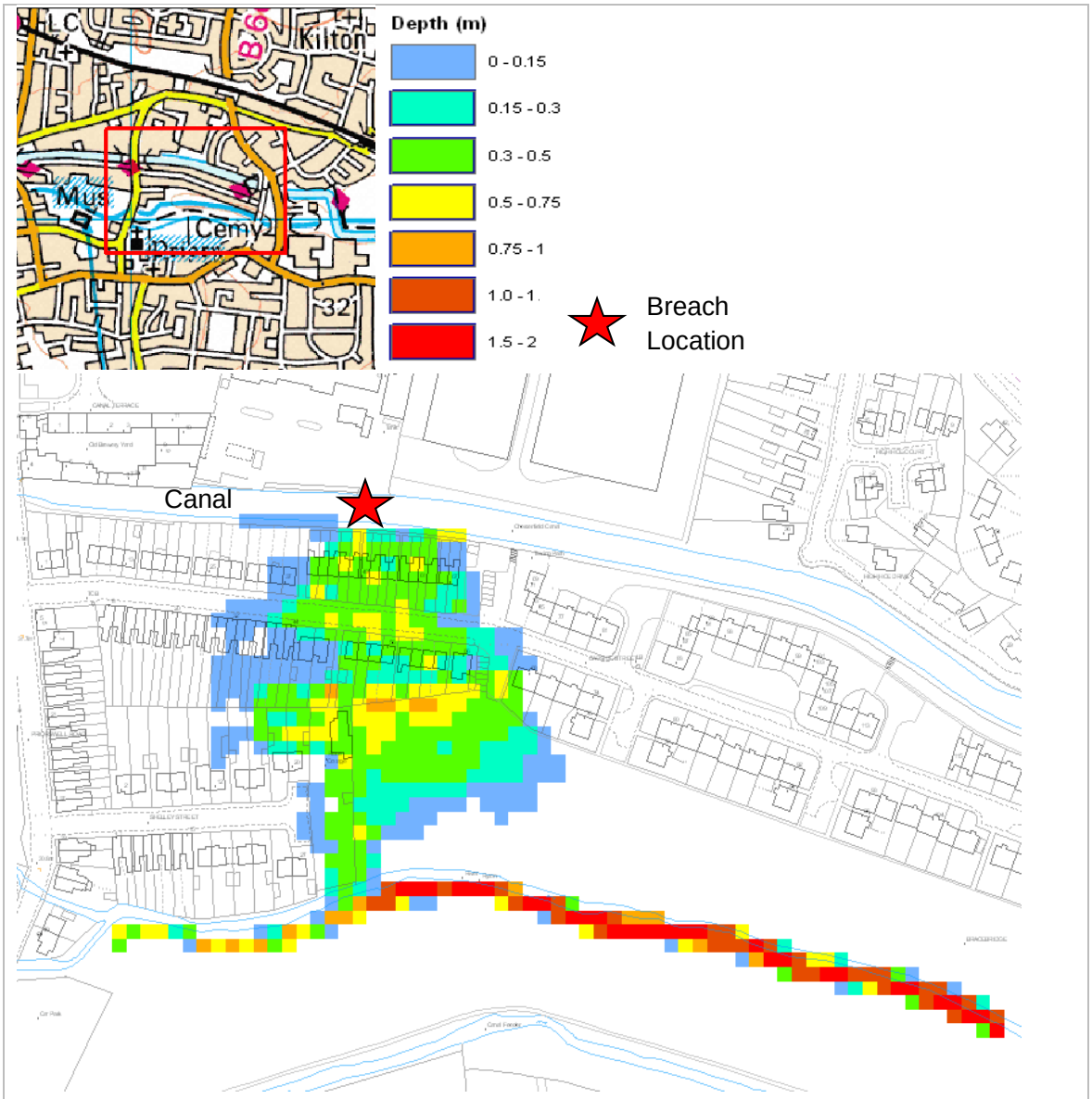
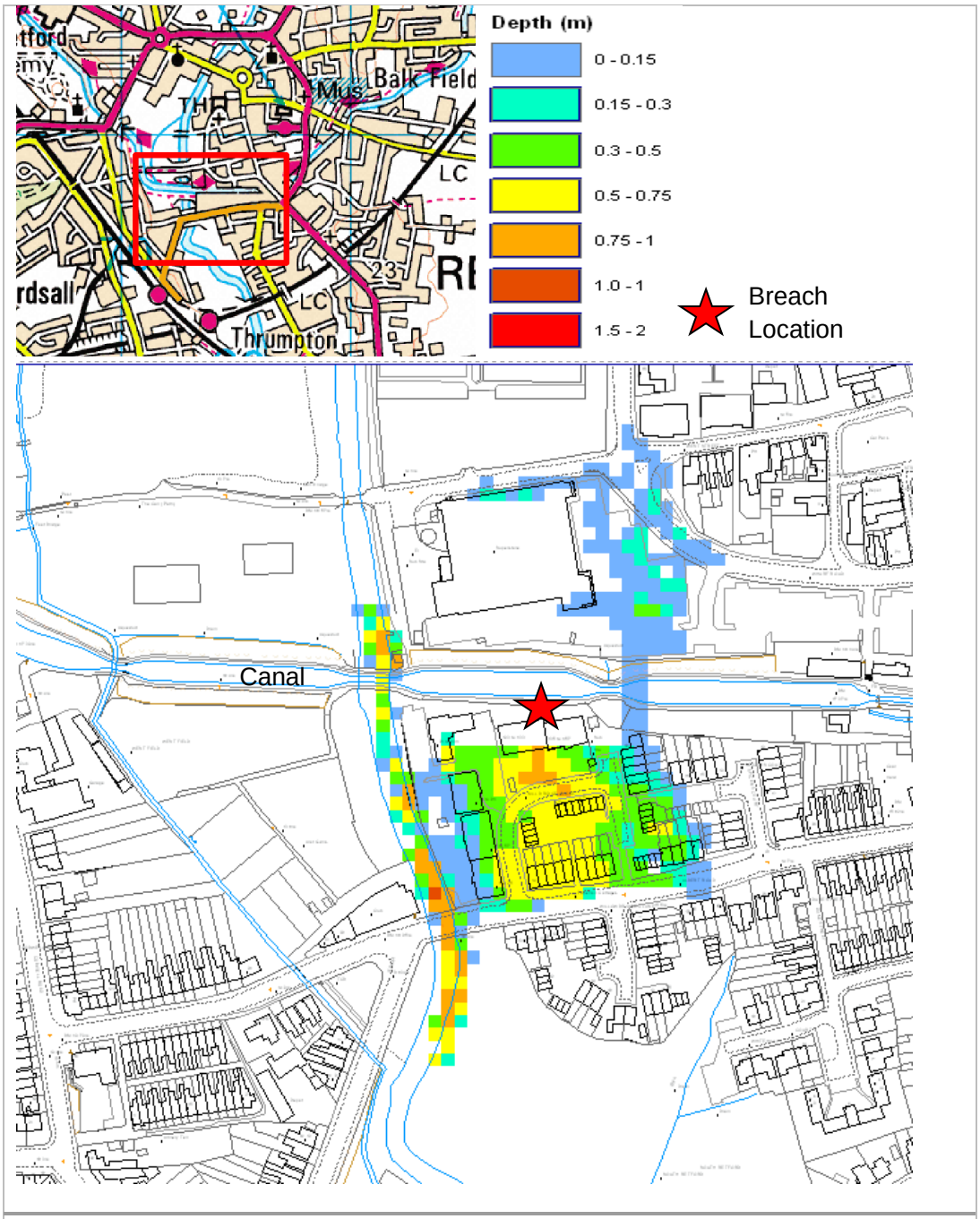


Figure 6-5: Retford Canal Breach



Any development proposed adjacent to a canal should include a detailed assessment of how a canal breach would impact the site, as part of a site-specific Flood Risk Assessment. Data may need to be requested from the Canal and Rivers Trust to inform the assessment on historic breach and overtopping locations, the presence of cross canal culverts and where embanked sections are considered to be high and low risk.

6.8 Flooding from Reservoirs

Reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975 and are listed on a register held by the Environment Agency. The level and standard of inspection and maintenance required under the Act means that the risk of flooding from reservoirs is relatively low. Recent changes to legislation under the Flood and Water Management Act require the Environment agency to designate the risk of flooding from reservoirs over 25,000 cubic metres and at some time in the future to consider the risk from reservoirs with a volume greater than 10,000 cubic metres. The Environment agency is currently progressing a 'Risk Designation' process so that the risk is formally determined.

Flooding from reservoirs occurs following partial or complete failure of the control structure designed to retain water in the artificial storage area. 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 difficult to estimate but is low compared to flooding from rivers of surface water. It may not be possible to seek refuge upstairs from floodwater as buildings could be unsafe or unstable due to the force of water from the reservoir breach or failure.

The risk of inundation to Bassetlaw 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 Mapping (NIRIM) study. There are 31 reservoirs shown to affect Bassetlaw; this includes reservoirs located within Bassetlaw and a number of reservoirs outside of the area whose inundation mapping is shown to affect Bassetlaw. The reservoirs inundation extents are shown in Appendix G. Maps of the flood extent can also be found on the governments 'Long term flood risk assessment for locations in England' website.

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.

Table 6-2: Reservoirs with potential risk to Bassetlaw

Reservoir	Location - grid reference	Reservoir owner	Local Authority Area	Is the reservoir located within the study area?
Sandhill	458204, 379240	Bassetlaw District Council	Nottinghamshire	Yes
Harlesthorpe	449450, 376133	Sibbring	Derbyshire	No
Hodsock Priory Farm	461054, 384833	Hodsock Farms Ltd	Nottinghamshire	Yes
Langold Lake	458062, 386415	Bassetlaw District Council	Nottinghamshire	Yes
Morton Grange	468306, 377155	Joseph Camm Farms Ltd	Nottinghamshire	Yes
Cottam Power Station Cooling Towers Ponds	481774, 378691	EDF Energy (Cottam Power) Ltd	Nottinghamshire	Yes
Forest Farm	467879, 382213	Tiln Farms Limited	Nottinghamshire	Yes
Beckingham FSA	478706, 392650	Environment Agency	Nottinghamshire	No
Misson East FSA	470316, 394446	Environment Agency	Nottinghamshire	Yes
Cottam South Coal Stock Ash Lagoon	482191, 378867	EDF Energy (Cottam Power) Ltd	Nottinghamshire	Yes
Shrubbery Lake	456595, 374123	The Welbeck Estates Co. Ltd	Nottinghamshire	Yes
South Farm No. 2	461286, 370179	Naish Farms Ltd	Nottinghamshire	No
Rufford Lake	464788, 365580	Nottinghamshire County Council	Nottinghamshire	No
Great Lake	458180, 372416	The Welbeck Estates Co. Ltd	Nottinghamshire	Yes
Gouldsmeadow Lake	456239, 374748	The Welbeck Estates Co. Ltd	Nottinghamshire	Yes

Reservoir	Location - grid reference	Reservoir owner	Local Authority Area	Is the reservoir located within the study area?
Carburton Forge	459161, 372292	The Welbeck Estates Co. Ltd	Nottinghamshire	Yes
Carburton	460008, 372501	The Welbeck Estates Co. Ltd	Nottinghamshire	Yes
Thoresby Lake (Upper)	463819, 370665	Trustees of The Thoresby Settlement	Nottinghamshire	No
King's Mill	451964, 359795	Ashfield District Council	Nottinghamshire	No
Sherwood Forest Lake	462668, 363612	Center Parcs Plc	Nottinghamshire	No
Pebley	448695, 379292	Canal & River Trust	Derbyshire	No
Harthill	448900, 380630	Canal & River Trust	Rotherham	No
Clumber Lake	464035, 375185	The National Trust	Nottinghamshire	Yes
Apleyhead	465787, 375808	J C M Glassford Ltd	Nottinghamshire	Yes
Howard's Farm Irrigation Reservoir	464265, 392475	BAWTRY FARMS LIMITED	Nottinghamshire	Yes
Green Mile Farm	464951, 381983	J C M Glassford Ltd	Nottinghamshire	Yes
Sandbeck Park (Lower Lake)	457733, 390558	Scarborough	Rotherham	No
Sandbeck Park (Upper Lake)	457465, 390557	Scarborough	Rotherham	No
Misson West FSA	467414, 393613	Environment Agency	Nottinghamshire	Yes
Newington Reservoir	467071, 393935	Tunnel Tech North Ltd	Nottinghamshire	Yes
Carr Farm Reservoir	471744, 393622	POLLYBELL FARMS LIMITED	Nottinghamshire	Yes

6.9 Risk to development: considerations for developers

Impoundments which fall under the Reservoirs Act are inspected and regularly maintained, and therefore, the likelihood of failure is considered to be very low and there has been no loss of life since 1925. Reservoirs governed by the Reservoir Act 1975 have strict regulations; part of this forms maintenance schedules which should help operators identify any issues or changes in behaviour before these become an issue which may compromise the safety of a reservoir.

However; there remains residual risk to development from reservoirs which developers should consider 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; and
    - inspection / maintenance regime.
- Developers should apply the sequential approach to locating development within the site:
    - 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? and
    - 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?
- Developers should consult with relevant authorities regarding emergency plans in case of reservoir breach.
- Developers should consider the impact of a breach and overtopping, particularly for sites proposed to be located downstream of a reservoir. This should consider whether there is sufficient time to respond.
- The Environment Agency's online 'Long term flood risk assessment for locations in England' Reservoir Flood Maps contain information on the extents, depths and velocities following a reservoir breach (note: only for those reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975). For proposed sites located within the extents, consideration should be given to the extent, depths and velocities shown in these online maps.
- In addition to the risk of inundation, those considering development in areas affected by breach events should also assess the potential

hydraulic forces imposed by the rapid flood event and check that that the proposed infrastructure fabric can withstand the loads imposed on the structures by a breach event.

6.10 Flood warning and emergency planning

Emergency planning is one option to help manage flood related incidents. From a flood risk perspective, emergency planning can be broadly split into three phases: before, during and after a flood. The measures involve developing and maintaining arrangements to reduce, control or mitigate the impact and consequences of flooding and to improve the ability of people and property to absorb, respond to and recover from flooding.

In development planning, a number of emergency planning activities are already integrated in national building control and planning policies e.g. the NPPF Flood Risk Vulnerability and Flood Zone 'Compatibility' table seeks to avoid inappropriate development in areas at risk from all sources of flooding. However; safety is a key consideration for any new development and includes considering: the residual risk of flooding, the availability of adequate flood warning systems for the development, safe access and egress routes and evacuation procedures.

The National Planning Practice Guidance outlines how developers can ensure safe access and egress to and from development to demonstrate that development satisfies the second part of the Exception Test. As part of an FRA, the developer should review the acceptability of the proposed access in consultation with the LPA (where appropriate) and the Environment Agency.

There are circumstances where a flood warning and evacuation plan is required and / or advised:

- 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) and for essential ancillary sleeping or residential accommodation for staff required by uses in this category [water-compatible development], subject to a specific warning and evacuation plan.
- The Environment Agency and DEFRA's standing advice for undertaking flood risk assessments for planning applications states that details of emergency escape plans will be required for any parts of the building that are below the estimated flood level. At the time of writing this report the Environment Agency are in the process of creating more detailed standing advice for areas, which cover Bassetlaw. Please contact the Environment Agency for more details.

It is recommended that Emergency Planners at the LPA and / or Nottinghamshire County Council (where appropriate) are consulted prior to the production of any emergency flood plan.

In addition to the Flood Warning and Evacuation plan considerations listed in the NPPF / NPPG, it is advisable that developers also acknowledge the following:

- How to manage the consequences of events that are un-foreseen or for which no warnings can be provided e.g. managing the residual risk of a breach.
- Proposed new development that places additional burden on the existing response capacity of the Councils will not normally be appropriate.
- 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.
- The vulnerability of site occupants.
- Situations may arise where occupants cannot be evacuated (e.g. prisons) or where it is safer to remain "in-situ" and / or move to a higher floor or safe refuge area (e.g. at risk of a breach). These allocations should be assessed against the outputs of the SFRA and where applicable, a site-specific Flood Risk Assessment to help develop emergency plans.

The Bassetlaw District Council website provides Emergency Planning relevant information covering the local authority area that provides practical advice for residents, communities and businesses on preparing for emergencies. It also includes a section specifically on flooding with includes information on:

- Flooding advice
- Preparing a Flood Pack
- Preparing a Flood Plan
- Provision of Sandbags (Please note the provision of sandbags by the local authority is not guaranteed or required, property owners should seek to make their own arrangements)
- Nottinghamshire County Council also provide additional material online to help and support members of the community in relation to flooding specifically and emergency planning more broadly.
- Further emergency planning information links:
- 2004 Civil Contingencies Act
- DEFRA (2014) National Flood Emergency Framework for England
- Sign up for Flood Warnings with the Environment Agency

- National Flood Forum
- GOV.UK - Make a Flood Plan guidance and templates
- FloodRe
- Bassetlaw District Council Emergency Planning
- Nottinghamshire County Council Emergency Planning

6.10.1 Flood warnings

Flood warnings, along with evacuation plans, can inform emergency flood plans or flood response plans. The Environment Agency is the lead organisation for providing warnings of fluvial flooding (for watercourses classed as Main Rivers) and coastal flooding in England. Flood Warnings are supplied via the Flood Warning System (FWS) service, to homes and business within Flood Zones 2 and 3.

There are currently seven Flood Alert Areas (FAA) and twenty Flood Warning Areas (FWAs) covering significant parts of the Bassetlaw area. These are shown in Appendix G. A list of the Flood Alert Areas in the study area is shown in Table 6-3 and a list of the Flood Warning Areas in the study area is shown in Table 6-4.

Table 6-3: Flood Alert Areas within the Bassetlaw District area

Flood Alert Code	Flood Alert Name	Watercourse	Coverage
034WAF430	River Maun in Nottinghamshire	River Maun	Flood alert from Hughton to West Drayton via Markham Moor (approx..8.5km long)
034WAF422	River Idle in Nottinghamshire	River Idle	Flood Alert from West Drayton to West Stockwith (approx. 39km long)
034WAB421	Tidal Trent for properties away from the river between Gainsborough and the Humber Confluence	River Trent	Flood alert for West Stockwith and to the east of Finingley
034WAF427	Ryton Oldcotes catchment	River Ryton	Flood alert from Rhodesia to Scrooby (approx..29km long)
034WAB420	Tidal Trent Riverside Properties	River Trent	Flood alert for West Stockwith
034WAB424	River Trent from Cromwell Weir to Gainsborough	River Trent, River Idle	Flood alert from Sutton on Trent to Walkeringham (approx. 27km long)
034WAF434	River Meden in Nottinghamshire	River Meden	Flood alert from Hughton to West Drayton via Bothamsall (approx..6km long)

Table 6-4: Flood Warning Areas within the Bassetlaw District area

Flood Warning Code	Flood Warning Name	Watercourse	Coverage
034FWBIDBAWTRY	River Idle at Bawtry including the A631 Bawtry Bridge	River Idle	Flood warning from Bircotes to south of Austerfield (approx..1.5km long)
034FWFRYWORKSP	River Ryton at Worksop Town Centre including Shireoaks	River Ryton	Flood warning from Shireoaks to Worksop (city centre) (approx.6km long)
034FWBTRCOTTAM	River Trent at Cottam	River Trent	Flood warning from Laneham to Sturton le Steeple (appro.8.3km long)
034FWBTRLEA	River Trent at Lea	River Trent	Flood warning from north of Sturton Le Steeple to Bole (approx2km long)
034FWBTRHATFIELD	River Trent at Hatfield Chase	River Trent	Flood warnings at West Stockwith and the east of Finningley
034FWBTRTORKSEY	River Trent at Torksey	River Trent	Flood warning to the east of Dunham on Trent
034FWFMAHAMILWD	River Maun at Haughton, Milton and West Drayton	River Maun	Flood warning from West Markham to West Drayton (approx..4km long)

Flood Warning Code	Flood Warning Name	Watercourse	Coverage
034FWFRYBLYTH	River Ryton at Blyth	River Ryton	Flood warning from the south of Hodsock to the north of Ranskill (approx..7km long)
034FWFRYSCROOBY	River Ryton at Scrooby including Serlby	River Ryton	Flood warning from the south of Bircotes to the north of Bircotes
034FWFRYSHELLY	River Ryton at Worksop, Shelley Street	River Ryton	Flood warning within Worksop city centre
034FWBTREASTWILD	River Trent at East Ferry and Wildsworth	River Trent	Flood warning areas to the west of Walkerith and Morton
034FWBTRBECKHAM	River Trent at Beckingham Marsh	River Trent	Flood warning from Bole to Walkeringham
034FWBIDMISSON	River Idle at Misson	River Idle	Flood warning from West Stockwith to Scarftworth (approx.11km)
034FWBTRLANEHAM	River Trent at Laneham and Church Laneham	River Trent	Flood warning from Dunham on Trent to Laneham (approx..2.3km)
034FWBTRMARNHAM	River Trent at High Marnham and Low Marnham	River Trent	Flood warning from Grassthrope to the west of South Clifton
034FWBTROWSTON	River Trent at Owston Ferry	River Trent	Flood warning from the south of West Stockwith to the north of West Stockwith
034FWFIDRETFORD	River Idle at Retford, Eaton and Gamston	River Idle	Flood warning from Eaton to Sutton cum Lound
034FWFIDRETWEST	River Idle at West Retford and Ordsall	River Idle	Flood warning from Eaton to Sutton cum Lound

Flood Warning Code	Flood Warning Name	Watercourse	Coverage
034FWBTRDUNHAM	River Trent at Dunham-on-Trent	River Trent	Flood warning from south Laughterton to north Laughterton
034FWBTRFLEDBORO	River Trent at Fledborough and Ragnall	River Trent	Flood warning from south of Ragnall to north of Ragnall

7 Flood defences and assets

Preparation of the SFRA has included a high-level review of available information on flood assets and involved interrogation of existing evidence on asset condition and standards of protection. Details of the flood defence locations and condition were provided by the Environment Agency for the purpose of preparing this assessment, in addition to some supplementary explanation on asset performance. Defences are categorised as either raised flood defences (e.g. walls/embankments) or flood storage areas (FSAs). The Environment Agency flood assets and their locations are summarised in the following sections.

7.1 Flood defences and standard of protection

Formal structures are given a rating based on a grading system for their condition. This detail, in addition to descriptions and standard of protection for each, were provided by the Environment Agency for the purpose of preparing this SFRA which reports on the standard of protection using this information. Defences are given a rating based on a grading system for their condition. A summary of the grading system used by the Environment Agency for condition is provided in Table 7-1.

Developers should consider the standard of protection provided by defences and residual risk as part of a detailed FRA. The Environment Agency should be contacted for detailed defence information such as crest levels and standard of protection.

Table 7-1: Defence asset condition rating Grade

Condition	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 asset.
3	Fair	Defects that could reduce the performance of the asset.
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.

A broadscale overview of formal flood defences is provided using AIMS data from the Environment Agency and information from the Council, provided in Table 7-2.

It should be noted that the Environment Agency's on-going hydraulic modelling programme may revise flood risk datasets and as a consequence, the standard of protection offered by flood defences in the area, may differ from those discussed in this report because it has been reassessed.

Standard of Protection

Flood defences are designed to give a specific standard of protection, reducing the risk of flooding to people and property in flood prone areas. For example, a flood defence with a 1% AEP standard of protection means that the flood risk in the defended area is reduced to a 1% chance of flooding in any given year.

Although flood defences are designed to a standard of protection it should be noted that, over time, the actual standard of protection provided by the defence may decrease, for example due to deterioration in condition or increases in flood risk due to climate change.

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 light of this, whether possible site options for development are appropriate and sustainable. In addition, detailed Flood Risk Assessments (FRAs) will need to thoroughly explore the condition of defences, especially where these defences are informal and demonstrate a wide variation of condition grades. It is important that all of these assets are maintained to a good condition and their function remains unimpaired.

The Environment Agency has a dataset called "Areas Benefiting from Defences". This dataset shows those areas that benefit from the presence of defences in a 1 in 100 (1%) chance of flooding each year from rivers; or 1 in 200 (0.5 %) chance of flooding each year from the sea. However, the dataset does not show all areas that benefit from defences as the Environment Agency do not map defences that offer a lower standard of protection than that stated above. There is only two areas benefiting from defences in Bassetlaw district, east of Scrooby long the left bank of the River Ryton and upstream of the River Ryton and River Idle confluence.

Table 7-2: Flood defences in Bassetlaw

Watercourse	Location	NGR	Type	Asset Maintained By	Design SOP	Condition Rating
River Idle	West of Scaftworth	465799 392069	Embankment	EA	10	3
River Ryton	West of Scartworth	465799 392069	Embankment	EA	10	3
River Idle	East of Bawtry	465686 393148	High ground (LB), Embankment (RB)	EA	50	3/4
River Idle	West of Clayworth	471336 387038	Embankment	EA	50	3
River Trent	East Stockwith	478966 394596	Wall, embankment	EA	100	2
River Idle	West Stockwith	478871 394866	Wall, embankment, high ground, flood gate	EA	100	3
Saundby Beck	South East of Saundby	480429 388078	Embankment, high ground, flood storage reservoir	EA, IDB	100	1/2
River Ryton	Central Worksop	458237 379083	High ground, wall, embankment	Private, Local Authority, EA	100	N/A
River Idle	Central Retford	470615 379997	Embankment, gate, high ground, wall	EA, Private, Local Authority	100	N/A
River Trent	Left bank from West Burton Power station to Durham-on-Trent	480043 385979	Embankment, wall, high ground	EA, Private	100	1/2/3
Old Trent	High Marnham	480956 370223	Embankment	EA	100	1
Old Trent	Low Marnham	480737 369326	Embankment	EA	100	4

7.2 Flood alleviation schemes

Details of recent flood alleviation and / or risk management schemes across Bassetlaw are listed in Table 7-3.

Table 7-3: Recent and planned Flood Alleviation Schemes

FAS	Description	Estimated Completion date
Grove Lane, Retford	Flood risk management on two small watercourses including the Main River, Retford Beck. An Outline Business Case is currently being prepared to further consider the viability of a scheme.	Preliminary estimate for delivery 2021
Clarborough FAS	A number of options are being investigated regarding reducing the flood risk from Clarborough Beck and surface water.	Completion date to be agreed.
Walkeringham FAS	This scheme comprises of a by-pass channel to divert flood water away from the village and reconnect with the river further downstream.	Completed 2017

7.3 Residual flood risk

Residual risk refers to the risks that remain in circumstances after measures have been taken to alleviate flooding (such as flood defences). 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 overtopping 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.
- 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.

Parts of Bassetlaw rely on formal flood defences for protection against fluvial flooding. Any planned defence works will further increase the existing standard of protection offered to certain communities and will protect new parts of Bassetlaw from fluvial flooding. Consequently, there are areas vulnerable to rapid inundation in the event of a breach / failure.

Any inundation resulting from a failure in raised embankments (which are not formal flood defences and no areas of development are currently indicated as benefiting from, or being reliant upon, these structures), it would be unlikely that flooding would extend beyond the Flood Zones or impact upon any existing development, or any future built development.

The impact of a breach or impoundment failure is dependent on the location, the magnitude of the event, and the type of breach. Siting of any built development downstream within close proximity should be avoided unless it can be demonstrated that flood risks due to rapid inundation may be eliminated or adequately mitigated. The Environment Agency should be consulted at site-specific development level for advice on breach/ overtopping parameters, if it is a requirement to model such an event.

Flood infrastructure maintenance

There is potential for the risk of flooding to increase in areas where flood alleviation measures are not maintained regularly and/or adequately. Breaches in raised flood defences are most likely to occur where the defence has been degraded or not maintained to its design standard. Drainage infrastructure in urban areas can also frequently become blocked with debris which can lead to blockages in culverts and backing up of a watercourse. It is therefore essential that all flood alleviation schemes and hydraulic structures are regularly maintained to their specified design standard. It is the responsibility of the riparian owner to maintain the watercourses or defences to a suitable standard. The Local Authority or Environment Agency has permissive powers to act should the riparian owner not satisfy their maintenance requirements.

7.3.1 Implications for development

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 given to the characteristics of flood emergencies and the roles and responsibilities during such events. Additionally, in the cases of breach or overtopping events, consideration should be given to the structural safety of the dwellings or structures that could be adversely affected by significant high flows or flood depths.

Developers should include an assessment of the residual risk where developments are located in areas benefitting from defences, including identifying rapid inundation zones. They should consider both the impact

of breach, including the effect on safe access and egress, as well as potential for flood risk to increase in the future due to overtopping.

At areas susceptible to breach failure, it is expected that more detailed assessment be completed to evidence the severity of the risk. This more detailed assessment should refine the information prepared as part of SFRA assessment and describe how the residual risk will be safely managed at the development site. This more detailed assessment should at least include consideration of the following elements which may also be included within a site flood risk management plan:

- Extent of flooding
- Depth of flooding
- Velocity of flood water
- Speed of onset of flooding
- Hazard to people
- Duration of flooding
- Warning and evacuation procedures
- Forces on buildings and infrastructure

Any improvements to defences should ensure they are in keeping with wider catchment policy.

7.3.2 LLFA Asset Register

LLFA Asset Register Nottinghamshire County Council has compiled a Flood Risk Asset Register for the County under Section 21 of the FWMA (2010). This list is compiled from flood investigations and local FRAs enabling data to be collected on structures and features which are likely to have a significant effect on flood risk within Nottinghamshire. Examples of structures include culverts, drainage ditches and embankments and can be both natural and man-made.

Before structures are added to the Asset Register, the relevant information about each asset such as ownership and condition are recorded. The list is updated periodically as Nottinghamshire County Council becomes aware of significant assets.

Table 7-4 shows the assets listed on the Nottinghamshire County Council Asset Register located within the district which have a significant effect on flood risk.

Table 7-4: LLFA Asset Register within the Study Area

ID	Location	Asset type	Ownership
3055-01108	Dunham on Trent	Culvert	NCC
3055-01152	Dunham on Trent	Culvert	NCC
3055-01178	Walkeringham	Culvert	NCC

8 Cumulative impact of development and cross-boundary issues

8.1 Introduction

Under the revised 2018 NPPF, strategic policies and their supporting Strategic Flood Risk Assessments (SFRAs), are required to 'consider cumulative impacts in, or affecting, local areas susceptible to flooding' (para. 156), rather than just to or from individual development sites.

When allocating land for development, consideration should be given to the potential cumulative impact of the loss of floodplain storage volume. 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.

Conditions imposed by Bassetlaw District Council should allow for mitigation measures so any increase in runoff as a result of development is properly managed and should not exacerbate flood risk issues, either within, or outside of the Council's administrative area

The cumulative impact of development should be considered at the planning application and development design stages and the appropriate mitigation measures undertaken to ensure flood risk is not exacerbated, and where possible, the development should be used to improve flood risk.

8.2 Cross boundary considerations

The topography of the district means that a number of major watercourses such as the River Trent and River Idle flow through the study area and into neighbouring authorities. As such, future development, both within and outside Bassetlaw District can have the potential to affect flood risk to existing development and surrounding areas, depending on the effectiveness of SuDS and drainage implementation. The Bassetlaw area has boundaries with the following Local Authorities, which can be seen on Figure 1-1:

- Bolsover District
- Doncaster District
- Mansfield District
- Newark and Sherwood District
- North Lincolnshire
- Rotherham District
- West Lindsey District

No significant planned developments were found in neighbouring authorities near watercourses that flow into the study area, although several authorities were yet to publish their final site allocations. All developments are required to comply with the NPPF and demonstrate they

will not increase flood risk elsewhere. Therefore, providing developments near watercourses in neighbouring authorities comply with the latest guidance and legislation relating to flood risk and sustainable drainage, they should result in no increase in flood risk within Bassetlaw.

Development control should ensure that the impact on receiving watercourses from development in Bassetlaw district has been sufficiently considered during the planning stage and appropriate development management decisions put in place to ensure there is no adverse impact on flood risk or water quality.

The impact of new development on downstream IDB watercourses also needs to be considered. Planners and developers should be aware of local conditions and requirements set by the Water Management Consortium (comprising Isle of Axeholme and North Nottinghamshire, Doncaster East and Trent Valley IDB). The Water Management Consortium have published application guidance notes.

8.3 Cumulative impact assessment

A cumulative impact assessment was undertaken for the SFRA. This considered urban catchments at highest risk of localised flooding, rural villages at high and low flood risk and the implications of significant localised new development in specific new settlements.

The Cumulative Impact Assessment supports a tiered approach, with bespoke policy depending on the location of the development. Specific policies to relate to:

- The New Settlements
- Retford Beck
- Rural villages at higher risk of flooding (shown in Appendix I)
- Rural villages at low risk of flooding (shown in Appendix I)

The policy recommendations can be found in Chapter 13.2.

9 Neighbourhood Plans

9.1.1 What are Neighbourhood Plans

Neighbourhood Plans were introduced in the Localism Act 2011. They give communities direct power to develop a shared vision for their neighbourhood and collectively shape development and growth in the area. It enables them to choose where they want new homes and amenities to be located and contribute to shaping the aesthetics and infrastructure of a place.

9.1.2 How do Neighbourhood Plans work

Neighbourhood Plans are designed to work alongside Local Plans to help communities meet both local and strategic needs. Neighbourhood Plans are not a legal requirement and are optional. Local authorities should work closely with Neighbourhood Plan groups to ensure there is appropriate consideration to managing flood risk. Just like a Local Plan, Neighbourhood Plans require an evidence base to support them and justify the development and vision proposed.

Once approved through a local referendum, Neighbourhood Plans are legal documents in the same way as the local plan and are part of the statutory development plan. The planning authority will consider both the Local Plan, Neighbourhood Plan and other relevant material when assessing a planning application.

Local communities can use neighbourhood planning to determine their own local policies:

- set planning policies through a neighbourhood plan that is used in determining planning applications.
- grant planning permission through Neighbourhood Development Orders and Community Right to Build Orders for specific development which complies with the order.
- Development Orders and Community Right to Build Orders allow communities to grant planning permission either in full or in outline for the types of development they want to see in their areas.
- policies produced cannot block development that is already part of the Local Plan. What they can do is shape where that development will go and what it will look like.

9.1.3 How can Neighbourhood Plans help to manage flood risk

Neighbourhood Plans should also seek ways manage and reduce flood risk in the local community. They can develop their own policies, suggested policies to help in managing the risk of flooding include:

- Allocating and steering development to areas at low flood risk where possible.
- Ensuring that where development does take place in areas that are susceptible to flooding, that the design mitigates the risk of flooding to the development without increasing the risk from the site.
- Allocating space on streets and surrounding buildings as green infrastructure to reduce rainfall run-off.
- Promoting the usage of SuDS to reduce surface water run-off and in particular encourage the usage of 'natural' SuDS features such as infiltration, swales, storage basins, ponds and wetlands. Such features usually provide multiple benefits including: reduced flood risk, improved water quality, increased biodiversity, improved local aesthetics.
- Promoting increased water efficiency in new development i.e. rainwater harvesting technology alongside SuDS.
- Promoting tree planting, rain gardens, green roofs and other vegetated spaces that also contribute towards increasing infiltration and slows flows.

As part of their evidence base, in some cases Neighbourhood Plans have previously undertaken their own Strategic Flood Risk Assessments to reduce the risk of flooding.

Neighbourhood Plans that have identified the source and areas at flood risk, including existing buildings, can also use this information to support other measures within the community that reduce the risk of flooding, including:

- Encouraging members at risk to sign up to Flood Line to get alerts and warnings when flooding is possible/expected.
- Consider the usage of 'property level resilience/resistance measures'
- Used to inform the creation of individual and community flood plans

Support for the creation of a Neighbourhood Plan

The body commissioning the Neighbourhood Plan (Parish Council, Town Council or neighbourhood forum) should consult with the following bodies on flood risk when preparing a Neighbourhood Plan:

- The Local Planning Authority
- The Environment Agency
- The Lead Local Flood Authority (Nottinghamshire County Council)

Sources of further information include:

- Neighbourhood planning GOV.UK:
- Bassetlaw District Council, What is a Neighbourhood Plan:

- Royal Town Planning Institute – Neighbourhood Planning:
- New Neighbourhood Planning programme & changes to My Community – everything you need to know:
- Forum for Neighbourhood Planning – Creating resilient communities.

10 FRA requirements and guidance for developers

10.1 Over-arching principles

This SFRA is a strategic assessment of flood risk, intended to inform strategic allocations of land for development and support Local Plan flood risk and drainage policy. It does not replace the need for site specific Flood Risk Assessments (FRAs)

Site-specific FRAs are required by developers to provide a greater level of detail on flood risk and any protection provided by defences. Developers should, where required, undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent (including latest climate change allowances), to inform the sequential approach within the site and prove, if required, whether the Sequential and Exception Tests can be satisfied.

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

10.2 Planning consultees

There are statutory consultees that provide advice on development and flood risk; key stakeholders are listed below (note, this list is not exhaustive):

- Bassetlaw District Council decides all planning matters, including those related to flood risk, in their decision whether or not to grant planning permission.
- The Environment Agency is a statutory consultee for applications in areas of flood risk.
- Nottinghamshire County Council (as LLFA), provides technical advice on surface water drainage strategies and designs put forward for new 'major' developments.

Developers should consult with the relevant LPA (i.e. Bassetlaw District Council), Nottinghamshire County Council, the Environment Agency, Anglian Water or Sever Trent Water and, where necessary, relevant IDBs at an early stage to discuss flood risk including requirements for site-specific FRAs, detailed hydraulic modelling, and drainage assessment and design. If applications cross administrative boundaries, the neighbouring LLFA may need to be contacted.

10.3 Requirements for site-specific Flood Risk Assessments

Site-specific FRAs are carried out by (or on behalf of) developers to assess flood risk to and from a site. They are submitted with planning applications and should demonstrate how flood risk will be managed over the

development's lifetime, taking into account climate change and vulnerability of users.

10.3.1 When is an FRA required?

An FRA is required in the following circumstances:

- All developments located within Flood Zone 2 or 3. This includes minor developments such as non-residential extensions, alterations which do not increase the size of the building or householder developments. It also includes changes of use of an existing development
- All developments greater than 1 ha located in Flood Zone 1
- All developments less than 1 ha in Flood Zone 1 where a change of use in development type leads to a more vulnerable classification or where the development could be affected by sources of flooding other than rivers and the sea. This would include surface water, drains and reservoirs
- All developments located in an area which has been highlighted as having critical drainage problems by the Environment Agency. Note that there are currently no such areas within Bassetlaw, although the Retford Beck may be classified in future)

An FRA may also be required for some specific situations:

- If the site may be at risk from the breach of a local defence (even if the site is actually in Flood Zone 1);
- Where the site is intended to discharge to the catchment or assets of a water management authority which requires a site-specific FRA;
- Where the site's drainage system may have an impact on an IDB's system;
- In an area of an IDB that is in an area of known flood risk.
- Where a direct discharge of surface water or treated effluent is proposed into an IDB's catchment.
- Where a site is located 20m from a watercourse that doesn't have an associated Flood Zone;
- Where evidence of historical or recent flood event have been passed to the LPA;
- In an area of significant surface water flood risk; and/or,
- Where the site (including less than 1ha) could be affected by sources of flooding other than from rivers and sea.

Advice should be sought from the LPA and the Environment Agency at the pre-planning application stage to determine the need for a site-specific FRA. DEFRA's Guidance notes FD2320/TR2 'Flood Risk Assessment

Guidance for New Development' and FD2321/TR2 'Flood Risks to People' should also be consulted.

The Flood Zones, whilst generally accurate on a large scale, are not provided for land where the catchment of the watercourse falls below 3km2. There are a number of small watercourse and field drains which may pose a risk to development (e.g. some ordinary watercourses and / or drains managed by Internal Drainage Boards). Therefore, whilst these smaller watercourses may not be shown as having flood risk on the flood risk mapping, it does not necessarily mean that there is no flood risk. As part of a site-specific FRA the potential flood risk and extent of flood zones should be determined for these smaller watercourses.

Where a site-specific FRA has produced modelling outlines which differ from the EAs Flood Map for Planning (Rivers and Sea) then a Flood Map Challenge may need to be undertaken. Where the modelling and results are deemed acceptable to the EA, amendments to the Flood Map for Planning (Rivers and Sea) may take place.

All new development within the 1% AEP flood extent including an allowance for climate change (for the lifetime of the development) must not normally result in a net loss of flood storage capacity.

Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage. Where proposed development results in a change in building footprint, the developer should normally ensure that it does not impact upon the ability of the floodplain to store or convey water and seek opportunities to provide floodplain betterment. Similarly, where ground levels are elevated to raise the development out of the floodplain, compensatory floodplain storage within areas that currently lie outside the floodplain should normally be provided to ensure that the total volume of the floodplain storage is not reduced by applying a level for level compensation

There are a number of guidance documents which provide information on the requirements for site-specific FRAs:

- Standing Advice on Flood Risk (Environment Agency)**;**
- Flood Risk Assessment for Planning Applications (Environment Agency); and,
- Site-specific Flood Risk Assessment: CHECKLIST (NPPG, Defra).

At locations reliant on flood risk management measures to provide appropriate levels of safety for communities, special consideration should be given to the assessment of residual risk, particularly in relation to tidal flooding and areas relying on pumped drainage systems. Where residual risks give rise to unsafe conditions, consideration should be given to the introduction of additional measures or identification of tactical responses that can be conducted during an emergency.

10.4 Objectives of site specific FRAs

Site-specific FRAs should be proportionate to the degree of flood risk, as well as appropriate to the scale, nature and location of the development. Site-specific FRAs should establish:

- Whether a proposed development is likely to be affected by current or future flooding from any source
- Whether a proposed development will increase flood risk elsewhere
- Whether the measures proposed to deal with the effects and risks are appropriate
- The evidence, if necessary, for the Local Planning Authority to apply the Sequential Test
- Whether, if applicable, the development will be safe and pass the Exception Test

FRAs for sites located in Bassetlaw District should follow the approach recommended by the NPPF (and associated guidance) and guidance provided by the Environment Agency, Nottinghamshire County Council and / or Bassetlaw District Council (where relevant).

Guidance for local planning authorities for reviewing flood risk assessments submitted as part of planning applications has been published by Defra in 2015 – Flood Risk Assessment: Local Planning Authorities.

In circumstances where FRAs are prepared for windfall sites then they should include evidence that demonstrates the proposals are in accordance with the policies described in the Local Plan.

10.4.1 Surface water drainage strategies

The requirement for a Surface Water Drainage Strategy is in addition to a Flood Risk Assessment; however, the two documents wil include similar details and should inform one another. A Surface Water Drainage Strategy may therefore form part of the FRA but for validation purposes must be clearly identified. Failure to do so may result in an application not being made valid. Chapter 11 provides further guidance for developers on surface water drainage strategies.

10.5 Hydraulic modelling

Hydraulic modelling may be required as part of a site-specific Flood Risk Assessment, to provide the required level of detail to support a site's development. This may occur where:

- The Environment Agency's Flood Zone maps do not cover the watercourse. Environment Agency mapping of Flood Zones covers watercourses with a catchment greater than 3km2 (Rivers and Sea). If a watercourse or drain is shown on OS mapping but is not covered by a Flood Zone, this does not mean there is no potential flood risk.

- For areas within the Flood Zones, further and more detailed modelling may be necessary, based on more detailed survey of the site (and watercourses, if the model is old or the Flood Zones are based on generalised 2D modelling)
- Locations where surface water flooding is the predominant flood risk could be investigated further by use of surface water hydraulic modelling, or in combination with fluvial modelling, to assess the interactions between the two in more detail. Similarly, for any locations which suffer from sewer flooding or sewer capacity issues; this data can be incorporated into hydraulic models to more accurately represent the surface water system.
- Any developments shown to be at residual flood risk, for example from a breach or overtopping scenario (e.g. reservoir, canal, perched watercourse), may require modelling.

Any existing hydraulic models which are represented in 1D-only could be upgraded in future to 1D-2D hydraulic models, if it is deemed necessary (for example if properties are at flood risk or a flood event has occurred, and more detailed information is required, or to support the Exception Test). This type of model would provide a greater level of floodplain flood risk information, for example depths, velocity and hazard in the floodplain.

10.6 Flood risk management guidance - Mitigation measures

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 as far as possible, only then should mitigation measures be considered. When designing mitigation measures, developers should consult with statutory consultees at an early stage to understand their requirements.

10.6.1 Site layout and design

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

The NPPF states that a sequential, risk-based approach should be applied to try to locate more vulnerable land use away from Flood Zones, 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 the 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.

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.

The provision of a buffer strip can 'make space for water', allow additional capacity to accommodate climate change and ensure access to the watercourse, structures and defences is maintained for future maintenance purposes.

It also enables the avoidance of disturbing riverbanks, adversely impacting 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 itself, making future maintenance of the river much more difficult.

10.6.2 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 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, raising land above the floodplain would reduce conveyance or flood storage in the floodplain and could adversely impact 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 or property.

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.

Any proposal for modification of ground levels will need to be assessed as part of a detailed flood risk assessment.

10.6.3 Raised floor levels

The raising of internal floor levels within a development avoids damage occurring to the interior, furnishings and electrics in times of flood. The Environment Agency advises that minimum finished floor levels should be set 300mm above the 1% AEP plus climate change peak flood level, where the new climate change allowances have been used (see Chapter 4 for the climate change allowances). The minimum finished floor level should be set 600mm above the 1% AEP plus climate change peak flood level, where only a 20% allowance for climate change is available. The additional height that the floor level is raised above the maximum water level is referred to as the "freeboard". Additional freeboard may be required because of risks relating to blockages to the channel, culvert or bridge and should be considered as part of an FRA.

Allocating the ground floor of a building for less vulnerable, non-residential, use is an effective way of raising living space above flood levels. 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. However, access and egress would still be an issue, particularly when flood duration covers many days.

Similarly, the use of basements should be avoided. Habitable uses of basements within Flood Zone 3 should not be permitted, whilst basement dwellings in Flood Zone 2 will be required to pass the Exception Test. Access should be situated 300mm above the design flood level and waterproof construction techniques used.

10.6.4 Development and 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. 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.

10.6.5 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 the 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).

National Flood and Coastal Risk Management Grant in Aid (FCRMGiA) 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. FCRMGiA should not be used to enable new development to come forward, which should be bearing full costs itself.

The NPPF (Paragraph 204) also sets out legal tests required in order for planning obligations to be sought (where it is not possible to address unacceptable impacts through a planning condition).

These are:

- Necessary to make the development acceptable in planning terms;
- Directly related to the development; and
- Fairly and reasonable related in scale and kind to the development.
- 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 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 Environment Agency request that developers contact them to discuss potential solutions.

10.7 Flood resistance measures

There may be instances where flood risk to a development remains despite implementation of such planning measures as those outlined above. 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 1 in 1,000-year scenario. 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 normally be relied on for new development as an appropriate mitigation method. Most of the measures should be regarded as reducing the rate at which flood water can enter a property during an event and considered an improvement on what could be achieved with sand bags. They are often deployed with small scale pumping equipment to control the flood water that does seep through these systems. The following measures are often deployed:

Permanent barriers

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

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.

Community resistance measures

These include demountable defences that can be deployed by local communities to reduce the risk of water ingress to a number of properties. The methods require the deployment of inflatable (usually with water) or temporary quick assembly barriers in conjunction with pumps to collect water that seeps through the systems during a flood.

10.8 Flood resilience measures

Flood-resilient buildings are designed and constructed to reduce the impact of flood water entering the building. These measures aim to ensure no permanent damage is caused, the structural integrity of the building is not compromised and the clean up after the flood is easier. Interior design measures to reduce damage caused by flooding include:

- 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

10.9 Reducing flood risk from other sources

10.9.1 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 (development form), ensuring floor levels are raised above the water levels caused by a 1 in 100-year 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.

Infiltration SuDS can cause increased groundwater levels and subsequently may increase flood risk on or off of the site. Developers should provide evidence and ensure that this will not be a significant risk. When redeveloping existing buildings, it may be acceptable to install pumps in basements as a resilience measure. However, for new development this is not considered an acceptable solution.

10.9.2 Surface water and sewer flooding

Developers should discuss public sewerage capacity with the water utility company at the earliest possible stage. The development must improve the drainage infrastructure to reduce flood risk on site and regionally. It is important that a drainage impact assessment shows that this will not increase flood risk elsewhere, and that 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 floodproofing and resilience measures could protect 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 a property's private sewer upstream of the public sewerage system. These need to be carefully installed and must be regularly maintained.

Consideration must also be given to attenuation and flow ensuring that flows during the 100-year plus climate change storm event are retained within the site if any flap valves shut. This should be demonstrated with suitable modelling techniques.

11 Surface water management and SuDS

11.1 Surface Water Drainage Strategies

A Surface Water Drainage Strategy (SWDS) demonstrates planning, design, construction, and maintenance considerations for surface water management systems. This applies to both greenfield and previously developed sites. A Surface Water Drainage Strategy should be appropriate to the scale, nature, and location of the development that is proposed, taking into account the requirements set out in national and local policy.

11.2 Role of the LLFA and Local Planning Authority in surface water management

From April 2015, local planning policies and decisions on planning applications relating to major development or major commercial development should ensure that sustainable drainage systems for management of run-off are put in place. The approval of sustainable drainage solution lies with the Local Planning Authority.

Nottinghamshire County Council was made a statutory consultee on the management of surface water and, as a result, will be required to provide technical advice on surface water drainage strategies and designs put forward for new major developments.

Major developments are defined as:

- residential development: 10 dwellings or more, or residential development with a site area of 0.5 hectares; and
- non-residential development: provision of a building or buildings where the total floor space to be created is 1,000 square metres or more or, where the floor area is not yet known, a site area of one hectare or more.

The LLFA may also provide advice on minor development on a non-statutory basis.

When considering planning applications, local planning authorities should seek advice from the relevant flood risk management bodies, principally the LLFA on the management of surface water (including what sort of SuDS they would consider to be reasonably practicable), satisfy themselves that the proposed minimum standards of operation are appropriate and ensure, through the use of planning conditions or planning obligations, that there are clear arrangements for on-going maintenance over the development's lifetime. Judgement on what SuDS system would be reasonably practicable should be through reference to Defra's 'Non-statutory technical standards for SuDS' document and should take into account design and construction costs.

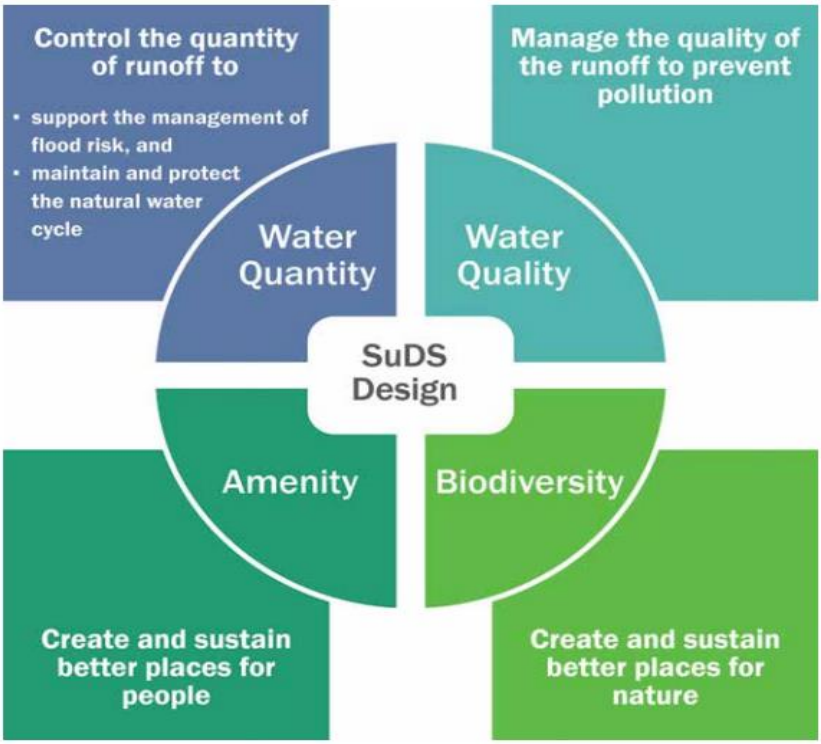
Further, development proposals must demonstrate that appropriate provision has been made for the on-site attenuation and treatment of surface water run-off.

It is essential that developers consider sustainable drainage at an early stage of the development process – ideally at the master-planning stage. This will assist with the delivery of well designed, appropriate and effective SuDS. As part of the early discussions relating to development proposals Bassetlaw District Council pre-planning application discussion service can be used to discuss with the Councils liaisons following:

- Gain an understanding of community views
- Identifying any initial problems which may prevent the scheme from gaining planning permission
- Identifying any proposals which may be unacceptable thereby saving time and money of the applicant
- Advice on information which is likely to be required to accompany the application

Proposals should also comply with the key SuDS principles regarding solutions that deliver multiple long-term benefits. These four principles are outlined in Figure 11-1.

Figure 11-1: Four principles of SuDS design



11.3 LLFA guidance

Nottinghamshire County Council standard advice sets out guidance for developers wishing to submit a planning application with surface water drainage implications.

1 Drainage from the site should be via a sustainable drainage system that aligns with the CIRIA Suds Manual and non-statutory technical guidance. The hierarchy of drainage options should be infiltration, discharge to watercourse and finally discharge to sewer subject to the approval of the statutory utility. If infiltration is not to be used on the site, justification should be provided including the results of infiltration tests.

2 For greenfield areas, the maximum discharge should be the greenfield run-off rate (Qbar) from the area. For brownfield areas that previously drained to sewers, the previous discharge rate should be reduced by 30% to allow for future climate change effects. Note that it is not acceptable to simply equate impermeable areas with discharge as it is the maximum discharge that could have been achieved by the site through the existing pipe system without flooding that is the benchmark to be used prior to a 30% reduction. An existing drainage survey with impermeable areas marked and calculations top determine the existing flow will be required as part of any justification argument for a discharge into the sewers from the site.

3 The site drainage system should cater for all rainfall events up to a 100-year plus 30% climate change allowance level of severity. The underground drainage system should be designed not to surcharge in a 1-year storm, not to flood in a 30-year storm and for all flooding to remain within the site boundary without flooding new buildings for the 100-year plus 30% climate change event. The drainage system should be modelled for all event durations from 15 minutes to 24 hours to determine where flooding might occur on the site. The site levels should be designed to direct this to the attenuation system and away from the site boundaries.

4 Consideration must be given to exceedance flows and flow paths to ensure properties are not put at risk of flooding.

5 Any proposals to use SUDS must include details showing how these will be maintained to ensure their effectiveness for the lifetime of the development. The county council SuDS standards supports the 'non-statutory technical standards for sustainable drainage systems' in conjunction with the NPPF and Planning Practice Guidance

11.4 Internal Drainage Board Guidance

Planners should be aware of local conditions and requirements set by the Internal Drainage Boards (Trent Valley, Isle of Axholme & North Nottinghamshire Water Level Management Board and Doncaster East) have published application guidance notes.

11.5 Sustainable Drainage Systems (SuDS)

Sustainable Drainage Systems (SuDS) are designed to maximise the opportunities and benefits that can be secured from surface water management practices.

SuDS provide a means of dealing with the quantity and quality of surface water whilst offering additional benefits over traditional systems of improving amenity and biodiversity. The correct use of SuDS can also allow developments to counteract the negative impact that urbanisation has on the water cycle by promoting infiltration and replenishing ground water supplies. SuDS if properly designed can improve the quality of life within a development offering additional benefits such as:

- improving air quality;
- regulating building temperatures;
- reducing noise;
- providing education opportunities; and
- cost benefits over underground piped systems.

Given the flexible nature of SuDS they can be used in most situations within new developments as well as being retrofitted into existing developments. SuDS can also be designed to fit into most spaces. For example, permeable paving could be used in parking spaces or rainwater gardens into traffic calming measures.

It is a requirement for all new major development proposals to ensure that sustainable drainage systems for management of runoff are put in place. Likewise, minor developments should also ensure sustainable systems for runoff management are provided. The developer is responsible for ensuring the design, construction and future/ongoing maintenance of such a scheme is carefully and clearly defined, and a clear and comprehensive understanding of the existing catchment hydrological processes and existing drainage arrangements is essential.

11.6 Types of SuDS Systems

There are many different SuDS techniques that can be implemented in attempts to mimic pre-development drainage (Table 11-1Table 11-1: Examples of SuDS techniques and potential benefits). The suitability of the techniques will be dictated in part by the development proposal and site conditions.

Table 11-1: Examples of SuDS techniques and potential benefits

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	✓		

11.6.1 Treatment

A key part of SuDS is to provide the maximum improvement to water quality through the use of the "SuDS management train". To maximise the treatment within SuDS, CIRIA recommends the following good practice is implemented in the treatment process:

1 Manage surface water runoff close to source: This makes treatment easier due to the slower velocities and also helps isolate incidents rather than transport pollutants over a large area.

2 Treat surface water runoff on the surface: This allows treatment performance to be more easily inspected and managed. Sources of pollution and potential flood risk is also more easily identified. It also helps with future maintenance work and identifying damaged or failed components.

3 Treat a range of contaminates: SuDS should be chosen and designed to deal with the likely contaminates from a

development and be able to reduce them to acceptably low levels.

4 Minimise the risk of sediment remobilisation: SuDS should be designed to prevent sediments being washed into receiving water bodies or systems during events greater than what the component may have been designed for.

5 Minimise the impact of spill: Designing SuDS to be able to trap spills close to the source or provide robust treatment along several components in a series.

The number of treatment stages required depends primarily on the source of the runoff. A drainage strategy will need to demonstrate that an appropriate number of treatment stages are delivered.

Where reasonably practical, all drainage proposals should follow the SuDS discharge hierarchy and management train which prioritises infiltration at source first. How proposals follow this hierarchy and management train should clearly be demonstrated, with adequate evidence and reasoning. If necessary, adequate evidence and explanation concerning why infiltration methods are not considered to be feasible and why methods lower down the hierarchy are considered to be feasible, may need to be provided with drainage proposals.

11.6.2 SuDS Management

SuDS should not be used individually but as a series of features in an interconnected system designed to capture water at the source and convey it to a discharge location. Collectively this concept is described as a SuDS Management Train. The number of treatment stages required within the Management Train depends primarily on the source of the runoff and the sensitivity of the receiving waterbody or groundwater. A drainage strategy will need to demonstrate that an appreciate number of treatment stages are delivered.

11.6.3 Overcoming SuDS constraints

The design of a SuDS system will be influenced by a number of physical and policy constraints. These should be taken into account and reflected upon during the conceptual, outline and detailed stages of SuDS design, outlined in .

Table 11-2: Example of SuDS design constraints and possible solutions

Considerations	Solution
Land availability	SuDS can be designed to fit into small areas by utilising different systems. For example, features such as permeable paving and green roofs can be used in urban areas where space may be limited.
Contaminated soil or groundwater below site	SuDS can be placed and designed to overcome issues with contaminated groundwater or soil. Shallow surface SuDS can be used to minimise disturbance to the underlying soil. The use of infiltration should also be investigated as it may be possible in some locations within the site. If infiltration is not possible linings can be used with features to prevent infiltration.
High groundwater levels	Non-infiltrating features can be used. Features can be lined with an impermeable line or clay to prevent the egress of water into the feature. Additional, shallow features can be utilised which are above the groundwater table.
Steep slopes	Check dams can be used to slow flows. Additionally, features can form a terraced system with additional SuDS components such as ponds used to slow flows.
Shallow slopes	Use of shallow surface features to allow a sufficient gradient. If the gradient is still too shallow pumped systems can be considered as a last resort.
Sites with deep backfill	Infiltration should be avoided unless the soil can be demonstrated to be sufficiently compacted. Some features such as swales are more adaptable to potential surface settlement.
Open space in floodplain zones	Design decisions should be done to take into consideration the likely high groundwater table and possible high flows and water levels. Features should also seek to not reduce the capacity of the floodplain and take into consideration the influence that a watercourse may have on a system. Facts such as siltation after a flood event should also be taken into account during the design phase.
Future adoption and maintenance	Local Planning Authority should ensure development proposals, through the use of planning conditions or planning obligations, have clear arrangements for on-going maintenance over the development's lifetime.

For proposed developments, geotechnical investigation should be undertaken to determine whether the ground at the site has infiltration potential. This information should be representative of on-site conditions. If the ground at the site is found to have infiltration potential, detailed infiltration testing should be undertaken in line with BRE 365 to establish representative infiltration rates.

For SuDS techniques that are designed to encourage infiltration, it is imperative that the water table is low enough and a site-specific infiltration test is conducted early on as part of the design of the development. Infiltration should be considered with caution within areas of possible subsidence or sinkholes. Where sites lie within or close to Groundwater Source Protection Zones (GSPZs) or aquifers, further restrictions may be applicable, and guidance should be sought from the LLFA.

11.7 Sources of SuDS guidance

11.7.1 10.5.1 C753 CIRIA SuDS Manual (2015)

The C753 CIRIA SuDS Manual (2015) replaces and updates the previous version (C697) providing up to date guidance on planning, design, construction and maintenance of SuDS. The document is designed to help the implementation of these features into new and existing developments, whilst maximising the key benefits regarding flood risk and water quality. The manual is divided into five sections ranging from a high-level overview of SuDS, progressing to more detailed guidance with progression through the document. It is recommended that developers and the LPA utilise the information within the manual to help design SuDS which are appropriate for a development.

11.7.2 Non-Statutory Technical Guidance, Defra (March 2015)

Non-Statutory Technical guidance has been developed by Defra to sit alongside PPG to provide non-statutory standards as to the expected design and performance for SuDS. The guidance provides a valuable resource for developers and designers outlining peak flow control, volume control, structural integrity of the SuDS, and flood considerations for both within and outside the development as well as maintenance and construction considerations. It considers the following: flood risk inside and outside the development, peak flow, volume control, structural integrity, designing for maintenance considerations and construction.

The Local Planning Authority will refer to these standards when determining whether proposed SuDS are considered reasonably practicable.

11.8 Other surface water considerations

11.8.1 Groundwater Vulnerability Zones

The Environment Agency have published new groundwater vulnerability maps in 2015. These maps provide a separate assessment of the vulnerability of groundwater in overlying superficial rocks and those that comprise of the underlying bedrock. The map shows the vulnerability of groundwater at a location based on the hydrological, hydro-ecological and soil propertied within a one-kilometre grid square.

Two maps are available:

- Basic groundwater vulnerability map: shows the likelihood of a pollutant discharged at ground level (above the soil zone) reaching groundwater for superficial and bedrock aquifers and is expresses as high, medium and low vulnerability.
- Combined groundwater vulnerability map: this map displays both the vulnerability and aquifer designation status (principal or secondary). The aquifer designation status is an indication of the importance of the aquifer for drinking water supply.

The groundwater vulnerability maps should be considered when designing SuDS. Depending on the height of the water table at the location of the proposed development site, restrictions may be placed on the types of SuDS appropriate to certain areas.

11.8.2 Groundwater Source Protection Zones (GSPZ)

In addition to the AStGWF data the Environment Agency also defines Groundwater Source Protection Zones in the vicinity of groundwater abstraction points. These areas are defined to protect areas of groundwater that are used for potable supply, including public/private potable supply (including mineral and bottled water) or for use in the production of commercial food and drinks. The Groundwater SPZ requires attenuated storage of runoff to prevent infiltration and contamination. The definition of each zone is shown below:

- Zone 1 (Inner Protection Zone) – the most sensitive zone: defined as the 50-day travel time from any point below the water table to the source. This zone has a minimum radius of 50 metres
- Zone 2 (Outer Protection Zone) – also sensitive to contamination: defined by a 400-day travel time from a point below the water table. This zone has a minimum radius around the source, depending on the size of the abstraction.
- Zone 3 (Total catchment) – defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source. For heavily exploited aquifers, the final Source Catchment Protection Zone can be defined

as the whole aquifer recharge area where the ratio of groundwater abstraction to aquifer recharge (average recharge multiplied by outcrop area) is >0.75. Individual source protection areas will still be assigned to assist operators in catchment management.

- Zone 4 (Zone of Special Interest) – a fourth zone SPZ4 or 'Zone of Special Interest' usually represents a surface water catchment which drains into the aquifer feeding the groundwater supply (i.e. catchment draining to a disappearing stream). In the future this zone will be incorporated into one of the other zones, SPZ 1, 2 or 3, whichever is appropriate in the particular case or becomes a safeguard zone.

The location of the Groundwater SPZs in relation to the District are shown in Figure 10-2. The western half of the district is located within a Zone 3 of the Groundwater Source Protection Zone. Throughout the area there are small isolated areas of Zone 1 and 2 at West Markham, Elkesley, Worksop, the east of Retford, to the west of Retford, Ranby and Mattersey. Depending on the nature of the proposed development and the location of the development sire with regards to SPZ's, restrictions may be in place on the types of SuDS used within appropriate areas. For example, infiltration SuDS are generally accepted within Zone 3, whereas in Zones 1 or 2, the Environment Agency will need to be consulted and infiltration SuDS may only be accepted if the correct treatments and permits are put in place. Any restrictions imposed on the discharge of the site generated runoff by the Environment Agency will be determined on a site by basis using risk-based approach.

11.8.3 Nitrate Vulnerable Zones

Nitrate Vulnerable Zones (NVZs) are areas designated as being at risk from agricultural nitrate pollution. Nitrate levels in waterbodies are affected by surface water runoff from surrounding agricultural land entering receiving waterbodies. The level of nitrate contamination will potentially influence the choice of SuDS and should be assessed as part of the design process. The definition of each NVZ is as follows:

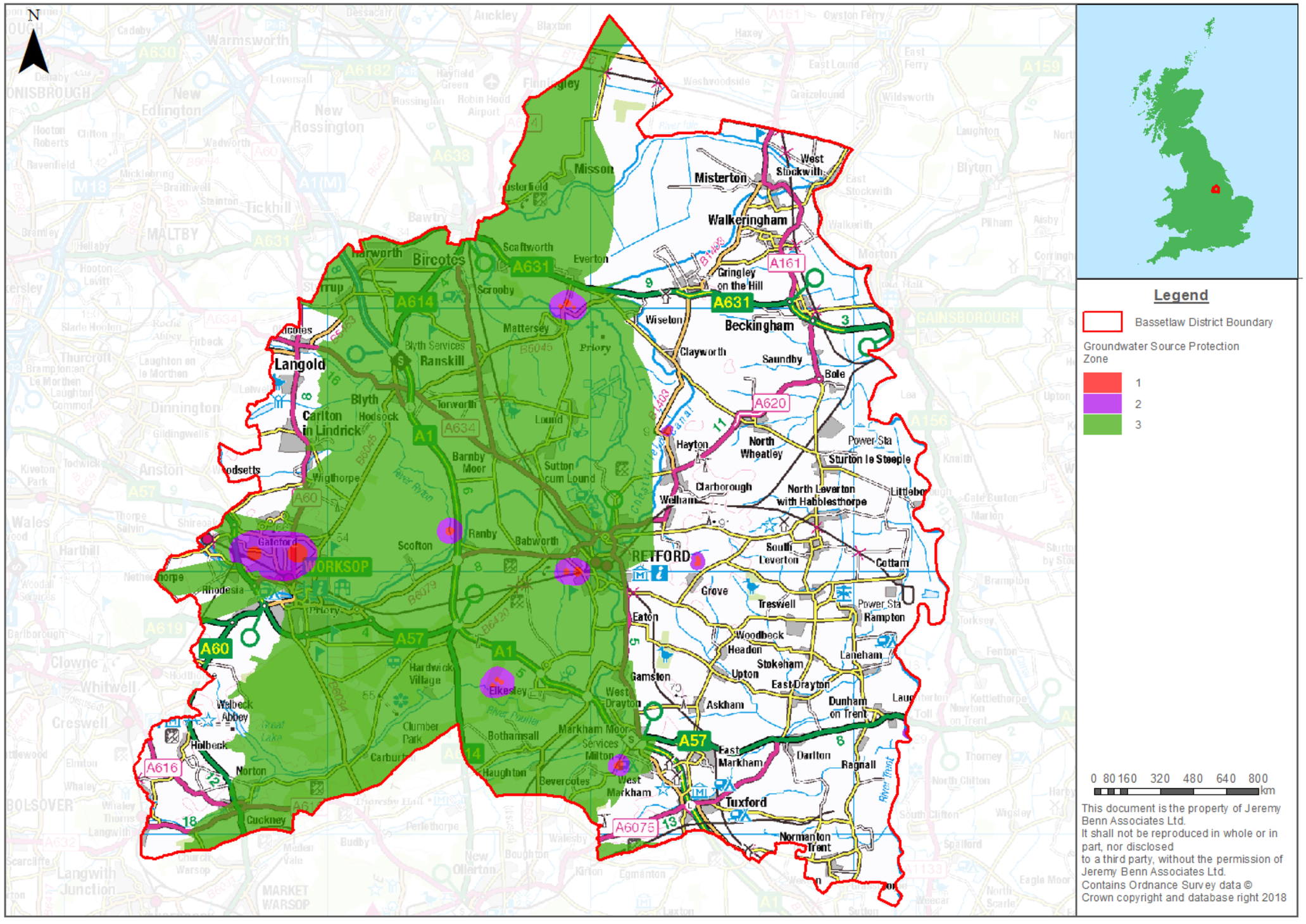
- Groundwater NVZ – water held underground in the soil or in pores and crevices in rock, which has, or could have if action is not taken, a nitrate concentration greater than 50mg/l.
- Surface Water NVZ – areas of land that drain into a freshwater water body which has, or could have is action is not taken, a nitrate concentration greater than 50mg/l.
- Eutrophic NVZ – bodies of water, mainly lakes and estuaries, that are, or may become, enriched by nitrogen compounds which cause a growth of algae and other plant life that unbalances the quality of the water and to organisms present in the water.

Bassetlaw District is entirely within a Surface Water NVZ. Areas west of Retford are within a groundwaters NVZ. There are two Drinking Water

safeguard Zones (around Newington and south west from Retford towards the A1) and the south western most corner are covered by two Eutrophic Waters (The Clumber Lake & Welbeck Great Lake EL125 and Thoresby Lake EL1 45).

Nitrate Vulnerability Zones can be viewed on the Environment Agency's website here.

Figure 11-2: Groundwater Source Protection Zones



12 Strategic flood risk solutions

12.1 Introduction

Strategic flood risk solutions may offer a potential opportunity to reduce flood risk in the district. As described in Section 2.3.8, Bassetlaw District is covered by Axholme and North West Linconshire, Sherwood and Shelford to Gainsborough policy Units as part of the River Trent CFMP. The specific 'actions' relevant to Bassetlaw in relation to strategic flood risk mitigation are:

- Investigate locations, ways and funding sources to return the river channel to a more natural state, particularly through Retford, Mansfield, Worksop, and the middle Idle.
- Identify areas where efficiencies can be achieved, such as reduced channel maintenance and the removal of flood risk management structures.
- Encourage rural and urban best-practices in land-use and in land-management to restore more sustainable natural floodplains and to reduce run-off.
- Complete the implementation of an appropriate flood alleviation scheme for Gainsborough and Newark.
- Investigate options for removing, abandoning or breaching sections of embankments where they provide little or no flood risk management benefit, to allow more targeted effort where it is needed. By investigating options for managed realignment, it will be possible to counter the effects of climate change and help to prevent an increase in overall flood risk.
- Investigate options for creating and restoring existing wash lands to accommodate climate change.

The following sections outline different options which could be considered for strategic flood risk solutions in the Bassetlaw District.

12.2 Natural flood management

Natural flood management (NFM) or Working with Natural Processes (WwNP) is a type of flood risk management used to protect, restore and re-naturalise the function of catchments and rivers to reduce flood and coastal erosion risk. WwNP has the potential to provide environmentally sensitive approaches to minimising flood risk, to reduce flood risk in areas where hard flood defences are not feasible and to increase the lifespan of existing flood defences. NFM and WwNP are used interchangeably in the UK though the term NFM will be used throughout this report.

A wide range of techniques can be used that aim to reduce flooding by working with natural features and processes in order to store or slow down

flood waters before they can damage flood risk receptors (e.g. people, property, infrastructure, etc.). NFM involves taking action to manage flood and coastal erosion risk by protecting, restoring and emulating the natural regulating functions of catchments, rivers, floodplains and coasts. Techniques and measures, which could be applied in Bassetlaw include:

- Peatland and moorland restoration in upland catchments
- Offline storage areas
- Re-meandering streams
- Targeted woodland planting
- Reconnection and restoration of functional floodplains
- Restoration of rivers and removal of redundant structures
- Installation or retainment of large woody material in river channels
- Improvements in management of soil and land use
- Creation of rural and urban SuDS

Both the European Commission and UK Government are actively encouraging the implementation of NFM measures within catchments and coastal areas in order to assist in the delivery of the requirements of various EC Directives relating to broader environmental protection and national policies. It is fully expected that the sustained interest in NFM implementation across the UK will continue in the post-Brexit era as a fundamental component of the flood risk management tool kit.

Evidence base for NFM to reduce flood risk

There has been much research on NFM, but it has never been synthesised into one location. This has meant that it has been hard for flood risk managers to access up-to-date information on NFM measures and to understand their potential benefits. The EA has now produced the NFM evidence base.

Mapping showing the potential for NFM in Bassetlaw is shown in Appendix J. These maps are intended to be used alongside the evidence directory to help practitioners think about the types of measure that may work in a catchment and the best places in which to locate them. There are limitations with the maps, however it is a useful tool to help start dialogue with key partners.

According to the spatial model of slowly permeable soils there are areas within Bassetlaw where by removing existing defences and reconnecting the floodplain could create areas for potential without causing risk to properties. These areas are predominately located on the left bank of the River Ryton downstream of Worksop, upstream of Retford on the River Maun and River Meden, with the largest area outside of Retford on the River

Idle, south of Chainbridge Lane. Reconnecting the river with its floodplain and naturalising the river itself should lead to reduced peak flood levels which will protect properties and infrastructure in settlements downstream.

NFM measures are designed to reduce the flow of floodwater to minimise the risk of flooding to areas downstream. Tree planting can play a vital role in reducing flood risk within an area. Increased rainfall interception and infiltration may reduce surface water runoff and therefore increase the potential of NFM in the area. There are vast expanses along the River Idle and River Ryton in the north of the district that would benefit from tree planting. There are also opportunities for potential wider catchment planting around Rampton, Gringley on the Hill and west of Durham on Trent along with other isolated locations within the District.

Bassetlaw should look to become actively engaged with the catchment partnerships and the Rivers Trust's NFM investigations with a view to setting aside land for NFM.

The effectiveness of NFM measures is site-specific and depends on many factors, including the location and scale at which they are used. It may not always be possible to guarantee that these measures alone will deliver a specified standard of defence. Consequently, flood risk management measures should be chosen from a number of options ranging from traditional forms of engineering through to more natural systems. The research gaps that need to be addressed to move NFM into the mainstream are identified in the evidence directory.

12.3 Flood storage

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:

- enlarging the river channel;
- raising the riverbanks; and/or
- constructing flood banks set back from the river.

The construction of new upstream storage schemes as part of upstream catchment-based approaches within Bassetlaw district 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.

12.4 Catchment and 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, and by creating space for naturally functioning floodplains working with natural processes.

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

- Promoting existing and future brownfield sites that are adjacent to watercourses to naturalise banks as much as possible. Buffer areas around watercourses provide an opportunity to restore parts of the floodplain
- Removal of redundant structures to reconnect the watercourse and the floodplain. There are a number of culverted sections of watercourse located throughout the district which if returned to a more natural state would potentially reduce flood risk to the local area
- Apply the Sequential Approach to avoid new development within currently undefended floodplain.

For those sites considered within the Local Plan and / or put forward by developers, that also have watercourses flowing through or past them, the sequential approach should be used to locate development away from these watercourses. This will ensure the watercourses retain their connectivity to the floodplain. Loss of floodplain connectivity in rural upper reaches of tributaries which flow through urban areas in the district, could potentially increase flooding within the urban areas. This will also negate any need to build flood defences within the sites. It is acknowledged that sites located on the fringes of urban areas within the district are likely to have limited opportunity to restore floodplain in previously developed areas.

12.4.1 Structure Removal and / or modification (e.g. Weirs), de-culverting

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 regimes, 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 historical/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.

With careful early planning, watercourses can be made a feature of the site and ownership and maintenance should be considered early. De-culverting of a watercourse, to open it up and make it a feature of the site to allow for flood storage and betterment downstream, should be considered for all sites with culverted watercourses within their boundary.

Further information is provided in the Trash and Security Screen Guide 2009, published by the Environment Agency/ Defra, which should be used as evidence for any culvert assessment, improvement or structure retention.

12.4.2 Re-naturalisation

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.

12.5 Flood defences

There are some formal flood defences present within Bassetlaw District (see Section 7 for further information). 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.

For example, the Walkeringham Flood Alleviation Scheme was completed in 2017 will protect approximately 50 homes in the town which severely suffered from flooding in 2007 and again in 2012. The alleviation scheme involved building a by-pass channel to divert flood waters away from the village and reconnect with the river further downstream.

12.6 Green Infrastructure

Bassetlaw District Council defines green infrastructure (GI) as the following:

"Green infrastructure comprises networks of multi-functional open space, at all scales. Its fundamental principles are therefore the multi-functionality of open space resources, to enable them to maximise public benefit, and the connectivity of these resources into functional networks to ensure that the overall value of the network is greater than the sum of its component parts."

The Bassetlaw District Council aims to implement GI as an integral part of the development process by 2026. GI can be introduced through both rural and urban landscapes such as, woodlands, watercourses, playing fields, nature reserves, cemeteries, footpaths, hedgerows, and amenity landscaping. These aim to meet five GI themes:

- Open Space
- Access
- Biodiversity
- Historic Environment
- Landscape

The identification and planning of GI 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 urban 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.

The May 2010 Bassetlaw District Council Green Infrastructure Study 'Overarching Vision' identified that the environmental and cultural assets currently in Bassetlaw need to be protected and maintained, with new initiatives complementing those already existing. The functions of new GI should be designed to incorporate multiple functions; including sustainable drainage, informal recreation, biodiversity, visual amenity, adventure play and organised sport.

Woodland has the potential to provide significant GI opportunities within Bassetlaw. It is suggested that accessible, well-managed areas of woodland and river valley wetlands will encourage greater biodiversity, climate change mitigation and facilitate recreational opportunities for local occupants. Development of wetland areas from grey to green infrastructure has previously occurred along the River Trent, Idle and Ryton developing areas such as Sandhill Lake.

Opportunities for green infrastructure arise in new-build developments, sustainable transport, recreation and tourism, and provide potential for linkages with authorities surrounding Bassetlaw.

12.7 Engaging with key stakeholders

Where complex flood risk issues are highlighted it is important that all stakeholders are actively encouraged to work together to identify issues and provide suitable solutions. Engagement with riparian owners is also important to ensure they understand their rights and responsibilities including maintaining river beds and banks; allowing the flow of water to pass without obstruction; and controlling invasive alien species e.g. Japanese knotweed. Engagement is also important to determine whether an Environmental Permit is required from the Environment Agency or whether consent from the LLFA or IDB is required.

More information about riparian owner responsibilities can be found in the Environment Agency's Owning a watercourse publication.

13 Summary and recommendations

This Level 1 SFRA delivers a strategic assessment of risk from all sources of flooding in Bassetlaw. It also provides an overview of policy and provides guidance for planners and developers.

13.1 Sources of flood risk

- Flood history shows that Bassetlaw has been subject to flooding from several sources of flood risk, with the principal risk being fluvial from watercourses within the district. Additionally, there are recorded incidents of surface water flooding, particularly in the main urban areas of the district.
- The primary fluvial flood risk for the majority of Bassetlaw is associated with the River Trent and its tributary, the River Idle. In the west area of the district, the River Ryton and its tributaries are the primary sources of fluvial risk. There are also other small tributaries that influence the fluvial flood risk in Worksop and Retford.
- Bassetlaw has experienced a number of historic surface water flooding incidents. The Risk of Flooding from Surface Water map further shows a number of prominent overland flow routes in the district; these predominantly follow topographical flow paths of existing watercourses or road networks in urban areas, with some isolated flow-routes through properties by virtue of run-off.
- The majority of the district is classified as <25% in the AStGWF map with areas of increased groundwater flooding susceptibility in the East along the River Trent and to the West over the Carlton Beck. There is increased risk of groundwater flooding throughout the district due to an history of mining in Bassetlaw.
- There are 20 reservoirs located within Bassetlaw and a number located outside of the area whose inundation mapping is shown to affect Bassetlaw. There are no records of flooding from reservoirs impacting properties inside the study area. The level and standard of inspection and maintenance required under the Act means that the risk of flooding from reservoirs is relatively low.
- The Severn Trent Water HFRR register indicates a total of 208 recorded incidents of sewer flooding in Bassetlaw District administrative area. Anglian water had o recorded incidents in Bassetlaw. The settlements with the most recorded incidents include Retford, Worksop and Costhorpe.
- There are records of historic canal overtopping and breach along the Chesterfield Canal.

13.2 Policy recommendations

13.2.1 Recommendations for planners

1. Take a risk-based approach to the allocation of future developments

The NPPF supports a risk-based and sequential approach to development and flood risk in England, so that development is located in the lowest flood risk areas where possible; it is recommended that this approach is adopted for all future developments within Bassetlaw District.

The Flood Zones show that areas of Bassetlaw are at high risk of flooding from fluvial sources; the main urban centres of Worksop and Retford in particular are at high risk from fluvial flooding sources. There are formal flood defences in Bassetlaw, which offer a standard of protection to five communities. If the defences along the main watercourses were to fail, there may be a high risk of flooding to developments within the floodplain. Another significant flood risk in the district is from surface water sources; the majority of settlements are at a level of surface water flood risk. Therefore, proposed development sites will be required to pass the Sequential Test and, where necessary, Exception Tests in accordance with the NPPF. To demonstrate the Exception Test has been passed, flood resilience design and emergency planning must be accounted for including:

- The development will remain safe and operational under flood conditions;
- A strategy for safe evacuation and / or safely remaining in the building under flood conditions;
- Key services will continue to be provided under flood conditions; and
- Buildings are designed for a quick recovery following a flood.

The District Council should use the Flood Zone information in this SFRA to apply the Sequential Test and inform the allocation of sites for the Local Plan. When the Sequential Test is applied to strategic allocations, the District Council should also refer to information on flooding from other sources and consider the likely impact of climate change. If the Exception Test is needed at a strategic allocation stage, the District Council should consider if a more detailed assessment of flood depth, velocity and hazard is needed in a Level 2 SFRA.

2. Develop a strategic approach to flood risk management and drainage provision in the District

The LLFA and other RMAs should use the information in SFRA to inform a long-term pipeline of flood alleviation studies and schemes to help inform where further contributions from developers on/ off site would be beneficial. This should consider how strategic flood mitigation measures,

SuDs, natural flood management techniques, green infrastructure and green-blue corridors can be planned strategically for the District to both facilitate sustainable drainage and flood risk management and ensure wider benefits such as biodiversity, amenity, water quality and recreation are realised. For successful future flood risk management, it is recommended that local planning authorities also adopt a catchment partnership working approach in tackling flood risk and environmental management.

3. Apply the following policy on cumulative impact

New settlements

The new settlement area should be accompanied by an overall Surface Water Management Masterplan and Strategy. This should cover:

- How the cumulative effects of potential peak rates and volumes of water from development sites would impact on peak flows, duration of flooding and timing of flood peaks on receiving watercourses. This should be used to develop and implement appropriate drainage sub catchments and specific runoff rate and volume requirements for each phase of the development.
- The risk of flooding from all sources, including for rainfall events greater than the design standard of the surface water drainage system should be taken into account to ensure there is no flood risk to new properties and that exceedance flows in extreme events are safely routed around those properties
- The consideration of how SuDs, natural flood management techniques, green infrastructure and green-blue corridors can be designed into the development master plan to facilitate drainage flood risk management and ensure wider benefits such as biodiversity, amenity, water quality and recreation are realised.
- Based on the above, a Drainage Phasing Plan should be developed, based on the SuDS train method (considering firstly how water can be infiltrated/ stored at a plot level, then conveyed through the site and any regional storage needs at a settlement level)
- The provision of drainage during building phase shall be based on the Drainage Phasing Plan to ensure adequate drainage is provided and implemented throughout the development life
- The LLFA, Environment Agency and BDC should be consulted during the development of the Surface Water Management Masterplan and Strategy

Retford Beck

Retford Beck's impact on east Retford, which suffers from a combination of foul water, surface water and river flooding, creates many interlinked problems for the town. The lower reaches of the Retford Beck are heavily

culverted and are considerably under capacity to convey catchment flows, resulting in frequent flooding at culvert entrances. The Retford Beck is one of the highest flood risk catchments in the District and as such, as flood alleviation scheme is being progressed by the District Council, working in partnership with the Environment Agency and Nottinghamshire County Council. All new development (other than minor extensions) in this catchment should:

- Incorporate SuDs and provide details of adoption, ongoing maintenance and management. Proposals will be required to provide reasoned justification for not using SuDS techniques, where ground conditions and other key factors show them to be technically feasible. Preference will be given to systems that contribute to the conservation and enhancement of biodiversity and green infrastructure in the District where practicable.
- Seek to provide wider betterment by demonstrating in site specific Flood Risk Assessments and Surface Water Drainage Strategies what measures can be put in place to contribute to a reduction in flood risk downstream. This may either be by provision of additional storage on site e.g. through oversized SuDS, natural flood management techniques, green infrastructure and green-blue corridors and/or by providing a Partnership Funding contribution towards the Retford Beck scheme. Consultation on the site-specific requirements should be undertaken with BDC at the earliest opportunity.
- A Surface Water Drainage Strategy will be required for all developments in this catchment, regardless of development size.
- Nottinghamshire County Council as LLFA will review Surface Water Drainage Strategies in accordance with their local requirements for major developments. These should take into account all sources of flooding to ensure that future development is resilient to flood risk and does not increase flood risk elsewhere.
- The District Council as LPA will review Surface Water Drainage Strategies for non-major developments
- The Environment Agency, in consultation with BDC and NCC, should consider whether to formally designate the Retford Beck catchment as a Critical Drainage area. This would mean that a detailed Flood Risk Assessment would be required for all developments that are proposed, regardless of their size.

<u>Rural villages at higher risk of flooding</u>

Based on historic flooding and mapping of areas at most risk of localised water flooding, development in these catchments has the most potential to increase flood risk elsewhere. Therefore:

- All new development (other than minor extensions) will be required to incorporate SUDs and provide details of adoption, ongoing maintenance and management. Proposals will be required to provide reasoned justification for not using SuDS techniques, where ground conditions and other key factors show them to be technically feasible. Preference will be given to systems that contribute to the conservation and enhancement of biodiversity and green infrastructure in the District where practicable.
- A Surface Water Drainage Strategy will be required for all developments in this catchment, regardless of development size.
- Nottinghamshire County Council as LLFA will review Surface Water Drainage Strategies in accordance with their local requirements for major developments. These should take into account all sources of flooding to ensure that future development is resilient to flood risk and does not increase flood risk elsewhere.
- The District Council as LPA will review Surface Water Drainage Strategies for non-major developments

This policy is suggested for the following parishes:

- Worksop
- Carlton in Lindrick CP
- Walkeringham CP
- Clarborough and Welham CP
- North Leverton with Habblesthorpe CP
- Harworth Bircotes CP
- Beckingham CP
- East Markham CP
- Treswell CP

Rural villages at low risk of flooding

Nottinghamshire County Council as LLFA will review Surface Water Drainage Strategies in accordance with their local requirements for major developments. These should take into account all sources of flooding to ensure that future development is resilient to flood risk and does not increase flood risk elsewhere.

13.2.2 Recommendations for Neighbourhood Planners

Neighbourhood planners should use the SFRA information to assess the risk of flooding to sites within their community and relevant flood risk policy and guidance that should apply. The SFRA will also be helpful for developing community level flood risk policies in high flood risk areas. In particular, Neighbourhood Planners should refer to the policy recommendations with regards to cumulative impact.

13.2.3 Recommendations for developers

Site-specific FRAs are required by developers to provide a greater level of detail on flood risk and any protection provided by defences. Developers should, where required, undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent (including latest climate change allowances), to inform the sequential approach within the site and prove, if required, whether the Sequential and Exception Tests can be satisfied.

Developers should:

1. Apply the Sequential and Exception Tests (as necessary)

Developers must provide evidence that the Sequential Test has been passed for windfall developments. If the Exception Test is needed, they must also provide evidence that all parts of the Test can be met for all developments, based on the findings of a detailed Flood Risk Assessment.

Developers should also 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 layout?
- can it be demonstrated that less vulnerable uses for the site have been considered and reasonably discounted? and
- 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?

2. Consult with statutory consultees at an early stage to understand their requirements.

Developers should consult with the relevant local planning authority, the Environment Agency, Nottinghamshire County Council as LLFA, the Isle of Axholme, Doncaster East or Trent Valley Internal Drainage Boards (if applicable) and the relevant water and sewerage company (Anglian Water and / or Severn Trent Water), at an early stage to discuss flood risk including requirements for site-specific FRAs, detailed hydraulic modelling and drainage assessment and design.

3. Consider the risk from all sources of flooding and that they are using the most up to date flood risk data

The SFRA can be used by developers to scope out what further detailed work is likely to be needed to inform a site-specific Flood Risk Assessment. At a site level, Developers will need to check before commencing on a more detailed Flood Risk Assessment that they are using the latest available datasets. Those that are most likely to be updated not long after this SFRA is published include the Flood Map for Planning and the Flood Risk from Reservoirs maps.

4. Apply the 2019 Environment Agency climate change guidance and ensure the development has taken into account climate change adaptation measures

Developers should follow the 2019 Environment Agency updated climate change guidance when it becomes available. The Flood Zone, flood risk vulnerability classification and lifetime of the development should be considered when deciding which allowances to apply and the latest Environment Agency models should be obtained. If uncertain as to which allowance should be applied, developers are advised to consult with the Environment Agency. Developers should demonstrate how the impacts of climate change will be managed, over the lifetime of the development, as part of a site-specific Flood Risk Assessment.

5. Check which cumulative impact policy applies to the development site and what this requires

The Cumulative Impact Assessment suggests a tiered approach, with bespoke policy depending on the location of the development. Specific policies relate to:

- The New Settlements
- Retford Beck
- Rural villages at low risk of flooding
- Rural villages at higher risk of flooding

6. Take a sustainable approach to surface water management

Nottinghamshire County Council standing advice sets out guidance for developers wishing to submit a planning application with surface water drainage implications.

1 Drainage from the site should be via a sustainable drainage system

2 For greenfield areas, the maximum discharge should be the greenfield run-off rate (Qbar) from the area. For brownfield areas that previously drained to sewers, the

previous discharge rate should be reduced by 30% to allow for future climate change effects.

3 The site drainage system should cater for all rainfall events up to a 100-year plus 30% climate change allowance level of severity. The underground drainage system should be designed not to surcharge in a 1-year storm, not to flood in a 30-year storm and for all flooding to remain within the site boundary without flooding new buildings for the 100-year plus 30% climate change event.

4 Consideration must be given to exceedance flows and flow paths to ensure properties are not put at risk of flooding.

5 Any proposals to use SUDS must include details showing how these will be maintained to ensure their effectiveness for the lifetime of the development.

7. Account for residual flood risk

Whilst areas benefit from defences and alleviation measures, there remains a residual risk. 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').
- Failure of the defences or flood risk management measures e.g. a breach or pumping station failure.

At locations reliant on flood risk management measures to provide appropriate levels of safety for communities, special consideration should be given to the assessment of residual risk, particularly in relation to tidal flooding and areas relying on pumped drainage systems.

If sites are allocated for development, developers should consider the residual risk as part of a detailed site-specific flood risk assessment, where development is in areas benefiting from defences. The assessment should consider the standard of protection by defences, their condition, impact of a breach/ pumping station failure and future over-topping. It should consider the flood hazard to the development site, including the potential depths and velocities of flooding. These will help inform if the Exception Test can be passed.

Developers must consider both flood resilient design and the emergency arrangements (including flood warnings, evacuation and dry access and egress) that need to be in place if flood defences were to overtop or fail and ensure future users of the site are aware of these. Finished Floor Levels should be above the 1 in 100-year (1% AEP) flood level, plus an allowance for climate change and an appropriate allowance for freeboard. The additional height that the floor level is raised above the maximum water level is referred to as the "freeboard".

8. Enhance the natural river corridor and floodplain environment through new development

Developments should demonstrate opportunities to create, enhance and link green assets. This can provide multiple benefits across several disciplines including flood risk and biodiversity/ ecology and may provide opportunities to use the land for an amenity and recreational purposes. Development that may adversely affect green infrastructure assets should not be permitted. Where possible, developers should identify and work with partners to explore all avenues for improving the wider river corridor environment.

9. Consider and contribute to wider flood mitigation strategy and measures in the District

Flood mitigation measures should only be considered for new developments if, after application of the Sequential Approach, 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.

Further flood mitigation measures may be needed for any developments in an area protected by flood defences, where the condition of those defences is 'fair' or 'poor', and where the standard of protection is not of the required standard.

Wherever possible, developments should seek to help reduce flood risk in the wider area e.g. by contributing to a wider community scheme or strategy for strategic measures, such as defences or natural flood management or by contributing in kind by mitigating wider flood risk on a development site.

Appendices

A Watercourses in Bassetlaw District Council

B Flood Zone mapping

C Climate change mapping

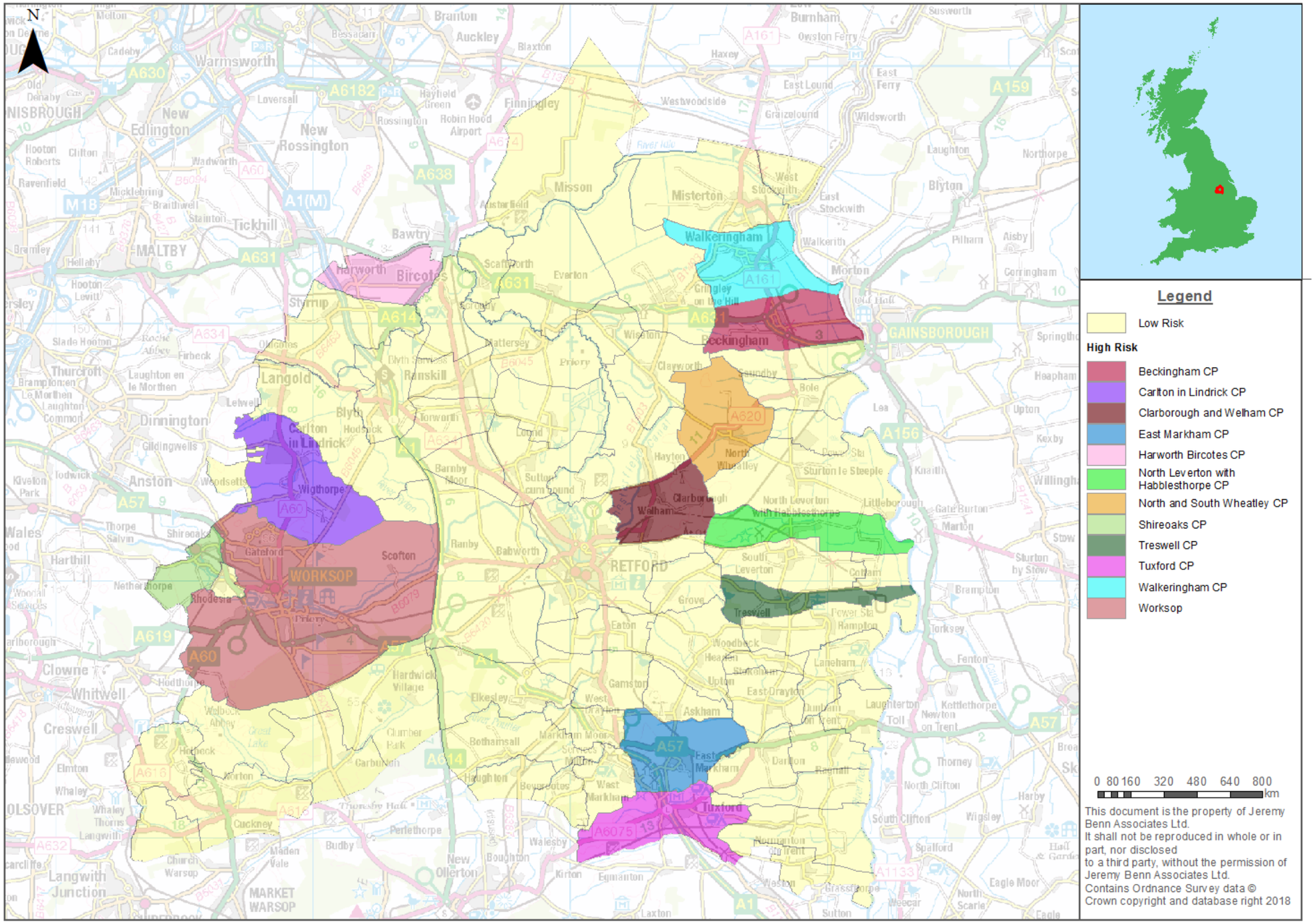
D Surface water mapping

E Groundwater mapping

F Flood warning and flood alert coverage

G Natural Flood Management or Working with Natural Processes

H Cumulative Impact Map



I Neighbourhood Planning Sources of Flood Risk Summary

J Severn Trent Water Guidance

Severn Trent Water have set out some general guidelines that may be useful when considering flood risk within Bassetlaw.

Position Statement

As a water company we have an obligation to provide water supplies and sewage treatment capacity for future development. It is important for us to work collaboratively with Local Planning Authorities to provide relevant assessments of the impacts of future developments. For outline proposals we are able to provide general comments. Once detailed developments and site-specific locations are confirmed by local councils, we are able to provide more specific comments and modelling of the network if required. For most developments we do not foresee any particular issues. Where we consider there may be an issue we would discuss in further detail with the Local Planning Authority. We will complete any necessary improvements to provide additional capacity once we have sufficient confidence that a development will go ahead. We do this to avoid making investments on speculative developments to minimise customer bills.

Sewage Strategy

Once detailed plans are available, and we have modelled the additional capacity, in areas where sufficient capacity is not currently available, and we have sufficient confidence that developments will be built, we will complete necessary improvements to provide the capacity. We will ensure that our assets have no adverse effect on the environment and that we provide appropriate levels of treatment at each of our sewage treatment works.

Surface Water and Sewer Flooding

We expect surface water to be managed in line with the Government's Water Strategy, Future Water. The strategy sets out a vision for more effective management of surface water to deal with the dual pressures of climate change and housing development. Surface water needs to be managed sustainably. For new developments we would not expect surface water to be conveyed to our foul or combined sewage system and, where practicable, we support the removal of surface water already connected to foul or combined sewer.

We believe that greater emphasis needs to be paid to consequences of extreme rainfall. In the past, even outside of the flood plain, some properties have been built in natural drainage paths. We request that developers providing sewers on new developments should safely accommodate floods which exceed the design capacity of the sewers.

To encourage developers to consider sustainable drainage, Severn Trent currently offer a 100% discount on the sewerage infrastructure charge if

there is no surface water connection and a 75% discount if there is a surface water connection via a sustainable drainage system. More details can be found on our website - https://www.stwater.co.uk/building-and-developing/regulations-and-forms/application-forms-and-guidance/infrastructure-charges/

Water Quality

Good quality river water and groundwater is vital for provision of good quality drinking water. We work closely with the Environment Agency and local farmers to ensure that water quality of supplies are not impacted by our or others operations. The Environment Agency's Source Protection Zone (SPZ) and Safe Guarding Zone policy should provide guidance on development. Any proposals should take into account the principles of the Water Framework Directive and River Basin Management Plan for the Severn River basin unit as prepared by the Environment Agency.

Water Supply

When specific detail of planned development location and sizes are available a site-specific assessment of the capacity of our water supply network could be made. Any assessment will involve carrying out a network analysis exercise to investigate any potential impacts.

We would not anticipate capacity problems within the urban areas of our network, any issues can be addressed through reinforcing our network. However, the ability to support significant development in the rural areas is likely to have a greater impact and require greater reinforcement to accommodate greater demands.

Water Efficiency

Part G of Building Regulations specify that new homes must consume no more than 125 litres of water per person per day. We recommend that you consider taking an approach of installing specifically designed water efficient fittings in all areas of the property rather than focus on the overall consumption of the property. This should help to achieve a lower overall consumption than the maximum volume specified in the Building Regulations.

We recommend that in all cases you consider:

- Single flush siphon toilet cistern and those with a flush volume of 4 litres.
- Showers designed to operate efficiently and with a maximum flow rate of 8 litres per minute.
- Hand wash basin taps with low flow rates of 4 litres or less.
- Water butts for external use in properties with gardens.

To further encourage developers to act sustainably Severn Trent currently offer a 100% discount on the clean water infrastructure charge if properties are built so consumption per person is 110 litres per person per day or less. More details can be found on our website - https://www.stwater.co.uk/building-and-developing/regulations-and-forms/application-forms-and-guidance/infrastructure-charges/

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Registered Office
South Barn
Broughton Hall
SKIPTON
North Yorkshire
BD23 3AE
United Kingdom

+44(0)1756 799919
info@jbaconsulting.com
www.jbaconsulting.com
Follow us:

Jeremy Benn Associates Limited

Registered in England 3246693