River Blythe through Shirley Golf Club

Solihull Metropolitan Borough Council Strategic Flood Risk Assessment

Final Report

April 2017

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Revision History

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Contract

This report describes work commissioned by Solihull Metropolitan Borough Council. The Council's representative for the contract was Maurice Barlow. Sophie Dusting and Freyja Scarborough of JBA Consulting carried out this work.

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Purpose

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JBA Consulting has no liability regarding the use of this report except to Solihull Metropolitan Borough Council.

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- Birmingham City Council
- Bromsgrove and Redditch District Council
- Coventry City Council
- North Warwickshire Borough Council
- Warwick District Council

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Executive Summary

Introduction

This Strategic Flood Risk Assessment replaces the Level 1 SFRA originally published by Solihull Metropolitan Borough Council in January 2008. The main purpose of the SFRA update is to provide a comprehensive and robust evidence base to support the production of the Local Plan and to support the selection of site allocations.

SFRA objectives

The key objectives of the 2016 SFRA are:

- To provide up to date information and guidance on flood risk for Solihull Metropolitan Borough Council, taking into account the latest flood risk information (including the probable impacts of climate change), the current state of national planning policy and legislation and relevant studies
- To provide the basis for applying the flood risk Sequential Test, and if necessary the Exception Test
- To provide a comprehensive set of maps presenting flood risk from all sources that can be used as part of the evidence base for the local plan
- Identify the requirements for site-specific flood risk assessments and the application of Sustainable Drainage Systems (SuDS)

SFRA outputs

- Assessment of all potential sources of flooding
- Assessment of the potential impact of climate change on flood risk
- An assessment of the surface water management issues and the application of Sustainable Drainage Systems
- Review and update new and amended data sources (e.g. Catchment Flood Management Plans, Preliminary Flood Risk Assessment, Updated Flood Maps and modelling, etc.)
- Recommendations of the criteria that should be used to assess future development proposals and the development of a Sequential Test and sequential approach to flood risk
- Guidance for developers including requirements for site-specific flood risk assessments
- Mapping of location and extent of functional floodplain
- Mapping areas at risk from other sources including surface water, sewer, ground water, reservoir inundation
- Mapping areas covered by an existing flood alert / warning
- Identify opportunities to reduce flood risk.

Summary of Level 1 Assessment

Sources of flood risk

- The historical flood record shows that the borough has been subject to flooding from several sources of flood risk, with the principal risk from fluvial and surface water sources. There is also an indication that blockages of undersized culverts (locations unknown) have been an issue. Notable flood events include July 2007, June 2012, November 2012, September 2015, June 2016 and September 2016
- The key watercourses flowing through the study area are the River Blythe and its tributaries. Tributaries of the River Blythe include, but are not limited to the River Cole, Mount Brook, Alder Brook, Purnell's Brook, Shadow Brook, and Hollywell Brook. The Kingshurst Brook, the Hatchford Brook and several other Main River and ordinary watercourses flow through the borough. The River Blythe flows through the majority of the borough. However, the areas it flows through are predominantly rural and the fluvial flood risk from the River Blythe to property in this area is minimal. The River Cole, a tributary of the Blythe, flows through Kingshurst in the north and south east of Solihull. Whilst the River Cole has relatively narrow floodplains, it flows through areas that are heavily urbanised and as such, produces a higher flood risk to properties in the

Kingshurst, Chelmsley Wood and Solihull wards. Several other Main Rivers and ordinary watercourses also present a fluvial flood risk.

- There are no formal flood defences in the borough
- Solihull has experienced a number of historic surface water / drainage related flood events caused by a number of mechanisms such as culvert blockage. The updated Flood Map for Surface Water further shows a number of prominent overland flow routes; these predominantly follow topographical flow paths of existing watercourses or dry valleys with some isolated ponding located in low lying areas
- The sewers are managed by Severn Trent Water. The Hydraulic Sewer Flooding Risk Register (HFRR) was supplied for use in this assessment. The HFRR register is a database of recorded historical sewer flooding incidents, on a post-code basis. A total of 185 recorded flood incidents in the Solihull Metropolitan Borough were listed in the HFRR register. The most frequently flooded localities are Solihull town, Dorridge, and Hampton-in-Arden. 20 incidents were recorded during June and July 2007. A further 12 incidents were recorded in August 1999, 9 incidents were recorded in November 2012 and August 2004. July 2007 and November 2012 are also recorded historical fluvial and blockages indicating that there may be some interaction between the fluvial and surface water drainage networks. However, most the dates do not correlate to significant historic fluvial or surface water flood events, indicating that the events listed in the HFRR are possibly isolated incidents.
- 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
- There are two canals flowing through the borough; the Grand Union Canal and the Stratford-upon-Avon Canal. There is one record of a canal breach with in the borough, on the Grand Union Canal, dated November 1997

Climate change

Climate change modelling for the watercourses in Solihull has been undertaken based on the new climate change guidance, using a combination of existing Environment Agency hydraulic models and Jflow modelling, run for the 2080s period for all three allowance categories.

The Flood Zone 2 extent is comparatively similar to the 100-year plus 20% allowance for climate change across Solihull. Due to the nature of the topography, the flood zones are largely confined and subsequently, the flood extent is not significantly different when a 20% or 30% or 50% allowance for climate change is used. Whilst the flood extent in more constrained catchments may not increase significantly, the flood depth and hazard may. The Hatchford Brook, Low Brook and Kingshurst Brook appear to be more sensitive to increases in the climate change allowances.

Key policies

There are many relevant regional and local key policies which have been considered within the SFRA, such as the Catchment Flood Management Plan, River Basin Flood Risk Management Plan, the Preliminary Flood Risk Assessment and Local Flood Risk Management Strategy. Other policy considerations have also been incorporated, such as sustainable development principles, climate change and flood risk management.

Development and flood risk

The Sequential and Exception Test procedures for both Local Plans and Flood Risk Assessments have been documented, along with guidance for planners and developers. Links have been provided for various guidance documents and policies published by other Risk Management Authorities such as the Lead Local Flood Authority and the Environment Agency.

Recommendations

Development control

Sequential approach to development

The National Planning Policy Framework supports a risk-based and sequential approach to development and flood risk in England, so that development is in the lowest flood risk areas where possible; it is recommended that this approach is adopted for all future developments within the district.

New development and re-development of land should wherever possible seek opportunities to reduce overall level of flood risk at the site

Site-specific flood risk assessments

Site specific FRAs are required by developers to provide a greater level of detail on flood risk and, where necessary, demonstrate the development passes part b of the Exception Test.

Developers should, where required, undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent (including latest climate change allowances), inform development zoning within the site and prove, if required, whether the Exception Test can be passed. The assessment should also identify the risk of existing flooding to adjacent land and properties to establish whether there is a requirement to secure land to implement strategic flood risk management measures to alleviate existing and future flood risk.

Sequential and Exception tests

The Strategic Flood Risk Assessment has identified that areas of the borough are at high risk of flooding from both fluvial and surface water sources. Therefore, a large number of proposed development sites will be required to pass the Sequential and, where necessary, Exception Tests in accordance with the National Planning Policy Framework. Solihull Metropolitan Borough Council should use the information in this SFRA when deciding which development sites to take forward in their Local Plan.

It is recommended that the Council considers using the SFRA climate change maps when applying the Sequential Test for site allocations and windfall sites.

Developers should consult with Solihull Metropolitan Borough Council, the Environment Agency, Severn Trent Water, where necessary, at an early stage to discuss flood risk including requirements for site-specific FRAs, detailed hydraulic modelling, and drainage assessment and design.

Windfall sites

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

Council review of planning applications

The Council should consult the Environment Agency's 'Flood Risk Standing Advice for Local Planning Authorities', last updated 15 April 2015, when reviewing planning applications for proposed developments at risk of flooding.

Residual risk

The risk to development from reservoirs is residual but developers should consider reservoir flooding during the planning stage. They should seek to contact the reservoir owner to obtain information and should apply the sequential approach to locating development within the site. Developers should also consult with relevant authorities regarding emergency plans in case of reservoir breach.

Drainage assessments and promotion of SuDS

Drainage strategies and Sustainable Drainage

Planners should be aware of the conditions set by the Lead Local Flood Authority for surface water management and ensure development proposals and applications are compliant with the Council's policy. These policies should also be incorporated into the Local Plan. Wherever possible, sustainable drainage (SuDS) should be promoted:

- It should be demonstrated through a Surface Water Drainage Strategy, that the proposed drainage scheme, and site layout and design, will prevent properties from flooding from surface water. A detailed site-specific assessment of SuDS would be needed to incorporate SuDS successfully into the development proposals. All development should adopt source control SuDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff
- For proposed developments, it is imperative that a site-specific infiltration test is conducted early on as part of the design of the development, to confirm whether the water

table is low enough to allow for SuDS techniques that are designed to encourage infiltration

- Where sites lie within or close to Groundwater Source Protection Zones or aquifers, there may be a requirement for a form of pre-treatment prior to infiltration. Further guidance can be found in the CIRIA SuDS manual on the level of water quality treatment required for drainage via infiltration
- Consideration must also be given to residual risk and maintenance of sustainable drainage and surface water systems
- SuDS proposals should contain an adequate number of treatments stages to ensure any pollutants are dealt with on site and do not have a detrimental impact on receiving waterbodies
- The promotion and adoption of water efficient practices in new development will help to manage water resources and work towards sustainable development and will help to reduce any increase in pressure on existing water and wastewater infrastructure

Safe access and egress

Safe access and egress will need to be demonstrated at all development sites; the development should be above the 1 in 100-year flood level, plus an allowance for climate change, and emergency vehicular access should be possible during times of flood. Finished Floor Levels should be above the 1 in 100-year (1% Annual Exceedance Probability) flood level, plus an allowance for climate change.

Future flood management

- Development should take a sequential approach to site layout
- Upstream storage schemes are often considered as one potential solution to flooding. However, this is not a solution for everywhere. Upstream storage should be investigated fully before being adopted as a solution
- Floodplain restoration represents a sustainable form of strategic flood risk solution, by allowing watercourses to return to a more naturalised state,

Use of Strategic Flood Risk Assessment data

Strategic Flood Risk Assessments are high level strategic documents and, as such, do not go into detail on an individual site-specific basis. The Strategic Flood Risk Assessment has been developed using the best available information at the time of preparation.

The Strategic Flood Risk Assessment should be updated when new information on flood risk, new planning guidance or legislation becomes available.

The Environment Agency regularly reviews their flood risk mapping, and it is important that they are approached to determine whether updated information is available prior to commencing a detailed Flood Risk Assessment. It is recommended that the Strategic Flood Risk Assessment is reviewed internally on an annual basis, allowing a cycle of review, followed by checking with the above bodies for any new information to allow a periodic update.

Contents

List of Figures

List of Tables

Using this document

Hyperlinks

Hyperlinks have been provided where there are useful reference points. These are shown as red text.

Appendix A: Mapping of all sources of flood risk across the borough.

These are a series of interactive maps that show all sources of flooding in Solihull Metropolitan Borough. Clicking on a grid square in the Index Map will open a separate interactive PDF map that has options for turning on and off the map layers of interest.

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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
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
Defra	Department for Environment, Food and Rural Affairs
HFRR Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years.
DTM	Digital Terrain Model
EA	Environment Agency
EU	European Union
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG (Welsh Assembly Government).
Flood Risk Regulations	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Floods and Water Management Act	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing surface water flood risk in England.
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a main river
FRA	Flood Risk Assessment - A site specific assessment of all forms of flood risk to the site and the impact of development of the site to flood risk in the area.
FWMA	Flood and Water Management Act
Greenfield	Undeveloped parcel of land
Ha	Hectare
JBA	Jeremy Benn Associates
LFRMS	Local Flood 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
mAOD	metres Above Ordnance Datum
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers

Term	Definition
Major development	Residential development: 10 dwellings or more, or site area of 0.5 hectares or more is dwelling numbers are unknown. 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 flood area is not yet known, a site area of one hectare or more.
NPPF	National Planning Policy Framework
NPPG	National Planning Policy Guidance
NRD	National Receptor Database
Ordinary Watercourse	All watercourses that are not designated Main River. Local Authorities or, where they exist, IDBs have similar permissive powers as the Environment Agency in relation to flood defence work. However, the riparian owner has the responsibility of maintenance.
OS NGR	Ordnance Survey National Grid Reference
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.
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Resistance Measures	Measures designed to keep flood water out of properties and businesses; could include flood guards for example.
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
Return Period	Is an estimate of the interval of time between events of a certain intensity or size, in this instance it refers to flood events. It is a statistical measurement denoting the average recurrence interval over an extended period of time.
RoFfSW	Risk of Flooding from Surface Water map.
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
SFRA	Strategic Flood Risk Assessment
SoP	Standard of Protection - Defences are provided to reduce the risk of flooding from a river and within the flood and defence field standards are usually described in terms of a flood event return period. For example, a flood embankment could be described as providing a 1 in 100-year standard of protection.
Stakeholder	A person or organisation affected by the problem or solution, or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.
SuDS	Sustainable Drainage Systems - Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques
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

1 Introduction

1.1 Purpose of the Strategic Flood Risk Assessment

> ***"Local Plans should be supported by a strategic flood risk assessment and develop policies to manage flood risk from all sources, taking account of advice from the Environment Agency and other relevant flood risk management bodies, such as Lead Local Flood Authorities and Internal Drainage Boards. Local Plans should apply a sequential, risk-based approach to the location of development to avoid, where possible, flood risk to people and property and manage any residual risk, taking account of the impacts of climate change".*** (National Planning Policy Framework, paragraph 100)

This Strategic Flood Risk Assessment (SFRA) 2016 document replaces the Level 1 SFRA originally published by Solihull Metropolitan Borough Council in January 2008. The SFRA study area is shown in Figure 1-1. The main purpose of the SFRA update is to provide a comprehensive and robust evidence base to support the production of the Local Plan and to support the selection of site allocations.

The key objectives of the 2016 SFRA are:

- To provide up to date information and guidance on flood risk for Solihull Metropolitan Borough Council, taking into account the latest flood risk information (including the probable impacts of climate change), the current state of national planning policy and legislation and relevant studies
- To provide the basis for applying the flood risk Sequential Test, and if necessary the Exception Test
- To provide a comprehensive set of maps presenting flood risk from all sources that can be used as part of the evidence base for the local plan
- Identify the requirements for site-specific flood risk assessments and the application of Sustainable Drainage Systems

1.2 Levels of SFRA

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

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

This report fulfils the Level One SFRA requirements.

1.3 SFRA outputs

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

- Assessment of all potential sources of flooding
- Assessment of the potential impact of climate change on flood risk
- An assessment of surface water management issues and the application of Sustainable Drainage Systems (SuDS)
- A review and update of new and amended data sources (e.g. Catchment Flood Management Plans, Preliminary Flood Risk Assessment, Updated Flood Maps and modelling, etc)
- Recommendations of the criteria that should be used to assess future development proposals and the development of a Sequential Test and sequential approach to flood risk
- Guidance for developers including requirements for site-specific flood risk assessments

- Mapping of location and extent of functional floodplain
- Mapping areas at risk from other sources including surface water, sewer, ground water, reservoir inundation
- Mapping areas covered by an existing flood alert / warning
- Identify opportunities to reduce flood risk
- High-level screening of proposed development sites against flood risk information

Other outputs requested related to flood defence infrastructure. However, data sources show there are no formal flood defences within the borough.

1.4 SFRA user guide

Table 1-1: SFRA report contents

Section	Contents
1. Introduction	Provides a background to the study, defines objectives, outlines the approach adopted and the consultation performed.
2. The Planning Framework and Flood Risk Policy	Includes information on the implications of recent changes to planning and flood risk policies and legislation, as well as documents relevant to the study.
3.The Sequential, risk based approach	Describes the Sequential Approach and application of Sequential and Exception Tests. Outlines cross-boundary issues and considerations.
4. Climate change	Outlines climate change guidance and the implications for Solihull.
5. Sources of information used in preparing the SFRA	Outlines what information has been used in the preparation of the SFRA.
6. Understanding flood risk in Solihull	Introduces the assessment of flood risk and provides an overview of the characteristics of flooding affecting the borough. Provides a summary of responses that can be made to flood risk, together with policy and institutional issues that should be considered. Outlines the flood warning service in Solihull and provides advice for emergency planning, evacuation plans and safe access and egress.
7. FRA requirements and flood risk management guidance	Identifies the scope of the assessments that must be submitted in FRAs supporting applications for new development. Provides guidance for developers and outlines conditions set by the LLFA that should be followed.
8. Surface water management and SuDS	Advice on managing surface water run-off and flooding and the application of SuDS.
9. Strategic flood risk solutions	Overview of possible strategies to reduce flood risk
10. Summary	Review of the Level 1 SFRA.
11. Recommendations	Identifies recommendations for the council to consider as part of Flood Risk Management policy.
Appendix A: **Flood risk mapping**	Interactive maps showing flood risk information from all sources
Appendix B: **Flood warning coverage**	Maps of flood alerts and flood warning coverage

1.5 Consultation

The following parties have been consulted during the preparation of this version of the SFRA:

- Solihull Metropolitan Borough Council (in their role as the Lead Local Flood Authority)

- Environment Agency
- Severn Trent Water
- Canal and River Trust
- Neighbouring local authorities including
    - Birmingham City Council
    - Bromsgrove District Council
    - Coventry City Council
    - North Warwickshire Borough Council
    - Stratford-on-Avon District Council
    - Warwick District Council

1.6 Use of SFRA data

It is important to recognise that SFRAs are high level strategic documents and, as such, do not go into detail on an individual site-specific basis. The SFRA has been developed using the best available information at the time of preparation. This relates both to the current risk of flooding from rivers, and the potential impacts of future climate change.

SFRAs should be a 'living document', and as a result should be updated when new information on flood risk, new planning guidance or legislation becomes available. New information on flood risk may be provided by Solihull Metropolitan Borough Council, the Highways Authority, Severn Trent Water and the Environment Agency. Such information may be in the form of:

- New hydraulic modelling results
- Flood event information following a flood event
- Policy/ legislation updates
- Environment Agency flood map updates
- New flood defence schemes etc.

The Environment Agency regularly reviews their flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a detailed Flood Risk Assessment. It is recommended that the SFRA is reviewed internally, in line with the Environment Agency's Flood Zone map updates to ensure latest data is still represented in the SFRA, allowing a cycle of review and a review of any updated data by checking with the above bodies for any new information.

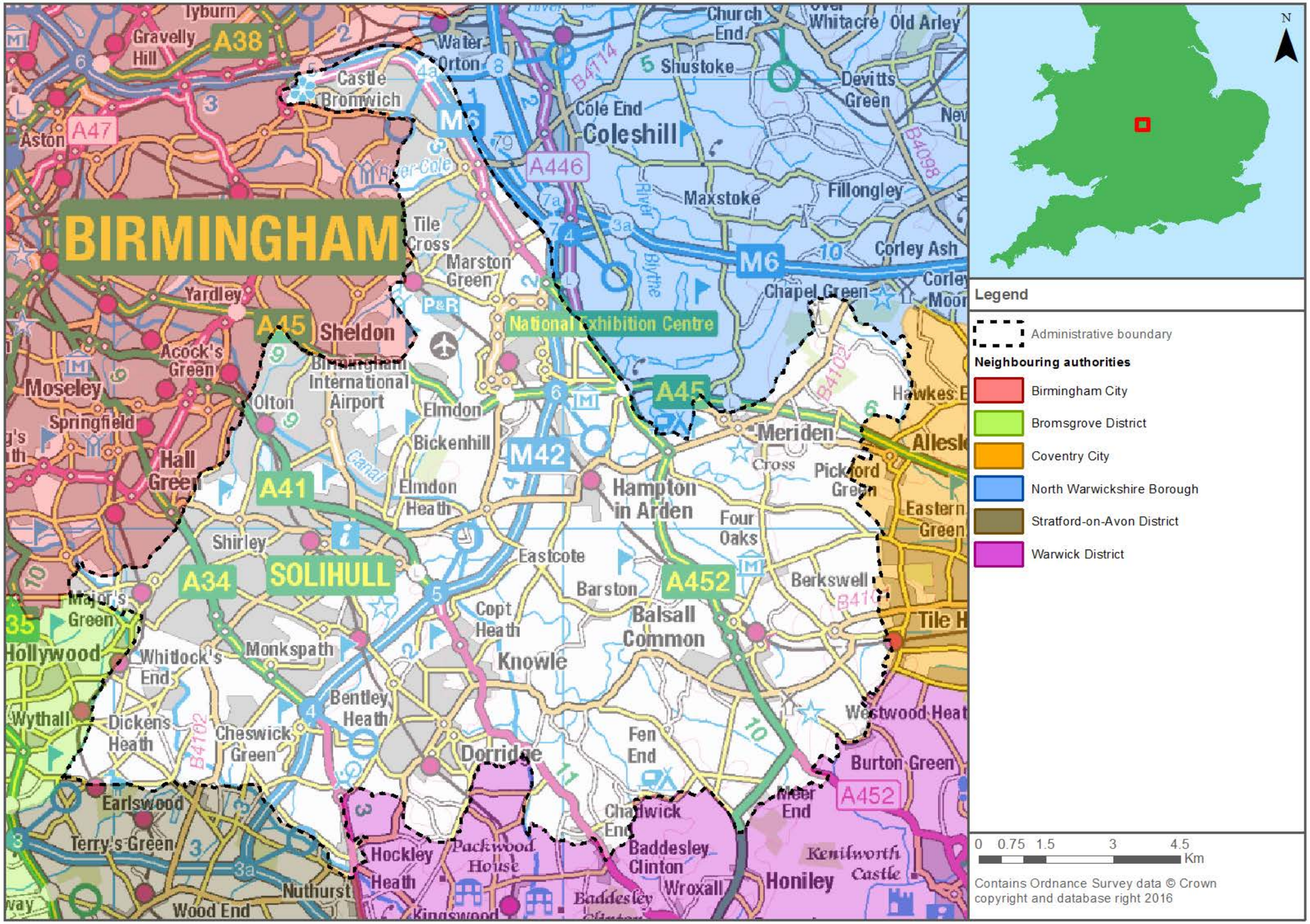


Figure 1-1: Study area

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.

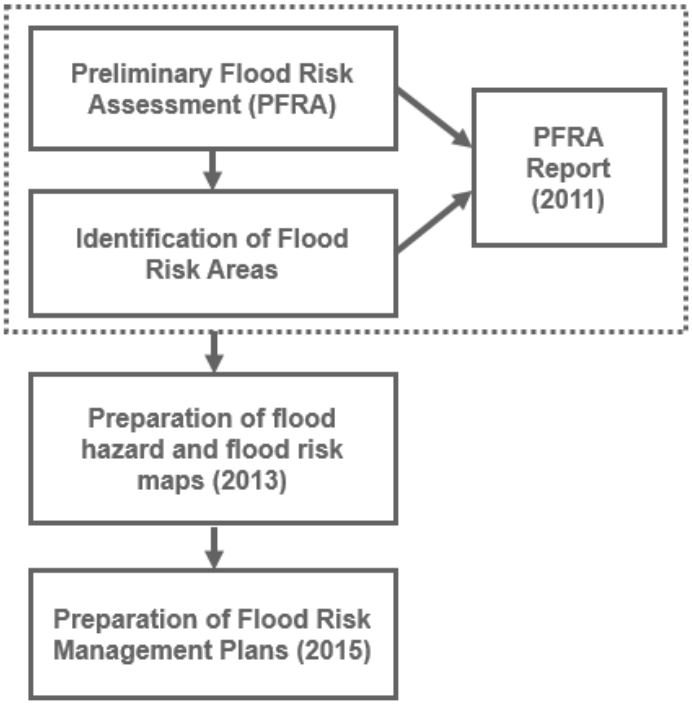
2.2 Flood Risk Regulations (2009) and Flood and Water Management Act (2010)

2.2.1 Flood Risk Regulations, 2009

The Flood Risk Regulations (2009) translate the current EU Floods Directive into UK law and place responsibility upon all Lead Local Flood Authorities (LLFAs) to manage localised flood risk. Under the Regulations, the responsibility for flooding from rivers, the sea and reservoirs lies with the Environment Agency; however, responsibility for local and all other sources of flooding rests with LLFAs. In the instance of this SFRA, the LLFA is Solihull Metropolitan Borough Council. Detail on the responsibilities of LLFAs is provided in Sections 2.2.4 to 2.2.6.

Figure 2-1 illustrates the steps that have / are being taken to implement the requirements of the EU Directive in the UK via the Flood Risk Regulations.

Figure 2-1: Flood Risk Regulation Requirements



2.2.2 Preliminary Flood Risk Assessments (PFRAs)

Under this action plan and in accordance with the Regulations, LLFAs had the task of preparing a Preliminary Flood Risk Assessment (PFRA) report.

PFRAs report on significant past and future flooding from all sources except from Main Rivers and reservoirs, which are covered by the Environment Agency, and sub-standard performance of the adopted sewer network (covered under the remit of Severn Trent Water). PFRAs are a high-level screening exercise and co2.2.6nsider floods which have significant harmful consequences for human health, economic activity, the environment and cultural heritage. The PFRA document that covers the study area was published by Solihull Metropolitan Borough Council in 2011. The Regulations require the LLFA to identify significant Flood Risk Areas.

Ten national indicative Flood Risk Areas were identified by the Defra/Environment Agency; the majority of the western, urban area of Solihull is included within an indicative Flood Risk Area.

Due to significant historic flood events, the indicative Flood Risk Area was extended to include nationally important infrastructure of Birmingham International Airport, the National Exhibition Centre (NEC), and the A45. The primary source of flood risk to these locations, identified in the PFRA, is surface water.

2.2.3 Flood Risk Management Plans (FRMPs)

Under the Regulations the Environment Agency exercised an 'Exception' and did not prepare a PFRA for risk from rivers, reservoirs and the sea. Instead they had to prepare and publish a FRMP. The FRMP summarises the flooding affecting the area and describes the measures to be taken to address the risk in accordance with the Flood Risk Regulations.

The majority of the borough falls within the Humber river basin. However; the upper reaches of ordinary watercourses in the far eastern part of the borough, flow into the Severn river basin.

The final Humber River Basin District Flood Risk Management Plan (FRMP) and the final Severn River Basin District FRMP were issued in March 2016 and covers the period of 2015 to 2021[1]. The FRMP draws on policies and actions identified in Catchment Flood Management Plans (section 2.6) and also incorporates information from Local Flood Risk Management Strategies (Section 2.2.5).

2.2.4 Flood and Water Management Act (FWMA), 2010

Following the 2007 floods, Sir Michael Pitt was appointed to chair an independent review into the floods. The final report was published in June 2008. The Flood and Water Management Act (2010)[2] implements Sir Michael Pitt's recommendations and aims to create a simpler and more effective means of managing both flood risk and coastal erosion.

The FWMA established Lead Local Flood Authorities (LLFAs). Duties for LLFAs include:

- Local Flood Risk Management Strategy (LFRMS): LLFAs must develop, maintain, apply and monitor a LFRMS to outline how they will manage flood risk, identify areas vulnerable to flooding and target resources where they are needed most.
- Flood Investigations: When appropriate and necessary LLFAs must investigate and report on flooding incidents (Section 19 investigations).
- Register of Flood Risk Features: LLFAs must establish and maintain a register of structures or features which, in their opinion, are likely to have a significant effect on flood risk in the LLFA area.
- Designation of Features: LLFAs may exercise powers to designate structures and features that affect flood risk, requiring the owner to seek consent from the authority to alter, remove or replace it.
- Consenting: When appropriate LLFAs will perform consenting of works on ordinary watercourses.

2.2.5 Solihull Local Flood Risk Management Strategy (2015)[3]

The LFRMS is used as a means by which the LLFA co-ordinates flood risk management on a day to day basis. The LFRMS also sets measures to manage local flood risk i.e. flood risk from surface water, groundwater and ordinary watercourses.

The high-level objectives proposed in the LFRMS for managing flood risk are:

1. Improving the understanding and communication of flood risk in Solihull
2. Managing the likelihood of flooding and impacts of flooding
3. Helping Solihull's citizens to manage their own risk
4. Guiding appropriate development in Solihull
5. Improving flood prediction, warning and post flood recovery
6. Working in partnership with others to deliver the Local Strategy

1 Humber and Severn FRMPs (2016)

2 Flood and Water Management Act (2010): http://www.legislation.gov.uk/ukpga/2010/29/pdfs/ukpga_20100029_en.pdf

3 http://www.solihull.gov.uk/Portals/0/CrimeAndEmergencies/Final_LFRMS.pdf

The LFRMS also sets out an action plan of how the LLFA intends to achieve these objectives. The LFRMS should be updated regularly or when key triggers are activated. An example of a key trigger would be issues such as amendments to partner responsibilities, updates to legislation, alterations in the nature or understanding of flood risk or a significant flood event.

2.2.6 LLFAs, surface water and SuDS

On 18 December 2014 a Written Ministerial Statement laid by the Secretary of State for Communities and Local Government set out changes to the planning process that would apply for major development from 6 April 2015. 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
- there are clear arrangements for on-going maintenance over the development's lifetime, through the use of planning conditions or planning obligations.

In March 2015 the LLFA was made a statutory consultee which came into effect on 15 April 2015. As a result, Solihull Metropolitan Borough Council, 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 or more where the number of dwellings is not yet known; 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 1 hectare or more.

2.2.7 The National Flood and Coastal Erosion Risk Management Strategy for England (2011)

The National Flood and Coastal Erosion Risk Management Strategy for England provides the overarching framework for future action by all risk management authorities to tackle flooding and coastal erosion in England. It was prepared by the Environment Agency with input from Defra.

This strategy builds on existing approaches to flood and coastal risk management and promotes the use of a wide range of measures to manage risk. It describes how risk should be managed in a co-ordinated way within catchments and along the coast and balance the needs of communities, the economy and the environment.

The strategy encourages more effective risk management by enabling people, communities, business, infrastructure operators and the public sector to work together to:

- ensure a clear understanding of the risks of flooding and coastal erosion, nationally and locally, so that investment in risk management can be prioritised more effectively;
- set out clear and consistent plans for risk management so that communities and businesses can make informed decisions about the management of the remaining risk;
- manage flood and coastal erosion risks in an appropriate way, taking account of the needs of communities and the environment;
- ensure that emergency plans and responses to flood incidents are effective and that communities are able to respond effectively to flood forecasts, warnings and advice;
- help communities to recover more quickly and effectively after incidents.

2.3 National Planning Policy and Guidance

The National Planning Policy Framework (NPPF)[4] was issued in 2012 to replace the previous documentation as part of reforms to make the planning system less complex and more accessible, and to protect the environment and promote sustainable growth. It replaces most of the Planning Policy Guidance Notes (PPGs) and Planning Policy Statements (PPSs) that were referred to in the previous version of the SFRA. The NPPF sets out the Government's requirements for the planning system and provides a framework within which local people and councils can produce distinctive local and neighbourhood plans to reflect the needs and properties of their communities. The NPPF must be taken into account by local planning authorities when preparing Local Plans and for applicants preparing planning submissions.

4 National Planning Policy Framework (Department for Communities and Local Government, March 2012)

National Planning Practice Guidance (NPPG) was published in 2014 and sets out how the NPPF should be implemented. NPPG: Flood Risk and Coastal Change advises on how planning can account for the risks associated with flooding and coastal change in plan making and the application process. It sets out Flood Zones, the appropriate land uses for each zone, flood risk assessment requirements, including the Sequential and Exception Tests and the policy aims for developers and authorities regarding each Flood Zone. Further details on Flood Zones and associated policy is provided in Table 3-1 and throughout this report. The Sequential and Exception tests are covered in greater detail in Section 3.

The Sequential Test

"The Sequential Test ensures that a sequential approach is followed to steer new development to areas with the lowest probability of flooding. The flood zones, as refined in the Strategic Flood Risk Assessment for the area, provide the basis for applying the Test. The aim is to steer new development to Flood Zone 1 (areas with a low probability of river or sea flooding). Where there are no reasonably available sites in Flood Zone 1, local planning authorities in their decision making should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2 (areas with a medium probability of river or sea flooding), applying the Exception Test if required. Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 (areas with a high probability of river or sea flooding) be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required".

(National Planning Practice Guidance, paragraph 019)

The Exception Test

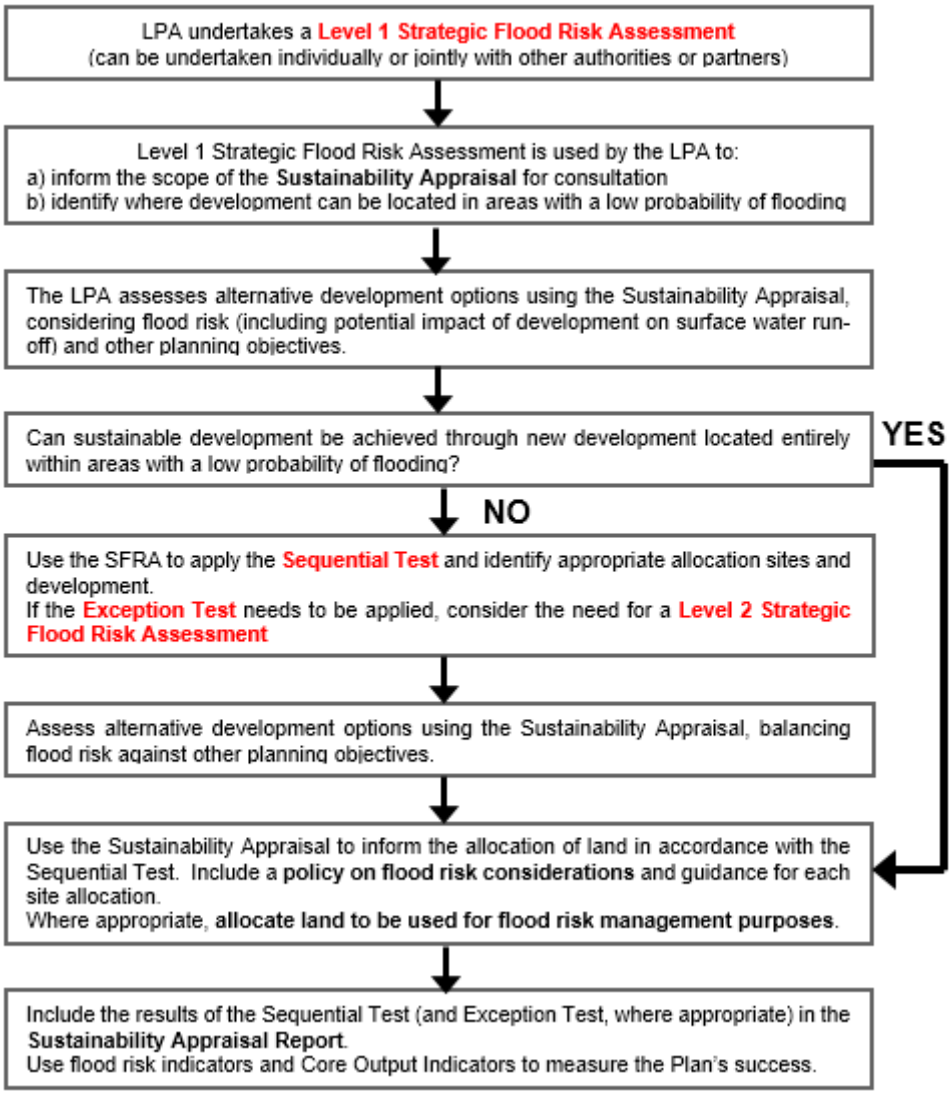
"The Exception Test, as set out in paragraph 102 of the NPPF, is a method to demonstrate and help ensure that flood risk to people and property will be managed satisfactorily, while allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available.

Essentially, the two parts to the Test require proposed development to show that it will provide wider sustainability benefits to the community that outweigh flood risk, and that it will be safe for its lifetime, without increasing flood risk elsewhere and where possible reduce flood risk overall.".

(National Planning Practice Guidance, paragraph 023)

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 (Figure 2-2).

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



† Diagram 1 of NPPG: Flood Risk and Coastal Change (paragraph 004, Reference ID: 7-005-20140306) March 2014

2.4 Water Cycle Studies

Climate Change is predicted to present unprecedented new challenges, such as more frequent and extreme rainfall events and rising global temperatures, which are expected to exert greater pressure on the existing infrastructure. Planning for water management therefore has to take these potential challenges into account. A large number of new homes for instance may cause the existing water management infrastructure to be overwhelmed which would result in adverse effects on the environment, both locally and in wider catchments.

Water Cycle Studies assist Local Authorities to select and develop sustainable development allocations so that there is minimal impact on the environment, water quality, water resources, and infrastructure and flood risk. 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 Water Cycle Study for Solihull Metropolitan Borough Council is being prepared in parallel to this SFRA.

2.5 Surface Water Management Plans

Surface Water Management Plans (SWMPs) outline the preferred surface water management strategy in a given location. SWMPs are undertaken 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.

Solihull Metropolitan Borough Council is preparing a SWMP for the borough. The SWMP is likely to include recommendations regarding the management of surface water in the borough; once published, developers will be required to consult the SWMP, when preparing site-specific flood risk assessments. Any Critical Drainage Areas (CDAs) in the borough will also be identified as part of the SWMP.

2.6 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.

2.6.1 River Trent CFMP (2009)

The majority of the study area is covered by the River Trent CFMP[5]. The primary policy unit for Solihull is 'Sub Area 10'. The area is covered by Policy Option 5, which is for areas of moderate to high flood risk where the Environment Agency are generally taking further action to reduce flood risk. The proposed actions to implement this policy, applicable to the borough, are the following:

- Provide a more accurate and community focused flood warning service.
- Conclude River Tame flood risk management strategy.
- Reduce the incidence of foul water flooding by involving Severn Trent Water Ltd more in flood risk management.
- Investigate and promote opportunities to create green corridors along watercourses through Birmingham and the Black Country.
- Produce and implement an integrated urban drainage strategy.
- Identify locations where flood storage ponds or wetland areas could be developed within the urban areas, with associated habitat creation.
- Produce an integrated flood defence asset management strategy.

The upper reaches of ordinary watercourses in the far eastern part of the borough, flow into the Severn river basin; this is covered by the River Severn CFMP[6].

5 River Trent CFMP https://www.gov.uk/government/publications/river-trent-catchment-flood-management-plan
6 River Severn CFMP https://www.gov.uk/government/publications/river-severn-catchment-flood-management-plan

2.7 River Basin Management Plans

River Basin Management Plans (RBMPs) are prepared under the Water Framework Directive (WFD) and assess the pressure facing the water environment in River Basin Districts. The majority of the borough falls within the Humber river basin. The updated 2015 Humber RBMP[7]identified a number of pressures on the water environment and significant water management issues.

The RBMP describes how development and land-use planning needs to consider a number of issues relevant to the RBMP including Sustainable Drainage Systems, urban diffuse pollution, water efficiency measures, green and blue infrastructure, reducing the impact of pesticides, managing pollution from mine waters and sewage treatment options. The RBMP provides a summary of measures to protect and improve the water environment in the river basin district.

The upper reaches of ordinary watercourses in the far eastern part of the borough, flow into the Severn river basin; this is covered by the updated 2015 Severn RBMP[8].

2.8 Roles and responsibilities of Risk Management Authorities in Solihull Metropolitan Borough

The roles and responsibilities of Risk Management Authorities (RMAs) in Solihull Metropolitan Borough are summarised below.

2.8.1 Solihull Metropolitan Borough Council

As a Local Planning Authority, Solihull Metropolitan Borough Council assess, consult on and determine whether development proposals are acceptable, ensuring that flooding and other, similar, risks are effectively managed.

The council will consult relevant statutory consultees as part of planning application assessments and may, in some cases, also contact non-statutory consultees, such as Severn Trent Water, that have an interest in the planning application.

In addition to the Local Planning Authority role, Solihull Metropolitan Borough Council is also a LLFA. As a LLFA, Solihull Metropolitan Borough Council duties include:

- Local Flood Risk Management Strategy (LFRMS): LLFAs must develop, maintain, apply and monitor a LFRMS to outline how they will manage flood risk, identify areas vulnerable to flooding and target resources where they are needed most.
- Flood Investigations: When appropriate and necessary LLFAs must investigate and report on flooding incidents (Section 19 investigations).
- Register of Flood Risk Features: LLFAs must establish and maintain a register of structures or features which, in their opinion, are likely to have a significant effect on flood risk in the LLFA area.
- Designation of Features: LLFAs may exercise powers to designate structures and features that affect flood risk, requiring the owner to seek consent from the authority to alter, remove or replace it.
- Consenting: When appropriate LLFAs will perform consenting of works on ordinary watercourses.

Solihull Metropolitan Borough Council is also the Local Highway Authority and manages highway drainage, carrying out maintenance and improvement works on an on-going basis, as necessary, to maintain existing standards of flood protection for highways, making appropriate allowances for climate change. It also has the responsibility to ensure road projects to no increase flood risk.

2.8.2 Environment Agency

The Environment Agency is responsible for protecting and enhancing the environment and contributing to the government's aim of achieving sustainable development in England and Wales.

7 Humber River Basin Management Plan (2015) https://www.gov.uk/government/publications/humber-river-basin-district-river-basin-management-plan

8 Severn River Basin Management Plan (2015) https://www.gov.uk/government/publications/severn-river-basin-district-river-basin-management-plan

The Environment Agency has powers to work on Main Rivers to manage flood risk. These powers are permissive, which means they are not a duty, and they allow the Environment Agency to carry out flood and coastal risk management work and to regulate the actions of other flood risk management authorities on main rivers and the coast.

The EA also has powers to regulate and consent works to Main Rivers. Prior written consent is required from the Environment Agency for any work in, under, over or within nine metres of a Main River or between the high water line and the secondary line of defence e.g. earth embankment. The Environment Agency also has a strategic overview role across all types of flooding as well as other types of water management matters.

2.8.3 Water and wastewater providers

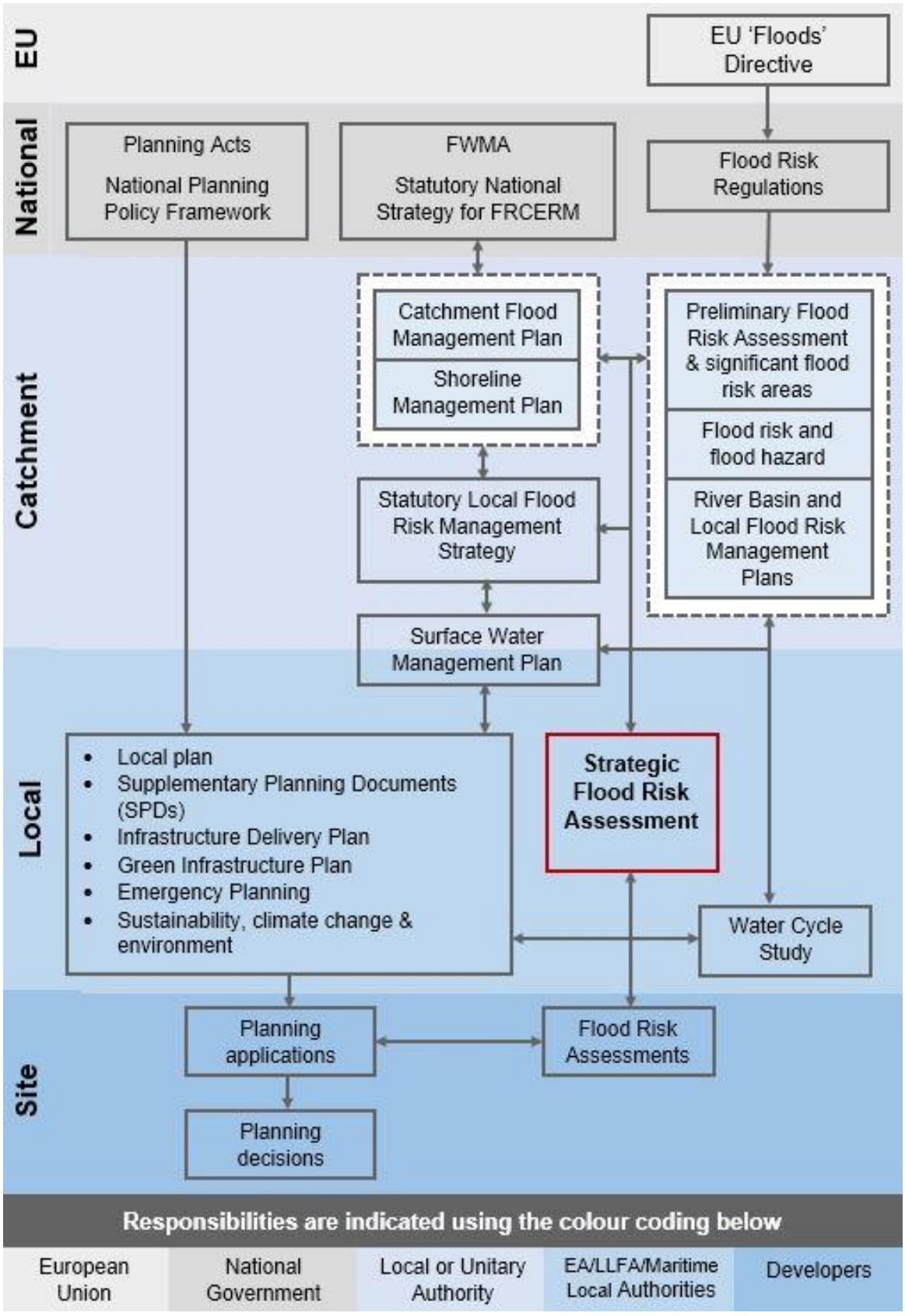
Severn Trent Water is the sewerage undertaker for Solihull Metropolitan Borough. They have the responsibility to maintain surface, foul and combined public sewers to ensure the area is effectively drained. When flows (foul or surface water) are proposed to enter public sewers, Severn Trent Water will assess whether the public system has the capacity to accept these flows as part of their pre-application service. If there is not available capacity, they will provide a solution that identifies the necessary mitigation. Severn Trent Water also comments on the available capacity of foul and surface water sewers as part of the planning application process. Further information can be found on their website.

Consent, prior to commencing work, is required from the relevant provider if installing water systems, or altering existing systems, is intended.

2.9 Key strategic planning links

Figure 2-3 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, have introduced a wider requirement for the mutual exchange of information and the preparation of strategies and management plans.

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



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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.

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) are 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 of 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. Local planning authorities should identify, in their SFRA, areas of functional floodplain, in agreement with 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. They must also be safe for users and not increase flood risk elsewhere. Essential Infrastructure will only be permitted if it passes the Exception Test.
		All developments in this zone require an FRA.

3.1.2 Surface water flood risk information

In 2016, the Environment Agency, working with LLFAs, produced the Risk of Flooding from Surface Water (RoFfSW) dataset. This superseded the previous Flood Map for Surface Water and Areas Susceptible to Surface Water Flooding maps. The RoFfSW is a national scale map and assesses flooding scenarios as a result of rainfall with the following chance of occurring in any given year. It is 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 3-2).

Table 3-2: RoFfSW risk categories

Risk	Definition
High	Probability of flooding greater than 1 in 30 (3.3%) each year.
Medium	Probability of flooding between 1 in 100 (0.1%) and 1 in 30 (3.3%) each year.
Low	Probability of flooding between 1 in 1,000 (0.1%) and 1 in 100 (1%) each year.
Very Low	Probability of flooding of less than 1 in 1,000 (0.1%) each 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 particular 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. Such an assessment will use the RoFfSW in partnership with other sources of local flooding information to confirm the presence of a surface water risk at that particular location.

The surface water map is available via the Long term flood risk information page on the government's website, and is also provided in Appendix A of this SFRA. In addition to showing the extent of surface water flooding, there are depth and velocity maps for each risk category. These maps should be used when considering other sources of flooding when applying the Sequential and Exception tests.

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

When preparing a local plan, the local planning authority should demonstrate it has considered a range of site allocations, using SFRAs to apply the Sequential and Exception Tests where necessary.

The Sequential Test should be applied to the whole local planning authority area to increase the likelihood of allocating development in areas not at risk of flooding. It is recommended that the Council considers using the SFRA climate change maps when applying the Sequential Test for site allocations and windfall sites. 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).

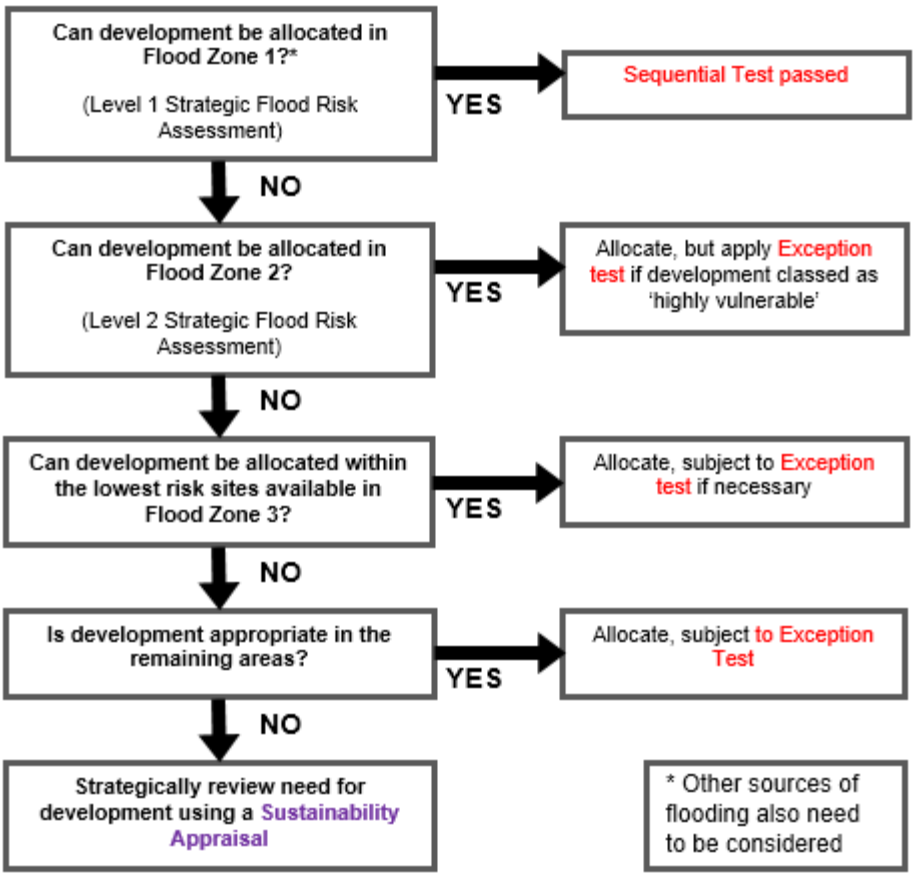

Figure 3-1: Applying the Sequential Test in the preparation of a local plan

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

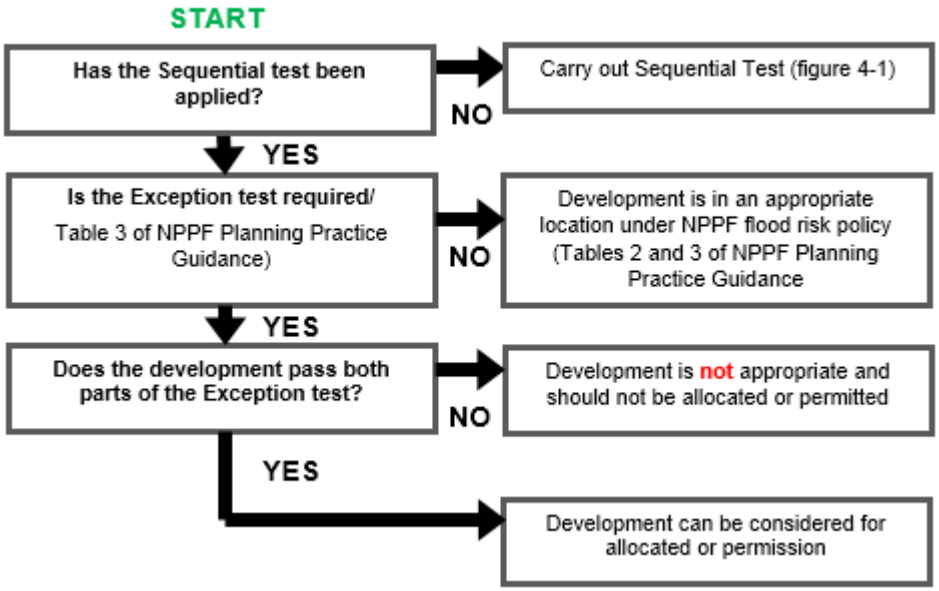

Figure 3-2: Applying the Exception Test in the preparation of a local plan

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.

Solihull Metropolitan Borough 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 uses, 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, the following two 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[9].

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[10]:

   - 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

9 NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 037, Reference ID: 7-056-20140306) March 2014
10 NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 038, Reference ID: 7-056-20140306) March 2014

- Flood warning and evacuation procedures
- Any funding arrangements required for implementing measures

The NPPG provides detailed information on how the Test can be applied

3.4 Actual flood risk

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

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

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

- The level of protection afforded by existing defences might be less than the appropriate standards and hence may need to be improved if further growth is contemplated
- The flood risk management policy for the defences will provide information on the level of future commitment to maintain existing standards of protection. If there is a conflict between the proposed level of commitment and the future needs to support growth, then it will be a priority for the Flood Risk Management Strategy to be reviewed
- The standard of safety must be maintained for the intended lifetime of the development. Over time the effects of climate change may reduce the standard of protection afforded by defences, due to increased river flows and levels, 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 a) the consequences of flooding need to be mitigated or b) where it is proposed to place lower vulnerability development in areas of flood risk.

3.5 Residual flood risk

Residual risk refers to the risks that remain 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; and/or
- failure of the defences or flood risk management measures to perform their intended duty. This could be breach failure of flood embankments, failure of flood gates to operate in the intended manner, or failure of pumping stations.

The Environment Agency AIMS database identified no formal, raised, flood defences within Solihull Metropolitan Borough and, therefore, no further assessment of flood defences and residual risk was required.

However, there is still potential residual risk in the borough from reservoirs and canals. The residual risk from these sources is discussed further in Section 6.

3.6 Impact of additional development on flood risk

When allocating land for development, consideration must be given to the potential cumulative impact of development on flood risk. The increase in impermeable surfaces and resulting increase in runoff increases the chances of surface water flooding if suitable mitigation measures, such as SuDS, are not put in place. Additionally, the increase in runoff may result in more flow entering watercourses, increasing the risk of fluvial flooding downstream.

Consideration must also be given to the potential cumulative impact of the loss of floodplain as a result of development. The effect of the loss of floodplain storage should be assessed, at both the development and elsewhere within the catchment and, if required, the scale and scope of appropriate mitigation should be identified.

Whilst the increase in runoff, or loss in floodplain storage, from individual developments may only have a minimal impact on flood risk, the cumulative effect of multiple developments may be more severe without appropriate mitigation measures.

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 in many cases the development should be used to improve the flood risk.

4 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.

4.2 Revised climate change guidance

The Environment Agency published updated climate change guidance on 19 February 2016, 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. The Environment Agency can give a free preliminary opinion to applicants on their proposals at pre-application stage. There is a charge for more detailed pre-application planning advice.

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. There allowances are based on climate change projections and difference scenarios of carbon dioxide emissions to the atmosphere.

Due to the complexity of projecting climate change, there are uncertainties attributed to climate change allowances. As a result, the guidance presents a range of possibilities to reflect the potential variation in climate change impacts over three periods.

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. Rising 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. The allowance category to be used is based on the vulnerability classification of the development and the flood zones within which it is located.

These allowances (increases) are provided, in the form of figures for the total potential changed 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 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 '2020s' (2015 to 39)	Total potential change anticipated for '2050s' (2040 to 2069)	Total potential change anticipated for '2080s' (2070 to 2115)
Upper end	20%	30%	50%
Higher central	15%	20%	30%
Central	10%	15%	20%

The upper reaches of ordinary watercourses in the far eastern part of the borough, flow into the Severn river basin; the allowances for the Severn River Basin District should be used in this area.

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 of 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 intensities

Climate change is predicted to result in wetter winters and increased summer storm intensity in the future. This increased rainfall intensity will affect land and urban drainage systems, resulting in 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 change allowances

To help decide which allowances to use to inform the flood levels that the flood risk management strategy will be based on for 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

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.

4.8 The impact of climate change in Solihull Metropolitan Borough

Climate change modelling for the watercourses in Solihull has been undertaken based on the new climate change guidance. Existing Environment Agency hydraulic models have been run for the 2080s period for all three allowance categories. As part of this SFRA, additional 2D modelling, using Jflow+, was undertaken for those watercourses where no detailed hydraulic models exist but the watercourse is shown in the Environment Agency Flood Zone mapping.

The Flood Zone 2 extent is comparatively similar to the 100-year plus 20% allowance for climate change across Solihull. Due to the nature of the topography, the flood zones are largely confined and subsequently, the flood extent is not significantly different when a 20% or 30% or 50% allowance for climate change is used. Whilst the flood extent may not increase significantly, the flood depth and hazard may in areas where the floodplain is more constrained. The Hatchford Brook, Low Brook and Kingshurst Brook appear to be more sensitive to increases in the climate change allowances used.

The climate change modelling indicates where areas currently shown to be in Flood Zone 1, may be affected by climate change. These include, but are not limited to:

- Residential areas around the vicinity of Conway Road and Chelmsley Road in Solihull town, near the Kingshurst Brook
- Residential areas around the vicinity of Cambridge Drive, Liverpool Croft and Holly Lane in Marston Green, near the Kingshurst and Low Brooks
- Residential areas around the vicinity of Brook Croft in Marston Green, near the Low Brook
- Upper reaches of the Low Brook, around the vicinity of Birmingham International Airport
- Commercial and residential areas along Station Road and Truggist Lane in Balsall Common, near an un-named watercourse
- Residential areas around the vicinity of Riverside Drive in Solihull town, near the River Blythe
- Residential and commercial areas around the vicinity of the Prince's Way roundabout, including Alderwood Place, Prince's Way and Church Hill Road in Solihull town, near an un-named watercourse
- Residential and commercial areas around the vicinity of Cheswick Way and Willow Drive in Cheswick Green, near the Mount Brook and River Blythe
- Residential areas around the vicinity of Corley Close, Eversleigh Crescent, Colebrook Road and Nethercote Gardens in Shirley, near the River Cole.

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5 Sources of information used in preparing the SFRA

5.1 Summary of SFRA mapping for all sources of flood risk

5.1.1 Fluvial

The data used to prepare the fluvial mapping for this study is based on Flood Zones and the results from hydraulic models either provided by the Environment Agency or prepared for the purposes of this SFRA. Hydraulic models used include:

- River Blythe
- River Cole
- Cheswick Green.

5.1.2 Surface Water

Mapping of surface water flood risk in Solihull Metropolitan Borough Council has been taken from the Risk of Flooding from Surface Water (RoFfSW) published online by the Environment Agency.

5.1.3 Groundwater

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 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. 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 AStGWF 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 where finer resolution datasets exist.

5.1.4 Sewers

Historical incidents of flooding are detailed by Severn Trent Water through their HFRR register. The HFRR database records incidents of flooding relating to public foul, combined or surface water sewers and displays which properties suffered flooding.

5.1.5 Canals

Historical incidents of over-topping or a breach of canals in the borough, is stored by the Canal and Rivers Trust.

5.1.6 Reservoirs

The risk of inundation as a result of reservoir breach or failure of a number of reservoirs within the area has been mapped using the outlines produced as part of the National Inundation Reservoir Mapping (NIRIM) study.

5.1.7 Suite of Maps

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

- Appendix A: Mapping of all sources of flood risk across the borough. These are a series of interactive maps that show all sources of flooding in Solihull Metropolitan Borough, as well as other supporting map layers.

  Clicking on a grid square in the Index Map will open a separate interactive PDF map that has options for turning on and off the map layers of interest.

- Appendix B: Environment Agency Flood Warning coverage

5.2 Other relevant flood risk information

Users of this SFRA should also refer to other relevant information on flood risk where available and appropriate. This information includes:

- River Trent Catchment Flood Management Plan (2009) and River Severn Catchment Flood Management Plan (2009)
- Solihull Metropolitan Borough Council Local Flood Risk Management Strategy (2015)
- Solihull Metropolitan Borough Council Surface Water Management Plan (once published)
- Solihull Metropolitan Borough Council Water Cycle Study (once published)
- Humber Flood Risk Management Plan (March 2016) and Severn Flood Risk Management Plan (March 2016)
- Environment Agency's Asset Information Management System (AIMS) – users should note that recently completed schemes may not yet be included in this dataset. Provides information on assets in the area. Can be used to identify where residual risk should be assessed.

6 Understanding flood risk in Solihull Metropolitan Borough

6.1 Historic flooding

Solihull Metropolitan Borough has a history of documented flood events with the main source being from 'fluvial' sources i.e. Main Rivers including the River Cole and River Blythe. However, information from the council indicates the blockages of undersized culverts have also been an issue throughout the borough.

The main historical fluvial flood event took place in July 2007 where over 20 houses were flooded in Nethercote Gardens and Cheswick Green. The estimated return period for this event was 1 in 75-year, for both the River Cole and the River Blythe. It is noted that the flooding along the River Blythe was exacerbated due to localised surface water and ordinary watercourse flooding.

Solihull News reported on a surface water flash flood event in Solihull town, in June 2012, which caused external flooding to many properties.

Rail services were disrupted by flooding in Hampton in Arden and 10 properties were flooded in Dickens Heath, in November 2012. The incident was suspected to be caused by a blockage of a culvert inlet which has since had works undertaken to reduce the risk of a blockage reoccurring here. Multiple properties in the village of Meridan also flooded during this event due to high sediment loads blocking a trash screen.

Data was provided for this SFRA from Solihull Metropolitan Borough Council, as LLFA. The supplied database recorded over 200 incidences of property flooding grouped into distinct flood events

- September 2016 had one incidence of internal flooding and seven incidences of external flooding, four of which were confirmed to be from fluvial sources.
- June 2016 had 45 incidences of flooding spread across northern and western parts of the borough but gave no detail on the source or extent of flooding.
- 119 records of flooding were recorded on 01/09/2015 of which 68 were noted to be internal flooding. There were also 18 records of external flooding, including garages, gardens highways and driveways; two of these incidences were confirmed to be flooding from surface water sources.
- A single incidence of flooding was recorded on 06/02/2016.

6.2 Topography, geology and soils

The topography, geology and soil are all important in influencing the way the catchment responds to a rainfall event. 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 rapid surface runoff, whereas more permeable rock such as limestone and sandstone may result in a more subdued response.

6.2.1 Topography

The topography of the study area can be seen in Figure 6-1 and is primarily comprised of higher elevations in the north east and south west with lower lying areas in the central and northern areas of the borough. In the north east, elevations reach approximate 180 metres Above Ordnance Datum (m AOD) with steep gradient slopes to central areas where the lowest elevations can be found in the vicinity of Hampton in Arden. The north of the borough is defined by relatively lower, flatter topography. West of the River Blythe, elevations gradually rise in a south westerly direction towards Dickens Heath, over Solihull and Dorridge.

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 borough 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 and, 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 significant for water supply or river base flow.

The bedrock in the borough is predominately Secondary B, associated with mudstone, siltstone and sandstone. These bedrocks have lower permeability which have minimal interaction with groundwater and often produce high levels of runoff. In central areas where there are lower elevations, outcrops of Secondary A superficial deposits overlay the bedrock. Outcrops of Secondary A bedrock can also be found in the southern part of the borough. To the east, there is a large area of principle bedrock, which provide high levels of permeability and water storage. The high ground to the east and west are overlaid with a mixture of Secondary (undifferentiated) and unproductive superficial strata.

The underlying geology and aquifer designation also has implications for what sustainable drainage solutions may be suitable for a site. For example, infiltration SuDS will be dependent on the permeability of the underlying deposits. Further information on geology can be found via the British Geological Society's Geology of Britain website.

The British Geological Society have also produced an Infiltration SuDS map which gives a preliminary indication of the suitability of the ground for infiltration SuDS

Figure 6-1: Solihull Topography

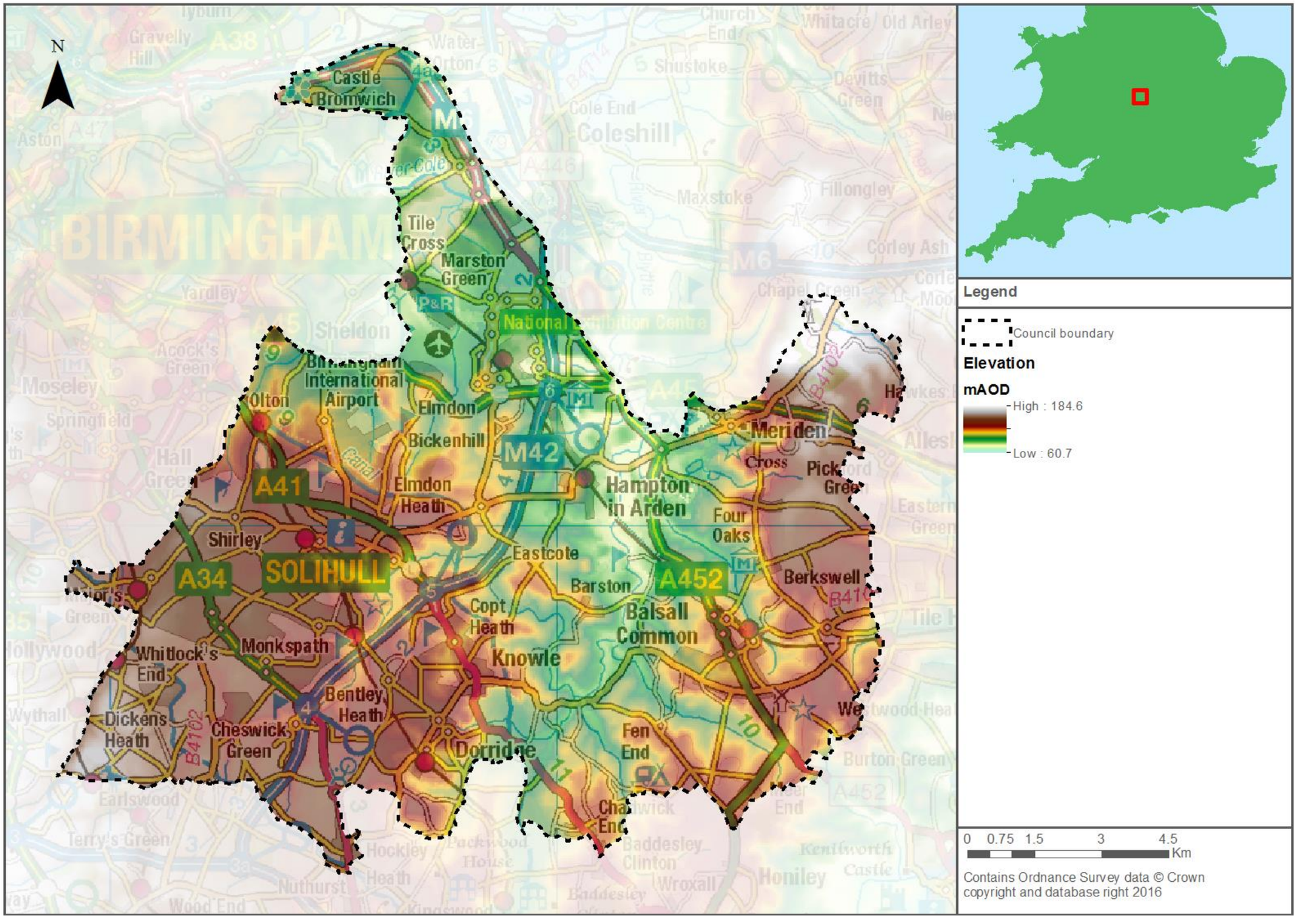


Figure 6-2: Bedrock aquifer classification in the Solihull Metropolitan Borough

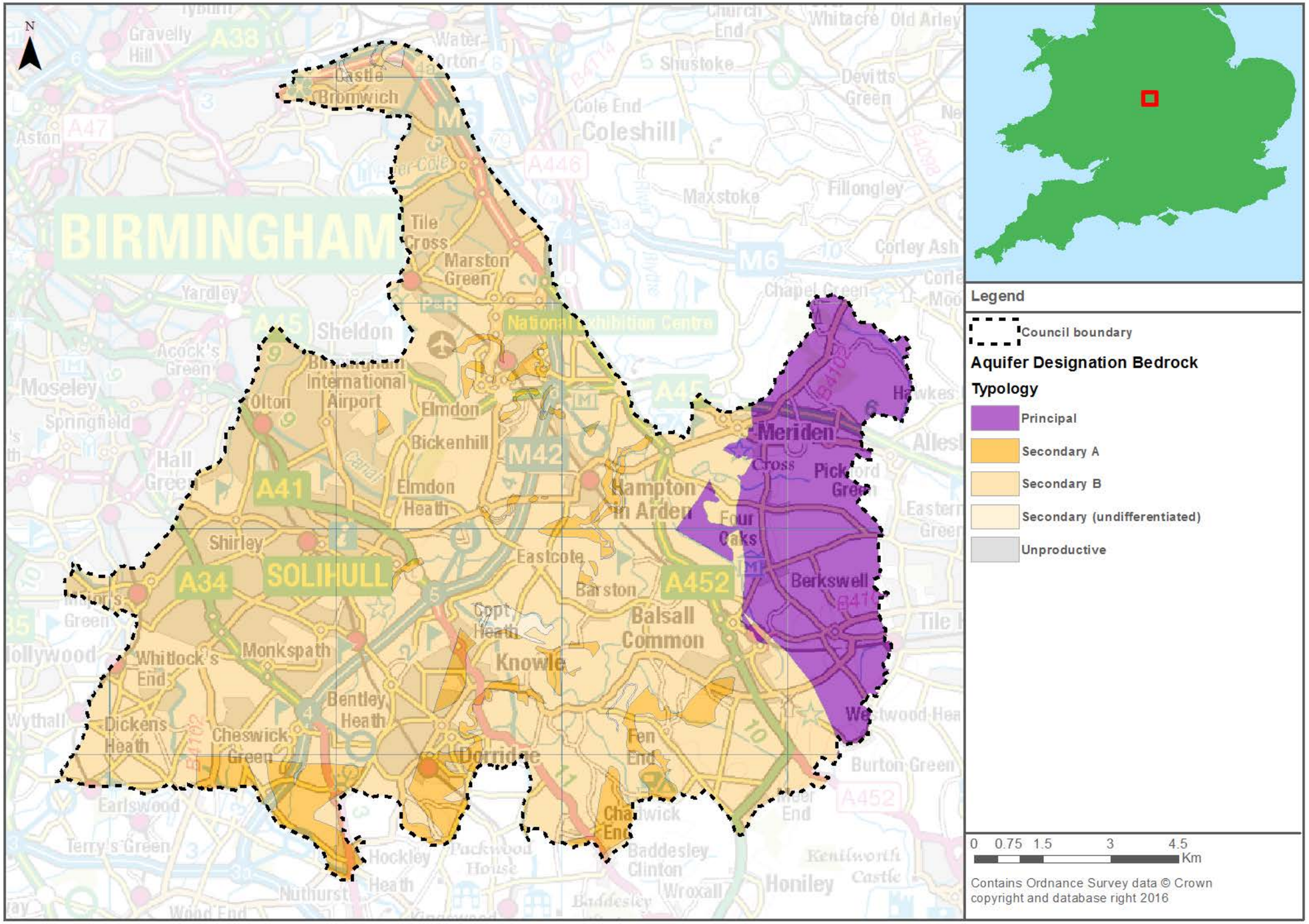
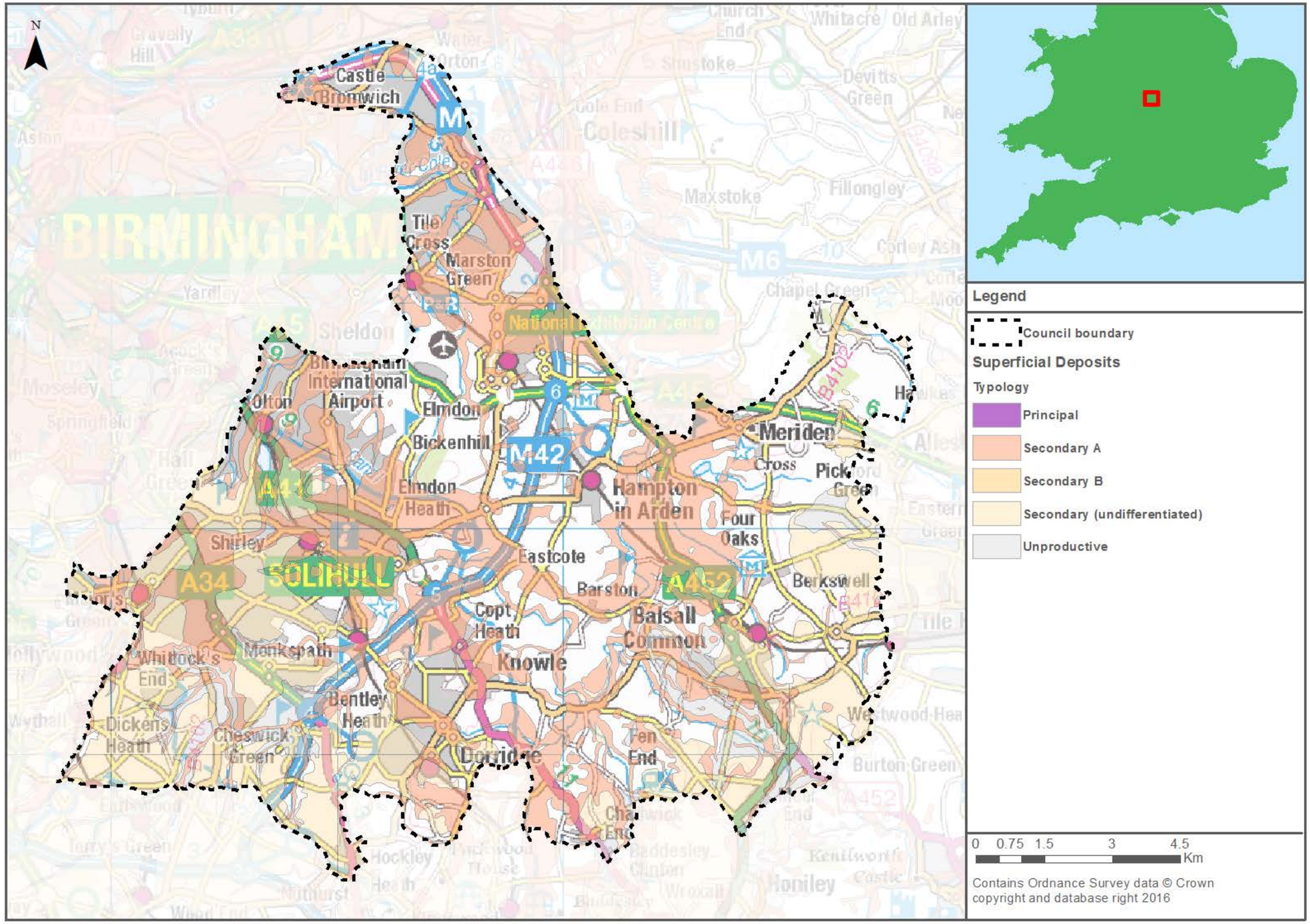


Figure 6-3: Superficial aquifer classification in the Solihull Metropolitan Borough



6.2.3 Hydrology

The principle watercourses flowing through the SFRA area are the River Blythe and its tributaries including the River Cole. Tributaries of these watercourses include other Main Rivers as well as smaller Ordinary Watercourses. A summary of the principal watercourses in the SFRA is provided in Table 6-1. Mapping indicating the location of the principal watercourses can be found in Appendix A.

Table 6-1: Watercourses in the study area

Watercourse	Classification	Description
Alder Brook	Main River	A 2.9km long tributary of the River Blythe flowing east through Solihull to its confluence with the River Blythe west of junction five of the M42.
Cuttle Brook	Ordinary watercourse	A tributary of the River Blythe that flows in an easterly direction for 3.8km, through predominately rural land, from Dorridge close to the southern boundary.
Hatchford Brook	Main River	Originating from the Olton Reservoir in Kineton Green, Solihull, the Hatchford Brook flows in a northerly direction to the A45 and the borough boundary. Here it leaves the borough boundary for 1.5km and re-enters north of the Sheldon Golf course. The Hatchford Brook then flows along north western boundary until Alocott Wood in Marston Green where it merges with Kingshurst Brook.
Hollywell Brook	Main River / Ordinary watercourse	Flowing from Pendigo Lake, the Hollywell Brook is classed as ordinary watercourse until it passes under the M42. From here, it is classed as Main River and flows in an easterly direction until its confluence with the River Blythe.
Kingshurst Brook	Main River	A short 1.4km stretch of Main River flowing in a north easterly direction, after the confluence of the Hatchford Brook and low Brook, to its confluence with the River Cole between Chelmsley Wood and Fordbridge.
Low Brook	Main River / Ordinary watercourse	Low Brook rises east of Elmdon Heath as an ordinary watercourse, flowing northerly through rural land until it passes culverted under the A45. It emerges classified as a Main River and continues north passed Marston Green until its confluence with the Kingshurst Brook.
Mount Brook	Main River	A tributary of the River Blythe, the Mount Brook flows for 1.7km from Tamworth Lane to its confluence with the River Blythe south west of Cheswick Green
Pickford Brook	Ordinary watercourse	A tributary of the River Sherbourne (located out of the borough boundary), the Pickford Brook rises north of Hollyberry End and flows in a southerly direction for 2.9km along the borough boundary until Harvest Hill where is leaves the borough.
Purnell's Brook	Main River / Ordinary watercourse	The Purnell's Brook is classed as ordinary watercourse for 0.6km from its source in Knowle in Dorridge. After passing under Longdon Road it is classified as a Main River, flowing in a north easterly direction until its confluence with the River Blythe 2.1km downstream.
River Blythe	Main River	The River Blythe enters the borough, north of Earlswood and Earlswood Lakes and flows in a north easterly direction along the eastern extent of Cheswick Green, Hillfield and Solihull's, Lode Heath. After crossing the M42, it flows south east towards Temple Balsall. At Temple Balsall, it turns to flow northwards, through predominately rural land towards the A45/A452 roundabout in the north of the borough.

Watercourse	Classification	Description
River Cole	Main River	The River Cole rises in the Bromsgrove district and flows along the south west boundary of the borough. At Solihull Lodge, it enters the borough for a short distance, before leaving the borough and entering Birmingham. Here, it continues to flow in a predominantly north easterly direction until Stechford Bridge, where it flows in an easterly direction and re-enters, at the northern part of the borough, around Kinghurst and Fordbridge. Flowing for 3.3km it then leaves the borough, at the junction with the M6. The River Cole then flows to its confluence with the River Blythe.
Shadow Brook	Main River / Ordinary watercourse	The Shadow Brook flows in a predominately north eastern direction to its confluence with the River Blythe on the northern borough boundary near Diddington Hill. The shadow Brook is classified as an ordinary watercourse, east of the M42.
Westly Brook	Main River	The Westly Brook flows through a predominately urban area from Kineton Green, through Olton in Solihull for approximately 2.9km.

6.3 Fluvial flood risk

The primary fluvial flood risk in Solihull is associated with the River Blythe and its tributaries. Tributaries of the River Blythe include, but are not limited to the River Cole, Mount Brook, Alder Brook, Purnell's Brook, Shadow Brook, and Hollywell Brook. The River Blythe flows through the majority of the borough. However, the areas it flows through are predominantly rural and the fluvial flood risk from the River Blythe to property in this area is minimal.

The River Cole, a tributary of the Blythe, flows through Kingshurst in the north and south east of Solihull. Whilst the River Cole has relatively narrow floodplains, it flows through areas that are heavily urbanised and as such, produces a higher flood risk to properties.

Locations with associated fluvial flood risk from Solihull (as well as other sources of flooding) are detailed in Table 6-4.

A review of the Environment Agency's AIMS dataset and flood storage area GIS layer indicates there are currently no formal flood defences in the borough. However, as part of the Trent Regional Flood and Coastal Committee six-year programme, Solihull Metropolitan Borough Council, submitted a bid for improvements to Dickens Heath balancing pond. This pond is located to the sough of Dickens Heath, off Rumbush Brook, a tributary of Mount Brook. The council are also in the very early stages of looking to see whether the Dickens Heath scheme could be expanded to benefit Cheswick Green.[11]

6.4 Surface water flood risk

Flooding from surface water runoff (or 'pluvial' flooding) is usually caused by intense rainfall that may only last a few hours and usually occurs in lower 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.

The Risk of Flooding from Surface Water (RoFfSW) predominantly follows topographical flow paths of existing watercourses or dry valleys with some isolated ponding located in low lying areas.

A summary of surface water flood risk to key locations in Solihull (as well as other sources of flooding) are detailed in Table 6-4.

The RoFfSW mapping for the borough can be found in Appendix A.

6.5 Groundwater flood risk

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. Under

[11] https://cllrkenhawkins.co.uk/2016/03/31/flood-defence-grant-in-aid-bid-dickens-heath/

the Flood and Water Management Act (2010), LLFAs have powers to undertake risk management functions in relation to groundwater flood risk. Groundwater level monitoring records are available for areas on Major Aquifers. However, for lower lying valley areas, which can be susceptible to groundwater flooding caused by a high water table in mudstones, clays and superficial alluvial deposits, very few records are available. Additionally, there is increased risk of groundwater flooding where long reaches of watercourse are culverted as a result of elevated groundwater levels not being able to naturally pass into watercourses and be conveyed to less susceptible areas.

Mapping of the borough has been provided showing the AStGW dataset and can be found in Appendix A.

6.6 Flooding from artificial sources

6.6.1 Flooding from sewers

Sewer flooding occurs when intense rainfall overloads the sewer system capacity (surface water, foul or combined), and/or when sewers cannot discharge properly to watercourses due to high water levels. Sewer flooding can also be caused when problems such as blockages, collapses or equipment failure occur in the sewerage system. Infiltration 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.

Historical flood events provided by Solihull Metropolitan Borough Council included records from possible sewer flooding events. For confidentiality reasons this data has been displayed on a 4-digit postcode basis.

Table 6-2: Solihull Metropolitan Borough Council flood database

Post Code	Locality	Recorded Flood Incidents
B37 6	Kingshurst	1
B37 7	Marston Green	1
B90 2	Hasluck's Green	3
B91 1	Blossomfield	2
B91 2	Lode Heath	9
B91 3	Tippets Field	3
B92 0	Hampton in Arden	2
B92 8	Ulverly Green	3
B92 9	Elmdon Heath	8
B93 9	Knowle	1
CV7 7	Basall Common	1
Unknown		1
		Total = 35

A total of 35 recorded flood incidences where listed in the Solihull Metropolitan Borough Council flooding database. The most frequently flooded post codes are B91 2, (Lode Heath) and B92 9, (Knowle).

Historical incidents of flooding are detailed by Severn Trent Water through their HFRR registers (see Table 6-3). 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 exported on 06/03/2017.

Table 6-3: Severn Trent Water HFRR (sewer flood risk register)

Locality	Post Code	Recorded Flood Incidents	Locality	Post Code	Recorded Flood Incidents
Balsall Common	CV7 7	5	Hockley Heath	B94 6	7
Bentley Heath	B93 8	2	Kingshurst	B37 6	14
Berkswell	CV7 7	2	Knowle	B93 9	6
				B93 0	7
Birmingham	B36 0	2	Meriden	CV7 7	15
	B27 6	3			
Carol Green	CV7 7	1	Olton	B92 8	5
Castle Bromwich	B36 9	3	Sheldon	B92 9	1
Dorridge	B93 8	16	Shirley	B90 1	10
	B94 6	9		B90 2	5
				B90 4	1
Hampton-in-Arden	B92 0	24	Solihull town	B90 1	2
				B90 2	4
				B91	1
				B91 1	12
				B92 2	13
				B92 7	10
				B92 9	4
				B93 8	4
				B94 6	3
					Total = 185

A total of 185 recorded flood incidents in the Solihull Metropolitan Borough were listed in the HFRR register. The most frequently flooded localities are

- Solihull town, accounting for 29% of all recorded incidents;
- Dorridge, accounting for 14% of all recorded incident; and,
- Hampton-in-Arden, accounting for 13% of all recorded incidents.

20 incidents were recorded during June and July 2007. A further 12 incidents were recorded in August 1999, 9 incidents were recorded in November 2012 and August 2004. July 2007 and November 2012 are also recorded historical fluvial and blockages indicating that there may be some interaction between the fluvial and surface water drainage networks. However, the majority of the dates do not correlate to significant fluvial or surface water flood events noted in Section 6.1; indicating that the events listed in the HFRR are possibly isolated incidents.

It is important to recognise the HFRR does not contain information about properties and areas at risk of sewer flooding caused by operational issues such as blockages. Also the register represents a snapshot in time. As such the sewer flooding flood risk register is not a comprehensive 'at risk register'.

6.7 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 these reservoirs. The Environment agency is currently progressing a 'Risk Designation' process so that the risk is formally determined.

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 it is less likely than flooding from rivers or 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.

There is a residual risk of inundation to the borough because of reservoir breach or failure of reservoirs both within and outside the borough. The risk was assessed as part of the National Inundation Reservoir Mapping (NIRIM) study. The results from the NRIM study show inundation outlines follow the River Blythe corridor, from where it enters the borough at Dickens Heath, to where it leaves the borough, at the A45 / A452 roundabout. There are also reservoir inundation outlines from the lakes east of Hampton in Arden, south of Meriden, to Pickford Green, east of the borough as well as from Pendigo Lake, south of the NEC. Maps of the flood extent can be found on the Environment Agency's 'Long term flood risk information' 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.

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

- Developers should seek to contact the reservoir owner to obtain information which may include
    - reservoir characteristics: type, dam height at outlet, area/volume, overflow location;
    - operation: discharge rates / maximum discharge;
    - discharge during emergency drawdown; and
    - inspection / maintenance regime.
- Developers should apply the sequential approach to locating development within the site. The following questions should be considered
    - can risk be avoided through substituting less vulnerable uses or by amending the site lay-out?
    - can it be demonstrated that less vulnerable uses for the site have been considered and reasonably discounted? 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?
- Consult with relevant authorities regarding emergency plans in case of reservoir breach
- 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 the proposed infrastructure fabric can withstand the loads imposed on the structures by a breach event.

6.8 Flooding from canals

Canals do not generally pose a direct flood risk as they are a regulated waterbody. The residual risk from canals tends to be associated with lower probability events such as overtopping and embankment failure (breach and sudden escape of the water retained in the canal channel).

There are two canals in Solihull (see Figure 6-4). The Grand Union Canal cuts through the south west of the borough and flows as a navigable canal for over 14km through the centre of the borough. There are a series of five locks on the Grand Union Canal, known as "Knowle Locks"; these are located south of the B4104 Kenilworth road bridge, south east of Knowle. Several unnamed drains have the potential to interact with the Grand Union Canal as well as the River Blythe which the Grand Union Canal flows over as an aqueduct.

The **Stratford-on-Avon Canal** crosses the River Cole and River Blythe as is flows along the south-western boundary of the borough and is navigable along its entire length.

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.

6.8.1 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 is 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

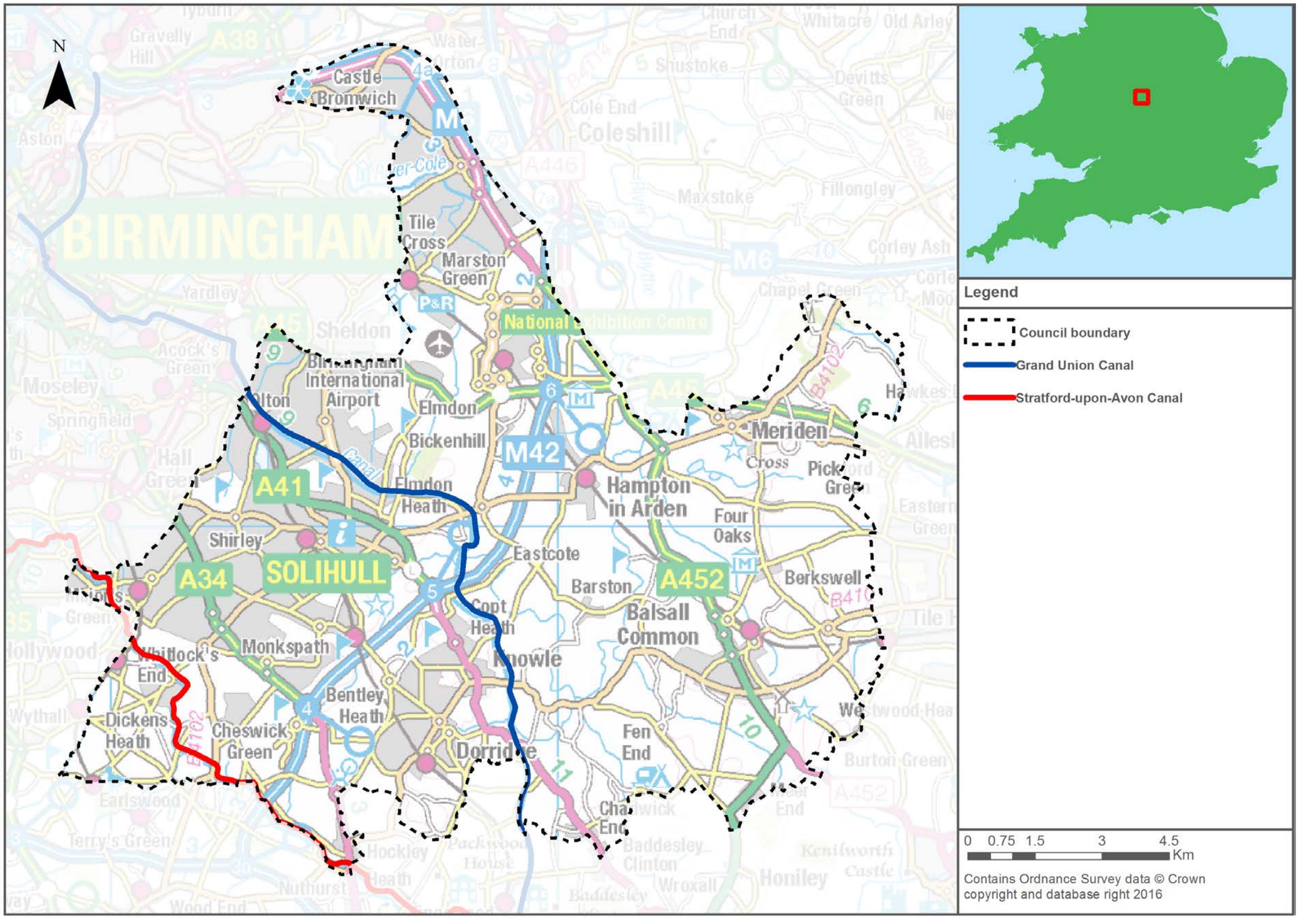
Flooding from a breach of a canal embankment is largely dictated by canal and ground levels, canal embankment construction, breach characteristics and the volume of water within the canal that can discharge into the lower lying areas behind the embankment. The volume of water released during a breach 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.

6.8.2 Recorded flood incidents from canals in the borough

There is one record of a canal breach with in the borough on the Grand Union Canal, in November 1997, by Copt Heath, thought to be caused by a farmer excavating an embankment which resulted in a 65m slope failure.

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.

Figure 6-4: Canal locations in the Solihull Metropolitan Borough



6.9 Flood warning and emergency planning

6.9.1 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.

6.9.2 NPPF

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 residual risk of flooding, the availability of adequate flood warning systems for the development, safe access and egress routes and evacuation procedures.

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

There are circumstances where a flood warning and evacuation plan[12] 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 DEFRAs 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 estimate flood level.

It is recommended that Emergency Planners at Solihull Metropolitan Borough 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 / PPG, 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 considered to 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.

Further emergency planning information links:

- 2004 Civil Contingencies Act
- DEFRA (2014) National Flood Emergency Framework for England

12 Flood warning and evacuation plans may also be referred to as an emergency flood plan or flood response plan.

- How to register with the Environment Agency's Flood Warnings Direct service
- National Flood Forum
- GOV.UK Make a Flood Plan guidance and templates
- FloodRe
- Coventry, Solihull and Warwickshire Council resilience team website

6.9.3 Flood warnings

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.

Flood warnings can be derived and, 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 Floodline Warnings Directive (FWD) service, to homes and business within Flood Zones 2 and 3.

Within the borough, there are four flood alert areas (FAA) and six flood warning areas (FWA). These are shown in Appendix B.

6.10 Cross boundary considerations

The topography and location of the borough means that all the major watercourses such as the River Blythe and River Cole flow through the study area. As such, future development, both within and outside the borough can have the potential to affect flood risk to existing development and surrounding areas, depending on the effectiveness of SuDS and drainage implementation. Solihull has boundaries with the following Local Authorities:

- Birmingham City Council
- Bromsgrove District Council
- Coventry City Council
- North Warwickshire Borough Council
- Stratford-on-Avon District Council
- Warwick District Council

Neighbouring authorities were contacted and, where possible, Local Plans and SFRAs were reviewed to assess whether there are any proposed developments that may affect flood risk in the borough. Details of any known cross-boundary flooding issues were also requested. Based on the responses received, there is nothing to suggest there will be any developments proposed in neighbouring authorities that would adversely affect flood risk within Solihull. None of the neighbouring authorities reported any known cross boundary flooding issues.

The only notable reference to potential cross-boundary issues was in the LFRMS. In times of flood, foul water can enter the surface water network (as stated in the River Trent CFMP) and negatively impact water quality in the Tame, Anker and Mease sub-catchments.

Development control should ensure that the impact on receiving watercourses from development in Solihull has been sufficiently considered during the planning stages and appropriate mitigation measures put in place to ensure there is no adverse impact on flood risk or water quality. The Water Management policy P11, listed in the LFRMS, refers to ensuring that there is no deterioration of water quality and that where possible, development should seek to reduce the flood risk to third party land.

Table 6-4: Summary of flood risk in Solihull Metropolitan Borough

Settlement	Fluvial flood risk	Surface water flood risk	Reservoir inundation risk	Historic, recorded flood events
Balsall Common	Elevated above the surrounding watercourses, Balsall Common is located in Flood Zone 1. Whilst there is the River Blythe Tributary and two unnamed drains which are not covered by the Environment Agency's Flood Zones given the topographical location it is unlikely to flood from fluvial sources.	The majority of surface water flood risk falls to areas in the vicinity of the River Blythe Tributary, and two unnamed drains in the west and north east. Additional risk is predominantly confined to dry valleys leading to the three watercourses which present significant risk to properties.	None	None
Meriden	As the watercourses in the vicinity of the settlement are classed as Ordinary Watercourses, fluvial flood risk is not shown in the Environment Agency's Flood Zones. Fluvial flood risk could potentially come from the primary flow path of an unnamed drain which flows under the B4104.	Surface water flooding up to the 1% AEP is relatively minor with small flow routes following roads such as Leys Lane. However, at 0.1% AEP a significant flow route is present from Alspath Road, crossing The Croft and Main Road, flooding predominately open spaces and gardens, towards the unnamed drain and lake near Meriden Hall in the south. There is also significant risk to properties in the vicinity of the unnamed watercourse in the west of Meriden.	There is medium to low risk of reservoir inundation in Meriden south of the B4104	In 2012, high sediment load blocked a trash screen flooding several properties.
Hampton in Arden	The majority of Hampton in Arden is situated on relatively high ground west of the railway. This area is located in Flood Zone 1 as it is elevated from the watercourses surrounding it. Properties east of the railway along Lapwing Drive and The Crescent are split by the primary flow path of an unnamed drain. Although the Flood Zones do not extend as far as Hampton in Aden, the surrounding flood plains are flat, wide and would act as a flow route during flood events.	The majority of surface water flood risk falls to areas in the vicinity of existing watercourses with additional risk predominantly confined to roads such as High Street and Meriden Road	None	Rail services were disrupted in November 2012.
Dorridge	The primary fluvial flood risk in Dorridge is the unnamed drain in the south which has many properties in its immediate vicinity, as well as an unnamed tributary of the River Blythe and Cuttle Brook. The majority of properties are located on elevated land and located in Flood Zone 1. The rivers which rise within Dorridge are ordinary watercourses and are not covered by the Environment Agency's Flood Zones; however, given the topography of the area it is unlikely to flood from fluvial sources.	The surface water flood risk to Dorridge is predominantly via run-off from surrounding dry valleys towards the surrounding watercourses. In the 0.1% AEP event there is significant areas of ponding on Conker Lane (path) with the surface water extent causing risk to properties in the area.	None	None
Marston Green	The Flood Zones along the Low Brook in Marston Green are narrow north of the railway covering a few properties on Sycamore Crescent and Farndon Avenue. However, north of Alcott Lane, Flood Zone 2 is comparatively wider covering properties in Gloucester Way, Lincoln Grove and Cambridge Drive as Low Brook and Hatchford Brook meet at their confluence. A few properties along Holly Lane are within Flood Zone 2. South of the railway the Flood Zones are wide and cover buildings associated with Birmingham International Airport.	Surface water flooding is largely confined to the close vicinity of existing watercourses. Mapping also shows surface water ponding in open spaces and gardens. However, there is a large flow route through Birmingham International Airport towards Low Brook. .	None	None
Knowle	As the watercourses in the vicinity of the settlement are small, fluvial flood risk is not shown in the Environment Agency's Flood Zones. Fluvial flood risk could potentially come from Purnell's Brook, the largest of these watercourses, or one of the several unnamed drains flowing through Knowle.	The majority of properties within Knowle are not within surface water flood risk extents. However, properties in the vicinity of the Purnell's Brook and the unnamed drain to the north east are at risk in the 0.1% event where the surface water extent is significantly larger than in lower return periods.	None	None
Chelmsley Wood	Mapping shows Chelmsley Wood is primarily affect by fluvial flood risk from the River Cole. Chelmsley Wood is situated on significantly higher ground and so is predominantly located in Flood Zone 1. However, a few properties are at risk after the confluence of the Kinghurst Brook, Low Brook and Hatchford Brook as Flood Zone 2 becoming significantly larger.	Mapping shows that surface water flood risk is predominately confined to roads which act as conduits for run off toward the River Cole. In the 0.1% AEP event there is a prominent overland flow route in the normally dry-valleys adjacent to Greenlands Road which causes significant flood risk to properties.	None	None

Settlement	Fluvial flood risk	Surface water flood risk	Reservoir inundation risk	Historic, recorded flood events
Kingshurst	Flood Zones show the main fluvial flood risk is from the River Cole, which flows from west to east through the south of Kingshurst. The Flood Zones are located predominantly within the rural flood plain and with limited impact upon the settlement. The exception is Corinne Croft and Ford Bridge where several properties are located in Flood Zones 2 and 3.	The majority of properties in Kingshurst are not within surface water extents. Areas at risk tend to be roads, which are conduits for run-off from the surrounding hills (e.g. Gilson Way, Fordbridge Road, Meriden Drive). There are a few properties at risk along Fordbridge Road during the 0.1% AEP event.	None	None
Castle Bromwich	Castle Bromwich is not located near any Main Rivers or Ordinary Watercourses and is entirely located within Flood Zone 1.	The majority of properties within Castle Bromwich are not within surface water extents in the 1% AEP event. However; a significant number of overland flow routes, via local roads and dry valleys, present a risk to properties in the higher return periods.	None	None
Solihull	Flood Zones show the main fluvial flood risk is from the River Cole, Westly Brook, Hatchford Brook, Alders Brook and an unnamed drain through Hillfield. Although the Flood Zones on these main watercourses are narrow due to the densely urbanised nature of Solihull they provide significant flood risk to properties.	Mapping shows surface water flood risk for the 1% AEP event in Solihull is relatively minor, with ponding on roads and in open space, with a minor flow route following the River Cole in the south east. However, in the 0.1% AEP event the surface water extent covers significant amount of Solihull with the majority of the road network at risk from surface water flooding. Properties in the vicinity of existing watercourses and flow routes through dry valleys are at risk in the higher return periods.	Inundation from Olton reservoir may affect properties in Ulverley Green, Olton, Elmdon, with high risk to properties in Ulverley Green and Olton.	In June 2012 a surface water flash flood caused external flooding to several properties.
Dickens Heath	Flood risk from the majority of the watercourses flowing through Dickens Heath are not shown in the Environment Agency's Flood Zones. However, there is potentially some fluvial flood risk from numerous unnamed drains and residual risk from breaches of the Stratford-upon-Avon canal.	Mapping shows surface water flood risk in Dickens Heath is in isolated pockets in the 1% AEP, the largest along Griffin Lane with several notable flow routes following existing watercourses including the Stratford-upon-Avon canal. However, risk is widespread in the 0.1% AEP, following the path of the roads and waterways. Numerous residential and commercial areas are at risk from a 0.1% AEP. Areas most affected include Yarn Lane and Rumbush Lane.	None	A culvert blockage caused 10 properties to flood in 2012.
Cheswick Green	Cheswick Green is partially located within Flood Zones 2 and 3 of the River Blythe and Mount Brook; the majority of properties within the Flood Zones are located in the south west at the confluence of the two watercourses, primarily along Coppice Walk, Cheswick Way and Watery Lane.	The majority of surface water flood risk falls to areas in the vicinity of existing watercourses with additional risk predominantly confined to roads and ponding in rural areas and gardens. Areas notably at risk include Coppice Walk, Watery Lane and Saxon Wood Road. The majority of risk is from a 1% or higher AEP event.	Inundation from Earlswood Lakes may affect Cheswick Green with medium risk in the south of the village in the vicinity of the River Blythe	In July 2007 over 20 houses flooded due to a combination of surface water flood and fluvial flooding from ordinary watercourses and a 1 in 75-year event on the River Blythe.

7 FRA requirements and flood risk management guidance

7.1 Over-arching principles

This SFRA focuses on delivering a strategic assessment of flood risk within Solihull Metropolitan Borough. Due to the strategic scope of the study, prior to any construction or development, site-specific assessments will need to be undertaken for individual development proposals (where required) so all forms of flood risk at a site are fully addressed. It is the responsibility of the developer to provide an FRA with an application.

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.

7.2 Requirements for site-specific flood risk assessments

7.2.1 What are site specific FRAs?

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.

Paragraph 068 of the NPPG Flood Risk and Coastal Change Planning Practice Guidance sets out a checklist for developers to assist with site specific flood risk assessments.

Site specific FRAs are required in the following circumstances:

- Proposals for new development (including minor development and change of use) in Flood Zones 2 and 3
- Proposals for new development (including minor development and change of use) in an area within Flood Zone 1 which has critical drainage problems (as notified to the LPA by the Environment Agency)
- Proposals of 1 hectare or greater in Flood Zone 1
- Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding
- Proposals of less than one hectare in Flood Zone 1 where they could be affected by sources of flooding other than rivers and the sea (e.g. surface water)

7.2.2 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; and
- whether, if applicable, the development will be safe and pass the Exception Test.

FRAs for sites located in Solihull should follow the approach recommended by the NPPF (and associated guidance) and guidance provided by the Environment Agency and Solihull Metropolitan Borough Council. Guidance and advice for developers on the preparation of site specific FRAs include

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

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.

7.3 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.

7.3.1 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.

7.3.2 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 and structures 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.

Solihull Metropolitan Borough Council can use Section 106 agreements of the Town and Country Planning Act 1990 to use planning to manage flood risk; in line with the ‘Making Space for Water’ concept, Section 106 agreements can be put in place to ensure new SuDS features will be maintained in the future.

Catchment and floodplain restoration

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 river 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.

7.3.3 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.

If it has been agreed with the Environment Agency that, in a particular instance, the raising of floor levels is acceptable finished flood levels should be set a minimum of 600mm above the 1% AEP plus climate change peak flood level. 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 600mm above the design flood level and waterproof construction techniques used.

7.3.4 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.

7.3.5 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.

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.

7.3.6 Developer contributions

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

DEFRA's Flood and Coastal Risk Management Grant in Aid (FCRMGiA)[13] can be obtained by operating authorities to contribute towards the cost of a range of activities including flood risk management schemes that help reduce the risk of flooding and coastal erosion. Some schemes are only partly funded by FCRMGiA and therefore any shortfall in funds will need to be found from elsewhere when using Resilience Partnership Funding, for example local levy funding, local businesses or other parties benefitting from the scheme.

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

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

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

The Environment Agency is also 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.

Community Infrastructure Levy

The Community Infrastructure Levy (CIL) allows local authorities to raise funds from developers undertaking new building projects in their administrative area. The CIL rate is set locally, within a

13 Principles for implementing flood and coastal resilience funding partnerships (Environment Agency, 2012)

Charging Schedule. The CIL can be used for a variety of local infrastructure needs arising from new development in the Borough including flood defences. Further information on CIL can be found on the Councils website.

7.4 Flood risk management guidance – resistance measures

Measures designed to keep flood water out of properties and businesses.

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 effectiveness of these forms of measures are often dependant on the availability of a reliable forecasting and warning system to user the measures are deployed in advance of an event. 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.

7.5 Flood risk management guidance – resilience measures

Measures designed to reduce the impact of water that enters property and businesses.

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; and
- non-return valves to prevent waste water from being forced up bathroom and kitchen plugs, or lavatories.

7.6 Reducing flood risk from other sources

7.6.1 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.

7.6.2 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 the wider area. 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 flood-proofing 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 must be demonstrated with suitable modelling techniques.

7.6.3 Sustainable Drainage Systems

Sustainable Drainage Systems (SuDS) aim to mimic the natural processes of greenfield surface water drainage by encouraging water to flow along natural flow routes and thereby reduce runoff rates and volumes during storm events while providing some water treatment benefits. SuDS also have the advantage of providing effective blue and green infrastructure and ecological and public amenity benefits when designed and maintained properly.

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

More detailed guidance on the use of SuDS is providing in Section 8.

8 Surface water management and SuDS

8.1 What is meant by surface water flooding?

Surface water flooding describes flooding from sewers, drains, and ditches that occurs during heavy rainfall.

Surface water flooding includes

- **pluvial flooding:** flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (overland surface runoff) before it either enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity;
- **sewer flooding:** flooding that occurs when the capacity of underground water conveyance systems is exceeded, resulting in flooding inside and outside of buildings. Normal discharge of sewers and drains through outfalls may be impeded by high water levels in receiving waters which may cause water to back up and flood around buildings or in built up areas. Sewer flooding can also arise from operational issues such as blockages or collapses of parts of the sewer network; and
- **overland flows entering the built up area from the rural/urban fringe:** includes overland flows originating from groundwater springs.

8.2 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.

In April 2015 Solihull Metropolitan Borough 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

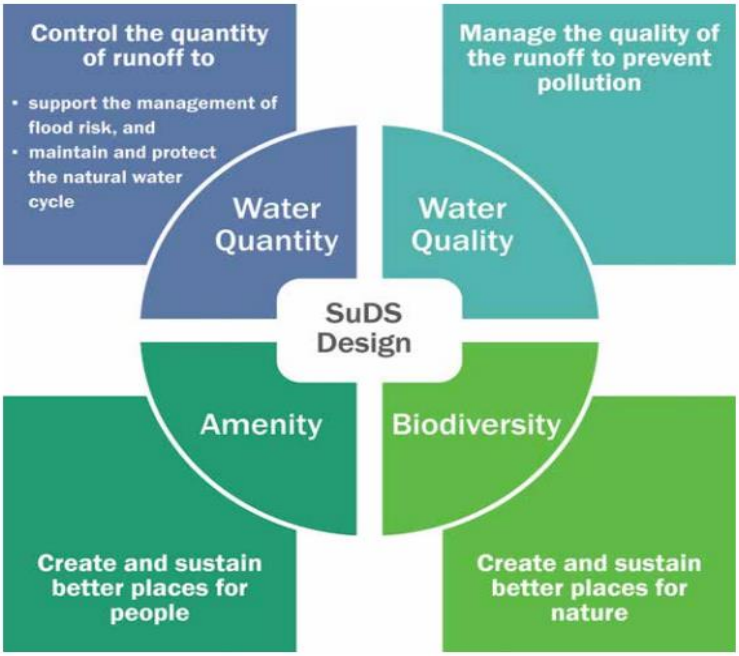
- residential development: 10 dwellings or more, or residential development with a site area of 0.5 hectares or more where the number of dwellings is not yet known; and
- non-residential development: provision of a building or buildings where the total floor space to be created is 1,000 square metres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

The LLFA will 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.

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. Proposals should also comply with the key SuDS principles regarding solutions that deliver multiple long-term benefits. These four principles are shown in Figure 8-1.

Figure 8-1: Four pillars of SuDS design



Source: The SuDS Manual (C753)

8.3 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.

S 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 addition benefits such as:

- Improving air quality
- Regulating building temperatures
- Reducing noise
- Providing education opportunities
- 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 the majority of spaces. For example, permeable paving could be used in parking spaces or rainwater gardens into traffic calming measures.

If 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.

8.3.1 Types of SuDS System

There are many different SuDS techniques that can be implemented in attempts to mimic pre-development drainage (Table 8-1). Techniques can include soakaways, infiltration trenches, permeable pavements, grassed swales, green roofs, ponds and wetlands and these do not necessarily need to take up a lot of space. The suitability of the techniques will be dictated in part by the development proposal and site conditions. Advice on best practice is available from

the Environment Agency and the Construction Industry Research and Information Association (CIRIA) e.g. the CIRIA SuDS Manual C753 (2015).

Table 8-1: 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	✓		

8.3.2 Treatment

A key part of the four pillars 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[14] 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 contaminants:** SuDS should be chosen and designed to deal with the likely contaminants 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.
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 series.

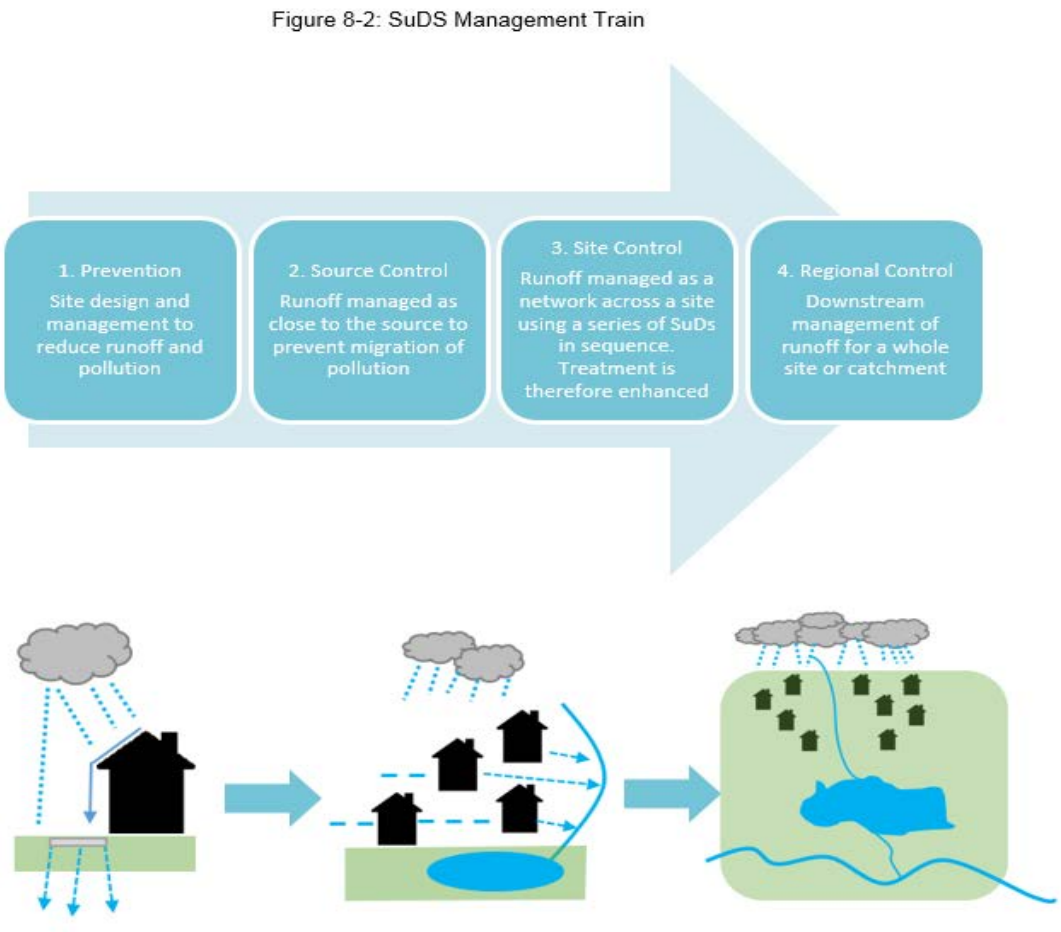
The number of treatment stages required depends primarily on the source of the runoff. A drainage strategy will need to demonstrate that an appropriate number of treatment stages are delivered.

14 C753 CIRIA SuDS Manual (2015)

8.3.3 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 (see Figure 8-2). 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 appropriate number of treatment stages are delivered.

Figure 8-2: SuDS management train



SuDS components should be selected based on design criteria and how surface water management is to be integrated within the development and landscaping setting. By using a number of SuDS features in series it is possible to reduce the flow and volume of runoff as it passes through the system as well as minimising pollutants which may be generated by a development.

8.3.4 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. Table 8-2 details some possible constraints and how they may be overcome.

Table 8-2: Example 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.

Considerations	Solution
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.
Ground instability	Geotechnical site investigation should be done to determine the extent of unstable soil and dictate whether infiltration would be suitable or not.
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 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 protection zones (GSPZs) or aquifers, further restrictions may be applicable and guidance should be sought from the LLFA.

8.4 Sources of SuDS guidance

Part of Solihull Metropolitan Borough Council's responsibility as a LLFA is to be a statutory consultee to the planning process for surface water on all major developments. As part of this role the LLFA will also advise on surface water drainage applications based on National Planning Practice Guidance[15] and non-statutory technical standards for sustainable drainage schemes[16].

The Water Management policy P11, listed in the LFRMS, states that developers will be expected to undertake thorough risk assessments of the impact of proposals on surface and groundwater systems. SuDS should be incorporated into all new development and where possible retrofitted into renovation schemes. Where Sustainable Drainage Systems are possible, the Council will expect that these will contribute towards a range of wider sustainability benefits, as well as flood alleviation and water quality.

8.4.1 C753 CIRIA SuDS Manual (2015)

The C753 CIRIA SuDS Manual (2015)[17] 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

[15] National Planning Practice Guidance (2015) http://planningguidance.communities.gov.uk/blog/guidance/flood-risk-and-coastal-change/

[16] Non-Statutory Guidance for Sustainable Drainage Schemes (2015) https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards

17 C753 CIRIA SuDS Manual (2015):
http://www.ciria.org/Memberships/The_SuDs_Manual_C753_Chapters.aspx

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.

8.4.2 Surface Water Advice Note – Using SuDS on new developments (June 2015)

When considering SuDS as part of a major planning application, local planning authorities need to satisfy themselves that the minimum standard of operation is appropriate for SuDS, and ensure through the use of planning conditions that clear arrangements are in place for their ongoing maintenance over the lifetime of the development.

The NPPF expects local planning authorities to give priority to the use of SuDS in determining planning applications. Where SuDS are used, it must be established that these options are feasible, can be adopted and properly maintained and would not lead to any other environmental problems. This is a material planning consideration for all major applications as of the 6 April 2015 and should therefore be given full consideration in an application.

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

Nom-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.

In March 2015, the latest guidance was released providing amendments as to what is expected by the LPA to meet the National standards. The guidance provides a valuable resource for developers and designers outlining peak flow control, volume control, structural integrity of the SuDS, and flood considerations 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 LPA will make reference to these standards when determining whether proposed SuDS are considered reasonably practicable.

8.4.4 Surface Water Management plan

At the time of publishing this SFRA, Solihull Metropolitan Borough Council were in process of creating a Surface Water Management Plan.

8.5 Other surface water considerations

8.5.1 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 the underlying bedrock. The maps show the vulnerability of groundwater at a location based on the hydrological, hydrogeological and soil properties within a one-kilometre grid square.

Two maps are available:

- Basic groundwater vulnerability map: this shows the likelihood of a pollutant discharged at ground level (above the soil zone) reaching groundwater for superficial and bedrock aquifers and is expressed 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.

8.5.2 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) – 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 become a safeguard zone

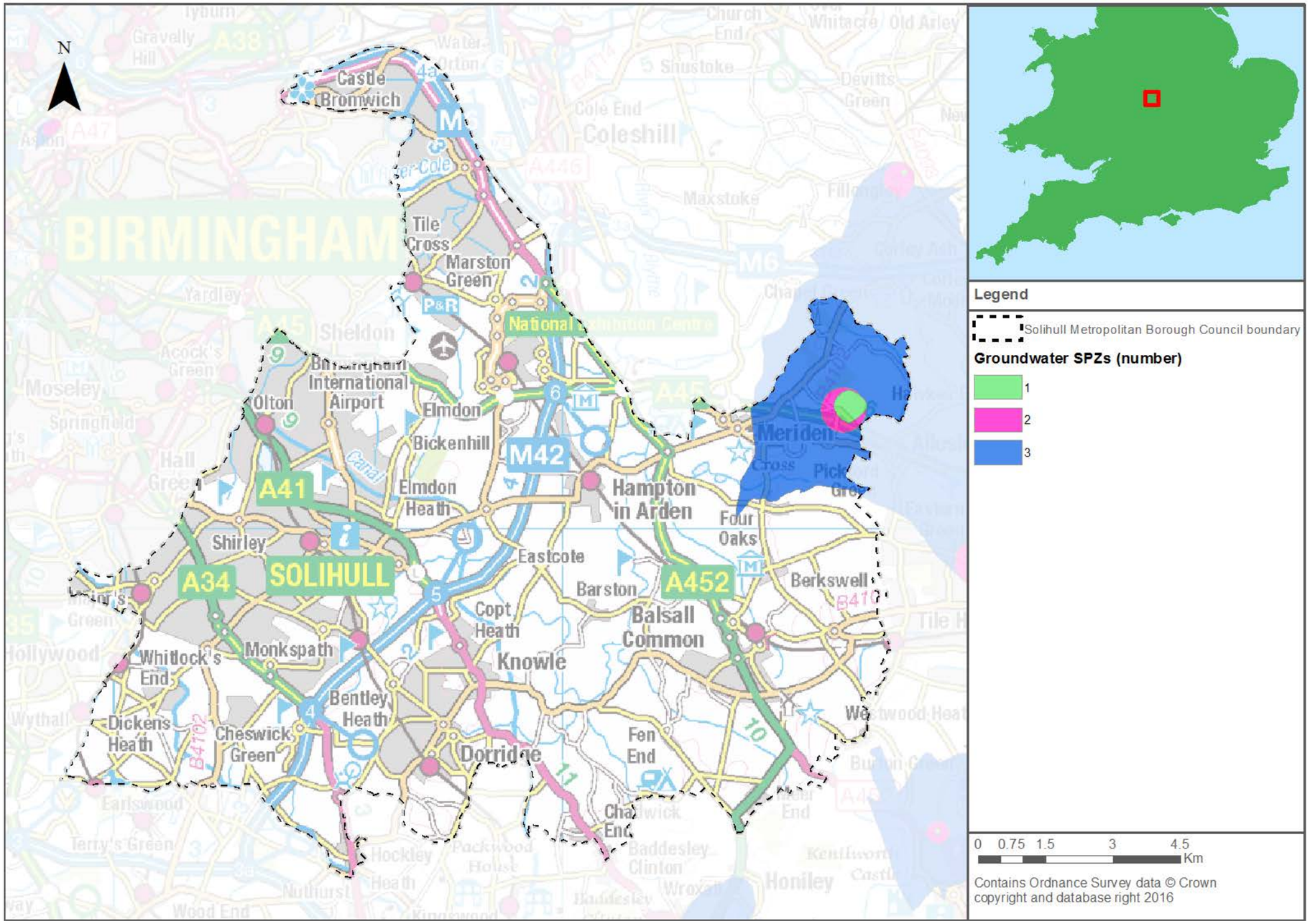
The location of the Groundwater SPZs in relation to the borough are shown in Figure 8-3. The majority of the district is located outside of a Groundwater Source Protection Zone. In the north eastern corner, over Meriden, there is an area of Zone 1 which includes a small extent of Zone 2 and Zone 3 centred east of Eaves Green. Depending on the nature of the proposed development and the location of the development site with regards to the SPZs, restrictions may be placed on the types of SuDS appropriate to certain areas. For example, infiltration SuDS are generally accepted within Zone 3, whereas in Zones 1 or 3, the Environment Agency will need to be consulted and infiltration SuDS may only be accepted if correct treatments and permits are put in place. Any restrictions imposed on the discharge of site generated runoff by the Environment Agency will be determined on a site by site basis using risk-based approach.

8.5.3 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 whole of the Solihull Metropolitan Borough Council is classed as a surface water NVZ. The level of nitrate contamination will potential influence the choice of SuDS and should be assessed as part of the design process

Figure 8-3: Groundwater Source Protection Zones



9 Strategic flood risk solutions

9.1 Introduction

Strategic flood risk solutions may offer a potential opportunity to reduce flood risk in the district. The following sections outline different options which could be considered for strategic flood risk solutions. Any strategic solutions should ensure they are consistent with wider catchment policy and the local policies set out by Solihull Metropolitan Borough Council.

9.2 Flood storage schemes

Flood storage schemes aim to reduce the flows passed downriver to mitigate downstream flooding. Development increases the impermeable area within a catchment, creating additional and faster runoff into watercourses. Flood storage schemes aim to detain this additional runoff, releasing it downstream at a slower rate, to avoid any increase in flood depths and/or frequency downstream. Methods to provide these schemes include[18]:

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

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

9.2.1 Promotion of SuDS

Surface water flood risk is present in the area. By considering SuDS at an early stage in the development of a site, the risk from surface water can be mitigated to a certain extent within the site as well as reduce the risk that the site poses to third party land. Regionally SuDS should be promoted on all new developments to ensure the quantity and quality of surface water is dealt with sustainably to reduce flood risk. Given the various policies and guidance available on SuDS, developers should use this information to produce technically proficient and sustainable drainage solutions that conform with the non-statutory standards for SuDS (2015).

9.3 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 river and the floodplain.
- Apply the Sequential Approach to avoid new development within the 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 could potentially increase flooding.

9.3.1 Upstream natural catchment management

Opportunities to work with natural processes to reduce flood and erosion risk as well as benefit the natural environment and reduce costs of schemes should be sought, through integrated catchment management. It also requires partnership working with neighbouring authorities, organisations and water management bodies.

18 http://evidence.environment-agency.gov.uk/FCERM/en/FluvialDesignGuide/Chapter10.aspx?pagenum=2

Consideration of 're-wilding' rivers upstream could provide cost efficiencies as well as considering multiple sources of flood risk; for example, reducing peak flows upstream such as through felling trees into streams or building earth banks to capture runoff, could be cheaper and smaller-scale measures than implementing flood walls for example. With flood prevention schemes, consideration needs to be given to the impact that flood prevention has on the WFD status of watercourses. It is important that any potential schemes do not have a negative impact on the ecological and chemical status of waterbodies.

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

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

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

9.3.3 Bank Stabilisation

Bank erosion should be avoided and landowners encouraged to avoid using machinery and vehicles close to or within the watercourse.

There are several techniques that can be employed to restrict the erosion of the banks of a watercourse. In an area where bankside erosion is particularly bad and/or vegetation is unable to properly establish, ecologically sensitive bank stabilisation techniques, such as willow spiling, can be particularly effective. Live willow stakes thrive in the moist environment and protect the soils from further erosion allowing other vegetation to establish and protect the soils.

9.3.4 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.

9.4 Flood defences

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

10 Summary

10.1 Overview

This SFRA 2016 document replaces the Level 1 SFRA originally published by Solihull Metropolitan Borough Council in January 2008. This Level 1 SFRA delivers a strategic assessment of risk from all sources of flooding in Solihull. It also provides an overview of policy and provides guidance for planners and developers.

10.2 SFRA summary

10.2.1 Sources of flood risk

- The historical flood record shows that the borough has been subject to flooding from several sources of flood risk, with the principal risk from fluvial and surface water sources. There is also an indication that blockages of undersized culverts have been an issue. Notable flood events include July 2007, June 2012, November 2012, September 2015, June 2016 and September 2016
- The key watercourses flowing through the study area are the River Blythe and its tributaries. Tributaries of the River Blythe include, but are not limited to the River Cole, Mount Brook, Alder Brook, Purnell's Brook, Shadow Brook, and Hollywell Brook. The Kingshurst Brook, the Hatchford Brook and several other Main River and ordinary watercourses flow through the borough. The River Blythe flows through much of the borough. However, the areas it flows through are predominantly rural and the fluvial flood risk from the River Blythe to property in this area is minimal. The River Cole, a tributary of the Blythe, flows through Kingshurst in the north and south east of Solihull. Whilst the River Cole has relatively narrow floodplains, it flows through areas that are heavily urbanised and as such, produces a higher flood risk to properties in the Kingshurst, Chelmsley Wood and Solihull wards. Several other Main Rivers and ordinary watercourses also present a fluvial flood risk.
- There are no formal flood defences in the borough
- Solihull has experienced several historic surface water / drainage related flood events caused by several mechanisms such as culvert blockage. The RoFfSW further shows several prominent overland flow routes; these predominantly follow topographical flow paths of existing watercourses or dry valleys with some isolated ponding located in low lying areas
- The sewers are managed by Severn Trent Water. The Hydraulic Sewer Flooding Risk Register (HFRR) was supplied for use in this assessment. The HFRR register is a database of recorded historical sewer flooding incidents, on a post-code basis. A total of 185 recorded flood incidents in the Solihull Metropolitan Borough were listed in the HFRR register. The most frequently flooded localities are Solihull town, Dorridge, and Hampton-in-Arden. 20 incidents were recorded during June and July 2007. A further 12 incidents were recorded in August 1999, 9 incidents were recorded in November 2012 and August 2004. July 2007 and November 2012 are also recorded historical fluvial and blockages indicating that there may be some interaction between the fluvial and surface water drainage networks. However, most the dates do not correlate to significant historic fluvial or surface water flood events, indicating that the events listed in the HFRR are isolated incidents.
- 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
- There are two canals flowing through the borough; the Grand Union Canal and the Stratford-upon-Avon Canal. There is one record of a canal breach with in the borough, on the Grand Union Canal, dated November 1997

10.2.2 Climate change

Climate change modelling for the watercourses in Solihull has been undertaken based on the new climate change guidance, using a combination of existing Environment Agency hydraulic models and Jflow modelling, run for the 2080s period for all three allowance categories.

The Flood Zone 2 extent is comparatively like the 100-year plus 20% allowance for climate change across Solihull. Due to the nature of the topography, the flood zones are largely confined and subsequently, the flood extent is not significantly different when a 20% or 30% or 50% allowance for climate change is used. Whilst the flood extent in more constrained catchments may not increase significantly, the flood depth and hazard may. The Hatchford Brook, Low Brook and Kingshurst Brook appear to be more sensitive to increases in the climate change allowances.

10.2.3 Key policies

There are many relevant regional and local key policies which have been considered within the SFRA, such as the CFMPs, RBMPs, the PFRA and LFRMS. Other policy considerations have also been incorporated, such as sustainable development principles, climate change and flood risk management.

10.2.4 Development and flood risk

The Sequential and Exception Test procedures for both Local Plans and FRAs have been documented, along with guidance for planners and developers. Links have been provided for various guidance documents and policies published by other Risk Management Authorities such as the LLFA and the Environment Agency.

11 Recommendations

A review of national and local policies has been conducted against the information collated on flood risk in this SFRA, along with assessment of the proposed sites brought forward into the Level 2 assessment. Following this, several recommendations have been made for the Council to consider as part of Flood Risk Management in Solihull.

11.1 Development management

11.1.1 Sequential approach to development

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 the borough.

New development and re-development of land should wherever possible seek opportunities to reduce overall level of flood risk at the site, for example by:

- Reducing volume and rate of runoff through the use of SuDS, as informed by national and local guidance
- Relocating development to zones with lower flood risk
- Creating space for flooding
- GI should be considered within the mitigation measures for surface water runoff from potential development and consider using Flood Zones 2 and 3 as public open space

11.1.2 Site-specific flood risk assessments

Site specific FRAs are required by developers to provide a greater level of detail on flood risk and any protection provided by defences and, where necessary, demonstrate the development passes part b of the Exception Test.

Developers should, where required, undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent (including latest climate change allowances), inform development zoning within the site and prove, if required, whether the Exception Test can be passed. The assessment should also identify the risk of existing flooding to adjacent land and properties to establish whether there is a requirement to secure land to implement strategic flood risk management measures to alleviate existing and future flood risk. Any flood risk management measures should be consistent with the wider catchment policies set out in the CFMP, FRMPs and LFRMS.

11.1.3 Sequential and Exception tests

The SFRA has identified that areas of Solihull are at high risk of flooding from both fluvial and surface water sources. Therefore, a large number of proposed development sites will be required to pass the Sequential and, where necessary, Exception Tests in accordance with the NPPF. The Council should use the information in this SFRA when deciding which development sites to take forward in their Local Plan.

It is recommended that the Council considers using the SFRA climate change maps when applying the Sequential Test for site allocations and windfall sites.

Developers should consult with the Council, the Environment Agency and 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.

11.1.4 Windfall sites

Windfall sites are sites that have not been specifically identified in the Local Plan or other Council assessment documents, that do not have planning permission and have unexpectedly become available. Local authorities can to make a realistic allowance for windfall development based on past trends.

The acceptability of windfall applications in flood risk areas should be considered at the strategic level through a policy setting out broad locations and quantities of windfall development that would be acceptable or not in Sequential Test terms[19].

11.1.5 Council review of planning applications

The Council should consult the Environment Agency's 'Flood Risk Standing Advice (FRSA) for Local Planning Authorities', last updated 15 April 2015, when reviewing planning applications for proposed developments at risk of flooding. When considering planning permission for developments, planners may wish to consider the following:

- Will the natural watercourse system which provides drainage of land be adversely affected?
- Will a minimum 8m width access strip be provided adjacent to the top of both banks of any Main River (5m for Ordinary Watercourses, 20m for Commissioner watercourses and 9m for IDB watercourses), for maintenance purposes and is appropriately landscaped for open space and biodiversity benefits?
- Will the development ensure no loss of open water features through draining, culverting or enclosure by other means and will any culverts be opened up?
- Have SuDS been given priority as a technique to manage surface water flood risk?
- Will there be a betterment in the surface water runoff regime; with any residual risk of flooding, from drainage features either on or off site not placing people and property at unacceptable risk?
- Is the application compliant with the conditions set out by the LLFA?

11.1.6 Drainage strategies and SuDS

Planners should be aware of the conditions set by the LLFA for surface water management and ensure development proposals and applications are compliant with the Council's policy. These policies should also be incorporated into the Local Plan. Wherever possible, SuDS should be promoted:

- It should be demonstrated through a Surface Water Drainage Strategy, that the proposed drainage scheme, and site layout and design, will prevent properties from flooding from surface water. A detailed site-specific assessment of SuDS would be needed to incorporate SuDS successfully into the development proposals. All development should adopt source control SuDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff
- For proposed developments, it is imperative that a site-specific infiltration test is conducted early on as part of the design of the development, to confirm whether the water table is low enough to allow for SuDS techniques that are designed to encourage infiltration
- Where sites lie within or close to Groundwater SPZs or aquifers, there may be a requirement for a form of pre-treatment prior to infiltration. Further guidance can be found in the CIRIA SuDS manual on the level of water quality treatment required for drainage via infiltration, and the LLFA's SuDS guidance and requirements
- Consideration must also be given to residual risk and maintenance of sustainable drainage and surface water systems
- SuDS proposals should contain an adequate number of treatments stages to ensure any pollutants are dealt with on site and do not have a detrimental impact on receiving waterbodies
- The promotion and adoption of water efficient practices in new development will help to manage water resources and work towards sustainable development and will help to reduce any increase in pressure on existing water and wastewater infrastructure

[19] http://webarchive.nationalarchives.gov.uk/20140328084622/http:/www.environment-agency.gov.uk/static/documents/Sequential_test_process_4.pdf

11.1.7 Cumulative impact of development and cross-boundary issues

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 in many cases the development should be used to improve the flood risk

Development control should ensure that the impact on receiving watercourses from development in Solihull has been sufficiently considered during the planning stages and appropriate mitigation measures put in place to ensure there is no adverse impact on flood risk or water quality, both within Solihull and the wider area.

11.1.8 Residual risk

The risk to development from reservoirs is residual but developers should consider reservoir flooding during the planning stage. They should seek to contact the reservoir owner to obtain information and should apply the sequential approach to locating development within the site. Developers should also consult with relevant authorities regarding emergency plans in case of reservoir breach.

Any development within the vicinity of either of the canals flowing through the borough should consider the residual risk from the canal, including the possibility of breach. Consideration should be given to the potential for safe access and egress in the event of rapid inundation of water due to a breach with little warning.

11.1.9 Safe access and egress

Safe access and egress will need to be demonstrated at all development sites and emergency vehicular access should be possible during times of flood. Finished Floor Levels should be 600mm above the 1 in 100-year (1% AEP) flood level, plus an allowance for climate change.

11.1.10 Future flood management

- Development should take a sequential approach to site layout
- Upstream storage schemes are often considered as one potential solution to flooding. However, this is not a solution for everywhere. Upstream storage should be investigated fully before being adopted as a solution
- Floodplain restoration represents a sustainable form of strategic flood risk solution, by allowing watercourses to return to a more naturalised state,

11.2 Technical recommendations

11.2.1 Potential modelling improvements

- The Environment Agency's Flood Zone maps do not cover every watercourse (for example if <3km^2 catchment area). Hydraulic modelling may be required for more detailed flood risk assessment studies, following on from Section 19 reports, or as part of a Level 2 SFRA, to provide the required detail to support a site's development. 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. A model would likely be required at detailed site-specific level to confirm the flood risk to the site.
- 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.
- 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.

- At site-specific level, 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.

11.2.2 Updates to SFRA

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

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

The SFRA should be **periodically updated** when new information on flood risk, flood warning or new planning guidance or legislation becomes available. New information on flood risk may be provided by the Council (in its role as LLFA), the Highways Authority, Severn Trent Water or the Environment Agency. It is recommended that the SFRA is reviewed internally on an annual basis, allowing a cycle of review, followed by checking with the above bodies for any new information to allow a periodic update.

Appendices

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A Mapping of all sources of flood risk across the borough

A.1 How to use these maps

These are a series of interactive maps that show all sources of flooding in Solihull Metropolitan Borough, as well as other supporting map layers.

Clicking on a grid square in the Index Map will open a separate interactive PDF map that has options for turning on and off the map layers of interest.

Further information on the source and background of the information contained within the interactive PDF can be found in this report and by clicking on the 'Background to Mapping Information' box in this map and the interactive PDFs.

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B Flood warning coverage

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C Preferred Options

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