Birmingham City Level 1 Strategic Flood Risk Assessment

Final Report

August 2023

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Birmingham City Council

Project Manager

Louise Goode
The Library
St Philips Courtyard
Church Hill
Coleshill
Warwickshire
B46 3AD

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This report describes work commissioned by Neil Holly on behalf of Birmingham City Council. Freya Nation, Sarah Hambling, Louise Goode and Alex Clark of JBA Consulting carried out this work.

Prepared by ..... Louise Goode BSc MRes PhD

..... Analyst

..... Sarah Hambling BSc MSc

..... Analyst

..... Freya Nation BSc

..... Technical Assistant

..... Alex Clark BSc MSc

..... Analyst

Reviewed by ..... David Kearney BSc MSc MCIWEM C.WEM

..... Associate Director

..... Edmund Mumford BSc MSc

..... Senior Analyst

Purpose

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Acknowledgements

We would like to acknowledge the assistance of:

- Birmingham City Council
- Environment Agency
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Executive summary

This report provides a comprehensive and robust evidence base on flood risk issues to support the update of the Birmingham Development Plan (BDP) 2017 and associated Planning Policy documents using the best available information. This Level 1 Strategic Flood Risk Assessment (SFRA) for Birmingham County Council was in preparation prior to the updated to the Planning Practice Guidance (PPG) issues on 25 August 2022. The content has been revised to take account of the amended requirements under the updated PPG in consultation with the Environment Agency and Birmingham City Council. This Level 1 SFRA has been prepared for the Birmingham area and will be used to inform the new Birmingham Plan on the location of future development and the preparation of sustainable policies for the long-term management of flood risk, provided the implications of the changes to the PPG are understood by those developing the Local Plan.

Introduction

To support the preparation of a new Local Plan for Birmingham City Council, the key objectives of the assessment are:

- To update the Birmingham Local Plan, taking into account the most recent policy and legislation in the National Planning Policy Framework (2021).
- To collate and analyse the latest available information and data for current and future (i.e. climate change) flood risk from all sources, and how these may be mitigated.
- To inform decisions in the emerging Local Plans, including the selection of development sites and planning policies.
- To provide evidence to support the application of the Sequential Test for the allocation of new development sites, to support Birmingham City Council in the preparation of the Local Plan.
- To provide a comprehensive set of maps presenting flood risk from all sources that can be used as evidence base for use in the emerging Local Plan.
- To provide advice for applicants carrying out site-specific Flood Risk Assessments and outline specific measures or objectives that are required to manage flood risk.

Summary of flood risk in the Birmingham City area:

- *Fluvial flooding*: The primary fluvial flood risk is along the River Tame, River Rea, River Cole and their main tributaries. These present fluvial flood risk to the main urban centres of Birmingham and The Royal Town of Sutton Coldfield. The fluvial flood extents are fairly well confined in the north and south of the study area, with wider extents through the centre of the area along the River Tame due to the lower lying, flat topography.
- *Surface water*: The Risk of Flooding from Surface Water map shows a number of prominent overland flow routes that largely follow the topography of the watercourses. There are some areas where there are additional flow paths and areas of ponding, for example where water is impounded at road or rail embankments and in low-lying areas. There are also considerable flow routes following the roads through the main urban areas of Birmingham and The Royal Town of Sutton Coldfield which alongside isolated areas of ponding affect many properties across these settlements.
- Areas at risk of flooding today are likely to become at increased risk in the future and the frequency of flooding will also increase in such areas as a result of climate change. Flood extents will increase; in some locations, this may not be by very much, but flood depth, velocity and hazard may have more of an impact due to climate change. It is recommended that Birmingham City Council work with other Risk Management Authorities (RMAs) to review the long-term sustainability of existing and new development in these areas when developing climate change plans and strategies for Birmingham.

- *Sewer*: The sewers in the City of Birmingham are managed by Severn Trent Water. The Hydraulic Flood Risk Register (HFRR) for Birmingham has been provided by Severn Trent Water which shows 857 incidences of sewer flooding within the area.
- *Groundwater*: The Areas Susceptible to Groundwater Flooding map shows that in general, the majority of the Birmingham study area is shown to be within the "less than 25%" and "greater than or equal to 25% and less than50%" classifications with a lower susceptibility to groundwater flooding or has no data available. There are however areas along the River Tame in particular, where flooding from groundwater is more likely to occur.

  JBA's Groundwater emergence risk map shows the areas with the predicted shallowest groundwater levels generally follow the low-lying topography and path of the River Tame through the centre of the city council boundary. Across large parts of the city, particularly in the south and east, the risk of groundwater flooding is considered to be negligible due to the nature of the local geological deposits.
- *Canals*: There are seven canals in the Birmingham study area: the Birmingham and Fazeley Canal, the Birmingham Canal, the Digbeth Branch Canal, the Stratford-upon-Avon Canal, the Worcester and Birmingham Canal, and the Tame Valley Canal. These have the potential to interact with other watercourses and become flow paths during flood events or in a breach scenario.
- *Reservoirs*: There is a potential risk of flooding from reservoirs both within Birmingham and those outside. The level and standard of inspection and maintenance required under the Reservoirs Act means that the risk of flooding from reservoirs is relatively low. However, there is a residual risk of a reservoir breach and this risk should be considered in any site-specific Flood Risk Assessments (where relevant).

Defences

The main flood defences in the study area are located along the main watercourses of the River Tame, River Rea, River Cole, Bourn Brook, Hatchford Brook, Westley Brook and Hockley Brook. These are mostly comprised of natural/engineered high ground, embankments and flood walls. The condition of these defences varies from poor to good, with the Standard of Protection varying between the defences.

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 Flood Risk Management Authorities such as the Lead Local Flood Authority and the Environment Agency.

When necessary, development and redevelopment within the Birmingham City area will require a Flood Risk Assessment appropriate to the scale of the development and to the scope as agreed with the Lead Local Flood Authority and/or Environment Agency. Flood Risk Assessments should consider flood risk from all sources including residual risk, along with promotion of Sustainable Drainage Systems to create a conceptual drainage strategy and safe access/egress at the development in the event of a flood. Latest climate change guidance (last updated in May 2022) should also be taken into account, for the lifetime of developments. Planners and developers must ensure that modelling in line with the most up to date Environment Agency climate change guidance has been run.

How to use this report

Planners

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

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

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

Developers

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

- Highly vulnerable and in Flood Zone 2
- Essential infrastructure in Flood Zone 3a or 3b
- More vulnerable in Flood Zone 3a
- Proposed development in locations affected by surface water flood risk

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

Developers can use the information in this SFRA, alongside site-specific research to help scope out what additional work will be needed in a detailed Flood Risk Assessment. To do this, they should refer to Section 5, Appendix A (Interactive PDF mapping) and Appendix B (Data sources used in the SFRA). At the planning application stage, developers may need to undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent (including latest climate change allowances, last updated in May 2022), inform Master-planning and demonstrate, if required, that the Exception Test is satisfied. As part of the Environment Agency's updated guidance on climate change, which must be considered for all new developments and planning applications, developers will need to undertake a detailed assessment of climate change as part of the planning application process when preparing FRAs. Catchments under 5km^2 are generally not represented in the EA's Flood Zones as they are generally not covered by detailed or broader modelling. For such catchments, fluvial modelling may be required, and surface water outputs can be used to give an idea of where Flood Zones may be.

Developers need to ensure that new development does not increase surface water runoff from a site or contribute to cumulative effects at sensitive locations, see Section 7 and Appendix F: Cumulative Impact Assessment (CIA). Section 9 provides information on the surface water drainage requirements of the LLFA. Sustainable Drainage Systems should be considered at the earliest stages that a site is developed which will help to minimise costs and overcome any site-specific constraints.

Site-specific Flood Risk Assessments will need to identify how flood risk will be mitigated so development is safe from flooding and does not have an adverse effect on third

parties. In high risk areas the Flood Risk Assessment will also need to consider emergency arrangements, including how there will be safe access and egress from the site.

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

Neighbourhood plans

The SFRA provides:

- Information on the sources of flooding and the variation in the risk across the Birmingham City area.
- Identifies the organisations that are involved in flood risk management and their latest strategic plans, current plans for major flood defences.
- The requirements for detailed Flood Risk Assessments and to inform the site selection process.

Neighbourhood planning groups can use this information to assess the risk of flooding to sites within their community, using Section 5, the sources of flooding in Birmingham and the flood mapping in the appendices. The SFRA will also be helpful for developing community level flood risk policies in high flood risk areas. Similarly, all known available recorded historical flood events for the Birmingham City area are listed in Section 5.1. This can be used to supplement local knowledge regarding areas worst hit by flooding. Ongoing and proposed flood alleviation schemes planned by Birmingham City Council are outlined in Section 6 and Section 8.3 discusses mitigations, resistance and resilience measures which can be applied to alleviate flood risk to an area.

Mapping

The SFRA mapping highlights on a strategic scale where flood risk from fluvial, surface water, and where groundwater emergence may occur; as well as where the effects of climate change are most likely. The maps are useful to provide a community level view of flood risk but may not identify if an individual property is at risk of flooding or model small scale changes in flood risk. Local knowledge of flood mechanisms will need to be included to complement this broadscale mapping. Similarly, all known available recorded historical flood events for Birmingham are listed in Section 5.1. This can be used to supplement local knowledge regarding areas worst hit by flooding. Ongoing and proposed flood alleviation schemes planned by Birmingham City Council are outlined in Section 6.6 and Section 8.4 discusses mitigations, resistance and resilience measures which can be applied to alleviate flood risk to an area.

Cumulative Impact Assessment

A cumulative impact assessment has been carried out and has identified which catchments in Birmingham are more sensitive to the cumulative impact of development and where more stringent policy regarding flood risk is recommended. Any development in these areas should seek to contribute to work that reduces wider flood risk in those catchments.

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Abbreviations and Glossary of Terms

Term	Definition
1D model	One-dimensional hydraulic model
2D model	Two-dimensional hydraulic model
AEP	Annual Exceedance Probability – The probability (expressed as a percentage) of a flood event occurring in any given year.
AStGWf	Areas Susceptible to Groundwater flooding
Brownfield	Previously developed parcel of land
BDP	Birmingham Development Plan
BCC	Birmingham City Council
CC	Climate change - Long term variations in global temperature and weather patterns caused by natural and human actions.
CDA	Critical Drainage Area - A discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, Main River and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure.
CFMP	Catchment Flood Management Plan- A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
CIRIA	Construction Industry Research and Information Association
Cumecs	The cumec is a measure of flow rate. One cumec is shorthand for cubic metre per second; also m^3/s.
Defra	Department for Environment, Food and Rural Affairs
Design flood	This is a flood event of a given annual flood probability, which is generally taken as: fluvial (river) flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year), or; tidal flooding with a 0.5% annual probability (1 in 200 chance each year), against which the suitability of a proposed development is assessed and mitigation measures, if any, are designed.
DTM	Digital Terrain Model
EA	Environment Agency
EU	European Union
Exception Test	Set out in the NPPF, the Exception Test is a method used to demonstrate that flood risk to people and property will be managed appropriately, where alternative sites at a lower flood risk are not available. The Exception Test is applied following the Sequential Test.
FCERM	Flood and Coastal Erosion Risk Management
FEH	Flood Estimation Handbook
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Map for Planning	The Environment Agency Flood Map for Planning (Rivers and Sea) is an online mapping portal which shows the Flood Zones in England. The Flood Zones refer to the probability of river and sea flooding, ignoring the

Term	Definition
	presence of defences and do not account for the possible impacts of climate change.
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG (Welsh Assembly Government).
Flood Risk Regulations	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Floods and Water Management Act	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing surface water flood risk in England.
FWA	Flood Warning Area
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a River
FRA	Flood Risk Assessment - A site-specific assessment of all forms of flood risk to the site and the impact of development of the site to flood risk in the area.
FRM	Flood Risk Management
FRMP	Flood Risk Management Plan
FSA	Flood Storage Area
FWMA	Flood and Water Management Act
FWS	Flood Warning System
GI	Green Infrastructure – a network of natural environmental components and green spaces that intersperse and connect the urban centres, suburbs and urban fringe
Greenfield	Undeveloped parcel of land
Ha	Hectare
IDB	Internal Drainage Board
Indicative Flood Risk Area	Nationally identified flood risk areas based on the definition of 'significant' flood risk described by Defra and WAG.
JBA	Jeremy Benn Associates
LFRMS	Local Food Risk Management Strategy
LIDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority - Local Authority responsible for taking the lead on local flood risk management
LPA	Local Planning Authority
m AOD	metres Above Ordnance Datum
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers
NFM	Natural Flood Management
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
NRD	National Receptor Database
NRIM	National Reservoir Inundation Mapping

Term	Definition
NVZs	Nitrate Vulnerability Zones
Ordinary Watercourse	All watercourses that are not designated Main River. Local Authorities or, where they exist, IDBs have similar permissive powers as the Environment Agency in relation to flood defence work. However, the riparian owner has the responsibility of maintenance.
PFRA	Preliminary Flood Risk Assessment
Pitt Review	Comprehensive independent review of the 2007 summer floods by Sir Michael Pitt, which provided recommendations to improve flood risk management in England.
Pluvial flooding	Flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (surface runoff) before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity.
RBMP	River Basin Management Plan
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Resistance Measures	Measures designed to keep flood water out of properties and businesses; could include flood guards for example.
Return Period	Is an estimate of the interval of time between events of a certain intensity or size, in this instance it refers to flood events. It is a statistical measurement denoting the average recurrence interval over an extended period of time.
Riparian owner	A riparian landowner, in a water context, owns land or property, next to a river, stream or ditch.
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
Risk Management Authority (RMA)	Operating authorities who's remit and responsibilities concern flood and/or coastal risk management.
RoFfSW	Risk of Flooding from Surface Water (formerly known as the Updated Flood Map for Surface Water (uFMfSW)
Sequential Test	Set out in the NPPF, the Sequential Test is a method used to steer new development to areas with the lowest probability of flooding.
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
SFRA	Strategic Flood Risk Assessment
SoP	Standard of Protection - Defences are provided to reduce the risk of flooding from a river and within the flood and defence field standards are usually described in terms of a flood event return period. For example, a flood embankment could be described as providing a 1 in 100-year standard of protection.
SPD	Supplementary Planning Document
SPZ	(Groundwater) Source Protection Zone
Stakeholder	A person or organisation affected by the problem or solution or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.
STW	Severn Trent Water
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

Term	Definition
Surface water flooding	Flooding as a result of surface water runoff as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity, thus causing what is known as pluvial flooding.
SWMP	Surface Water Management Plan - The SWMP plan should outline the preferred surface water management strategy and identify the actions, timescales and responsibilities of each partner. It is the principal output from the SWMP study.
WFD	Water Framework Directive – Under the WFD, all waterbodies have a target to achieve Good Ecological Status (GES) or Good Ecological Potential (GEP) by a set deadline. River Basin Management Plans (RBMPs) set out the ecological objectives for each water body and give deadlines by when objectives need to be met.

1 Introduction

1.1 Purpose of the Strategic Flood Risk Assessment

> ***"Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards.".***
>
> (National Planning Policy Framework, paragraph 160)

Birmingham City Council commissioned this Level 1 Strategic Flood Risk Assessment (SFRA) for the City Council area in Summer 2022. This study provides a comprehensive and robust evidence base to support the production of a new local plan. This SFRA replaces the previous **Level 1 report,** prepared by Atkins which was last updated in 2012.

This 2023 SFRA will be used in decision-making and to inform decisions on the location of future development and the preparation of sustainable policies for the long-term management of flood risk. Annex 1 – Updates to the Planning Practice Guidance (25 August 2022) provides more information on the August 2022 changes to the PPG, it is important that these changes in policy guidance are fully understood alongside the use of this SFRA.

1.2 Local Plan

Birmingham City Council is working to produce a new Local Plan for Birmingham, this will replace the current strategic policies of the existing **Adopted Birmingham Development Plan (BDP)** for 2011-2031. The new Local Plan, called the **'Birmingham Local Plan'** will guide how the city will develop in the future and provide policies to guide decisions on development proposals and planning applications until 2042.

1.3 Levels of SFRA

The **Planning Practice Guidance (PPG)** identifies the following two levels of SFRA:

- **Level 1**: where flooding is not a major issue in relation to potential site allocations and where development pressures are low. The assessment should be of sufficient detail to enable application of the Sequential Test.
- Level 2: where allocations are proposed in flood risk areas (i.e., from any source now and in the future), or where future windfall pressures in flood risk areas are expected. The Level 2 SFRA should be detailed enough to identify which development sites have the least risk of flooding and the application of the Exception Test, if relevant. The above text suggests that the Level 2 SFRA will only be used to assess whether the Exception Test can be passed, and not the Sequential Test.

This Level 1 Strategic Flood Risk Assessment (SFRA) for Birmingham City Council was in preparation prior to the updates to the Planning Practice Guidance (PPG) as issued on 25 August 2022. The content has been revised to take account of the amended requirements under the updated PPG in consultation with the Environment Agency and Birmingham City Council. This SFRA can be used to inform the Local Plan on the location of future development and the preparation of sustainable policies for the long-term management of flood risk. Annex 1 – Updates to the Planning Practice Guidance (25 August 2022) provides more information on the August 2022 changes to the PPG.

This is a Level 1 SFRA assessment. Should the Council be unable to place all development outside areas of Flood Risk, a Level 2 assessment may be required in the future.

1.4 SFRA outputs

- Identification of policy and technical updates.
- Identification of any strategic flooding issues or cumulative effects which may have cross boundary implications.
- Appraisal of all potential sources of flooding, including main river, ordinary watercourse, surface water, sewers, groundwater, reservoirs and canals.
- Review of historic flooding incidents.
- Reporting on the standard of protection provided by existing flood risk management infrastructure.
- Available mapping showing distribution of flood risk across all Flood Zones from all sources of flooding including climate change allowances.
- Assessment of the potential increase in flood risk due to climate change.
- Flood Risk Assessment guidance for developers.
- Assessment of surface water management issues, how these can be addressed through development management policies and the application of Sustainable Drainage Systems.
- 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.
- Assessment of strategic flood risk solutions that can be implemented to reduce risks.

1.5 SFRA study area

Birmingham is a major city in the West Midlands, covering 267.8km^2 with a population of approximately 1.149 million (2019 Census). The Council area is mostly urban, and outside of the city centre the other main urban areas within Birmingham are Sutton Coldfield, Harborne, Handsworth, Saltley, Balsall Heath and Tyseley amongst others

Birmingham is bounded by seven other authorities;

- Bromsgrove and Worcestershire
- Dudley
- Lichfield
- North Warwickshire
- Solihull
- Sandwell
- Walsall

An overview of the study area showing the neighbouring authorities is shown in Figure 1-1. The water authority in the area is covered by Severn Trent Water.

The main rivers which run through Birmingham are the River Cole, River Tame, and River Rea and several smaller Brooks including Hatchford Brook Plants Brook and The Bourn. These watercourses are shown in Figure 1-2.

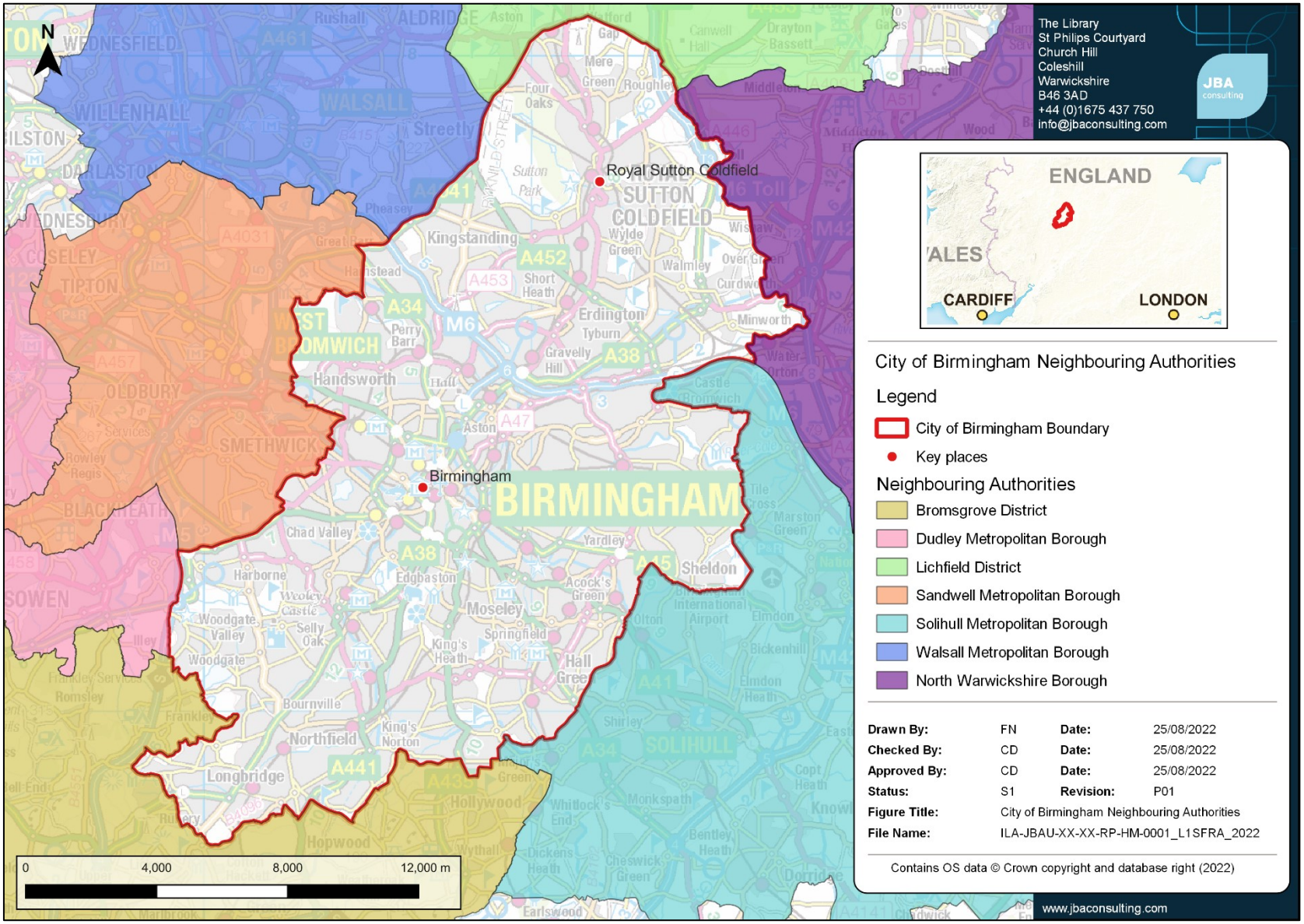

Figure 1-1: Birmingham study area and neighbouring authorities

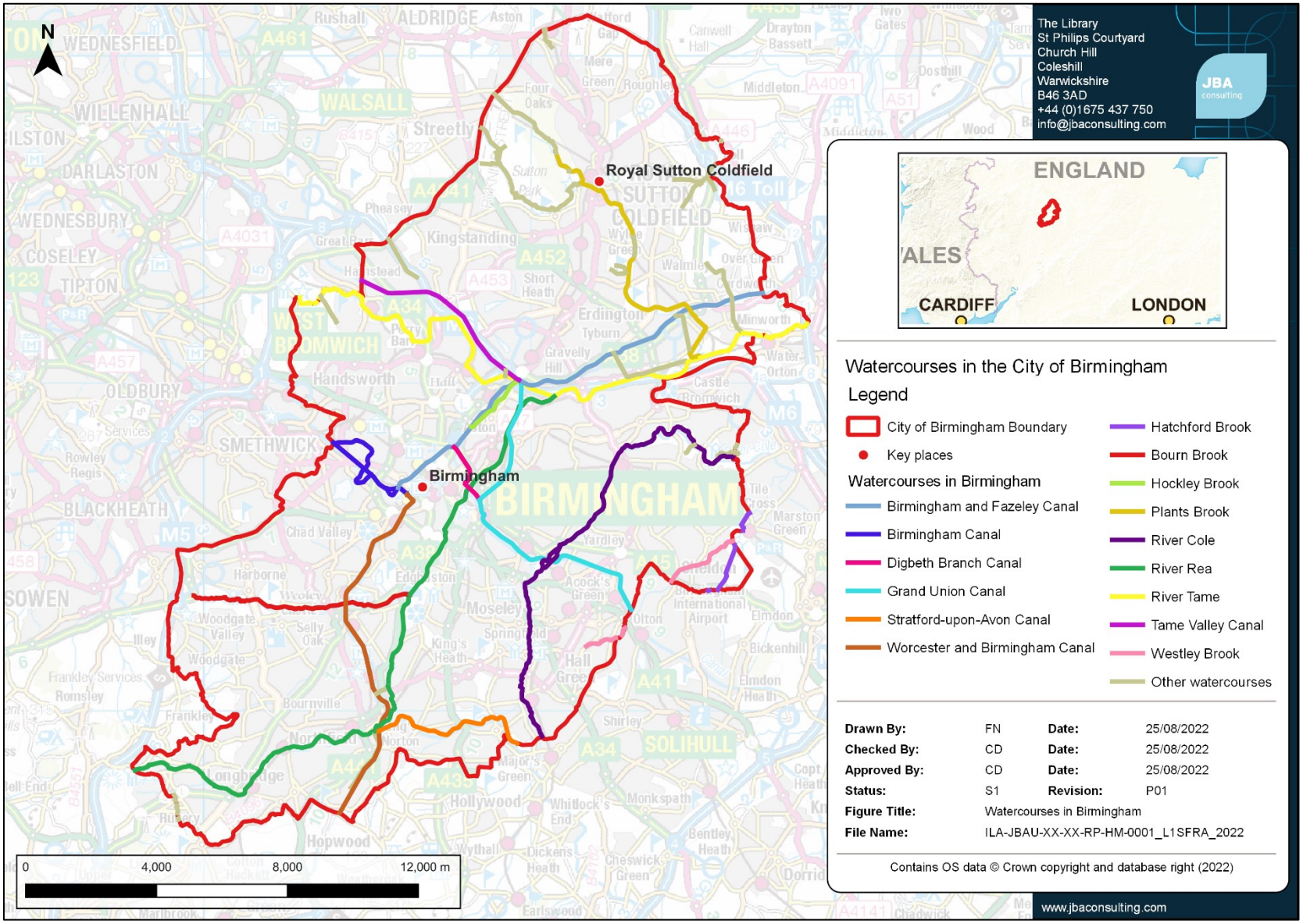

Figure 1-2: Main Rivers and watercourses within Birmingham

1.6 Consultation

SFRAs should be prepared in consultation with other risk management authorities. The following parties (external to Birmingham City Council) have been consulted during the preparation of this version of the SFRA:

- Environment Agency
- Birmingham City Council (LLFA)
- Canal and River Trust
- Severn Trent Water
- Neighbouring authorities including:
    - Bromsgrove District Council
    - Dudley Metropolitan Borough Council
    - Lichfield District Council/Staffordshire County Council
    - North Warwickshire Borough Council/Warwickshire County Council
    - Sandwell Metropolitan Borough Council
    - Solihull Metropolitan Borough Council
    - Walsall Metropolitan Borough Council

1.7 Use of SFRA data

Level 1 SFRAs are high-level strategic documents and do not go into detail on an individual site-specific basis. The primary purpose is to provide an evidence base to inform the preparation of Local Plans and any future flood risk policies.

Developers will still be required to undertake site-specific Flood Risk Assessments to support planning applications. Developers will be able to use the information in the SFRA to scope out the sources of flood risk that will need to be explored in more detail at site level.

Appendix C presents a SFRA User Guide, further explaining how SFRA data should be used, including reference to relevant sections of the SFRA, how to consider different sources of flood risk and recommendations and advice for Sequential and Exception Tests.

Advice to users has been highlighted in amber boxes throughout the SFRA.

Key reference material such as external guidance documents/ websites are provided in red throughout the SFRA.

On the date of publication, the SFRA contains the latest available flood risk information. Over time, new information will become available to inform planning decisions, such as updated hydraulic models (which then update the Flood Map for Planning), updated information on other sources of flood risk or evidence showing future flood risks, new flood event information, new defence schemes and updates to policy, legislation and guidance. Developers should check the online Flood Map for Planning in the first instance to identify any major changes to the Flood Zones and the long term flood risk mapping portal for any changes to flood risk from surface water or inundation from reservoirs.

1.8 Structure of this report

The contents of the report are set out according to the following structure:

Section	Contents	How to use
Executive Summary	Focuses on how the SFRA can be used by planners, developers and neighbourhood planners	Summarises the Level 1 findings and recommendations.
1. Introduction	Provides a background to the study, the Local Plan stage the SFRA informs, the study area, the roles and responsibilities for the organisations involved in flood management and how they were involved in the SFRA Provides a short introduction to how flood risk is assessed and the importance of considering all sources Includes this table of the contents of the SFRA	For general information and context.
2. Flood risk policy and strategy	Sets out the relevant legislation, policy and strategy for flood risk management at a national, regional and local level.	Users should refer to this section for any relevant policy which may underpin strategic or site-specific assessments.
3. Planning policy for flood risk management	Provides an overview of both national and existing Local Plan policy on flood risk management This includes the Flood Zones, application of the Sequential Approach and Sequential/Exception Test process. Provides guidance for the National Planning Authority and Developers on the application of the Sequential and Exception Test for both allocations and windfall sites, at allocation and planning application stages.	Users should use this section to understand and follow the steps required for the Sequential and Exception Tests.
4. Impact of climate change	Outlines the latest climate change guidance published by the Environment Agency and how this was applied to the SFRA Sets out how developers should apply the guidance to inform site specific Flood Risk Assessments	This section should be used to understand the climate change allowances for a range of epochs and conditions, linked to the vulnerability of a development.
5. Understanding flood risk in Birmingham	Provides an overview of the characteristics of flooding affecting the study area and key risks including historical flooding incidents, flood risk from all sources and flood warning arrangements.	This section should be used to understand all sources of flood risk in the Birmingham including where has flooded historically. This section may also help identify any data gaps, in conjunction with Appendix B.

Section	Contents	How to use
6. Flood alleviation schemes and assets	Provides a summary of current flood defences and asset management and future planned schemes. Introduces actual and residual flood risk.	This section should be used to understand if there are any defences or flood schemes in a particular area, for further detailed assessment at site-specific stage.
7. Cumulative impact of development and strategic solutions	This section provides an introduction to the cumulative impact assessment (CIA).	Planners should use this section to help develop policy recommendations for the cumulative impact of development.
8. Flood risk management for developers	Guidance for developers on Flood Risk Assessments, considering flood risk from all sources	Developers should use this section to understand requirements for FRAs and what conditions/ guidance documents should be followed, as well as mitigation options.
9. Surface water management and Sustainable Drainage Systems	An overview of Sustainable Drainage Systems, Guidance for developers on Surface Water Drainage Strategies, considering any specific local standards and guidance for Sustainable Drainage Systems (SuDS) from the Lead Local Flood Authority.	Developers should use this section to understand what national, regional and local SuDS standards are applicable. Hyperlinks are provided.
10. Summary and recommendations	Summarises sources of flood risk in the study area and outlines planning policy recommendations	Developers and planners should use this as a summary of the SFRA. Developers should refer to the Level 1 SFRA recommendations when considering requirements for site-specific assessments.
Appendices	Appendix A: Interactive flood risk maps Appendix B: Data sources used in the SFRA Appendix C: SFRA User Guide Appendix D: Flood Alert and Flood Warning Areas Appendix E: Summary of flood risk across Birmingham Appendix F: Cumulative Impact Assessment (CIA) Annex 1: August 2022 PPG changes	Planners should use these appendices to understand what data has been used in the SFRA, to inform the application of the Sequential and Exception Tests, as relevant, and to use these maps and tabulated summaries of flood risk to understand the nature and location of flood risk.

1.9 Understanding flood risk

The following content provides useful background information on how flooding arises and how flood risk is determined.

1.9.1 Sources of flooding

Flooding is a natural process and can happen at any time in a wide variety of locations. It constitutes a temporary covering of land not normally covered by water and presents a risk when people and human or environmental assets are present in the area that floods. Assets at risk from flooding can include housing, transport and public service infrastructure, commercial and industrial enterprises, agricultural land and environmental and cultural heritage. Flooding can occur from many different and combined sources and in many different ways, as illustrated in Figure 1-3. Major sources of flooding include:

- Fluvial (rivers) - inundation of floodplains from rivers and watercourses; inundation of areas outside the floodplain due to influence of bridges, embankments and other features that artificially raise water levels; overtopping or breaching of defences; blockages of culverts; blockages of flood channels/corridors.
- Surface water - surface water flooding covers two main sources including direct run-off from adjacent land (pluvial) and surcharging of piped drainage systems (public sewers, highway drains, etc.)
- Groundwater - water table rising after prolonged rainfall to emerge above ground level remote from a watercourse; most likely to occur in low-lying areas underlain by permeable rock (aquifers); groundwater recovery after pumping for mining or industry has ceased.
- Infrastructure failure - reservoirs; canals; industrial processes; burst water mains; blocked sewers or failed pumping stations.

Different types and forms of flooding present a range of different risks and the flood hazards of speed of inundation, depth and duration of flooding can vary greatly. With climate change, the frequency, pattern and severity of flooding are expected to change and become more damaging.

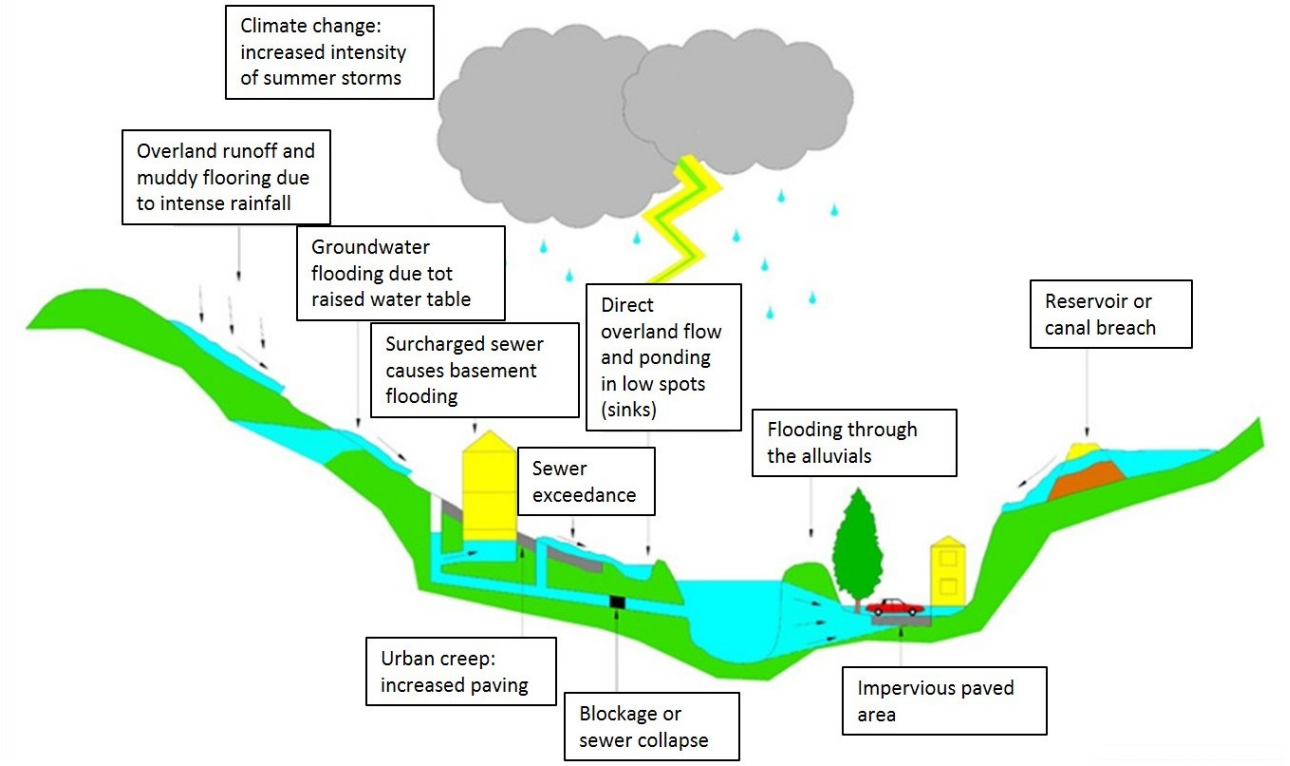

Figure 1-3: Flooding from all sources

1.10 Likelihood and Consequence

Flood risk is a combination of the likelihood of flooding and the potential consequences arising. It is assessed using the source – pathway – receptor model as shown in Figure 1-4 below. This is a standard environmental risk model common to many hazards and should be the starting point of any assessment of flood risk. However, it should be remembered that flooding could occur from many different sources and pathways, and not simply those shown in the illustration below.

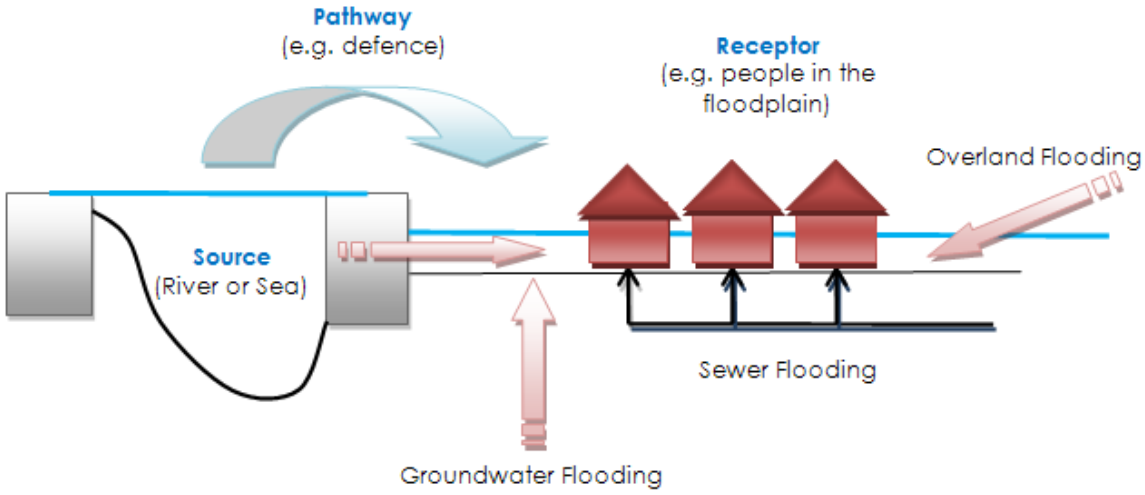

Figure 1-4: Source-Pathway-Receptor Model

The principal sources are rainfall; the most common pathways are rivers, drains, sewers, overland flow and river floodplains; their defence assets; and the receptors can include people, their property and the environment. All these elements must be present for flood risk to arise. Mitigation measures have little or no effect on sources of flooding, but they can block or impede pathways or remove receptors.

The planning process is primarily concerned with the location of receptors, taking appropriate account of potential sources and pathways that might put those receptors at risk. It is therefore important to define the components of flood risk in order to apply this guidance in a consistent manner.

1.11 Likelihood

Likelihood of flooding is expressed as the percentage probability based on the average frequency measured or extrapolated from records over a large number of years. A 1% probability indicates the flood level that is expected to be reached on average once in a hundred years, i.e. it has a 1% chance of occurring in any one year, not that it will occur at least once every hundred years.

Considered over the lifetime of development, such an apparently low frequency or rare flood has a significant probability of occurring. For example:

- A 1% flood has a 26% (1 in 4) chance of occurring at least once in a 30-year period - the period of a typical residential mortgage
- And a 49% (1 in 2) chance of occurring in a 70-year period - a typical human lifetime

1.12 Consequence

The consequences of flooding include fatalities, property damage, disruption to lives and businesses, with severe implications for people (e.g. financial loss, emotional distress, health problems). Consequences of flooding depend on the hazards caused by flooding (depth of water, speed of flow, rate of onset, duration, wave-action effects, water quality) and the vulnerability of receptors (type of development, nature, e.g. age-structure, of the population, presence and reliability of mitigation measures etc). Flood risk is then expressed in terms of the following relationship:

Flood risk = Probability of flooding x Consequences of flooding

1.13 Risk

Flood risk is not static; it cannot be described simply as a fixed water level that will occur if a river overtops its banks or from a high spring tide that coincides with a storm surge. It is therefore important to consider the continuum of risk carefully. Risk varies depending on the severity of the event, the source of the water, the pathways of flooding (such as the condition of flood defences) and the vulnerability of receptors as mentioned above.

2 Flood Risk Policy and Strategy

This section sets out the flood risk management roles and responsibilities for different organisations and relevant legislation, policy and strategy.

2.1 Roles and responsibilities for Flood Risk Management in Birmingham

There are different organisations in and around Birmingham that have responsibilities for flood risk management, known as Risk Management Authorities (RMAs). These are shown on Table 2.1, with a summary of their responsibilities.

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

When it comes to undertaking works to reduce flood risk, the Environment Agency and Birmingham City Council as LLFA do have powers but limited resources must be prioritised and targeted to where they can have the greatest effect. Permissive powers mean that Risk Management Authorities are permitted to undertake works on watercourses but are not obliged.

Table 2-1: Roles and responsibilities for Risk Management Authorities

Risk Management Authority	Strategic Level	Operational Level	Planning role
Environment Agency	Strategic overview for all sources of flooding National Strategy Reporting and general supervision	Main rivers (e.g. River Wharfe) Reservoirs	Statutory consultee for development in Flood Zones 2 and 3
Birmingham City Council as Lead Local Flood Authority (LLFA)	Preliminary Flood Risk Assessment Local Flood Risk Management Strategy	Surface Water Groundwater Ordinary Watercourses (consenting and enforcement) Ordinary watercourses (works)	Statutory consultee for major developments
Birmingham City Council as Local Planning Authority	Local Plans as Local Planning Authorities	Determination of planning applications as Local Planning Authorities Managing open spaces under National Park Authority ownership Ordinary watercourses (works)	As left
Severn Trent Water	Asset Management Plans, supported by Periodic Reviews (business cases)	Public sewers	Non-statutory consultee

Risk Management Authority	Strategic Level	Operational Level	Planning role
	Develop Drainage and Wastewater management plans		
Highways Authorities Highways England (motorways and trunk roads) Birmingham City Council (for non-trunk roads)	Highway drainage policy and planning	Highway drainage	Statutory consultee regarding highways design standards and adoptions

2.2 Relevant legislation

The following legislation is relevant to development and flood risk in Birmingham:

- **Flood Risk Regulations (2009)** - these transpose the European Floods Directive (2000) into law and require the Environment Agency and LLFAs to produce Preliminary Flood Risk Assessments and identify where there are nationally significant Flood Risk Areas. For the Flood Risk Areas, detailed flood maps and a Flood Risk Management Plan is produced; this is done in a six-year cycle.
- **Town and Country Planning Act (1990), Water Industry Act (1991), Land Drainage Act (1991), Environment Act (1995), Flood and Water Management Act (2010)** – as amended and implanted via secondary legislation. These set out the roles and responsibilities for organisations that have a role in FRM.
- The **Land Drainage Act (1991, as amended)** and **Environmental Permitting Regulations (2018)** also set out where developers will need to apply for additional permission (as well as planning permission) to undertake works to an **Ordinary Watercourse** or **Main River**.
- The **Water Environment Regulations (2017)** – these transpose the European Water Framework Directive (2000) into law and require the Environment Agency to produce River Basin Management Plans (RBMPs). These aim to ensure that the water quality of aquatic ecosystems, riparian ecosystems and wetlands reaches 'good' status.
- Other environmental legislation such as the Habitats Directive (1992), Environmental Impact Assessment Directive (2014) and Strategic Environmental Assessment Directive (2001) also apply as appropriate to strategic and site-specific developments to guard against environmental damage.

2.3 Relevant flood risk policy and strategy documents

Table 2-2 summarises relevant national, regional and local flood risk policy and strategy documents and how these apply to development and flood risk. Hyperlinks are provided to external documents. These documents may

- Provide useful and specific local information to inform Flood Risk Assessments within the local area.
- Set the strategic policy and direction for Flood Risk Management (FRM) and drainage – they may contain policies and action plans that set out what future flood mitigation and climate change adaptation plans may affect a development site. A developer should seek to contribute in all instances to the strategic vision for FRM and drainage in Birmingham.
- Provide guidance and/or standards that informs how a developer should assess flood risk and/or design flood mitigation and SuDS.

Table 2-2: National, regional and local flood risk policy and strategy documents

	Document, lead author and date	Flood Risk Information	Policy and measures	Development design requirements	Next update due
National	**Flood and Coastal Management Strategy** (Environment Agency) 2020	No	Yes	No	Due to be reviewed in 2026
	National Planning Policy Framework and Guidance (MHCLG) updated 2021	No	No	Yes	NPPF last updated 2021
	Building Regulations Part H (MHCLG) 2010	No	No	Yes	-
Regional	**River Trent Catchment Flood Management Plan** (Environment Agency) 2009	Yes	Yes	No	-
	Humber River Basin Management Plan (Environment Agency) 2016	No	Yes	No	2021
	Humber River Basin District flood risk management Plan (Environment Agency) 2015	No	Yes	No	2021
	Climate Change guidance for development and flood risk (Environment Agency) (last updated in May 2022)	No	No	Yes	-
	Drainage and Wastewater Management Plan (Severn Trent) 2023	Yes	Yes	No	-
Local	**Birmingham Preliminary Flood Risk Assessment** (BCC) 2017	Yes	No	No	-
	Birmingham Local Flood Risk Management Strategy (BCC) 2017	Yes	Yes	No	2023
	Birmingham Development Plan (BCC) 2017	Yes	Yes	Yes	2023
	Sustainable Drainage – Guide to Design, Adoption and Maintenance (BCC) 2015	Yes	No	Yes	-
	Surface Water Management Plan for Birmingham (BCC) 2015	Yes	No	Yes	-
	Aston, Newton and Lozells Area Action Plan (BCC) 2012	Yes	Yes	No	Policy ED1 replaced by the Local Plan
	Bordesley Park Area Action Plan (BCC) 2020	Yes	Yes	No	-
	Longbridge Area Action Plan (BCC) 2009	Yes	Yes	No	-
	Balsall Heath Neighbourhood Development Plan (BCC) 2015	No	Yes	Yes	-
	The Beeches, Booths and Barr (3Bs) Neighbourhood Plan (BCC) 2021	Yes	Yes	Yes	-
	The Jewellery Quarter Neighbourhood Development Plan (BCC) TBC	No	No	No	-

2.4 Key legislation for flood and water management

2.4.1 Flood Risk Regulations (2009)

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

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

The **Birmingham Preliminary Flood Risk Assessment** (2017) provides information on significant past and future flood risk from localised flooding in Warwickshire. Most of the Birmingham City Council administrative area, apart frm Sutton Coldfield, is within a Flood Risk Area.

The Environment Agency PFRA (2018) for river, sea and reservoir flooding identifies nationally significant Flood Risk Areas for these sources. They exercised an exemption clause for the first six-year cycle and so there are no current FRAs from these sources in Birmingham. However, the **Humber river basin flood risk management plan** does provide information on flood risk management work in the area.

2.4.2 Flood and Water Management Act (2010)

The Flood and Water Management Act (FWMA) was passed in April 2010. It aims to improve both flood risk management and the way water resources are managed.

The FWMA has created clearer roles and responsibilities and helped to define a more risk-based approach to dealing with flooding. This included the creation of a lead role for LAs, as LLFAs, designed to manage local flood risk (from surface water, ground water and ordinary watercourses) and to provide a strategic overview role of all flood risk for the EA.

The content and implications of the FWMA provide considerable opportunities for improved and integrated land use planning and flood risk management by LAs and other key partners. The integration and synergy of strategies and plans at national, regional, and local scales, is increasingly important to protect vulnerable communities and deliver sustainable regeneration and growth.

Below is a summary of some of the work Warwickshire County Council has undertaken to date as a LLFA.

- **Birmingham City Council's Local Flood Risk Management Strategy** was published in 2017.
- 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. A Flood Asset Register has been prepared for Birmingham City Council's Administrative area (see Section 7.4).

2.4.3 The Water Framework Directive & Water Environment Regulations

The purpose of the Water Framework Directive (WFD), which was transposed into English Law by the Water Environment Regulations (2003), is to deliver improvements across Europe in the management of water quality and water resources through a series of plans called River Basin Management Plans (RBMP), which were last published in 2015 and are currently being updated. Draft updates were published in 2021 and are currently undergoing public consultation.

Birmingham lies across Humber River Basin District.

2.5 Key national, regional and local policy documents and strategies

2.5.1 The National Flood and Coastal Erosion Risk Management Strategy for England (2020)

The **National Flood and Coastal Erosion Risk Management Strategy** (FCERM) for England provides the overarching framework for future action by all risk management authorities to tackle flooding and coastal erosion in England. The new Strategy has been in preparation since 2018. The Environment Agency brought together a wide range of stakeholders to develop the strategy collaboratively. The Strategy is much more ambitious than the previous one from 2011 and looks ahead to 2100 and the action needed to address the challenge of climate change.

The Strategy has been split into 3 high level ambitions:

- Climate resilient places: working with partners to bolster resilience to flooding and coastal change across the nation, both now and in the face of climate change.
- Today's growth and infrastructure resilient in tomorrow's climate: making the right investment and planning decisions to secure sustainable growth and environmental improvements, as well as infrastructure resilient to flooding and coastal change.
- A nation ready to respond and adapt to flooding and coastal change: ensuring local people understand their risk to flooding and coastal change, and know their responsibilities and how to take action.

The Strategy was laid before parliament in July 2020 for formal adoption and published alongside a **New National Policy Statement for Flood and Coastal Erosion Risk Management**. The statement sets out five key commitments which will accelerate progress to better protect and better prepare the country for the coming years:

1 Upgrading and expanding flood defences and infrastructure across the country,
2 Managing the flow of water to both reduce flood risk and manage drought,
3 Harnessing the power of nature to not only reduce flood risk, but deliver benefits for the environment, nature, and communities,
4 Better preparing communities for when flooding and erosion does occur, and
5 Ensuring every area of England has a comprehensive local plan for dealing with flooding and coastal erosion.

It can be expected that the implementation of the National Strategy will lead to the publication of new guidance and practice that is focused on resilience and adaptation over the coming years. It will be important to adjust the content of the SFRA so that changes in approach are captured in the delivery of the Local Plan.

2.5.2 Updated Strategic Flood Risk Assessment guidance

There was an update to the **'How to prepare a Strategic Flood Risk Assessment guidance'** in March 2022, which requires further adjustment to the approaches to both Level 1 and Level 2 assessments. There have also been minor updates to the guidance in September 2020 and a substantive adjustment in August 2019. The Level 1 assessment is undertaken in accordance with the latest guidance.

2.5.3 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.

The **River Trent Catchment Flood Management Plan** is the one that is most relevant to Birmingham. The actions of this were brought forward into the 2015 Flood Risk Management Plan for the Trent.

2.5.4 River Basin Management Plans

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

Birmingham falls within the Humber River Basin District. The River Basin Districts management plans highlight a number of actions to a number of issues raised either within the District as a whole or in sub Districts. Further information can be found in the RBMP and the **Catchment Based Approach (CaBA) website**.

2.5.5 Severn Trent Drainage and Wastewater Management Plan (DWMP) 2023

Water and sewerage companies such as Severn Trent have recently published Drainage and Wastewater Management Plans (DWMPs). These are long term plans that outline how water and sewerage companies plan to approach and manage sewerage and wastewater over the next 25 years. They include details of reported flooding and flood risk by catchment along with investment plans for the catchment.

Severn Trent's Drainage and Wastewater Management Plan was published in 2023 and sets out various targets which include:

- maintaining full monitoring on every storm overflow in Severn Trent's region by 2030;
- undertaking upgrades to improve surface water drainage in the highest risk areas to alleviate the 2% AEP (1 in 50-year) flood risk to around 24,000 properties by 2030; and
- zero serious pollutions caused by Severn Trent's operations by 2050.

2.5.6 Birmingham City Council Local Flood Risk Management Strategy (LFRMS) 2017

Birmingham City Council is responsible for developing, maintaining, applying and monitoring a LFRMS. The **most recent Strategy** was published in 2017 and is used as a means by which the LLFA co-ordinates Flood Risk Management on a day-to-day basis. The seven high-level objectives proposed in the Strategy for managing flood risk include:

- Stakeholder Responsibilities and Partnership Arrangements - identify all stakeholders with a role in flood risk management, set out their responsibilities and work with them to adopt a partnership approach to managing local flood risk;
- Local Flood Risk - develop a clear understanding of flood risk from surface water, groundwater and ordinary watercourses and set out how this information will be communicated and shared;
- Asset Management - outline how local flood risk assets are identified, managed and maintained and develop a clear understanding of riparian responsibilities;
- Responding to Flooding - define the criteria and procedure for responding to and investigating flooding incidents, and set out the role of emergency planning, flood action groups and individual property owners;
- Managing Flood Risk - define the criteria for how and when flood risk management measures will be promoted to ensure that they provide value for money whilst minimising the long-term revenue costs and maximising external funding contributions;
- Flood Risk and Development - minimise the impact of development on flood risk by developing guidance, policies and standards that manage flood risk and reduce the flood risk to existing communities; and
- Environmental Implications - adopt a sustainable app.

2.5.7 LLFAs, surface water and SuDS

The 2021 NPPF states that: 'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate' (Para 169). When considering planning applications, local planning authorities should consult the relevant LLFA on the management of surface water in order to satisfy that:

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

At the time of writing this SFRA, documents and policies relevant to SuDS and surface water for Birmingham are:

- **Birmingham City Council's guide on Sustainable Drainage - Design, Adoption and Maintenance**
- **Birmingham City Council's Birmingham Development Plan (2017) – Policy TP6- Management of flood risk and water resources**
- **Birmingham City Council's Guidance notes – consenting ordinary watercourse**
- **Surface Water Management Plan**
- **SuDS Manual (C753)** published in 2007, updated in 2015
- **DEFRA Non-statutory technical standards for sustainable drainage systems, 2015**
- **DEFRA National Standards for sustainable drainage systems Designing, constructing (including LASOO best practice guidance), operating and maintaining drainage for surface runoff, 2011**
- **Building Regulations Part H (MHCLG) 2010**

The 2021 NPPF states that flood risk should be managed "using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding." As such, Birmingham City Council expect SuDS to be incorporated on minor development in areas of risk as well as all major development.

2.6 Water Cycle Studies

Water Cycle Studies assist local authorities to select and develop growth proposals that minimise impacts on the environment, water quality, water resources, infrastructure and flood risk and help to identify ways of mitigating such impacts.

A Water Cycle Study is currently being prepared for BCC.

2.7 Surface Water Management Plans

Surface Water Management Plans (SWMPs) outline the preferred surface water management strategy in a given location. SWMPs are undertaken, when required, by LLFAs in consultation with key local partners who are responsible for surface water management and drainage in their area. SWMPs establish a long-term action plan to manage surface water in a particular area and are intended to influence future capital investment, drainage maintenance, public engagement and understanding, land-use planning, emergency planning and future developments. The SWMP for Birmingham City Council is available on their **website**.

3 Planning policy for flood risk management

This section summaries national planning policy for development and flood risk.

3.1 National Planning Policy Framework and Guidance

The revised **National Planning Policy Framework (NPPF)** was published in July 2021, replacing the 2019 version. The NPPF sets out Government's planning policies for England. It must be considered in the preparation of local plans and is a material consideration in planning decisions. The NPPF defines Flood Zones, how these should be used to allocate land and flood risk assessment requirements. The NPPF states that:

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

Planning Practice Guidance on flood risk was published in March 2014 and sets out how the policy should be implemented. **Diagram 1 in the NPPG** sets out how flood risk should be considered in the preparation of Local Plans. It was updated on the 25 August 2022, see Annex 1 – Updates to the Planning Practice Guidance (25 August 2022) for more information.

3.2 The risk-based approach

The NPPF takes a risk-based approach to development in flood risk areas. Since July 2021 the approach has adjusted the requirement for the Sequential Test (as defined in Para 162 of the NPPF) so that all sources of flood risk are included in the consideration. At the time of preparation of the 2022 SFRA the updated guidance (PPG) has been published, describing a revised approach to the Sequential Test. The requirement for the revised Sequential Test has been addressed by adopting the following approach:

- The test will cease to be based on the use of the Zones describing river and sea flood risk, and instead be based on whether development can be located in the lowest risk areas (high-medium-low) of flood risk both now and in the future (the test applied to all sources of flood risk – whereas previously the test was only performed for present day flood risk for the "Flood Zones" i.e. river and sea flood risk).
- Understanding flood risk to sites based on their vulnerability and incompatibility as opposed to whether development is appropriate
- As there is no available competent risk mapping for other sources of risk that is comparable with that for the sea, rivers and surface water it is not considered appropriate to use such mapping in a strict process that involves comparison of differing levels of flood risk. However, it is important that the potential implications of such risk is assessed in performing the Sequential Test and so reservoir, groundwater and sewer flood risk are addressed during the process of finalising the selection of allocation sites. This process is undertaken in a Level 2 SFRA and involves a more detailed assessment of the implications of reservoir, sewer and groundwater flood risk to establish that more appropriate locations at lower risk are not available. Thus consideration is given to all sources of flood risk using the available data to complete of the Sequential Test so decisions on the selection of preferred sites for allocation address the potential implications of groundwater, reservoir and sewer flooding and where necessary identify

sites where consideration should be given to satisfying the requirements of the Exception Test.

This process will be described in the future Level 2 SFRA and involves a more detailed assessment of the implications of reservoir, sewer and groundwater flood risk to establish that more appropriate locations at lower risk are not available. Thus consideration is given to all sources of flood risk using the available data to complete of the Sequential Test so decisions on the selection of preferred sites for allocation address the potential implications of groundwater, reservoir and sewer flooding and where necessary identify sites where consideration should be given to satisfying the requirements of the Exception Test.

3.2.1 Flood Zones – rivers risk

The definition of the Flood Zones is provided below. The Flood Zones do not take into account defences. This is important for planning long term developments as long-term policy and funding for maintaining flood defences over the lifetime of a development may change over time.

The Flood Zones do not take into account surface water, sewer or groundwater flooding or the impacts of canal or reservoir failure. They do not consider climate change. Hence there could still be a risk of flooding from other sources and that the level of flood risk will change over time during the lifetime of a development.

The Flood Zones are:

- **Flood Zone 1: Low risk**: less than a 0.1% chance of river and sea flooding in any given year
- **Flood Zone 2: Medium risk**: between a 1% and 0.1% chance of river flooding in any given year or 0.5% and 0.1% chance of sea flooding in any given year
- **Flood Zone 3a: High risk**: greater or equal to a 1% chance of river flooding in any given year or greater than a 0.5% chance of sea flooding in any given year. Excludes Flood Zone 3b.
- **Flood Zone 3b: Functional Floodplain**: land where water has to flow or be stored in times of flood. SFRAs identify this Flood Zone in discussion with the LPA and the Environment Agency. The identification of functional floodplain takes 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. It may be required to consider climate change on the functional floodplain; this would need hydraulic modelling to confirm extents and therefore it is recommended that this is considered in a Flood Risk Assessment and a suitable approach is agreed with the EA.
    - FZ3b is based on the best available model data
        - 3.3% AEP where available
        - 2% AEP where the 3.3% is not available
    - Where model data is not available, FZ3a (1% AEP) is used as a conservative proxy

Important note on Flood Zone information in this SFRA

The Flood Zones (Flood Zone 2 and 3a) in the Appendix A Geo-PDFs are shown from the online Environment Agency's **'Flood Map for Planning'** which incorporates modelled data where available. All the models used for this SFRA have been fully incorporated into the EA Flood Zones.

The Environment Agency Flood Zones do not cover all catchments or ordinary watercourses with areas <3km^2. As a result, whilst the Environment Agency Flood Zones may show an area is in Flood Zone 1, there may be a flood risk from smaller watercourse not shown in the Flood Zones.

Functional floodplain (Flood Zone 3b) is identified as land which would flood with an annual probability of 1 in 30 years (3.3% AEP), where detailed hydraulic modelling exists. The 1 in 30-year, 1 in 50-year (2% AEP) or 1 in 100-year (1% AEP) defended modelled flood extents have been used to represent Flood Zone 3b, where available from the Environment Agency. For areas outside of the detailed model coverage, or where no outputs were available, Flood Zone 3a has been used as a conservative indication. Further work should be undertaken as part of a detailed site-specific Flood Risk Assessment to define the extent of Flood Zone 3b where no detailed modelling exists.

3.2.2 Flood Zones – surface water risk and other sources of flooding

To address the requirement that flood risk from all sources is included in the Sequential Test a further set of Surface Water Zone maps has been prepared. It is not possible to prepare zone maps for reservoir flood risk, sewer flood risk or groundwater flood risk as the appropriate analyses and data are not available. The existing risk information on reservoirs, sewer flooding and groundwater is used in the sequential approach to development at a site in accordance with paragraph 161 of the NPPF (which could in some instances result in alternative sites being considered).

The Surface Water Zone maps describe two zones that indicate locations at either low or high risk of flooding from surface water based on the modelled extent of the 1 in 100 year plus 40% climate change allowance surface water flood event. The decision has been made to use the 1 in 100 year plus 40% climate change and 1 in 1000 year surface water flood extent as the low risk zone (Zone B).

The extent of flooding during the lower return period surface water flood events (1 in 30 year, 1 in 100 year and 1 in 100 year plus 25% climate change allowance) has been used to represent Zone A, indicating locations at high risk of flooding from surface water.

This decision has been made due to the likelihood of these events occurring. This is not strictly the same conceptual risk zone as defined for river and sea flooding as the mapping is based on different assumptions. However, it does create a product that can accommodate a form of sequential testing, as it would facilitate strategic decisions that directed development to land in a "low risk surface water flood zone (Zone B)", and outside of the "high risk surface water flood zone (Zone A)".

The proposed approach will direct development to areas at low risk in a similar way to the fluvial/tidal Flood Zone 1 and will not preclude development in the surface water high risk zone provided that an FRA is performed to demonstrate that the risks in the high risk zone can be appropriately managed.

The application of the test would require a preference that all proposed development on sites identified for allocation would be placed in the "low risk surface water flood zone". In circumstances where it is not possible to place all proposed development in the "low risk surface water flood zone (Zone B)" or circumstances arose where encroachment could not be avoided then it would be necessary to provide supplementary evidence that the Exception Test could be satisfied. For the purpose of the Local Plan this supplementary exercise could be set out in the Level 2 SFRA and might simply involve more specific requirements with respect to the scope of an FRA. The proposed approach is relatively simple, is not totally aligned with the river and sea zones, but from a practical perspective is strongly aligned with the sequential approach defined in para 161 of the NPPF. For these reasons it is recommended.

It is recommended that reservoir flooding is included in the Sequential Test. However, it will be made clear in the SFRA that the available information is not conceptually similar to the risks pertaining to river and sea flooding.

The Reservoir Flood Map Wet Day Extent will be used to define two zones:

1. Where reservoir flooding **is** predicted to make fluvial flooding worse.
2. Where reservoir flooding **is not** predicted to make fluvial flooding worse.

This will also identify locations where proposed development could result in a change to the risk designation of a reservoir. If proposed sites are located in a zone at reservoir risk, it will be necessary to include a more detailed assessment in a Level 2 SFRA to understand the extent to which the flooding could be made worse and to report on the implications with respect to allocating the land for development. On that basis such an approach is recommended.

3.2.3 The Sequential Test

Firstly, land at the lowest risk of flooding and from all sources should be considered for development. A test is applied called the 'Sequential Test' to do this. Figure 3-1 summarises the Sequential Test. The LPA will apply the Sequential Test to strategic allocations. For all other developments, developers must supply evidence to the LPA, with a planning application, that the development has passed the test.

The LPA should work with the Environment Agency to define a suitable area of search for the consideration of alternative sides in the Sequential Test. 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.

Whether any further work is needed to decide if the land is suitable for development will depend on both the vulnerability of the development and the flood risk in the area it is proposed for. **Table 2 of the NPPG** defines the flood risk vulnerability and flood zone 'incompatibility' of different development types to flooding.

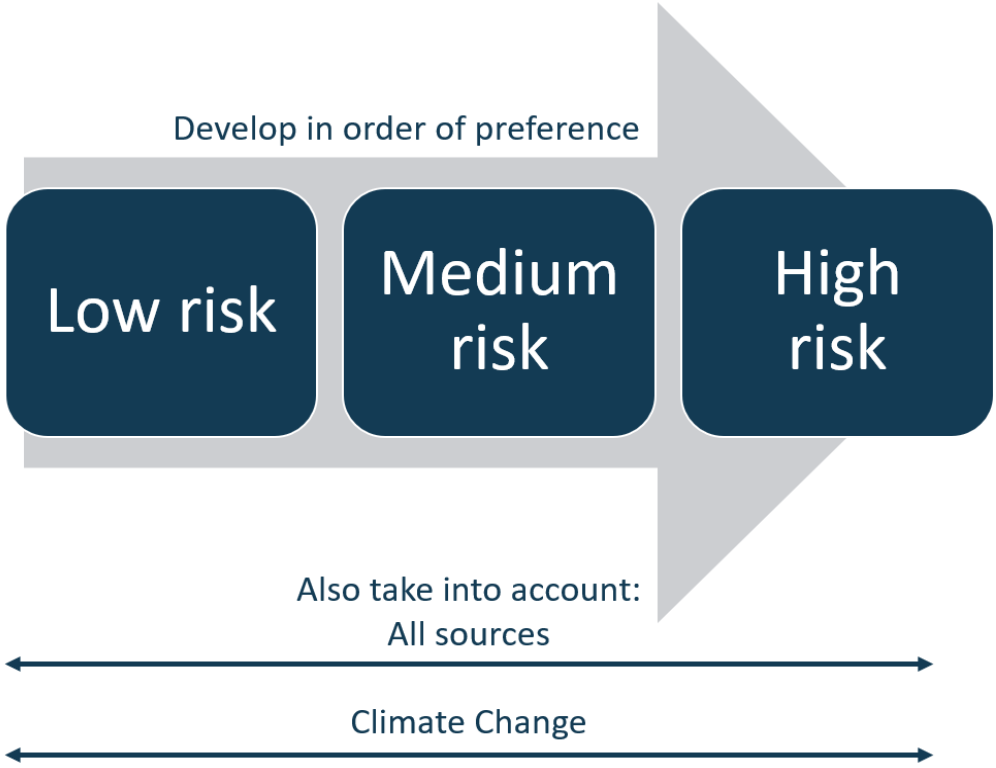

Figure 3-1: Diagram conceptually explaining the Sequential Test

Figure 3-2 illustrates the Sequential and Exception Tests as a process flow diagram (Diagram 2 of the NPPG) using the information contained in this SFRA to assess potential development sites against the flood risk in the area and development vulnerability compatibilities.

The LPA will apply the Sequential Test to strategic allocations. For all other developments, developers must supply evidence to the LPA, with a planning application, that the development has passed the test.

The LPA should work with the Environment Agency to define a suitable area of search for the consideration of alternative sites in the Sequential Test. 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. In addition, the risk of flooding from all sources and the impact of climate change must be considered when considering which sites are suitable to allocate.

The SFRA User Guide in Appendix C shows where the Sequential and Exception Test may be required for the datasets assessed in the SFRA, and how to interpret different levels of concern with the datasets, recommending what proposed development sites should be assessed at Level 2.

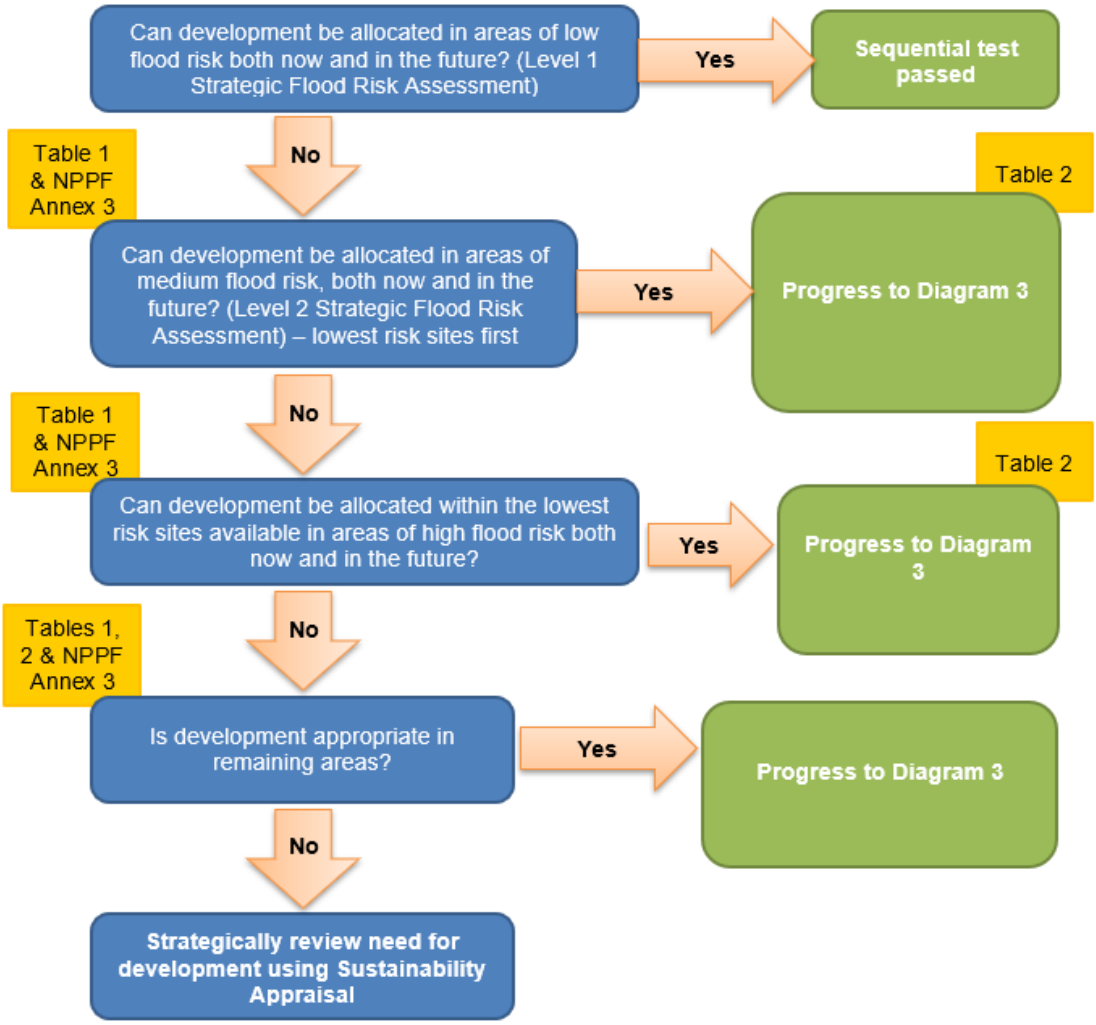

Figure 3-2: Application of the Sequential Test for plan preparation (Source: Planning Practice Guidance, 2022)

3.2.4 The Exception Test

It will not always be possible for all new development to be allocated on land that is at low risk of flooding. To further inform whether land should be allocated, or planning permission granted, a greater understanding of the scale and nature of the flood risks is required. In these instances, the Exception Test will be required.

The Exception Test should only be applied following the application of the Sequential Test. **Table 2 of the PPG** sets out the requirements for the Exception but does not reflect the need to avoid flood risk from sources other than rivers and the sea. There is no guidance on how to consider other sources of flood risk. BCC consider that the Exception Test should be applied in the following instances:

- More vulnerable in Flood Zone 3a
- Essential infrastructure in Flood Zone 3a or 3b
- Highly vulnerable in Flood Zone 2 (this is NOT permitted in Flood Zone 3a or 3b)
- Any development within the extent of flooding during the lower return period surface water flood events (1 in 30 year, 1 in 100 year and 1 in 100

year plus 25% climate change allowance) has been used to represent a 'Surface Water Flood Zone A' or high risk zone

Figure 3-3 summarises the Exception Test.

For sites allocated within the Local Plan, the Local Planning Authority should use the information in this SFRA to inform the Exception Test. At planning application stage, the Developer must design the site such that it is appropriately flood resistant and resilient in line with the recommendations in National and Local Planning Policy and supporting guidance and those set out in this SFRA. This should demonstrate that the site will still pass the flood risk element of the Exception Test based on the detailed site level analysis.

For developments that have not been allocated in the Local Plan, developers must undertake the Exception Test and present this information to the Local Planning Authority for approval. The Level 1 SFRA can be used to scope the flooding issues that a site-specific FRA should look into in more detail to inform the Exception Test for windfall sites.

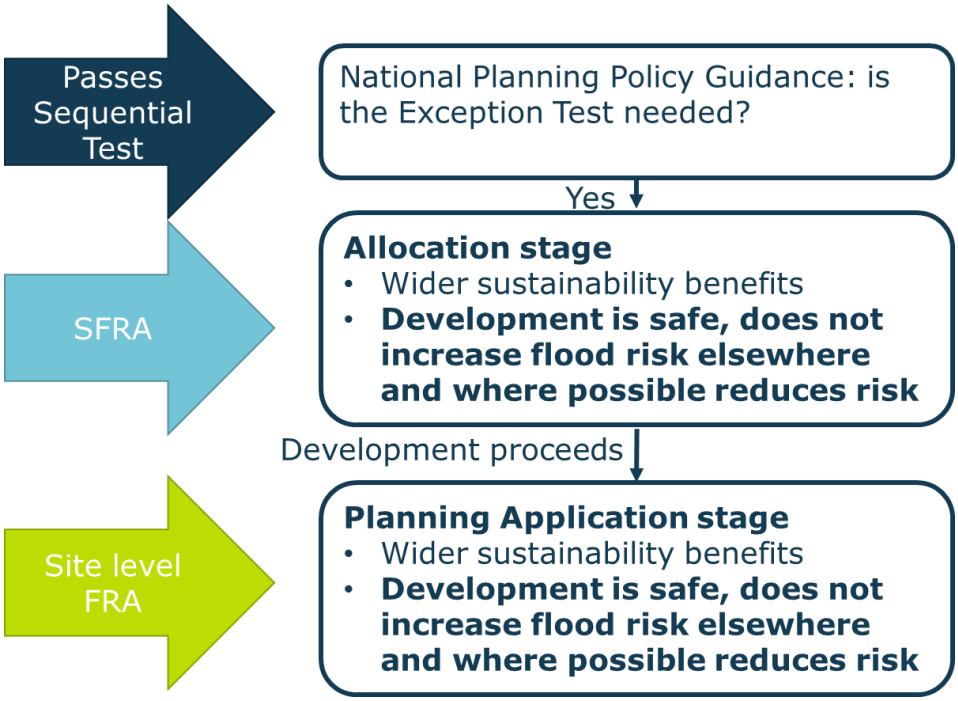

Figure 3-3 Diagram conceptually explaining the Exception Test

There are two parts to demonstrating a development passes the Exception Test:

1. Demonstrating that the development would provide wider sustainability benefits to the community that outweigh the flood risk

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.

At the stage of allocating development sites, Local Planning Authorities should consider wider sustainability objectives, such as those set out in Local Plan Sustainability Appraisals. These generally consider matters such as biodiversity,

green infrastructure, historic environment, climate change adaptation, flood risk, green energy, pollution, health, transport etc.

The Local Planning Authority should consider the sustainability issues the development will address and how doing so will outweigh the flood risk concerns for the site, e.g. by facilitating wider regeneration of an area, providing community facilities, infrastructure that benefits the wider area etc.

2. Demonstrating 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.

In circumstances where the potential effects of proposed development are material, a Level 2 SFRA is likely to be needed to inform the Exception Test. in these circumstances for strategic allocations to provide evidence that the principle of development can be supported. At planning application stage, a site-specific Flood Risk Assessment will be needed. Both would need to consider the actual and residual risk and how this will be managed over the lifetime of the development.

3.2.5 Making a site safe from flood risk over its lifetime

Local Planning Authorities will need to consider the actual and residual risk of flooding and how this will be managed over the lifetime of the development:

- The actual risk is the risk to the site considering existing flood mitigation measures. The fluvial 1% annual probability plus climate change flood event is a key event to consider because the National Planning Policy Guidance refers to this as the 'design flood' against which the suitability of a proposed development should be assessed and mitigation measures, if any, are designed.
- Safe access and egress should be available during the design flood event. Firstly, this should seek to avoid areas of a site at flood risk. If that is not possible then access routes should be located above the design flood event levels. Where that is not possible, access through shallow and slow flowing water that poses a low flood hazard may be acceptable.
- Residual risk is the risk that remains after the effects of flood defences have been taken into account and/ or from a more severe flood event than the design event. The residual risk can be:
    - The effects of an extreme 0.1% annual probability flood event. Where there are defences, this could cause them to overtop, which may lead to failure if this causes them to erode, and/ or
    - Structural failure of any flood defences, such as breaches in embankments or walls.

Flood resistance and resilience measures should be considered to manage any residual flood risk by keeping water out of properties and seeking to reduce the damage it does, should water enter a property. Emergency plans should also account for residual risk, e.g. through the provision of flood warnings and a flood evacuation plan where appropriate.

In line with the NPPF, the impacts of climate change over the lifetime of the development should be taken into account when considering actual and residual flood risk.

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

3.3.1 Sequential Test

Birmingham City Council, with advice from the Environment Agency, are responsible for considering the extent to which Sequential Test considerations have been satisfied.

Developers are required to apply the Sequential Test to all development sites, unless the site is:

- A strategic allocation and the test has already been carried out by the LPA, or
- A change of use (except to a more vulnerable use), or
- A minor development (householder development, small non-residential extensions with a footprint of less than 250m^2), or
- A development in flood zone 1 unless there are other flooding issues in the area of the development (i.e. surface water, ground water, sewer flooding).

The SFRA contains information on all sources of flooding and taking into account the impact of climate change. This should be considered when a developer undertakes the Sequential Test, including the consideration of reasonably available sites at lower flood risk.

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 e.g. school catchments, in other cases it may be identified by other Local Plan policies. For some sites e.g. regional distribution sites, it may be suitable to widen the search area beyond LPA administrative boundaries.

The sources of information on reasonably available sites may include:

- Site allocations in Local Plans
- Site with Planning Permission but not yet built out
- Strategic Housing and Economic Land Availability Assessments (SHELAAs)/ five-year land supply/ annual monitoring reports
- Locally listed sites for sale

It may be that a number of smaller sites or part of a larger site at lower flood risk form a suitable alternative to a development site at high flood.

Ownership or landowner agreement in itself is not acceptable as a reason not to consider alternatives.

3.3.2 The Exception Test

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 required (as set out in Table 3 of the NPPG). Developers are required to apply the Exception Test to all applicable sites (including strategic allocations).

The applicant will need to provide information that the application can pass both parts of the Exception Test:

- Demonstrating that the development would provide wider sustainability benefits to the community that outweigh the flood risk.
- Applicants should refer to wider sustainability objectives in Local Plan Sustainability Appraisals. These generally consider matters such as biodiversity, green infrastructure, historic environment, climate change adaptation, flood risk, green energy, pollution, health, transport etc.
- Applicants should detail the suitability issues the development will address and how doing it will outweigh the flood risk concerns for the site e.g. by facilitating wider regeneration of an area, providing community facilities, infrastructure that benefits the wider area etc.
- Demonstrating 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 (FRA) should demonstrate that the site will be safe, and the people will not be exposed to hazardous flooding from any source. The FRA should consider actual and residual risk and how this will be managed over the lifetime of the development, including:
    - The design of any flood defence infrastructure
    - Access and egress
    - Operation and maintenance
    - Design of the development to manage and reduce flood risk wherever possible
    - Resident awareness
    - Flood warning and evacuation procedures, including whether the developer would increase the pressure on emergency services to rescue people during a flood event; and
    - Any funding arrangements required for implementing measures.

4 Impact of Climate Change

Climate change projections show an increased chance of warmer, wetter winters and hotter, drier summers with a higher likelihood of more frequent and intense rainfall. This is likely to make severe flooding happen more often.

> The NPPF sets out that flood risk should be managed over the lifetime of a development, taking climate change into account. This section sets out how the impact of climate change should be considered.

4.1 Revised Climate Change Guidance

The Climate Change Act 2008 creates a legal requirement for the UK to put in place measures to adapt to climate change and to reduce carbon emissions by at least 80% below 1990 levels by 2050.

In 2018, the government published new UK Climate Projections (UKCP18). The Environment Agency used these projections to update their climate change guidance for new developments with regards to updated fluvial and rainfall allowances which were released in July 2021.

The Environment Agency published **updated climate change guidance** for fluvial risk in July 2021 on how allowances for climate change should be included in both strategic and site-specific FRAs. The guidance adopts a risk-based approach considering the vulnerability of the development and considers risk allowances on a management catchment level, rather than a river basin level. The guidance was further updated in May 2022 to address the changes to the requirements for rainfall allowances.

Developers should check the government website for the latest guidance before undertaking a detailed Flood Risk Assessment.

4.2 Applying the climate change guidance

To apply the climate change guidance, the following information needs to be known:

- The vulnerability of the development – see the **NPPF**
- The likely lifetime of the development – in general 75 years is used for commercial development and 100 for residential, but this needs to be confirmed in an FRA
- The Management Catchment that the site is in – Birmingham lies within the Tame, Anker and Mease management catchment.
- 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)
- The 'built in' resilience measures used, for example, raised floor levels
- The capacity or space in the development to include additional resilience measures in the future, using a 'managed adaptive' approach.

4.3 Relevant allowances for Birmingham

Table 4-1 shows the updated peak river flow allowances that apply in Birmingham for fluvial flood risk for the Tame, Anker and Mease Management Catchment (last updated in July 2021). These allowances supersede the previous allowances by River Basin District. In agreement with the Environment Agency,

the previous climate allowances can still be used where they lie within +/- 10% of the updated guidance.

Error! Reference source not found. shows the updated rainfall intensity allowances that apply in Birmingham for pluvial flood risk for the different Management Catchments (as of May 2022). These allowances supersede the previous country wide allowances.

Table 4-1: Peak river flow allowances for the Management Catchment in Birmingham

Management Catchment	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)
Tame, Anker and Mease	Upper end	22%	30%	51%
	Higher central	11%	17%	30%
	Central	10%	15%	24%

4.4 Representing climate change in the Level 1 SFRA

Representation of climate change within the SFRA was discussed with the EA. Where previous climate change runs were within +/- 10% of the updated climate change allowances, these were able to be used. The following models were provided with suitable climate change runs for the 2080s central, higher central and upper end estimates:

- River Rea
- Hatchford Brook

The following models were not provided with suitable climate change runs for the 2080s higher central and upper end estimates and were unable to be run for the latest climate change allowances:

- River Tame
- River Cole

However, the River Tame and River Cole have the central allowance climate change runs and this will be included in Appendix A.

Appendix B details the models used in this assessment.

Appendix G details the modelling technical notes for the River Tame, River Cole and Hatchford Brook. This includes information regarding the model extents and the methodology used to re-run the models.

For any sites not covered by the EA's detailed modelling or not able to be run for appropriate climate change allowances, the modelled 0.1% AEP outline is used as an indicative climate change extent. This is appropriate given the Upper End climate change estimates are often similar to the 0.1% AEP/Flood Zone 2 extents; therefore, the difference in effects of climate change are not anticipated to be substantial.

The 1,000-year surface water extent can be used as an indication of surface water risk, and risk to smaller watercourses, which are too small to be covered

by the EA's Flood Zones. Modelled Climate Change uplifts for the 3.3% and 1% AEP events were included as part of this SFRA and are presented in in Appendix A: GeoPDFs as 'SW Climate Change Uplifts' for the following events and scenarios:

- 3.3% AEP CC+25%
- 3.3% AEP CC+35%
- 1% AEP CC+25%
- 1% AEP CC+40%

Developers will need to undertake a more detailed assessment of climate change as part of the planning application process when preparing Flood Risk Assessments, using the percentage increases which relate to the proposed lifetime and the vulnerability classification of the development. In areas where no modelling is present, this may require development of a 'detailed' hydraulic model, using channel topographic survey. The EA should be consulted to provide further advice for developers on how best to apply the new climate change guidance.

Climate change mapping has been provided in Appendix A: GeoPDFs. The climate change outputs have been presented under:

- 'Climate Change Extent' including central and higher central

It is important to note that although the flood extent may not increase noticeably on some watercourses, the flood depth, velocity and hazard may increase compared to the 100-year current-day event.

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

- Confirm which national guidance on climate change and new development applies by visiting **GOV.uk**
- Apply this guidance when deciding the allowances to be made for climate change, having considered the potential sources of flood risk to the site (using this SFRA), the vulnerability of the development to flooding and the proposed lifetime of the development. If the site is just outside the indicative climate change extents in this SFRA, the impact of climate change should still be considered because these may get affected should the more extreme climate change scenarios materialise.
- Refer to Section 8 which provides further details on climate change for developers, as part of the FRA guidance, and the SFRA User Guide in Appendix C.

4.5 Impact of climate change in Birmingham

This section explores which areas of Birmingham are most sensitive to increases in flood risk due to climate change. It should be noted that areas that are already at high risk will also become at increasing risk in future and the frequency of flooding will increase in such areas.

It is recommended that the Council works with other Risk Management Authorities to review the long-term sustainability of existing and new development in these areas when developing climate change plans and strategies for the City.

4.5.1 Impact of climate change on fluvial flood risk

Climate change modelled flood extents can be compared to the 100-year flood extent (Flood Zone 3a), and where no detailed modelling exists, compared against Flood Zone 2, for an indication of areas most sensitive to climate change.

Areas in Birmingham most sensitive to fluvial impacts of climate change are:

- Along Plants Brook as it flows through The Royal Town of Sutton Coldfield.
- Along The Bourn as it flows through Bournville and Stirchley and at its confluence with the River Rea.
- Along Stonehouse Brook as it flows through California and Bournbrook, particularly around its confluences with other watercourses.
- Several areas along the River Tame including across Hamstead Industrial Estate, throughout Perry Barr, across the Gravelly Park industrial site and in the east of the area by Minworth Sewage Treatment Works.
- Along Hockley Brook as it flows between Aston and Nechells particularly where it crosses the railway line, through Barbury Park and to the east of the A38(M).
- In the lower reaches of the River Rea between Birmingham Wildlife Conservation Park and the Lawley Street Viaduct and where it flows through Saltley.
- Along the River Cole through the Springfield area and along the east side of the watercourse between Heybarnes Circus and Hob Moor Road.
- Along the west side of Westley Brook and along the east side of Hatchford Brook.

4.5.2 Impact of climate change on surface water flood risk

Using the 1% AEP surface water mapping datasets with allowances for climate change included, an indication of climate change can be understood (as well as for smaller watercourses; some of which are not included in the Flood Zones).

Areas in Birmingham most sensitive to changes in surface water flood risk are typically in areas of low-lying topography on the floodplains of the main watercourses. In particular the following areas are sensitive to increased surface water flooding due to climate change:

- The Royal Town of Sutton Coldfield, particularly along the path of Plants Brook and other flow paths through the area.
- The floodplain of the River Cole, particularly in the northern area of Stechford.
- Areas where surface water is able to build up behind an obstruction, noticeably along the west side of Birmingham Airport.
- The floodplain of the River Rea and its tributaries, particularly along Stonehouse Brook as it flows through Bournbrook.
- Birmingham City Centre, particularly around larger buildings within industrial estates across the city.

4.5.3 Impact of climate change on groundwater flood risk

There is no technical modelling data available to assess climate change impacts on groundwater. It would depend on the flooding mechanism, historic evidence of known flooding and geological characteristics, for example prolonged rainfall in

a chalk catchment. Flood risk could increase when groundwater is already high or emerged, causing additional overland flow paths or areas of still ponding.

A high likelihood of groundwater flooding may mean infiltration SuDS are not appropriate and groundwater monitoring may be recommended.

4.5.4 Adapting to climate change

The **NPPG Climate Change guidance** contains information and guidance for how to identify suitable mitigation and adaptation measures in the planning process to address the impacts of climate change. Examples of adapting to climate change include:

- Considering future climate risks when allocating development sites to ensure risks are understood over the development's lifetime;
- Considering the impact of and promoting design responses to flood risk and coastal change for the lifetime of the development;
- Considering availability of water and water infrastructure for the lifetime of the development and design responses to promote water efficiency and protect water quality;
- Promoting adaptation approaches in design policies for developments and the public realm for example by building in flexibility to allow future adaptation if needed, such as setting new development back from watercourses;
- Identifying no or low-cost responses to climate risks that also deliver other benefits, such as green infrastructure that improves adaptation, biodiversity and amenity, for example by leaving areas shown to be at risk of flooding as public open space;
- Considering the standard of protection of defences and sites for future development, in relation to sensitivity to climate change. Birmingham City Council and developers will need to work with RMAs and use the SFRA datasets to understand whether development is affordable or deliverable. Locating development in such areas of risk may not be a sustainable long-term option, such as at the defence locations mentioned in Section 6; and
- It is recommended that the differences in flood extents from climate change are compared by Birmingham City Council when allocating sites, to understand how much additional risk there could be, where this risk is in the site, whether the increase is marginal or activates new flow paths, whether it affects access/ egress and how much land could still be developable overall. Recommendations for development are made for the levels of risk in the SFRA User Guide in Appendix C.

5 Understanding flood risk in Birmingham

This section explores the key sources of flooding in the Birmingham City Council administrative area and the factors that affect flooding including topography, soils and geology. The main sources of flooding are from watercourses, surface water and sewers.

This is a strategic summary of the risk in the Birmingham City Council administrative area. Developers should use this section to scope out the flood risk issues they need to consider in greater detail in a site-specific Flood Risk Assessment to support a planning application.

Appendix B contains a list of the sources of data used in the SFRA and the approach to using hydraulic model data to inform the mapping.

5.1 Historic flooding

Birmingham City Council (LLFA) Section 19 reports include recorded historical flood events within the Birmingham area. The Environment Agency were unable to provide 'communities at risk' datasets for the area. This dataset is not currently used or available to be distributed to external parties.

There is a history of documented flood events, with the main sources being fluvial and surface water. Table 5-1 highlights the most significant historic flood events.

Birmingham City Council also provided a list of locations where they have investigated flooding within the County. There were incidents recorded in Selly Oak, Perry Barr, Bournville Longbridge, Kings Norton, Weoley Ward and Weoley Castle amongst others, however, no details about the flood mechanisms or dates of these flood events were available.

In addition, the EA's **Historic Flood Map (HFM)** shows areas of land that have been previously subject to fluvial flooding in the area. This includes flooding from rivers, the sea and groundwater springs but excludes surface water. The Historic Flood Map outlines for the Birmingham area are shown in Figure 5-1.

Please note this does not include all recorded flood events, such as those from other sources, which the LLFA's have recorded. Some of the historic extents may refer to older historic flood events, prior to flood defence improvements. It is recommended that the HFM is viewed alongside the **Recorded Flood Outline** dataset, in Appendix, A mapping.

Table 5-1: Historic flooding incidents held by Birmingham City Council

Postcode	Date	Number of incidents	Additional recorded information
B5 7	2016, 2018	9	Flooding type unknown; Internal and external flooding from <200mm to 400mm depth
B6 6	2007	3	Unknown
B6 7	2007	141	Flooding type unknown; Internal and external flooding from <200mm to 400-800mm and <1000mm depth
B9 5	2016	5	Flooding type unknown; External flooding from <200mm to 400-800mm depth

Postcode	Date	Number of incidents	Additional recorded information
B11 3	1998, 2005, 2007, 2009, 2015, 2016, 2018	120	Flooding type unknown; Internal and external flooding from <200mm to 800-1000mm depth
B13 0	1998, 1999, 2000, 2004, 2007, 2012, 2018	119	Flooding type unknown; Internal and external flooding from <200mm to 400-600mm depth
B13 8	1998, 2007, 2008, 2016, 2018	50	Flooding type unknown; Internal and external flooding from <200mm to 400-800mm depth
B13 9	2007, 2016, 2017, 2018	15	Flooding type unknown; Internal and external flooding from <200mm to 400-1000mm depth
B14 4	2004, 2008, 2016, 2018	23	Flooding type unknown; Internal and external flooding from <200mm to 400-1000mm depth
B14 5	1998, 1999, 2004, 2005, 2007, 2008, 2012, 2013, 2018, 2019	108	Flooding type unknown; Internal and external flooding from <200mm to 400-1000mm depth
B14 6	2008, 2011, 2012, 2014, 2018	37	Flooding type unknown; Internal and external flooding from <200mm to 400-800mm and <1000mm depth
B14 7	2005, 2018	8	Flooding type unknown; Internal and external flooding <200mm depth
B15 3	2007	33	Flooding type unknown; Internal and external flooding <200 to 400mm depth
B16 9	2014	1	Flooding type unknown; External flooding <200mm depth
B17 0	2005, 2007, 2008, 2014, 2016, 2017, 2018	278	Flooding type unknown; Internal and external flooding from <200mm to 400-1000mm depth
B17 8	1976, 2007, 2018	36	Flooding type unknown; Internal and external flooding from <200mm to 400-1000mm depth
B17 9	1950, 1983, 2005, 2016, 2017, 2018	46	Flooding type unknown; Internal and external flooding from <200mm to 400-1000mm depth
B20 1	2016	24	Flooding type unknown; Internal and external flooding from <200mm to 400-1000mm depth
B21 0	2005	2	Flooding type unknown; Internal flooding <200mm depth
B21 9	2016	4	Flooding type unknown; Internal and external flooding <200mm to 600-800mm depth
B23 5	2005, 2016, 2018	16	Flooding type unknown; Internal and external flooding <200mm to 600-600mm depth
B23 7	1998, 1999, 2000, 2012, 2013, 2018	23	Flooding type unknown; Internal and external flooding <200mm to 600-800mm depth
B24 0	2014, 2016, 2018	6	Flooding type unknown; Interal and external flooding from 400-800mm depth
B24 8	2014, 2018	2	Flooding type unknown; External flooding from 400-800mm depth
B24 9	1992, 2013, 2018	6	Flooding type unknown; Internal and external flooding from <200mm to 400-1000mm depth

Postcode	Date	Number of incidents	Additional recorded information
B26 1	2007	6	Flooding type unknown; External flooding from <200mm depth
B26 2	1998, 1999, 2000	4	Unknown
B27 7	2007, 2018	17	Flooding type unknown; Internal and external flooding from <200mm to 400-1000mm depth
B28 0	2007, 2018	4	Flooding type unknown; Internal flooding from <200mm depth
B28 8	2007, 2008, 2018	59	Flooding type unknown; Internal and external flooding from <200mm to 800-1000mm, to >1000mm depth
B29 4	2008, 2016	22	Flooding type unknown; Internal and external flooding from <200mm to 800-1000mm, to >1000mm depth
B29 5	1999, 2004, 2007, 2008, 2016, 2017, 2018	50	Flooding type unknown; Internal and external flooding from <200mm to 400-1000mm depth
B29 6	1999, 2000, 2002, 2004, 2005, 2007, 2008, 2015, 2016, 2018	91	Flooding type unknown; Internal and external flooding from <200mm to 400-1000mm depth
B29 7	1999, 2007, 2008, 2009, 2016, 2018	334	Flooding type unknown; Internal and external flooding from <200mm to 800-1000mm, to >1000mm depth
B30 1	2007, 2016	45	Flooding type unknown; Internal and external flooding from <200mm to 400mm
B30 2	2000, 2007, 2008, 2016, 2018	99	Flooding type unknown; Internal and external flooding from <200mm to 400-1000mm depth
B30 3	1998, 1999, 200, 2012, 2016, 2018	18	Flooding type unknown; Internal and external flooding from <200mm depth
B31 1	1998, 1999, 2000, 2018	31	Unknown
B31 2	1998, 1999, 2000, 2008	355	Flooding type unknown; Internal and external flooding from <200mm to 400mm depth
B31 3	1998, 1999, 2000, 2005, 2007, 2012	300	Flooding type unknown; Internal and external flooding from <200mm to 400-1000mm depth
B31 4	1998, 1999, 2000, 2004, 2005, 2016	60	Flooding type unknown; Internal and external flooding from <200mm to 400mm depth
B31 5	1998, 1999, 2000	254	Flooding type unknown; External flooding from <200mm to 600mm depth
B32 1	2002, 2007, 2012, 2014, 2015, 2016, 2018	14	Flooding type unknown; Internal and external flooding from <200mm to 600mm depth
B32 2	2005, 2012, 2016, 2018	36	Flooding type unknown; Internal and external flooding from <200mm to 400-800mm depth
B32 3	2005, 2008, 2012, 2016, 2017, 2018	198	Flooding type unknown; Internal and external flooding from <200mm to 400-1000mm, to >1000mm depth
B32 4	2008, 2012	20	Flooding type unknown; Internal and external

Postcode	Date	Number of incidents	Additional recorded information
			flooding from <200mm depth
B34 6	2007	40	Flooding type unknown; External flooding from <200mm to 400-1000mm, to >1000mm depth
B35 6	2016	1	Flooding type unknown; Internal flooding from <200mm depth
B38 8	1998, 1999, 2000, 2012, 2018	69	Flooding type unknown; Internal and external flooding from <200mm to 400 depth
B42 1	2016	23	Flooding type unknown; Internal and external flooding from <200mm to 600 depth
B42 2	1999, 2000, 2004, 2005, 2016	174	Flooding type unknown; External flooding from <200mm to 400-1000mm, to >1000mm depth
B43 6	2016	3	Unknown
B43 7	2012, 2016, 2018	8	Flooding type unknown; External flooding from <200mm to 400-1000mm depth
B44 0	2013, 2018	5	Flooding type unknown; External flooding from <200mm depth
B44 8	2007	2	Unknown
B44 9	2016	9	Flooding type unknown; Internal and external flooding from <200mm depth
B45 0	1998, 1999, 2000, 2016	205	Flooding type unknown; Internal and external flooding from <200mm to 400-1000mm depth
B45 9	2009, 2012	6	Unknown
B72 1	2016, 2018	16	Flooding type unknown; Internal and external flooding from <200mm depth
B73 5	2007, 2012, 2013, 2015, 2016, 2018	60	Flooding type unknown; Internal and external flooding from <200mm to 400-600mm depth
B73 6	1998, 1999, 2007, 2018	57	Flooding type unknown; External flooding from <200mm to 400-1000mm, to >1000mm depth
B74 2	2007, 2016, 2018	16	Flooding type unknown; Internal and external flooding from <200mm depth
B74 4	2016	9	Flooding type unknown; Internal and external flooding from <200mm depth
B75 5	2013, 2016, 2018	61	Flooding type unknown; Internal and external flooding from <200mm to 400-600mm depth
B75 7	2016	3	Flooding type unknown; Internal and external flooding from 400-600mm depth
B76 1	2003, 2004, 2012, 2016	37	Flooding type unknown; Internal and external flooding from <200mm to 400-800mm depth
B76 2	2014	9	Flooding type unknown; External flooding from <200mm depth

5.1.1 Section 19 Reports

Birmingham City Council also provided Section 19 Flooding reports from **June 2016** and **May 2018**.

Flooding in June 2016 was a result of a number of short, intense and highly localised storms. 435 flooding responses were reported, with a total of 205

flooding incidents in 23 areas identified to have experienced internal property flooding. The details of this flood event are included in Table 5-2.

Flooding in May 2018 was a result of a short, intense and highly localised storm. The storm was also extreme in terms of the amount of rainfall that fell during the event. 448 flooding responses were reported, with a total of 180 incidents across 41 areas of the city experiencing internal property flooding. The details of this flood event are included in

Table 5-3.

Table 5-2: Section 19 June 2016 Report Details

Flooding Location	No. of internally flooded properties	Cause of flooding
Alum Rock – Alum Rock Road	3	Surface water flooding from highway drainage blockages
Bartley Green – Middle Acre Road, Rush Green and Dainton Grove	5	Surface water flooding and flooding from rivers (Bartley Brook and Stonehouse Brook)
Bordesley Green – Pretoria Road	2	Surface water flooding and flooding from highway drainage
Bournville – Kingfisher Way	1	Surface water flooding and flooding from highway drainage
Falcon Lodge Sutton Coldfield	2	Surface water flooding, sewer flooding and flooding from rivers (Churchhill Brook)
Four Oaks – Highcroft Drive	1	Surface water flooding, flooding from sewer infrastructure and highway drainage flooding
Hampstead – Old Walsall Road	1	Surface water flooding
Handsworth Wood – Grestone Avenue and Sunningdale Close	3	Surface water flooding, sewer flooding and flooding from rivers (Hilltop Brook)
Handsworth Wood – Silvercroft Avenue	6	Surface water flooding, sewer flooding and flooding from rivers (Hilltop Brook)
Harborne (Bourn Brook) – Osmaston, Swinford, Elford, Reservoir and Quinton Roads, and Lismore Drive	33	Surface water flooding, flooding from highway drainage and from rivers (Harts Green Brook and Stonehouse Brook)
Harbone – Fredas Grove	1	Surface water flooding
Harbone – Queens Park, Queens Court and Harts Green Road	6	Surface water flooding, flooding from sewer infrastructure and highway drainage flooding
Mere Green – Cremorne and Mere Green Road	5	Surface water flooding, flooding from sewer infrastructure and highway drainage flooding
Oscott – School Lane, Aldbridge and Felstone Road, Sahdy Lane and Oscott School Lane	2	Surface water flooding
Perry Barr – Church Road	2	River flooding (River Tame) and from sewers
Perry Beeches – Beeches, Bradfield, Curbar, Grindleford, Haddon, Hassop,	44	Surface water flooding, river flooding (Perry Brook),

Flooding Location	No. of internally flooded properties	Cause of flooding
Sterndale, Turnberry Roads and Trehurst and Thornbridge Avenue.		flooding from sewer infrastructure, highway drainage and the motorway/motorway maintenance depot
Quinton – Ridgemount Croft, Overdale and Firsby Roads	5	Surface water flooding, flooding from sewer infrastructure, rivers (Welches Brook) and highway drainage
Roughley – Willmott and Slade Roads, Marlpit Lane	8	Surface water flooding, flooding from sewer infrastructure and highway drainage flooding
Selly Oak – Wood Brook and Bristol Road, Witherford Way, Middle Park Road	2	Surface water flooding, river flooding (Wood Brook), flooding from sewer infrastructure, and highway drainage
Selly Oak – Eastern Road	2	Surface water flooding
Selly Park North – Pershore and St John's Road, Riverside Drive, Third and Fourth Avenue	33	Surface water flooding, river flooding (Bourn Brook) and flooding from sewer infrastructure
Woodgate Valley – Plough Avenue, Bean Croft, Square and Tibbats Close. Ox Leaslow, Warston Avenue, County Close and Sommerfield Road. Rushy Piece and Gravel Bank	38	Surface water flooding, flooding from sewer infrastructure and highway drainage flooding

Table 5-3: Section 19 May 2018 Report Details

Flooding Location	No. of internally flooded properties	Cause of flooding
Acocks Green – Broom Hall Crescent	1	Surface water flooding, flooding from sewer infrastructure and highway drainage flooding
Billesley – Ardencote Road	3	Surface water flooding
Bournbrook and Selly Park – Hubert Road	1	Surface water flooding
Bournbrook and Selly Park – Oakfield and Serpentine Road	1	Surface water flooding
Bournbrook and Selly Park – Selly Park South, Kitchener Road, Moor Green Lane	1	Surface water flooding
Bournbrook and Selly Park – The Avenues	4	Surface water and fluvial flooding
Bournville and Cotteridge – Laburnum Road	1	Surface water flooding
Brandwood and Kings Heath – Brandwood cemetery, Broad Lane, Greenwood Close and Sunderton Road	5	Surface water flooding
Brandwood and Kings Heath – Brandwood Park Road	3	Surface water and fluvial flooding, and flooding from highway drainage
Brandwood and Kings Heath – High Street	2 (commercial)	Surface water flooding and flooding from highway drainage
Brandwood and Kings Heath – Newick Grove and Bryndale Avenue	2	Surface water flooding and flooding from highway drainage
Druids Heath and Monyhull – Bayston Road and Kinsey Grove	4	Surface water flooding
Druids Heath and Monyhull – Bicknell Croft and Saxelby Close	11	Surface water flooding
Druids Heath and Monyhull – Garretts Walk	1	Surface water flooding
Druids Heath and Monyhull – Rowcroft Covert	2	Surface water flooding
Druids Heath and Monyhull – Sherston Court	2	Surface water flooding
Druids Heath and Monyhull – Chanston Avenue	2	Surface water and sewer flooding
Druids Heath and Monyhull – Marsham Road	3	Flooding from highway drainage
Edgbaston – Barsham Close	2	Surface water flooding and flooding from highway drainage
Erdington – Spring Lane	1	Surface water and sewer

Flooding Location	No. of internally flooded properties	Cause of flooding
		flooding
Hall Green South – Brookwood Avenue	1	Surface water and fluvial flooding
Hall Green – Sarehole Road	3	Fluvial flooding
Harborne – Bourn Brook, Reservoir Road, Quinton Road and Beaumont Drive, Mellors Close, Ferncliffe and Omaston Roads	8	Fluvial flooding
Harborne – Clarence Road	4	Surface water flooding and flooding from highway drainage
Harborne – Mill Farm Road, Cadleigh Gardens, Quinton Road	8	Surface water flooding and flooding from highway drainage
Harborne – Weather Oaks	2	Surface water flooding and flooding from highway drainage
Highters Heath – Arundel Road and Maypole Lane	3	Surface water flooding and flooding from highway drainage
Highters Heath – Henlow and Sladepool Roads	5	Surface water and fluvial flooding
Highters Heath – Mountfield Close	2	Surface water flooding and flooding from highway drainage
Highters Heath – Warstock Road and Grendon Road	3 (including 1 commercial)	Surface water and sewer flooding
Moseley – Moor Green, Cadine Gardens, Moor Green Lane, Seaton Grove, Shutlock Lane, and Tilbury Grove	9 (including 1 school)	Surface water flooding and flooding from highway drainage
North Edgebaston – Wadhurst Road	11	Surface water flooding
Oscott – Queslett Road	1	Surface water flooding
Pype Hayes – Tyburn Road	1 (commercial)	Fluvial flooding
Quinton – Amersham Close	2	Surface water flooding
Sparkhill – Formans, Avondale, Percy Roads and Pentos Drive	31 (including 3 commercial)	Fluvial flooding
Stirchley – Dell Road	1	Surface water and sewer flooding
Stirchley – Pitcairn Close	3	Surface water flooding
Sutton Trinity – Wyndley Lane	2	Surface water flooding and flooding from highway drainage
Sutton Vesey – Boldmere Road and Wakefield Close	5 (2 commercial)	Surface water and sewer flooding

5.2 Topography, geology, soils and hydrology

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.

5.2.1 Topography

The Birmingham City Council administrative area is located on the Birmingham Plateau. Elevation varies from approximately 80mAOD in the mid-eastern to centre of Birmingham, to approximately 190mAOD to the south-western area of the study area. The large rivers of the Rea, Tame, Cole and Hatchford Brook dominate the topography of the area. The topography slopes downhill from the north and south-west towards the centre of the administrative area at Birmingham and to the mid-eastern of the area near Castle Vale, where the main rivers of the Tame and Rea and their tributaries flow into the study area.

There are some areas of higher topography up to approximately 190m to the south-west of Birmingham towards the edge of the Lickey Hills. There are some other areas of higher topography near Bartley Green, Woodgate, Rednel, Kings Heath, Harborne, Kingstanding and Mere Green.

The topography of the study area is shown in Figure 5-2**.**

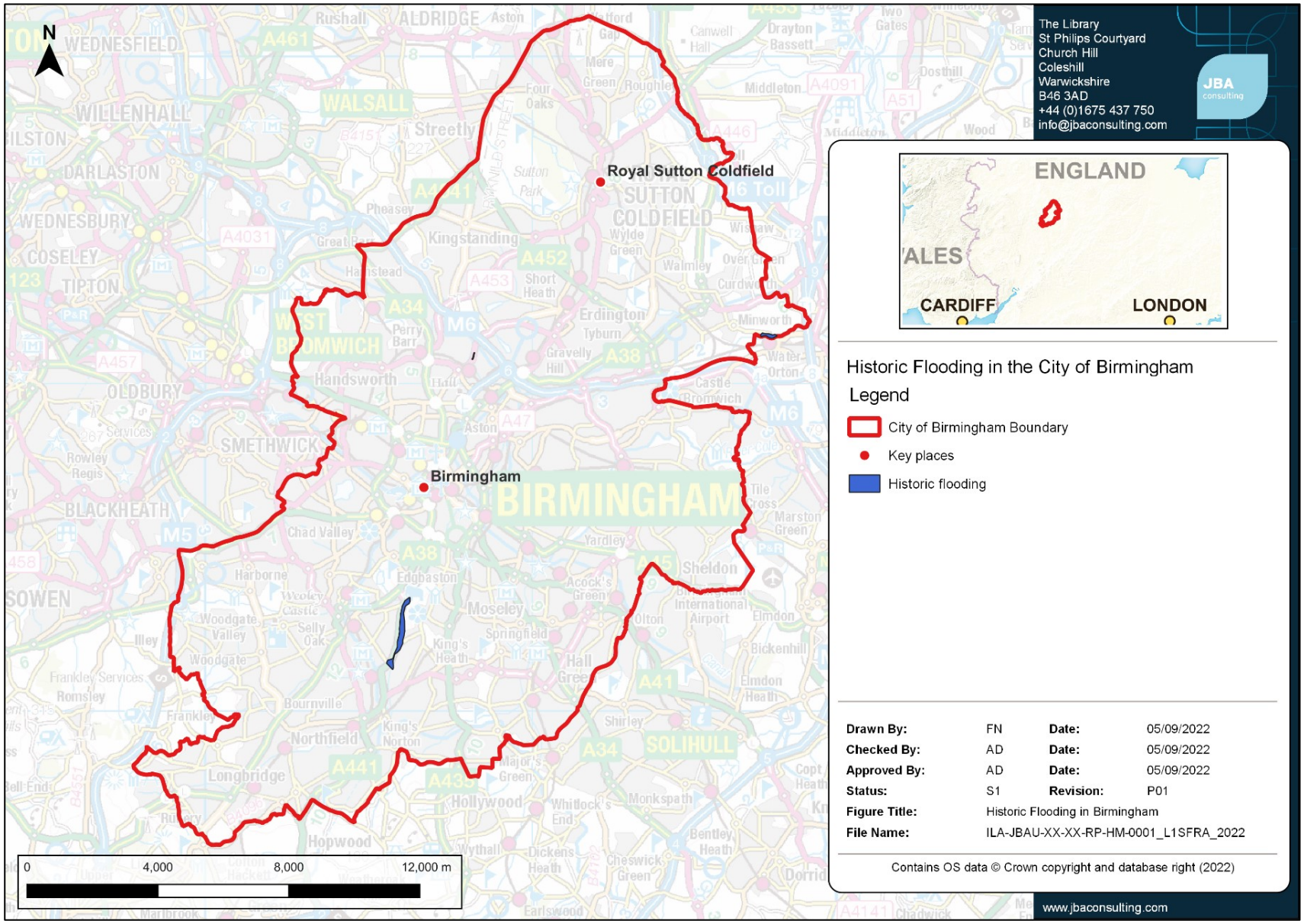

Figure 5-1: City of Birmingham historic flood outlines from the EA's Historic Flood Map

5.2.2 Geology

The underlying geology in the Birmingham area is predominantly the Sidmouth Mudstone Group to the eastern half of the study area. Mudstone tends to have low porosity and permeability however this is dependent upon grain size percentages and level of compaction undergone. The western half of the study area is predominantly sandstone, with interbedded areas of sandstone and conglomerate. Sedimentary rocks like sandstone are permeable and allow for the storage and movement of groundwater. The bedrock geology of the study area is shown in Figure 5-3.

The superficial geology across the study area is dominated by the presence of rivers. The superficial geology varies from glacial sand and gravel to clay, silt, sand and gravel. Where the river flood plains are the superficial deposits are alluvium comprised of clay, silt and sand, and river terrace deposits which comprise of sand and gravel. In the higher elevation areas to the south-west of Birmingham the superficial geology is dominated by till and diamicton.

The superficial geology of the study area is shown in Figure 5-4.

5.2.3 Soils

In the south of Birmingham there are some areas where the soils are predominantly slowly permeable, seasonally wet slightly acid but base-rich loamy and clayey soils. There are also some areas to the south-east where soils are slowly permeable, seasonally wet acid loamy and clayey soils such as in Hall Green. Around Yardley, the soils are slightly acid loamy and clayey soils with impeded drainage. Around Perry Barr, soils are naturally wet very acid sandy and loamy soils.

In the north of the study area, the soils are mostly freely draining slightly acid sandy soils, intermixed with freely draining loamy soils, and loamy and sandy soils with naturally high groundwater and a peaty surface.

In the river floodplains soils loamy and clayey soils with naturally high groundwater along watercourses.

5.3 Hydrology

The principal watercourses flowing through the Birmingham study area are:

- River Cole
- River Rea
- River Tame
- The Bourn
- Hatchford Brook
- Hockley Brook
- Plants Brook
- Westley Brook

Tributaries of these watercourses include smaller ordinary watercourses and numerous unnamed drains. There are also a number of ponds and lakes within the study area. A map of the key watercourses is included in Figure 1-2 and Geo-PDF mapping in Appendix A.

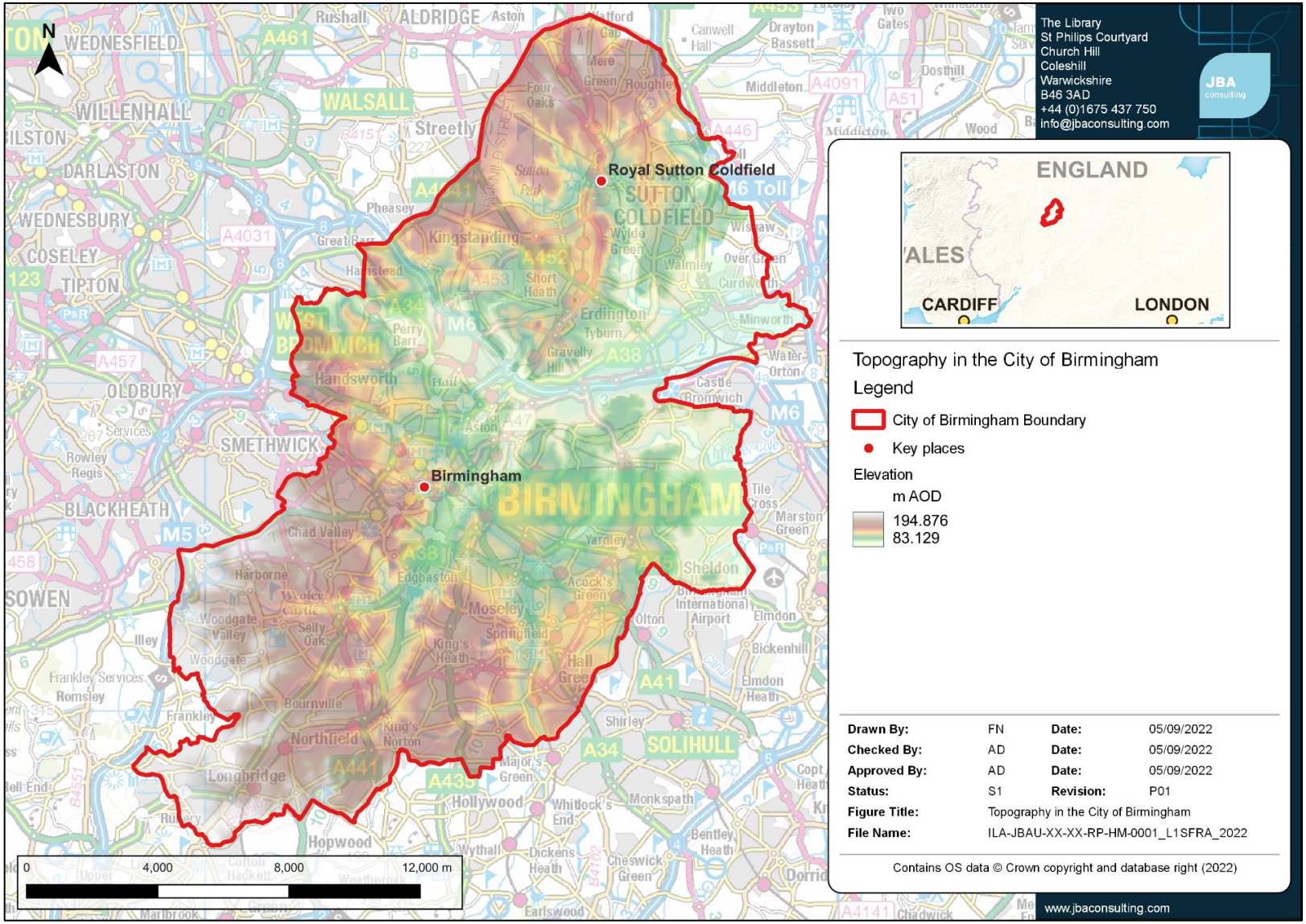

Figure 5-2: Topography of the study area

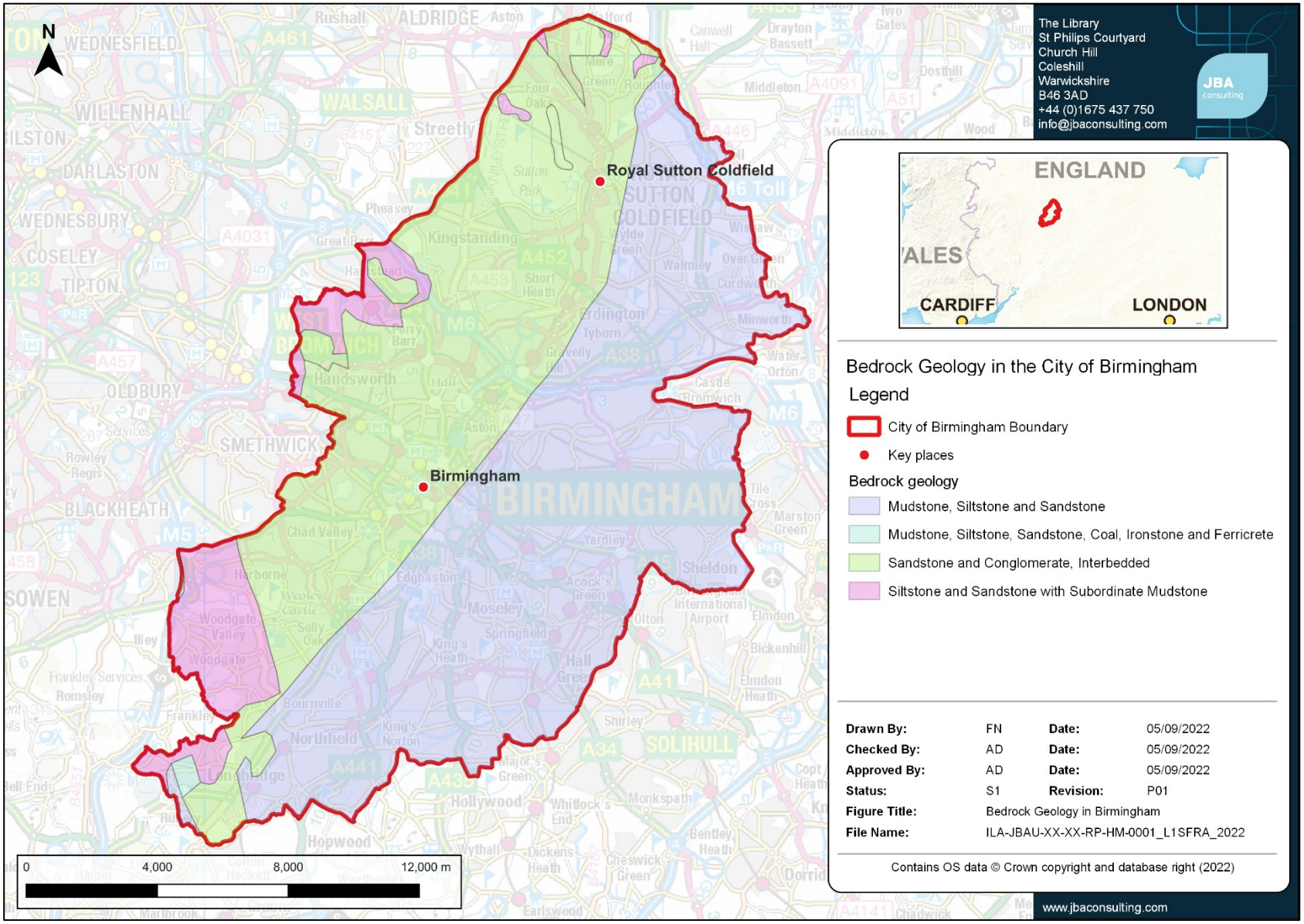

Figure 5-3: Bedrock geology of the City of Birmingham

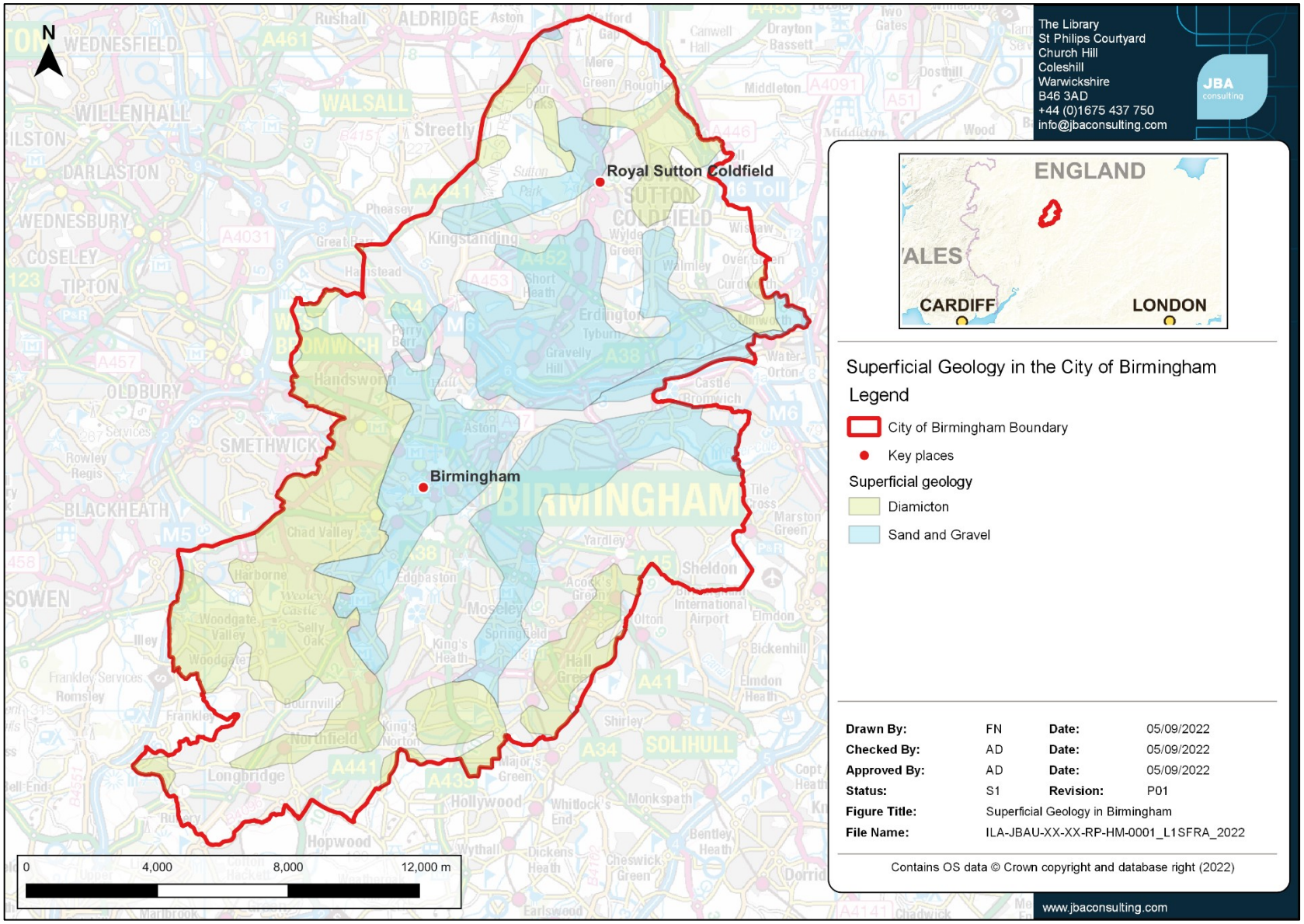

Figure 5-4: Superficial geology of the City of Birmingham

5.4 Fluvial flood risk

The primary fluvial flood risk is along the River Tame, River Rea, River Cole and their main tributaries. These present fluvial flood risk to the main urban centres of Birmingham and The Royal Town of Sutton Coldfield. The fluvial flood extents are fairly well confined in the north and south of the study area, with wider extents through the centre of the area along the River Tame due to the lower lying, flat topography.

The Flood Zone maps for the City of Birmingham are provided in Appendix A: Geo-PDFs, split into Modelled Flood Zones 2, 3a and 3b and The Environment Agency Flood Map for Planning Flood Zones 2 and 3a, which should be used in the absence of detailed model data. The flood risk associated with the major locations in the City of Birmingham are detailed in Appendix E.

5.5 Surface water flooding

Surface water runoff (or 'pluvial' flooding) is most likely to be caused by intense downpours e.g. thunderstorms. At times the amount of water falling can completely overwhelm the drainage network, which is not designed to cope with extreme storms. The flooding can also be complicated by blockages to drainage networks, sewers being at capacity and/ or high-water levels in watercourses that cause local drainage networks to back up.

The Environment Agency Risk of Flooding from Surface Water mapping (RoFSW) shows that a number of communities are at risk of surface water flooding. The mapping shows that surface water predominantly follows topographical flow paths of existing watercourses or dry valleys and can pond in low-lying areas. Whilst in the majority of cases the risk is confined to roads, there are notable prominent run-off flow routes around properties, e.g. properties situated at the foot of surrounding hills. The RoFSW mapping for the Birmingham study area can be found on the Geo-PDF mapping in Appendix A.

The RoFSW dataset has been used to derive surface water flood zones. Surface water flood zone A is defined as the 3.3%, 1% and 1% plus 25% climate change events. Development may be appropriate in this risk area. Surface water flood zone B is defined as the 1% +40% climate change and the 0.1% AEP events. Development on a site in this area is unlikely to be appropriate in this 'high risk' area.

5.6 Sewer flooding

Sewer flooding occurs when intense rainfall/river flooding overloads sewer capacity (surface water, foul or combined), and/or when sewers cannot discharge to watercourses due to high water levels.

Sewer flooding can also be caused by blockages, collapses, equipment failure or groundwater leaking into sewer pipes.

Since 1980, the Sewers for Adoption guidelines mean that new surface water sewers have been designed to have capacity for a rainfall event with a 1 in 30 chance of occurring in any given year, although until recently this did not apply to smaller private systems. This means that sewers will be overwhelmed in larger rainfall and flood events. Existing sewers can also become overloaded as new development adds to the surface water 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.

Severn Trent Water (STW) is the water company responsible for the management of the drainage networks across the Study Area.

Historical incidents of sewer flooding relating to the June 2016 and May 2018 Section 19 investigations are listed in Table 5-2.

Historical incidents of flooding recorded by STW are shown in Table 5-44. There has been a total of 857 sewer flooding incidents within the city of Birmingham, recorded in this Hydraulic Flood Risk Register. The highest risk localities include Woodgate, The Royal Town of Sutton Coldfield, Perry Barr and Moseley.

Severn Trent's DG5 register of historic sewer flooding incidents has recently been replaced by the 'At Risk Register', which gives properties a risk based on incident likelihood and impact on customer. Settlements with properties at risk on Severn Trent's 'At Risk Register' are set out in Table 5-4. For confidentiality reasons this data has been supplied on a postcode basis. Data was supplied from 1993 to March 2023.

Table 5-4: Recorded sewer flooding incidents (Hydraulic Flood Risk Register- Severn Trent Water)

Postcode	Number of external flooding incidents	Number of internal flooding incidents	Number of foul and surface water flooding incidents	Total number of incidents
B3	0	1	0	1
B5	0	5	0	5
B6	9	1	0	10
B7	0	1	0	1
B9	4	0	0	4
B10	1	0	0	1
B11	21	6	0	27
B12	1	3	0	4
B13	8	2	22	32
B14	12	0	16	28
B15	3	0	1	4
B16	4	1	2	7
B17	1	11	0	12
B18	3	1	1	5
B20	4	3	1	8
B21	0	1	1	2
B23	4	10	0	14
B24	6	0	1	7
B25	3	0	0	3
B26	12	0	0	12
B28	16	5	0	21
B29	25	0	4	29
B30	10	4	1	15
B31	10	7	5	22
B32	68	29	51	148
B36	4	0	0	4
B38	3	0	0	3
B42	43	5	56	104
B43	1	0	0	1
B44	4	1	0	5

Postcode	Number of external flooding incidents	Number of internal flooding incidents	Number of foul and surface water flooding incidents	Total number of incidents
B66	10	2	1	13
B68	2	0	3	5
B72	12	0	3	15
B73	50	21	19	90
B74	20	0	11	31
B75	92	5	39	136
B76	21	2	5	28
Totals	487	127	243	857

5.7 Groundwater flooding

In general, less is known about groundwater flooding than other sources. Groundwater flooding can be caused by:

- High water tables, influenced by the type of bedrock and superficial geology
- Seasonal flows in dry valleys, which are particularly common in areas of chalk geology
- Rebounding groundwater levels, where these have been historically lowered for industrial or mining purposes
- Where there are long culverts that prevent water easily getting into watercourses

Groundwater flooding is different to other types of flooding. It can last for days, weeks or even months and is much harder to predict and warn for. Monitoring does occur in certain areas, for example where there are major aquifers or when mining stops.

The JBA Groundwater emergence risk map for the Birmingham area provided in Appendix A. In high-risk areas, a site-specific risk assessment for groundwater flooding may be required to fully inform the likelihood of flooding.

The JBA Groundwater emergence risk map has the following hazard classification in the table below.

Table 5-5: Groundwater Flood Hazard Classification

Groundwater head difference (m)*	Gridcode	Class label
0 to 0.025	4	Groundwater levels are either at very near (within 0.025m of) the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
0.025 to 0.5	3	Groundwater levels are between 0.025m and 0.5m below the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to

Groundwater head difference (m)*	Gridcode	Class label
		surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
0.5 to 5	2	Groundwater levels are between 0.5m and 5m below the ground surface in the 100-year return period flood event There is a risk of flooding to subsurface assets but surface manifestation of groundwater is unlikely.
>5	1	Groundwater levels are at least 5m below the ground surface in the 100-year return period flood event. Flooding from groundwater is not likely.
N/A	0	No risk. This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.
*Difference is defined as ground surface in mAOD minus modelled groundwater table in mAOD.		

The areas most likely to have groundwater emergence are around the River Tame and Hawthorn Brook and Hockley Brook, the River Rea to the Bourn Brook and Chad Brook and the low-lying surrounding floodplain areas. In particular, this is around areas of Sutton Coldfield, Perry Barr, Handsworth Wood, Winson Green to the Jewellery Quarter (central Birmingham), Shore Heath, Castle Vale, west Edgebaston to Bournebrook and Rednal.

Groundwater flooding has been reported around Sparkhill, Kings Heath, Sutton Coldfield and Erdington.

5.8 Flooding from canals

Canals are regulated waterbodies and are unlikely to flood unless there is a sudden failure of an embankment or a sudden ingress of water from a river in areas where they interact closely. Embankment failure can be caused by:

- Culvert collapse
- Overtopping
- Animal burrowing
- Subsidence/ sudden failure e.g. collapse of former mine workings
- Utility or development works close or encroaching onto the footings of a canal embankment.

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 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. The Canal and River Trust monitor embankments at the highest risk of failure.

There are seven canals in the Birmingham study area: the Birmingham and Fazeley Canal, the Birmingham Canal, the Digbeth Branch Canal, the Stratford-upon-Avon Canal, the Worcester and Birmingham Canal, and the Tame Valley Canal. The Canal and River Trust were consulted to identify any instances of breaches and overtopping of each of the canals.

- The **Tame Valley Canal** comes into the study area in Hamstead, and the Birmingham and Fazeley Canal near the M6 near Gravelly Hill. There are two instances of overtopping along the Tame Valley Canal; one near Perry Reservoir, and one just north of Perry Barr.
- The **Birmingham and Fazeley Canal** enters the study area in the north-east near Minworth. It travels south-west where it meets the Birmingham Canal in the centre of Birmingham near New Street train station. There are 3 instances of breaches and one instance of overtopping along the Canal. Two breach events and one overtopping event occurred along the A38 near Castle Vale. The other breach event occurred near the Cambrian Wharf in Birmingham City.
- The **Birmingham Canal** enters the study area to the west near Edgbaston, and then travels eastward towards the Worcester and Birmingham Canal in Birmingham centre. There is one breach event that occurred along the canal near where it meets the Worcester and Birmingham Canal in the city.
- The **Worcester and Birmingham Canal** starts in the city centre and travels south out of the study area. There are four breach events along the canal, two south of the city centre, one in Selly Oak, and one in Bournville.
- The **Grand Union Canal** enters the study area in the south-east near Acocks Green to the north where it meets the Birmingham and Fazeley Canal at the Gravelly Hill Interchange. There are 8 breach events along the canal; two where the canal crosses the River Cole and the rest further north from Bordesley towards the interchange.
- The **Stratford-on-Avon Canal** comes into the study area at Warstock to the south, and travels west where it meets the Worcester and Birmingham Canal near Lifford. There are no instances of breach or overtopping on the Grand Union Canal within Birmingham.
- The **Digbeth Branch Canal** joins the Grand Union Canal to the Birmingham and Fazeley Canal in the centre of Birmingham. There are no instances of breach or overtopping on the Grand Union Canal within Birmingham.

The canals have the potential to interact with other watercourses in the study area, including the River Rea, Tame and Cole. These have the potential to become flow paths if these canals were overtopped or breached. 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. Guidance on development near canals is available from the **Canal and River Trust.**

5.9 Flooding from reservoirs

Reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the **Reservoir Act 1975** and are on a register held by the Environment Agency. The level and standard of inspection and maintenance required by a Supervising Panel of Engineers under the Act means that the risk of flooding from reservoirs is very low.

Flooding from reservoirs occurs following partial or complete failure of the control structure designed to retain water in the artificial storage area. Reservoir flooding is very different from other forms of flooding; it may happen with little, or no warning and evacuation will need to happen immediately. The likelihood of such flooding is difficult to estimate but is extremely low compared to flooding from other sources. It may not be possible to seek refuge upstairs from floodwater as buildings could be unsafe or unstable due to the force of water from the reservoir breach or failure.

The Environment Agency hold mapping showing what might happen if reservoirs fail. Developers and planners should check the **Long-Term Risk of Flooding website** before using the reservoir data shown in this SFRA to make sure they are using the most up to date mapping. The Environment Agency provide two flooding scenarios for the reservoir flood maps: a 'dry-day' and a 'wet-day'. The 'dry-day' scenario shows the predicted flooding which would occur if the dam or reservoir fails when rivers are at normal levels. The 'wet-day' scenario shows the predicted worsening of the flooding which would be expected if a river is already experiencing an extreme natural flood.

The current mapping shows that there are 32 reservoirs with extents that affect Birmingham, see Table 5-6. Section 8.5.3 provides further considerations for developing in the vicinity of reservoirs. The reservoir flood mapping for both the 'dry-day' and 'wet-day' scenarios in Birmingham has been provided in the Geo-PDFs in Appendix A. The Environment Agency maps represent a credible worst-case scenario. In these circumstances it is the time to inundation, the depth of inundation, the duration of flooding and the velocity of flood flows that will be most influential.

Table 5-6: Reservoirs with potential risk to Birmingham

Reservoir	Northings and eastings	Reservoir owner	Local Authority Area	Is the reservoir within the study area?	Does the reservoir impact the study area in the 'dry-day' scenario?
Barr Beacon No.1	406100, 297400	South Staffordshire Water PLC	Walsall	No	Yes
Barr Beacon No.2	406100, 297600	South Staffordshire Water PLC	Walsall	No	Yes
Bartley	400500, 281100	Severn Trent Water	Birmingham	Yes	Yes
Blackroot Pool	410700, 297200	Birmingham City Council	Birmingham	Yes	Yes
Bracebridge Pool	410000, 298000	Birmingham City Council	Birmingham	Yes	Yes
Dartmouth Boating Lake	401500, 291400	Sandwell Metropolitan Borough Council	Sandwell	No	Yes
Earlswood Lakes – Engine Pool	411100, 274100	Canal and Rivers Trust	Warwickshire	No	No
Earlswood Lakes – Windmill Pool	411420, 273874	Canal and Rivers Trust	Warwickshire	No	No
Edgbaston Pool	405500, 284000	Edgbaston Golf Club Ltd	Birmingham	Yes	Yes

Reservoir	Northings and eastings	Reservoir owner	Local Authority Area	Is the reservoir within the study area?	Does the reservoir impact the study area in the 'dry-day' scenario?
Erdington	410200, 291800	Severn Trent Water	Birmingham	Yes	Yes
Frankley Balancing Pond	399915, 277990	Environment Agency	Birmingham	Yes	Yes
Frankley Pure Water	400800, 279900	Severn Trent Water	Birmingham	Yes	Yes
Frankley Raw Water	400380	Severn Trent Water	Birmingham	Yes	Yes
Great Barr Lower Lake	405574, 294794	BCG Lakes Limited	Walsall	No	Yes
Lifford Reservoir	405805, 279864	Birmingham City Council	Birmingham	Yes	Yes
Longmoor Pool	409500, 295800	Birmingham City Council	Birmingham	Yes	Yes
Northfield	400200, 279200	Severn Trent Water	Worcestershire	No	Yes
Olton	413500, 281600	Canal and Rivers Trust	Solihull	No	Yes
Penns Hall Lake	413100, 293500	Sutton Coldfield Hotel Limited	Birmingham	Yes	Yes
Perry Barr	408300, 293500	Severn Trent Water	Birmingham	Yes	Yes
Perry Hall Playing Field	406019, 291697	Environment Agency	Birmingham	Yes	Yes
Perry Pool	406892	Birmingham City Council	Birmingham	Yes	Yes
Powells Pool	410500, 295300	Birmingham City Council	Birmingham	Yes	Yes
Rotton Park	404300, 286800	Canal and Rivers Trust	Birmingham	Yes	Yes
Salford Reservoir	409100, 290100	Birmingham City Council	Birmingham	Yes	Yes
Sandwell Valley Storage Lake	403200, 292600	Environment Agency	Sandwell	No	Yes
Swan Pool	402400, 292000	Sandwell Metropolitan Borough	Sandwell	No	Yes

Reservoir	Northings and eastings	Reservoir owner	Local Authority Area	Is the reservoir within the study area?	Does the reservoir impact the study area in the 'dry-day' scenario?
		Council			
Swanhurst Pool	409100, 281700	Birmingham City Council	Birmingham	Yes	Yes
Trittiford Mill Pool	409900, 280000	Birmingham City Council	Birmingham	Yes	Yes
Witton Lake	408800, 292300	Birmingham City Council	Birmingham	Yes	Yes
Wychall	403900, 279200	Environment Agency	Birmingham	Yes	Yes
Wyndley Pool	411295	Birmingham City Council	Birmingham	Yes	Yes

As above, the risk of reservoir flooding is extremely low. However, there remains a residual risk to development from reservoirs which developers should consider during the planning stage.

- Developers should seek to contact the reservoir owner to obtain information which may include:
    - reservoir characteristics: type, dam height at outlet, area/volume, overflow location;
    - operation: discharge rates/maximum discharge;
    - discharge during emergency drawdown; and
    - inspection/maintenance regime.
- Developers should apply the sequential approach to locating development within the site.
- Consult with relevant authorities regarding emergency plans in case of reservoir breach.
- The reservoir owners are contacted to confirm the Reservoir Risk Designation (if determined) and the inspection and maintenance regime of the reservoir.
- Consider the impact of a breach and overtopping, particularly for sites proposed to be located immediately downstream of a reservoir. This should consider whether there is sufficient time to respond.
- It should also be understood that the "risk category" of a reservoir is set by the potential damage and loss of life in circumstances where there is a breach or an extreme flood event. Accordingly, it is possible that allocation of new development downstream of an existing reservoir could potentially change the risk category and result in a legal requirement (under the Reservoirs Act 1975) to improve the structural and hydraulic capacity of the dam. As the cost of implementing such works can be substantial consideration should be given to considering the implications and whether it would be more appropriate to place development in alternative locations not associated with such risk.
- The EA online Reservoir Flood Maps contain information on the extents, depths and velocities following a reservoir breach (note: only for those reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoirs Act 1975). For proposed sites located within the extents, consideration should be given to the extent, depths and velocities shown in these online maps.
- In addition to the risk of inundation, those considering development in areas affected by breach events should also assess the potential hydraulic forces imposed by the rapid flood event and check that that the proposed infrastructure fabric can withstand the loads imposed on the structures by a breach event.

5.10 Flood Alert and Flood Warnings

The Environment Agency is the lead organisation for providing warnings of river flooding. Flood Warnings are supplied via the Flood Warning System (FWS) service, to homes and business within Flood Zones 2 and 3.

There are currently 11 Flood Alert Areas (FAA) and 25 Flood Warning Areas (FWAs) covering Birmingham. Flood Alerts are issued when there is water out of bank for the first time anywhere in the catchment, signalling that 'flooding is possible', and therefore Flood Alert Areas usually cover the majority of Main River

reaches. Flood Warnings are issued to designated Flood Warning Areas (i.e. properties within the extreme flood extent which are at risk of flooding), when the river level hits a certain threshold; this is correlated between the FWA and the gauge, with a lead time to warn that 'flooding is expected'.

A list of the Flood Alert and Flood Warning Areas is available in Appendix D. A map of the Flood Alert Areas and Flood Warning Areas is included in the Geo-PDF mapping in Appendix A.

5.11 Summary of flood risk in the Birmingham area

A table summarising all sources of flood risk to key settlements in the Birmingham City Council administrative area can be found in Appendix E.

6 Flood alleviation schemes and assets

This section provides a summary of existing flood alleviation schemes and assets in the Birmingham study area. Planners should note the areas that are protected by defences where further work to understand the actual and residual flood risk through a Level 2 SFRA may be beneficial. Developers should consider the benefit they provide over the lifetime of a development in a site-specific Flood Risk Assessment.

6.1 Asset management

- Risk Management Authorities hold databases of flood risk management and drainage assets:
- The Environment Agency holds a national database that is updated by local teams
- The LLFA holds a database of significant local flood risk assets, required under Section 21 of the Flood and Water Management Act (2010)
- Highways Authorities hold databases of highways drainage assets, such as gullies and connecting pipes
- Water Companies hold records of public surface water, foul and combined sewers, the records may also include information on culverted watercourses.
- The databases include assets RMAs directly maintain and third-party assets. The drainage network is extensive and will have been modified over time. It is unlikely that any RMA contains full information on the location, condition and ownership of all the assets in their area. They take a prioritised approach to collecting asset information, which will continue to refine the understanding of flood risk over time.
- Developers should collect the available asset information and undertake further survey as necessary to present an understanding of current flood risk and the existing drainage network in a site-specific Flood Risk Assessment.

6.2 Standards of Protection

- Flood defences are designed to give a specific Standard of Protection (SoP), reducing the risk of flooding to people and property in flood prone areas. For example, a flood defence with a 100-year SoP means that the flood risk in the defended area is reduced to at least a 1% chance of flooding in any given year.
- Over time the actual SoP provided by the defence may decrease, for example due to deterioration in condition or increases in flood risk due to climate change. The understanding of SoP may also change over time as RMAs undertake more detailed surveys and flood modelling studies.
- It should be noted that the Environment Agency's on-going hydraulic modelling programme may revise flood risk datasets and, as a consequence, the standard of protection offered by flood defences in the area may differ from those discussed in this report.
- Developers should consider the SoP provided by defences and residual risk as part of a detailed FRA. Developers should seek opportunities to enhance SoP within their site with RMAs.

6.3 Maintenance

- The Environment Agency and Lead Local Flood Authorities have permissive powers to maintain and improve Main Rivers and Ordinary Watercourses, respectively. There is no legal duty to maintain watercourses, defences or assets and maintenance and improvements are prioritised based on flood risk. Under common law, the ultimate responsibility for maintaining Ordinary Watercourses rests with the riparian owner, landowners who own bounding upon a river or other body of water. Riparian responsibilities include the maintenance of the bank and bed in that section of watercourse to avoid any obstructions of flow in the watercourse. Further guidance for Riparian Owners has been provided by the **Environment Agency.**
- Highway's authorities have a duty to maintain public roads, making sure they are safe, passable and the impacts of severe weather have been considered. Water companies have a duty to effectually drain their area. What this means in practise is that assets are maintained to common standards and improvements are prioritised for the parts of the network that do not meet this standard e.g. where there is frequent highway or sewer flooding. Birmingham City Council as the LLFA has permissive powers and limited resources are prioritised and targeted to where it can have the greatest effect.
- There is potential for the risk of flooding to increase in areas where flood alleviation measures are not maintained regularly. Breaches in raised flood defences are most likely to occur where the condition of a flood defences has degraded over time. Drainage networks in urban areas can also frequently become blocked with debris and this can lead to blockages at culverts or bridges.
- Developers should not assume that any defence, asset or watercourse is being or will continue to be maintained throughout the lifetime of a development. They should contact the relevant RMA about current and likely future maintenance arrangements and ensure future users of the development are aware of their obligations to maintain watercourses.
- Formal structural defences are given a rating based on a grading system for their condition. A summary of the grading system used by the Environment Agency for condition is provided in Table 6-1.

Table 6-1: Grading system used by the Environment Agency to assess asset condition

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

Source: Condition Assessment Manual – Environment Agency 2006

6.4 Major flood risk management assets in Birmingham

The Environment Agency 'AIMS' flood defence dataset gives further information on all flood defence assets within Birmingham. The following locations benefit from flood defences at a lower (or unknown) standard of protection in the study area (Table 6-2). 'Unknown' represents design SOPs, current SOPs and condition ratings which have not been recorded in the dataset.

Table 6-2: Locations shown in the 'EA AIMS' data set

Water course	Location	Type	Design SOP	Current SOP	Condition Rating
River Cole	Natural High Ground runs along the length of the Cole through the study area on both banks from where it enters the study area to the east, and then down to Springfield.	Natural High Ground	Either 5 years or 'unknown'	'Unknown'	'Unknown'
River Rea	Natural High Ground are along both banks from where it meets the River Tame near the city centre down to Vauxhall. There are small sections on the eastern banks of the river along Digbeth. Engineered High Ground runs along both banks of the river from Digbeth down to Canon Park. There are small sections along Ten Acres Park, Kings Norton and Northfield. Small sections of embankment run along the northern banks of the river at Longbridge and Ten Acres. There is a small Flood Wall near Dogpool Lane near Stirchley.	Embankment, Natural High Ground, Engineered High Ground and Wall	Embankment – 'unknown' to 100 years. High Ground – 'unknown' to 100 years. Walls – 'unknown' to 100 years.	Embankment – 'unknown' to 100 years High Ground – 'unknown' Walls – 'unknown'	'Unknown' to Good
River Tame	Natural High Ground runs along the length of the Tame along certain sections of the river, such as around the Graveley Hill Interchange, Witton and Tameside Drive. There are small sections of natural high ground on the southern/eastern banks of the river along Wolseley Drive. There is a small section of engineered high ground along Wolseley Drive. Engineered High Ground covers the Tame where there is no natural high ground. Embankments run along the southern bank of the Tame at	Embankment, Natural High Ground, Engineered High Ground and Wall	Embankment – 50 years High Ground – 50 years Walls – 'unknown' too 100 years	Embankment – 'unknown' High Ground – 'unknown' Walls – 'unknown' to 100 years	'Unknown' to Fair

Water course	Location	Type	Design SOP	Current SOP	Condition Rating
	Perry Hall. There are flood Walls along small sections of the Tame such as at Hurricane Park, the northern bank at Aston villa and at the Atlas Industrial Estate.				
Bourn Brook	Natural High Ground runs along both banks of the Brook from Northfield Road to Elford Road, and from Bristol Road to where the Brook meets the Tame. There are smaller sections along the northern banks of the Brook. Engineered High Ground runs along parts of the Brook such as near Selly Oak and north of Reservoir Road along the walkway. An Embankment runs along the northern bank of the river from Harborne Lane along the Bourn Brook Walkway as part of the Selly Park Flood Alleviation Scheme.	Natural High Ground, Engineered High Ground, Embankment	Embankment – 100 years High Ground – 'unknown' to 120 years	Embankment – 100 years High Ground – 'unknown' to 120 years	'Unknown' to Good
Hatchford Brook	Natural High Ground runs along the length of the Brook within the study area on both banks.	Natural High Ground	5 years	'Unknown'	'Unknown'
Westley Brook	Natural High Ground runs along the length of the Brook on both banks from the northern end of the Brook to Parkdale Road, then along the northern bank to Church Road. Engineered High Ground runs along the southern bank from Parkdale to Church road, and then along both banks from Church road to the south where it exits the study area. There are two short walls within Westley Brook protecting associated with the Warwick Road trash screen in Olton.	Natural High Ground Engineered High Ground Wall	High Ground – 5 years Wall – 'unknown' to 5 years	High Ground – 'unknown' Wall – 'unknown'	'Unknown' to Good

Water course	Location	Type	Design SOP	Current SOP	Condition Rating
Hawthorn Brook	Natural High Ground runs along the length of the Brook within the study area on both banks. There is also an embankment along the northern side of Brookvale Park Lake.	Natural High Ground Embankment	High Ground and Embankment – 5 years	High Ground and Embankment – 'unknown'	'Unknown'

6.5 Existing and future flood alleviation schemes

Below are the current and potential future schemes lead by the Environment Agency, Birmingham City Council and Severn Trent Water. Some of these schemes are outlined in more detail below.

6.5.1 Selly Park North

The Selly Park North flood risk management scheme is operational with landscaping to be finalised once the adjacent development has been completed. This project was EA run in partnership with Calthorpe Estates and Birmingham City Council to protect 150 properties.

6.5.2 Perry Barr and Witton flood risk management scheme

As part of the River Tame strategy this scheme includes two phases, including improvement works to flood walls, gates and culverts in the area. There has also been works to increase the flood storage capacity in the Sandwell Valley. The scheme affords protection to 1400 houses.

6.5.3 Bromford and Castle Vale flood risk management scheme

This scheme is also part of the River Tame flood risk management strategy and aims to protect more than 900 homes and businesses from flooding. The scheme involves improving and raising flood walls, constructing new flood walls and building embankments.

6.5.4 The Bourn and Lower Rea flood risk management scheme

The **Rea Catchment Partnership** outlines the intention of this scheme which is currently at Outline Business Case stage, is to build three storage areas to reduce the flood risk to southern Birmingham City Centre. One of these will be at Calthorpe Park. This aims to protect 270 residential and 360 commercial properties from fluvial flooding.

6.5.5 River Rea Landscape Visioning

The **Rea Catchment Partnership** outlines the project, commissioned by the EA, ARUP and Gillespies to address and restore the ecology of the catchment and improve flood management through a holistic masterplan. The catchment has been heavily canalised and culverted, and therefore this aims to provide specific environmental improvements.

6.5.6 Upper Rea Flood Risk Management Scheme

The Rea Catchment partnership outlines the project, which will identify and provide solutions to communities across the Upper Rea catchment from Rubery/Frankley to the confluence with the Bourn at Stirchley. This scheme is currently at the Initial Assessment stage so works are not identified yet, although it will assess potential options to reduce flood risk at Northfield and Kings Norton.

6.5.7 Stonehouse and Upper Bourn Brook

The Rea Catchment partnership outlines the project led by the EA working with BCC and STW. The partnership has developed a new flood risk computer model for the catchment to identify potential options to reduce flooding within the catchment. The scheme will aim to identify where water can be stored across the catchment in order to reduce flood risk from fluvial and surface water sources around Ridgearce, Woodgate Valley, Bartley Green, Weoley Castle and Harborne.

6.5.8 Tame, Anker and Mease Catchment Action Management Plan

There is currently a **Tame, Anker and Mease Catchment Action Management Plan**, running from 2020-2025 which aims to improve the ecological and WFD status of the rivers within the catchment. This will be done by improving the wildlife habitat, providing flood alleviation, and 'Greening the grey' to improve urban areas.

6.5.9 Natural flood management (NFM)

NFM is used to protect, restore and re-naturalise the function of catchments and rivers to reduce flood risk. A wide range of techniques can be used that aim to reduce flooding by working with natural features and processes in order to store or slow down flood waters before they can damage flood risk receptors (e.g. people, property, infrastructure, etc.). Techniques and measures, which could be applied in the Birmingham study area include:

- Creation of offline storage areas
- Re-meandering streams (creation of new meandering courses or reconnecting cut-off meanders to slow the flow of the river)
- Targeted woodland planting
- Reconnection and restoration of functional floodplains
- Restoration of rivers and removal of redundant structures i.e. weirs and sluices no longer used or needed
- Installation or retainment of large woody material in river channels
- Improvements in management of soil and land use
- Creation of rural and urban SuDS

In 2017, the Environment Agency published an online evidence base to support the implementation of NFM and maps showing locations with the potential for NFM measures. These maps are intended to be used alongside the evidence directory to help practitioners think about the types of measure that may work in a catchment and the best places in which to locate them. There are areas within the study area whereby removing existing defences and reconnecting the floodplain could create areas for potential without causing risk to properties. Areas where such opportunities could potentially be considered includes along the Rivers Rea, Cole, Tame and Bourn Brook. Areas in Birmingham where tree planting could potentially be considered as an NFM measure are most notably along the Bourn and Rea.

6.6 Other schemes

The EA's **Asset Management** map provides an updated indication of schemes that are under construction or have a forecast start date. There are capital schemes shown in this mapping in Birmingham which include:

- Eastern Road Flood Bund – Better protect homes against flooding.

6.7 Actual and residual flood risk

A Level 2 SFRA (for strategic allocations) or developer site-specific Flood Risk Assessment will need to consider the actual and residual flood risk due to the presence of flood and drainage assets in greater detail (although it should be noted that Zone 3b is based on the actual flood risk).

6.7.1 Actual flood risk

This is the risk to the site considering existing flood mitigation measures and any planned to be provided through new development. Note that it is not likely to be

acceptable to allocate developments in existing undefended areas on the basis that they will be protected by developer works, unless there is a wider community benefit that can be demonstrated.

The assessment of the actual risk should take into account that:

- 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 this to be reviewed.
- The standard of safety must be maintained for the intended lifetime of the development. Over time the effects of climate change will erode the present-day standard of protection afforded by defences and so commitment is needed to invest in the maintenance and upgrade of defences if the present-day levels of protection are to be maintained and where necessary, land secured and safe-guarded that is required for affordable future flood risk management measures.
- 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.

6.7.2 Residual risk

Residual risk is the risk that remains after the effects of flood risk infrastructure have been taken into account. 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 larger flood than defences were designed to alleviate (the 'design flood'). This can cause 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 amount of water.
- Failure of the defences or flood risk management measures, such as breaches in embankments or walls, failure of flood gates to open or close or failure of pumping stations.

It is the responsibility of the developer to fully assess flood risk, propose measures to mitigate it and demonstrate that any residual risks can be safely managed.

This SFRA does not assess the probability of failure other than noting that such events are very rare. However, in accordance with NPPF, all sources of flooding need to be considered. If a breach or overtopping event were to occur, then the consequences to people and property could be high. Developers should be aware that any site that is at or below defence level, may be subject to flooding if an event occurs that exceeds the design capacity of the defences, or the defences fail, and this should be considered in a detailed Flood Risk Assessment.

The assessment of residual risk should take into account:

- The flood hazard, depth and velocity that would result from overtopping or breach of defences. Flood gate or pumping station failure and/ or culvert blockage (as appropriate). The Environment Agency can provide advice at site-specific development level for advice on breach/ overtopping parameters for flood models.

- The design of the development to take account of the highest risk parts of the site e.g. allowing for flood storage on parts of the site and considering the design of the development to keep people safe e.g. sleeping accommodation above the flood level.
- A system of warning and a safe means of access and egress from the site in the event of a flood for users of the site and emergency services.
- Climate change and/ or policy-dependent residual risks (such as those that may be created if necessary, future defence improvements are required, or those associated with any managed adaptive strategies).

6.7.3 Overtopping

The risk from overtopping of defences is based on the relative heights of property or defence, the distance from the defence level and the height of water above the crest level of the defence. The Defra and Environment Agency **Flood Risks to People** guidance document provides standard flood hazard ratings based on the distance from the defence and the level of overtopping.

Any sites located next to defences or perched ponds/ reservoirs, may need overtopping modelling or assessments at the site-specific FRA stage, and climate change needs to be taken in to account.

6.7.4 Defence breach

A breach of a defence occurs when there is a failure in the structure and a subsequent ingress of flood water.

Where defences are present, risk of breach events should be considered as part of the site-specific FRA. Flood flows from breach events can be associated with significant depths and flow velocities in the immediate vicinity of the breach location and so FRAs must include assessment of the hazards that might be present so that the safety of people and structural stability of properties and infrastructure can be appropriately taken into account. Whilst the area in the immediate vicinity of a breach can be subject to high flows, the whole flood risk area associated with a breach must also be considered as there may be areas remote from the breach that might, due to topography, involve increased depth hazards.

Considerations include the location of a breach, when it would occur and for how long, the depth of the breach (toe level), the loadings on the defence and the potential for multiple breaches. There are currently no national standards for breach assessments and there are various ways of assessing breaches using hydraulic modelling. Work is currently being undertaken by the Environment Agency to collate and standardise these methodologies. It is recommended that the Environment Agency are consulted if a development site is located near to a flood defence, to understand the level of assessment required and to agree the approach for the breach assessment.

7 Cumulative impact of development and strategic solutions

Under the NPPF, strategic policies and their supporting Strategic Flood Risk Assessments (SFRAs), are required to 'consider cumulative impacts in, or affecting, local areas susceptible to flooding' (para.160), rather than just to or from individual development sites.

When allocating land for development, consideration should be given to the potential cumulative impact of the loss of floodplain storage volume, as well as the impact of increased flows on flood risk downstream. Whilst the loss of storage for individual developments may only have a minimal impact on flood risk, the cumulative effect of multiple developments may be more severe. Similarly the effect of the loss of surface water flow paths, surface ponding and infiltration can also give rise to cumulative effects and potentially exacerbate surface water flood risk. Local Plan Policy should be referred to and any requirements, such as meeting greenfield discharge rates as a requirement for all major developments.

All developments are required to comply with the NPPF and demonstrate they will not increase flood risk elsewhere. Therefore, providing developments comply with the latest guidance and legislation relating to flood risk and sustainable drainage and appropriate consideration is given to surface water flow paths and storage proposals should normally not increase flood risk downstream.

Catchments within the study area that have the potential to influence existing flood risk issues in neighbouring Local Authorities were identified, as well as catchments in the study area that may be influenced by development in catchments in neighbouring Local Authorities. Historic flood incidents, the current and predicted increase in surface water flood risk to properties and cross boundary issues in each catchment were assessed to identify the catchments at greatest risk.

Local planning policies can also be used to identify areas where the potential for development to increase flood risk is highest and identify opportunities for such new development to positively contribute to decreases in flood risk downstream.

Once the proposed development had been assessed against Fluvial Flood Risk, Risk of Flooding from Surface Water, Historic Flooding Incidents, and the potential increased developed area, the CIA identified five High Risk catchments within, or partially within the Birmingham City Council administrative area. These are:

- Tame (Oldbury Arm) - source to confluence with River Tame (Wton Arm)
- Rea from Bourn Brook to River Tame
- Tame – River Rea to River Blythe
- Rea source to Bourn Brook
- Arrow – source to Spernall Hall Farm, Studley

It is recommended that the BCC work closely with neighbouring local authorities to develop complementary Local Planning Policies for catchments that drain into and out of Birmingham to other local authorities in order to minimise cross boundary issues of cumulative impacts of development.

The Cumulative Impact Assessment (CIA) can be found in Appendix F.

8 Flood risk management requirements for developers

This section provides guidance on site-specific Flood Risk Assessments (FRAs). These 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, considering climate change and vulnerability of users.

The report provides a strategic assessment of flood risk within the Birmingham City Centre Authority study area. Prior to any construction or development, site-specific assessments will need to be undertaken so all forms of flood risk and the actual and residual risk and standard of protection and safety at a site are considered in more detail. Developers should, where required, undertake more detailed hydrological and hydraulic assessments of watercourses to verify flood extents (including latest climate change allowances), to inform the sequential approach within the site and prove, if required, whether the Exception Test can be satisfied.

A detailed FRA may show that a site, windfall[1] or other, is not appropriate for development of a particular vulnerability or even at all. The Sequential and Exception Tests in the NPPF apply to all developments and an FRA should not been seen as an alternative to proving these tests have been met. The requirements of the **BDP** Policy TP6 should also be met which includes guidance on FRAs and SuDS assessment, operation and maintenance.

8.1 Principles for new developments

8.1.1 Apply the Sequential and Exception Tests

Developers should refer to Section 3 for more information on how to consider the Sequential and Exception Tests. For allocated sites, Birmingham City Council should use the information in this SFRA to apply the Sequential Test. For windfall sites a developer must undertake the Sequential Test, which includes considering reasonable alternative sites at lower flood risk. Only if it passes the Sequential Test should the Exception Test then be applied if required. The Sequential and Exception Tests in the NPPF apply to all developments and an FRA should not be seen as an alternative to proving these tests have been met.

Developers should also apply the sequential approach to locating development within the site. The following questions should be considered:

- can risk be avoided through substituting less vulnerable uses or by amending the site layout?
- can it be demonstrated that less vulnerable uses for the site have been considered and reasonably discounted? and
- can the site layout be varied to reduce the number of people, the flood risk vulnerability or the building units located in higher risk parts of the site?

[1] 'Windfall sites' is used to refer to those sites which become available for development unexpectedly and are therefore not included as allocated land in a planning authority's development plan.

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

Developers should consult with the Environment Agency, Birmingham City Council as LLFA and STW at an early stage to discuss flood risk including requirements for site-specific FRAs, detailed hydraulic modelling and drainage assessment and design.

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

The SFRA can be used by developers to scope out what further detailed work is likely to be needed to inform a site-specific Flood Risk Assessment. At a site level, developers will need to check before commencing on a more detailed Flood Risk Assessment that they are using the latest available datasets. Developers should apply the most up-to-date Environment Agency climate change guidance (last updated in May 2022) and ensure the development has taken into account climate change adaptation measures.

8.1.4 Ensure that the development does not increase flood risk elsewhere

Section 9 sets out these requirements for taking a sustainable approach to surface water management. Developers should also ensure mitigation measures do not increase flood risk elsewhere and that floodplain compensation is provided where necessary.

8.1.5 Ensure the development is safe for future users

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. Developers should consider both the actual and residual risk of flooding to the site, as discussed in Section 3.

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

8.1.6 Enhance the natural river corridor and floodplain environment through new development

Developments should demonstrate opportunities to create, enhance and link green assets. This can provide multiple benefits across several disciplines including flood risk and biodiversity/ ecology and may provide opportunities to use the land for an amenity and recreational purposes. Development that may adversely affect green infrastructure assets should not be permitted. Where possible, developers should identify and work with partners to explore all avenues for improving the wider river corridor environment. Developers should open up existing culverts and should not construct new culverts on site except for short lengths to allow essential infrastructure crossings.

8.1.7 Consider and contribute to wider flood mitigation strategy and measures in the area and apply the relevant local planning policy

Wherever possible, developments should seek to help reduce flood risk in the wider area e.g. by contributing to a wider community scheme or strategy for strategic measures, such as defences or NFM or by contributing in kind by mitigating wider flood risk on a development site. More information on the contribution developers are expected to make towards achieving the wider vision for FRM and sustainable drainage in Birmingham can be found in Section 7.3. Developers must demonstrate in an FRA how they are contributing towards this vision.

8.2 Requirements for site-specific Flood Risk Assessments

8.2.1 When is an FRA required?

Site-specific FRAs are required in the following circumstances:

- Proposals of 1 hectare or greater in Flood Zone 1.
- Proposals for new development (including minor development such as non-residential extensions, alterations which do not increase the size of the building or householder developments 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).
- Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.
- At locations where it is proposed to locate development in a high-risk surface water flood zone.

An FRA may also be required for some specific situations:

- If the site may be at risk from the breach of a local defence (even if the site is actually in Flood Zone 1)
- Where evidence of historical or recent flood events have been passed to the LPA
- Land identified in an SFRA as being at increased risk in the future.

8.2.2 Objectives of a site-specific FRA

Site-specific FRAs should be proportionate to the degree of flood risk and 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 should follow the approach recommended by the NPPF (and associated guidance) and guidance provided by the Environment Agency and the Birmingham City Council administrative area. 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** Local requirements for mitigation measures such as the **BDP** policy TP6 for requirements for developers, such as all major applications need to submit a Sustainable Drainage assessment, operation and management plan along with a FR.

8.2.3 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. Whether parking in floodplains is appropriate will be based on the likely flood depths and hazard, evacuation procedures and availability of 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.

8.2.4 Modification of ground levels

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

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 as raising land above the floodplain could reduce conveyance or flood storage in the floodplain and could adversely impact flood risk downstream or on neighbouring land. 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.

Compensatory flood storage should be provided, and would normally be on a level for level, volume for volume basis on land that does not currently flood but is adjacent to the floodplain (in order for it to fill and drain). It should be in the vicinity of the site and within the red line of the planning application boundary (unless the site is strategically allocated). Guidance on how to address floodplain compensation is provided in Appendix A3 of the CIRIA Publication C624.

Where proposed development results in a change in building footprint, the developer should ensure that it does not impact upon the ability of the floodplain to store or convey water and seek opportunities to provide floodplain betterment.

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.

8.2.5 Raised floor levels

If raised floor levels are proposed, these should be agreed with Birmingham City Council and the Environment Agency. The minimum Finished Floor Level (FFL) may change dependent upon the vulnerability and flood risk to the development.

Environment Agency guidance states that FFLs should a minimum of 300mm above the design flood level – 1% AEP, plus an appropriate allowance for climate change (see Section 4). An additional allowance may be required because of risks relating to blockages to the channel, culvert or bridge and should be considered as part of an FRA.

If floor levels cannot be raised to meet the minimum requirements, developers will need to:

- Raise them as much as possible.
- Consider moving vulnerable uses to upper floors.
- Include extra flood resistance and resilience measures (see Section 8.3.).

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.

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

8.2.6 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.

Where development is located behind, or in an area benefitting from defences, the residual risk of flooding must be considered.

8.2.7 Developer contributions

In some cases, and following the application of the Sequential Test, it may be appropriate for the developer to contribute 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).

8.2.8 Buffer strips

The provision of a buffer strip to 'make space for water', allows additional capacity to accommodate climate change and ensure access to the watercourse, structures and defences is maintained for future maintenance purposes. It also enables the avoidance of disturbing riverbanks, adversely impacting ecology and having to construct engineered riverbank protection. A buffer strip of 8m is required from any Main River (16m if tidal influence). Additionally, development in Digbeth between Moseley Street and Gooch Street needs a 17.5m buffer strip as per the **River Rea Urban Quarter SPD.** Where flood defences are present, these distances should be taken from the toe of the defence.

Building adjacent to riverbanks can cause problems to the structural integrity of the riverbanks and the building itself, making future maintenance of the river much more difficult. Any development in these areas will likely require a Flood Risk Permit from the Environment Agency alongside any permission. There should be no built development within these distances from main rivers / flood defences (where present).

8.2.9 Making space for water

The **PPG** sets out a clear aim in Flood Zone 3 to create space for flooding by restoring functional floodplain. Generally, development should be directed away from these areas.

All new development close to rivers should consider the opportunity to improve and enhance the river environment. Buffer strips larger than the minimum easements required is desirable to allow space for connectivity and the construction of future flood defences if required as a result of climate change. 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.

8.3 Resistance and resilience measures

Flood resistance measures are designed to prevent water entering a property by sealing points of entry (e.g., doors, airbricks) up to a depth of 600mm. However, resistance measures can be deployed up to 900mm when verified by a structural engineer. Alternatively, flood resilience measures aim to reduce the damage caused by a flood (e.g., raised socket levels).

The consideration of resistance and resilience measures should not be used to justify development in inappropriate locations.

Having applied planning policy, there will be instances where developments, such as those that are water compatible and essential infrastructure are permitted in high flood risk areas. The above measures should be considered before resistance and resilience measures are replied on. The effectiveness of these forms of measures are often dependant on the availability of a reliable forecasting and warning system and the use of back up pumping to evacuate water from a property as quickly as possible. 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. Available resistance and resilience measures are shown in Table 8-1.

Table 8-1: Available temporary measures

Measures	Description
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.
Flood resilience measures	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 can include electrical circuitry installed at a higher level and water-resistant materials for floors, walls and fixtures.

8.4 Reducing flood risk from other sources

8.4.1 Groundwater

Groundwater flooding has a very different flood mechanism to any other and so many conventional flood 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 a site. Developers should provide evidence and ensure that this will not be a significant risk.

8.4.2 Surface water and sewer flooding

Developers should discuss public sewerage capacity with the water utility company at the earliest possible stage. Additionally, BCC as the LLFA are a statutory consultee on surface water drainage for major developments. It is important that a Surface Water Drainage Strategy (often done as part of a Flood Risk 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. As per **BCC sustainable drainage guidance**, major developments are expected to ensure that SuDS for the management of runoff are put in place. In addition to this there is an expectation that all developments in areas at risk of flooding should give priority to the use of SuDS.

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

When redeveloping existing buildings, the installation of some permanent or temporary floodproofing and resilience measures could protect against both

surface water and sewer flooding. Non-return valves prevent water entering the property from drains and sewers. Non-return valves can be installed within gravity sewers or drains within a property's private sewer upstream of the public sewerage system. These need to be carefully installed and must be regularly maintained.

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

8.4.3 Reservoirs

As discussed in Section 5.9, the risk of reservoir flooding is extremely low. However, there remains a residual risk to development from reservoirs which developers should consider during the planning stage:

- Developers should contact the reservoir owner for information on:
- the Reservoir Risk Designation
- reservoir characteristics: type, dam height at outlet, area/volume, overflow location
- operation: discharge rates / maximum discharge
- discharge during emergency drawdown; and
- inspection / maintenance regime.
- The EA online Reservoir Flood Maps contain information on the extents, depths and velocities following a reservoir breach (note: only for those reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975). Consideration should be given to the extent, depths and velocities shown in these online maps.
- The GOV.UK website on **Reservoirs: owner and operator requirements** provides information on how to register reservoirs, appoint a panel engineer, produce a flood plan and report an incident.
- In addition, developers should consult the **'West Midlands Conurbation Local Resilience Forum'** and **Birmingham Prepared** about emergency plans.

Developers should use the above information to:

- Apply the sequential approach to locating development within the site.
- Consider the impact of a breach and overtopping, particularly for sites proposed to be located immediately downstream of a reservoir. This should consider whether there is sufficient time to respond, and whether in fact it is appropriate to place development immediately on the downstream side of a reservoir.
- Assess the potential hydraulic forces imposed by sudden reservoir failure event and check that that the proposed infrastructure fabric could withstand the structural loads.
- Develop site-specific Emergency Plans and/ or Off-site Plans if necessary and ensure the future users of the development are aware of these plans. This may need to consider emergency drawdown and the movement of people beforehand.

Consideration should also be given to the potential implications of proposed development on the risk designation of the reservoir, as it is a requirement that

in particular circumstances where there could be a danger to life that a commitment is made to the hydraulic capacity and safety of the reservoir embankment and spillway. The implications of such potential obligations should be identified and understood so that it can be confirmed that these can be met if proposed new development is permitted.

8.5 Emergency planning

Emergency planning covers three phases: before, during and after a flood. 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. National Planning Policy takes this into account by seeking to avoid inappropriate development in areas of flood risk and considering the vulnerability of new developments to flooding.

The 2021 NPPF requires site level Flood Risk Assessments to demonstrate that

> *"d) any residual risk can be safely managed; and*
>
> *e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan."*

Certain sites will need emergency plans:

- Sites with vulnerable users, such as hospitals and care homes
- Camping and caravan sites
- Sites with transient occupants e.g. hostels and hotels
- Developments at a high residual risk of flooding from any source e.g. immediately downstream of a reservoir or behind raised flood defences
- Situations 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).

Emergency Plans will need to consider:

- The characteristics of the flooding e.g. onset, depth, velocity, hazard, flood borne debris
- The vulnerability of site occupants.
- Structural safety
- The impact of the flooding on essential services e.g. electricity, drinking water
- Flood warning systems and how users will be encouraged to sign up for them
- Safe access and egress for users and emergency services
- 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.
- A safe place of refuge where safe access and egress and advance warning may not be possible, having discussed and agreed this first with emergency planners. Proposed new development that places an additional burden on the existing response capacity of Birmingham City Council will not normally be appropriate.

The **Birmingham City Council's Resilience Team** provide emergency Planning, resilience based, information that is both general and flood specific. This includes practical advice before, during and after flooding has occurred including,

preparation, understanding warnings, actions to limit exposure to risk and recovery.

Further information is available from:

- **The National Planning Policy Guidance**
- **2004 Civil Contingencies Act**
- **DEFRA (2014) National Flood Emergency Framework for England**
- **FloodRe**
- The Environment Agency and DEFRA's **Standing Advice for FRAs**
- Birmingham City Council's **'Flooding' webpage.**
- Environment Agency's **'How to plan ahead for flooding'**
- Sign up for **Flood Warnings** with the Environment Agency
- The **National Flood Forum**
- **GOV.UK** - Make a Flood Plan guidance and templates
- **ADEPT Flood Risk Plans for new development**

9 Surface water management and SuDS

This section provides guidance and advice on managing surface water runoff and flooding.

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

In April 2015, Birmingham City Council as the LLFA was made a statutory planning consultee on the management of surface water. They provide technical advice on surface water drainage strategies and designs put forward for major development proposals, to ensure that onsite drainage systems are designed in accordance with the current legislation and guidance.

When considering planning applications Birmingham City Council will provide advice to the Planning Department on the management of surface water. As an LPA, Birmingham City Council should satisfy themselves that the development's proposed minimum standards of operation are appropriate and ensure, using planning conditions or planning obligations, that there are clear arrangements for on-going maintenance over the lifetime of the development.

It is essential that developers consider sustainable drainage at an early stage of the development process – ideally at the master-planning stage. To further inform development proposals at the master-planning stage, pre-application submissions are accepted by Birmingham City Council, dependent on the area. This will assist with the delivery of well designed, appropriate and effective SuDS.

9.2 Sustainable Drainage Systems (SuDS)

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

SuDS provide a means of dealing with the quantity and quality of surface water and can also provide amenity and biodiversity benefits. Given the flexible nature of SuDS they can be used in most situations within new developments as well as being retrofitted into existing developments. SuDS can also be designed to fit into most spaces. For example, permeable paving could be used in parking spaces or rainwater gardens as part of traffic calming measures.

It is a requirement for all new major development proposals to ensure that sustainable drainage systems for management of runoff are put in place, unless there is clear evidence that this would be inappropriate (NPPF para.169). 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 current drainage arrangements is essential.

9.3 Sources of SuDS guidance

9.3.1 Birmingham Development Plan, Policy TP6

Adopted in 2017, the **BDP** lists more specific requirements for developers under policy TP6 for the management of flood risk and water resources including a Sustainable Drainage Assessment, Operation and Maintenance plan. This requires developers to demonstrate that the disposal of surface water from the site will not exacerbate existing flooding, and that exceedance flows will be managed.

Where required, surface water discharge rates shall be limited to the equivalent site-specific greenfield runoff rates for all return periods up to the 1 in 100 year plus climate change event, unless it can be demonstrated that the cost of achieving this would make the proposed development unviable. SuDs should also aim to improve water quality and enhance biodiversity. Surface water should be managed as close to its source as possible in line with the drainage hierarchy set out within the document.

9.3.2 C753 CIRIA SuDS Manual (2015)

The C753 CIRIA SuDS Manual (2015) provides guidance on planning, design, construction and maintenance of SuDS. 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. This includes guidance on constraints (e.g., geology or topography) for site-specific SuDS design.

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

Non-Statutory Technical guidance provides non-statutory standards on the design and performance of SuDS. It outlines peak flow control, volume control, structural integrity, flood risk management and maintenance and construction considerations.

9.3.4 Non-statutory Technical Guidance for Sustainable Drainage Practice Guidance, LASOO (2016)

The Local Authority SuDS Officer Organisation produced their **practice guidance** in 2016 to give further detail to the Non-statutory technical guidance.

9.3.5 Birmingham City Council SuDS Guidance

Birmingham City Council have a **Sustainable Drainage – Guide to Design, Adoption and Maintenance** document. This includes a summary of what SuDS is, the design principle to consider such as volume control, construction and maintenance requirements and, planning application requirements. The guidance also provides examples of good practice for each type of SuDs in addition to where more information can be found. BCC recommend that a SuDS approach should be implemented on all development sites.

9.4 Other surface water considerations

9.4.1 Groundwater Vulnerability Zones

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

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. Groundwater vulnerability maps can be found on **Defra's interactive mapping.**

9.4.2 Groundwater Source Protection Zones (GSPZ)

The Environment Agency also defines Groundwater Source Protection Zones (GSPZs) near groundwater abstraction points. These protect areas of groundwater used for drinking water. The GSPZ requires attenuated storage of

runoff to prevent infiltration and contamination. GSPZs can be viewed on **DEFRA's Magic Map.**

There are GSPZ's near and within the Birmingham Study Area.

9.4.3 Nitrate Vulnerable Zones

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

NVZs can be viewed on the **Environment Agency's website.** There is currently a pre appeal NVZ area covering Birmingham.

10 Summary and Recommendations

Parts of the Birmingham study area are at risk of flooding from the following sources: fluvial, surface water, groundwater, sewers, reservoir inundation and canal overtopping/breaches. This study has shown that the most significant sources of flood risk in Birmingham that are fluvial and surface water.

- *Fluvial flooding:* The primary fluvial flood risk is along the River Tame, River Rea, River Cole and their main tributaries. These present fluvial flood risk to the main urban centres of Birmingham and The Royal Town of Sutton Coldfield. The fluvial flood extents are fairly well confined in the north and south of the study area, with wider extents through the centre of the area along the River Tame due to the lower lying, flat topography.
- *Surface water:* The Risk of Flooding from Surface Water map shows a number of prominent overland flow routes that largely follow the topography of the watercourses. There are some areas where there are additional flow paths and areas of ponding, for example where water is impounded at road or rail embankments and in low-lying areas. There are also considerable flow routes following the roads through the main urban areas of Birmingham and the Royal Town of Sutton Coldfield which alongside isolated areas of ponding affect many properties across these settlements.
- Areas at risk of flooding today are likely to become at increased risk in the future and the frequency of flooding will also increase in such areas as a result of climate change. Flood extents will increase; in some locations, this may not be by very much, but flood depth, velocity and hazard may have more of an impact due to climate change. It is recommended that Birmingham City Council work with other Risk Management Authorities (RMAs) to review the long-term sustainability of existing and new development in these areas when developing climate change plans and strategies for the study area.
- *Sewer*: The sewers in the City of Birmingham are managed by Severn Trent Water. The Hydraulic Flood Risk Register (HFRR) for Birmingham has been provided by Severn Trent Water which shows 857 incidences of sewer flooding within the area.
- *Groundwater:* The Areas Susceptible to Groundwater Flooding map shows that in general, the majority of the Birmingham study area is shown to be within the "< 25%" and ">= 25% <50% "classifications with a lower susceptibility to groundwater flooding or has no data available. There are however areas along the River Tame in particular flooding from groundwater is more likely to occur.

  JBA's Groundwater emergence risk map shows the areas with the predicted shallowest groundwater levels generally follow the low-lying topography and path of the River Tame through the centre of the study area. Across large parts of the study area, particularly in the south and east, the risk of groundwater flooding is considered to be negligible due to the nature of the local geological deposits.
- *Canals:* There are seven canals in the Birmingham study area: the Birmingham and Fazeley Canal, the Birmingham Canal, the Digbeth Branch Canal, the Stratford-upon-Avon Canal, the Worcester and Birmingham Canal, and the Tame Valley Canal. These have the potential to interact with other watercourses and become flow paths during flood events or in a breach scenario.

- *Reservoirs:* There is a potential risk of flooding from reservoirs both within Birmingham and those outside. The level and standard of inspection and maintenance required under the Reservoirs Act means that the risk of flooding from reservoirs is relatively low. However, there is a residual risk of a reservoir breach and this risk should be considered in any site-specific Flood Risk Assessments (where relevant).
- *Defences*: The main flood defences in the study area are located along the main watercourses of the River Tame, River Rea, River Cole, Bourn Brook, Hatchford Brook and Westley Brook. These are mostly comprised of natural/engineered high ground, embankment and flood walls. The condition of these defences varies from poor to good, with the Standard of Protection varying between the defences.

10.1 Recommendations

Reduction of flood risk through site allocations and appropriate site design

- To locate new development in areas of lowest risk, in line with the Sequential Test, by steering sites to river Flood Zone 1 and avoiding where possible areas with a high risk of surface water flooding. If a Sequential Test is undertaken and a site at flood risk is identified as the only appropriate site for the development, the Exception Test shall be undertaken. If development can't be avoided in a high-risk surface water Zone, then part "b" of the Exception Test should be satisfied.
- After application of the Exception Test, a sequential approach to site design will be used to reduce risk. Any re-development within areas of flood risk which provide other wider sustainability benefits will provide flood risk betterment and made resilient to flooding.
- Identification of long-term opportunities to remove development from the floodplain and to make space for water.
- Ordinary watercourses not currently afforded flood maps should be modelled to an appropriate level of detail to enable a sequential approach to the layout of the development.
- Ensure development is 'safe', dry pedestrian egress from the floodplain and emergency vehicular access should be possible for all residential development. If at risk, then as assessment should be made to detail the flood duration, depth, velocity and flood hazard rating in the 1 in 100-year plus climate change flood event, in line with FD2320.
- Raise residential and commercial finished floor levels 300mm above the 1 in 100-year plus climate change flood level. Protect and promote areas for future flood alleviation schemes.
- Safeguard functional floodplain from future development.
- Identify opportunities for brownfield sites in functional floodplain to reduce risk and provide flood risk betterment.
- Identify opportunities to help fund future flood risk management through developer contributions to reduce risk for surrounding areas.
- Seek opportunities to make space for water to accommodate climate change.

Promote SuDS to mimic natural drainage routes to improve water quality

- SuDS design should demonstrate how constraints have been considered and how the design provides multiple benefits e.g., provide effective surface run-off drainage, provide opportunities reduce the causes and impact of flood risk, remove pollutants from run-off at source, and combine water management with green space with benefits for amenity, recreation and wildlife.
- Planning applications for phased developments should be accompanied by a Sustainable Drainage Assessment, Operation and Maintenance Plan in line with Policy TP6 of the BDP.
- Use of the SuDS management train to prevent and control pollutants to prevent the 'first flush' polluting the receiving waterbody.
- SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.

Reduce Surface Water Runoff from New Developments and Agricultural Land

- As per the **BCC Sustainable Drainage: Guide to Design, Adoption and Maintenance**, BCC recommend the inclusion of SuDS on all allocated sites, outline proposals and full planning applications.
- Promote biodiversity, habitat improvements and **Countryside Stewardship schemes** help prevent soil loss and to reduce runoff from agricultural land.

Enhance and Restore River Corridors and Habitat

- Assess condition of existing assets and upgrade, if required, to ensure that the infrastructure can accommodate pressures/flows for the lifetime of the development.
- Natural drainage features should be maintained and enhanced.
- Identify opportunities for river restoration/enhancement to make space for water.
- A presumption against culverting of open watercourses except where essential to allow highways and/or other infrastructure to cross, in line with CIRIA's Culvert design and operation guide, (C689) and to restrict development over culverts.
- There should be no built development within 8m from the top of a watercourse or Main River for the preservation of the watercourse corridor, wildlife habitat, flood flow conveyance and future watercourse maintenance or improvement.

Mitigate Against Risk, Improved Emergency Planning and Flood Awareness

- Work with emergency planning colleagues and stakeholders to identify areas at highest risk and locate most vulnerable receptors.
- Exceedance flows, both within and outside of the site, should be appropriately designed to minimise risks to both people and property.
- For a partial or completely pumped drainage system, an assessment should be undertaken to assess the risk of flooding due to any failure of the pumps to be assessed. The design flood level should be determined if the pumps were to fail; if the attenuation storage was full, and if a design storm occurred.

- An emergency overflow should be included in the SuDS system design to accommodate events in excess of the design flood event where required.
- Consideration and incorporation of flood resilience measures up to the design flood event (1% AEP, plus an appropriate allowance for climate change) event.
- Ensure robust emergency (evacuation) plans are produced and implemented for major developments.
- Increase awareness and promote sign-up to the Environment Agency Flood Warnings Direct (FWD) within the Birmingham study area.

Annex 1 – Updates to the Planning Practice Guidance (25 August 2022)

The Planning Practice Guidance on Flood Risk and Coastal Change was updated on the 25 August 2022, triggered by: revisions to the NPPF in 2018, 2019 and 2021; practice experience since the PPG was first published in 2014; Policy review of development in flood risk areas; and other stakeholder and committee reviews.

Key Details of the changes included in the PPG update of 25 August 2022:

General

- 'Design flood' includes Climate Change and surface water risk
- Hierarchical approaches prioritises avoidance and passive approaches, which also applies to residual risk.
- Safety of development now accounts for impact of flooding on the services provided by development
- Inappropriate to consider likelihood of defence breach
- Functional floodplain "starting point" for extent uplifted to the 3.3% AEP from 5% AEP
- Lifetime of non-residential development now has a 75yrs starting point
- New culverting and building over culverts is discouraged
- Defra FD2320 research referenced for calculating flood hazard to people

Sequential Test

- Paragraph 162 of the NPPF has been changed such that the Sequential Test must now "steer new development to areas with the lowest risk of flooding **from any source**. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test. The sequential approach (as described in Para 161) should be used in areas known to be at risk now or in the future from **any form of flooding**."
- Prior to the changes to the NPPF the requirement was set out as follows and only required consideration of river and sea flood risk when applying the Sequential Test:

Previous Policy Wording	New Policy Wording (July 2021)
The aim of the Sequential Test is to steer new development to areas with the lowest risk of flooding *(the Planning Practice Guidance advised that the exercise should be performed using the flood zones, as describe river and sea flood risk assuming there are no flood risk management measures or defences in place*)	The aim of the Sequential Test is to steer new development to areas with the lowest risk of flooding **from any source** (*The Planning Practice Guidance has not yet been updated to describe how this exercise should be performed*)

- Removal of reference to Flood Zones (Diagram 2) when performing Sequential Test and requirement must now consider whether development can be located in the lowest areas (high – medium – low) of flood risk both now and in the future (the test applies to all source of flood risk – whereas previously the test was only performed for present day flood risk for the "Flood Zones" i.e. river and sea flood risk).

- Improved clarity about when test needs to be applied. Potential confusion about 'minor' development has been clarified.
- Clearer roles and responsibilities, with emphasis on the LP to define the area of search and decide if the test is passed.
- Key terms defined (e.g. 'reasonably available')
- Suggests approaches to improve certainty and efficiency
- Clarification about when it's appropriate to move onto the Exception Test
- Explicit statement that Table 2 (was Table 3) cannot be used to support performance of Sequential Test

Exception Test

- Key terms defined (e.g. 'wider sustainability benefits to the community')
- New section on how to demonstrate development has reduced flood risk overall
- Table 2 (was Table 3) shows flood zone ***incompatibility***, NOT whether 'development is appropriate'.

Integrated approach to flood risk management

- Catchment based approaches
- Improved connectivity with other strategies e.g. water cycle studies and drainage and wastewater management plans
- Encourages measures which deliver multiple benefits – including those which unlock sustainable development

Impact of development on flood risk elsewhere

- FRA's must detail any increase in risk elsewhere
- Guidance on compensatory flood storage – requirement for level-for-level storage
- Guidance on mitigating cumulative impacts
- Clarification that stilts/voids should not be relied upon for compensatory storage

Safeguarding land and relocation

- Guidance on how to safeguard land needed for future FCERM infrastructure
- Definition included for unsustainable locations
- Guidance for control of developments in unsustainable locations
- More detail and expectation on requirement to exercise Plan process to relocate development that is susceptible to frequent flood risk or coastal erosion.

Sustainable Drainage Systems (SuDS)

- Clearer definition of what SuDS are – this must meet the '4 pillars'
- Clearer requirement for SuDS Strategy
- Better recognition of wider SuDS benefits e.g. BNG, carbon sequestration, urban cooling
- Encouragement for earlier consideration in the design process
- Encourages policies setting out where SuDS would bring greatest benefits
- Highlights the need to check the need for other permits for SuDS

Reducing the causes & impacts of flooding

- Whole new section – links to all the EA's latest NFM tools, maps and research
- Support for river restoration such as culvert removal and other 'slow the flow' approaches
- Support for making space for river geomorphology e.g. meander migration

Coastal Change

- Encourages more precautionary designation of Coastal Change Management Areas (CCMAs)
- Allows more flexibility for existing buildings/land-use to adapt to change
- Clearer requirement for a 'coastal change vulnerability assessment' with apps for development in CCMAs
- Highlights need to consider removal of some Permitted Development rights in CCMAs

Other changes

- Guidance on how to consider flood risk in LDOs
- More detailed framework for local design code preparation
- Approach to article 4 in relation to flood risk
- Greater clarity on the application of the call-in direction process
- Guidance on development that might affect existing reservoirs
- Updated links to the latest tools and guidance

Summary of influential changes to the NPPF and implications for Sequential and Exception Tests

The Sequential Test was originally conceived to direct proposed new development to locations that did not rely on Flood Risk Management features so they inherently safe and don't place a burden on future generations. This was achieved using a set of "Zone" maps that showed the extent of river and sea flooding for circumstances where no defences were present for events with high, medium and low probability. Following this approach delivers new development that will not require future investment in flood risk management.

The test process recognised that in some circumstances it would not be possible to locate development in locations outside of medium and high-risk flood Zones, as there were no reasonable alternatives. In circumstances where the Sequential Test has been performed but is not satisfied the policy requires that the Exception Test is performed. The Exception Test is a two-part process that requires preparation of evidence to demonstrate that development proposals at risk of flooding deliver wider sustainability benefits and that it can be made safe for the intended lifespan (thus it is a requirement to demonstrate that proposed development will be safe under climate change conditions).

The updated NPPF requires the application of the Sequential Test to any source of flooding. The general implications of this are summarised as follows:

- The Sequential Test (July 2021) must be based on mapping that enables decision making according to a prioritisation based on a risk-based sequence (for river and sea flooding national mapping is available that describes low, medium and high risk flood zones for river and sea flooding based on the assumption that no flood risk management features are present).

- The other sources of flood risk that can potentially be included in the Sequential Test are surface water, groundwater, sewer flooding and reservoir flooding (or other water impounding features such as canals).
- It follows that proposed new development placed in locations at high or medium risk from flooding from other sources now and in the future (note that the explicit requirement to include climate change in the test, as set out in the August 2022 PPG will require the preparation of additional modelling and mapping) should be accompanied by evidence that the Exception Test can be satisfied (in a Level 2 SFRA).

A basic requirement for the Sequential Test to be performed is that appropriate, competent mapping can be prepared to enable logical comparison of the flood risk from different sources at alternative locations, as this is a fundamental requirement to establish a logical "risk sequence".

The following summary:

- describes the implications of including any source of flooding in the Sequential Test;
- highlights matters to be considered; and
- identifies a preferred approach.

Rivers and sea risk – now and in the future

Implications

Source of Flooding	Available Mapping	Implications of making use of mapping in the Sequential Test
Rivers and sea	Flood Map for Planning and detailed models	• The Sequential Test can be carried out using the Flood Map for Planning for present day low (Flood Zone 1), medium (Flood Zone 2) and high risk (Flood Zone 3) as previously was the case. • Where detailed modelling is available, future Flood Zones 2 (0.1% AEP event), 3a (1% AEP event) and 3b (now the 3.3% AEP) will be assessed with climate change allowances. It should be noted that there may be instability issues running the 0.1% AEP event with climate change allowances. • The fluvial models may experience instabilities during 0.1% AEP plus climate change runs which may mean that results cannot be prepared. • Generalised modelling (JFlow) is used to delineate Flood Zones where there is no detailed mapping, but does not include climate change data or risk mapping.

Surface Water Flood Risk

Implications

Source of Flooding	Available Mapping	Implications of making use of mapping in the Sequential Test
Surface Water	Risk of Flooding from Surface Water (RoFSW)	• Mapping based on a generalised modelling methodology. • Generally suitable for showing surface water flow routes at different probability flood events (1 in 30, 1 in 100 and 1 in 1000), although the uncertainty associated with the predicted outlines for the respective probabilities is high. JBA Consulting also hold the 1 in 100 year plus 40% climate change and 1 in 30 plus 35% allowances. • Doesn't always include allowance for drainage features such as culverts and can over or under estimate flooding where there are linear features such as embankments. • Unlike the Zone maps for river and sea flooding the surface water mapping makes an allowance for the assumed performance of a local drainage system. • Normal profile of extent and shape of flooding is a "dendritic" pattern that follows low lying topography and is not an extensive blanket, as is most often the case for river and sea flooding. • The flood risk is likely to be relatively short lived and much more localised than would be the case for river and sea flooding (most likely being caused by local high intensity short duration rainfall events). • It is likely that in many circumstances surface water flood risk zones based on the surface water mapping could affect a relatively small proportion of a proposed allocation site, but in practical terms this might not in itself be a factor that demonstrates that the principle of development could not be supported.

Groundwater Flood Risk

Implications

Source of Flooding	Available Mapping	Implications of making use of mapping in the Sequential Test
Groundwater	British Geological Survey (BGS) Groundwater flood susceptibility maps Also: JBA groundwater	• BGS mapping describes the risk of groundwater emergence but does not show the likelihood or risk of groundwater flooding occurring, i.e. it is a hazard and consequence base product and does not enable the application of risk based approach. • JBA groundwater map does potentially enable a risk-based approach to be taken as it depicts different levels of risk. However, this also is based on the risk of emergence of groundwater and not surface flooding due to groundwater. The analyses performed to prepare the mapping are all for a 1 in 100-year event and so provide a risk of groundwater emergence to the surface as they are based on predicted difference between groundwater level and the ground surface.

	emergence Flood Map BCC historic flood events and Section 19 investigations	Five zones are defined to describe the risk of groundwater being: at or very near ground surface; between 0.025m and 0.5m below the ground surface; between 0.5m and 5m below the ground surface; at least 5m below the ground surface; and negligible risk of groundwater flooding. • The underlying challenge is that the data is very uncertain and could not be used with confidence unless supported by more detailed local studies. The mapping provides an indication of where risk might be higher, but it would not be easy to defend sequential decisions based on the available mapping. • Historic flood data is available from Birmingham City Council, however this does not always list the source of flooding. In addition, it is often difficult to determine the source of historical flood events and groundwater and surface water flooding can often be confused. • There is no climate change mapping available for groundwater and in view of the uncertainty in the present day data it is unlikely that such mapping will be available in the near future.

Reservoir Flood Risk

Implications

Source of Flooding	Available Mapping	Implications of making use of mapping in the Sequential Test
Reservoir flooding risk	Reservoir Flood Mapping (RFM)	• The latest available mapping now shows "wet day" and "dry day" reservoir inundation extents. The "wet day" being a reservoir breach at the same time as a 1 in 1000 river flood (as this is a likely time when a reservoir might fail) and the dry day shows the failure just from the water retained by the dam. • Neither set of mapping describes a risk-based scenario as it does not provide the probability of a dam failure but are intended to describe a "worst credible case". • More detailed information on flood velocities and depths has been prepared as part of the modelling and mapping study, but this is not publicly available and can only be viewed by those with appropriate security classifications. The flood extents are publicly available. • A dataset exists which shows where the impact of reservoir flooding no longer affects the fluvial flood extent. This is known as a Wet Day Termination Extent. This dataset can be used to provide two zones: 1. Where reservoir flooding is predicted to

		make fluvial flooding worse. 2. Where reservoir flooding is not predicted to make fluvial flooding worse. • The mapping could be used to direct proposed new development away from locations that could potentially be affected by reservoir flood risk. However, it would not be conceptually similar to the risks pertaining to river and sea flooding and further assessment would be required to understand the magnitude of the potential hazard. • A consideration with respect to the reservoir maps is that placing new development in locations potentially affected by reservoir inundation could potentially change the "risk category" of the reservoir and this could result in the reservoir owner "undertaker" having to invest in substantive remedial works to demonstrate that the reservoir had the appropriate level of safety. This is not strictly related to the sequential test, but should be a consideration that should be appropriately managed when planning new development. • The mapping does not provide climate change information on future flood risk and provision of such mapping is unlikely based on the existing methodology

Impacts on the SFRA

The most relevant points to consider in relation to updating the SFRA process relate to the changes to the Sequential Test requirements and Exception Test requirements, particularly the requirement for updated Climate Change modelling for all sources of flood risk and the functional floodplain starting point at 3.3% AEP. Consideration also needs to be made to the changes to Table 2 (was Table 3) and the flood zone incompatibility. This should be considered during the screening phase prior to the Level 2 SFRA being undertaken.

For more information on the PPG updates, please visit the **gov.uk website** and see the briefing note **available here**.

Report Appendices

10.2 Interactive Flood Risk Mapping and User Guide

10.3 Data sources used in the SFRA

10.4 SFRA User Guide

10.5 Flood Alerts and Flood Warnings

10.6 Summary of flood risk across Birmingham

10.7 Cumulative Impact Assessment (CIA)

10.8 Modelling Technical Notes

Offices at
Coleshill
Doncaster
Dublin
Edinburgh
Exeter
Glasgow
Haywards Heath
Isle of Man
Limerick
Newcastle upon Tyne
Newport
Peterborough
Saltaire
Skipton
Tadcaster
Thirsk
Wallingford
Warrington

Registered Office
1 Broughton Park
Old Lane North
Broughton
SKIPTON
North Yorkshire
BD23 3FD
United Kingdom

+44(0)1756 799919
info@jbaconsulting.com
www.jbaconsulting.com
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Jeremy Benn Associates Limited

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