Lichfield District Council Level 2 Strategic Flood Risk Assessment

Final Report

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Lichfield District Council

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Revision History

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Contract

This report describes work commissioned by Lichfield District Council, by an email dated 16th April 2020. Joanne Chillingworth and Abi Speakman of JBA Consulting carried out this work.

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Purpose

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- Lichfield District Council;
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Executive summary

Introduction and context

This Level 2 Strategic Flood Risk Assessment (SFRA) document undertakes a Level 2 assessment of four large strategic sites identified for potential allocation within the Local Plan. It builds upon the Level 1 SFRA (2019) originally published for the southern Staffordshire authorities of Tamworth Borough Council, South Staffordshire Council, Stafford Borough Council, Cannock Chase Council and Lichfield District Council. In addition, there have been updates to national and local planning policy and recent flood events. This Level 2 SFRA has updated information on flood risk policy, flood history and recommendations for the cumulative impact of development.

SFRA objectives

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

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

Level 2 SFRA outputs

The Level 2 assessment includes detailed assessments of the proposed site options. These include:

- An assessment of all sources of flooding including fluvial flooding, surface water flooding, groundwater flooding, mapping of the functional floodplain and the potential increase in fluvial flood risk due to climate change and blockage scenarios.
- Reporting on current conditions of flood defence infrastructure, where applicable.
- An assessment of existing flood warning and emergency planning procedures, including an assessment of safe access and egress during an extreme event.
- Advice and recommendations on the likely applicability of sustainable drainage systems for managing surface water runoff.
- Advice on whether the sites are likely to pass the second part of the Exception Test with regards to flood risk and on the requirements for a site-specific FRA.

Summary of Level 2 SFRA

Lichfield District Council provided 4 strategic sites in total, for Level 2 SFRA assessment and detailed site summary tables and GeoPDF mapping have been produced, provided in Appendix A.

The summary tables set out the flood risk to each site. There is no detailed hydraulic modelling available at these sites, and flood risk is generally low. Climate change was therefore represented by Flood Zone 2 as a fluvial indication, and the 1,000-year surface water extent for an indication of surface water. The depth and velocity data for the surface water mapping was also used as an indication of risk for small watercourses. Each table also sets out the NPPF requirements for the site as well as guidance for site-specific FRAs. A broadscale assessment of suitable SuDS options has been provided, giving

an indication where there may be constraints to certain sets of SuDS techniques. This assessment is indicative and more detailed assessments should be carried out during the site planning stage to confirm the feasibility of different types of SuDS. It may be possible that those SuDS techniques highlighted as possibly not being suitable can be designed to overcome identified constraints. Where deemed required, culvert blockages were also presented to assess residual risk to sites.

To accompany each site summary table, there is an Interactive Geo-PDF map, with all the mapped flood risk outputs per site. This is displayed centrally, with easy-to-use 'tick box' layers down the right-hand side and bottom of the mapping, to allow easy navigation of the data.

The following points summarise the Level 2 assessment:

- All four sites are at low risk of flooding in general, with the majority of the site areas in Flood Zone 1. SHA4 is not at fluvial or surface water risk, according to the datasets used in the assessment. This shows that the majority of all these sites are suitable for development.
- Two of the sites (SHA1 and SHA2) are shown to be at very low fluvial flood risk. These sites are marginally affected along one side of their site boundaries. There are also some minor watercourses across three of the sites, including SHA3, but these are better represented using the surface water mapping given the small catchment sizes. Risk is localised in SHA3 around this drain and along the northern boundary. SHA4 has no fluvial flood risk.
- None of the sites are covered by detailed Environment Agency hydraulic models but are either covered by the EA's Flood Zone maps or national surface water mapping to help assess the risk.
- SHA1, SHA2 and SHA3 are at risk from some surface water flooding, with more areas of ponding in the higher return period events. Surface water tends to follow topographic flow routes, for example along the watercourses or isolated pockets of ponding where there are topographic depressions. Surface water should be considered when assessing safe access and egress to and from the site, and mitigation is recommended through SuDS.
- Indicative climate change mapping using Flood Zone 2 demonstrates that flood extents will increase with climate change. As a result, the depths, velocities and hazard of flooding may also increase. The significance of the increase tends to depend on the topography of site and the percentage allowance used. The Council and the Environment Agency require the 100-year plus 20%, 30% and 50% climate change scenarios to be considered at the more detailed site-specific Flood Risk Assessment stage. It should be noted that these figures may be subject to change over the lifetime of this Level 2 SFRA.
- No sites are located in a Historic Landfill Site.
- A strategic assessment was conducted of SuDS options using regional datasets. A detailed site-specific assessment of suitable SuDS techniques would need to be undertaken at site-specific level to understand which SuDS option would be best. This should be informed by both National guidance, standards and best practise as well as the Staffordshire Local Standards for SuDS.
- For some sites, there is the potential for safe access and egress to be impacted by fluvial or surface water flooding, though this risk is considered to be low overall. Consideration should be made to these sites as to how safe access and egress can be provided during flood events, both to people and emergency vehicles.

- In respect of cumulative impact assessment, there are no strategic development sites proposed that have the potential to provide a significant betterment to existing communities immediately downstream at high flood risk. This is largely due to the location of the sites, e.g. SHA1 is downstream of Lichfield City and/ or the relative catchment size compared to the size of the proposed development site(s). In order to prevent these developments having the potential to increase flood risk offsite, National and Local SuDS Standards should be applied. They also offer a great potential to enhance the wider Green and Blue Infrastructure of the local area through integrated planning for flood risk, sustainable drainage, biodiversity, amenity and sustainable transport provision.
- Developers proposing windfall sites in the same catchments as the sites for allocation here and in the red and amber catchments from the Level 1 SFRA should demonstrate through a site specific FRA how SuDS and surface water mitigation techniques will ensure that development does not increase flood risk elsewhere and seeks to reduce flood risk to existing communities.

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**), inform development zoning within the site and prove, if required, whether the Exception Test can be passed.

For sites allocated within the Local Plan, the Local Planning Authority should use the information in this SFRA to inform the Exception Test. In principle, it is possible for all sites assessed in the Level 2 SFRA to pass the flood risk element of the Exception Test, for example by:

- siting development away from the highest areas of risk into Flood Zone 1 (in the majority of sites assessed, the risk is along a site boundary, so steering away from this is advised),
- considering safe access/ egress in the event of a flood (from all parts of the site, if say the site is severed by a flood flow path),
- using areas in Flood Zone 2 for the least vulnerable parts of the development in accordance with Table 2 in the NPPF. Residential development should not be permitted in Flood Zone 3 and no development at all should be permitted in Flood Zone 3b (aside from essential infrastructure, such as a bridge crossing the lowest points of a site),
- testing flood mitigation measures if these are to be implemented, to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another),
- considering space for green infrastructure in the areas of highest flood risk.

If the strategic sites are split in future into smaller land parcels for development, and some of those parcels are in areas of flood risk, the Exception Test may need to be re-applied by the Developer at the planning application stage. At planning application stage, the Developer must design the site such that is appropriate 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.

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.

It is recommended that as part of the early discussions relating to development proposals, developers discuss requirements relating to site-specific Flood Risk Assessment and drainage strategies with both the Local Planning Authority and the LLFA, to identify any potential issues that may arise from the development proposals.

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Abbreviations and glossary of terms

Term	Definition
1D model	One-dimensional hydraulic model
2D model	Two-dimensional hydraulic model
AEP	Annual Exceedance Probability – The probability (expressed as a percentage) of a flood event occurring in any given year.
AStGWf	Areas Susceptible to Groundwater flooding
Brownfield	Previously developed parcel of land

CC	Climate change - Long term variations in global temperature and weather patterns caused by natural and human actions.
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.
EA	Environment Agency
EU	European Union
Exception Test	Set out in the NPPF, the Exception Test is a method used to demonstrate that flood risk to people and property will be managed appropriately, where alternative sites at a lower flood risk are not available. The Exception Test is applied following the Sequential Test.
FCERM	Flood and Coastal Erosion Risk Management
FEH	Flood Estimation Handbook
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Map for Planning	The Environment Agency Flood Map for Planning (Rivers and Sea) is an online mapping portal which shows the Flood Zones in England. The Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences and do not account for the possible impacts of climate change.
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG (Welsh Assembly Government).
Flood Risk Regulations	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Flood 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
FWMA	Flood and Water Management Act

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
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. In Lichfield this is Staffordshire County Council.
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
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
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
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. Also referred to as surface water flooding.
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.
SPZ	(Groundwater) Source Protection Zone
Stakeholder	A person or organisation affected by the problem or solution or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.
SuDS	Sustainable Drainage Systems - Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques
Surface water flooding	Flooding as a result of surface water runoff as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity, thus causing what is known as pluvial flooding.
SWMP	Surface Water Management Plan - The SWMP plan should outline the preferred surface water management strategy and identify the actions, timescales and responsibilities of each partner. It is the principal output from the SWMP study.
WFD	Water Framework Directive – Under the WFD, all waterbodies have a target to achieve Good Ecological Status (GES) or Good Ecological Potential (GEP) by a set deadline. River Basin Management Plans (RBMPs) set out the ecological objectives for each water body and give deadlines by when objectives need to be met.

1 Introduction

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 156)

This Level 2 Strategic Flood Risk Assessment (SFRA) 2019 document provides a Level 2 assessment of strategic sites identified for potential allocation within Lichfield.

1.2 Levels of SFRA

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

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

This report fulfils the requirements of a **Level 2** SFRA.

1.3 SFRA objectives

The objectives of this 2020 Level 2 SFRA are to:

1. Provide individual flood risk analysis for site options using the latest available flood risk data, thereby assisting the Council in applying the Exception Tests to its proposed site options in preparation of its Local Plan.
2. Using available data, provide information and a comprehensive set of maps presenting flood risk from all sources for each site option.
3. Where the Exception Test is required, provide recommendations for making the site safe throughout its lifetime.
4. Take into account most recent policy and legislation in the NPPF, PPG and Staffordshire County Council's 2017 **Sustainable Drainage System (SuDS) Handbook**. Using these documents provided, updating information on the requirements for site-specific Flood Risk Assessments (FRAs), considerations for suitable surface water management methods and opportunities to reduce flood risk to the existing communities.

1.4 Context of the Level 2 assessment

A Southern Staffordshire-wide **Level 1 SFRA** was commissioned in 2018 by the Southern Staffordshire Councils, in partnership with its Local Authorities including Lichfield District Council, Tamworth Borough Council, Cannock Chase District Council, Stafford Borough Council and South Staffordshire District Council. The reports were published in 2019.

This 2020 Level 2 SFRA builds on the work undertaken in the Level 1 SFRA in 2018 and assesses four large strategic sites in Lichfield District. In addition, there have been updates to national and local planning policy, and recent flood events. This Level 2 SFRA also has updated information on flood risk policy, flood history and recommendations for the cumulative impact of development.

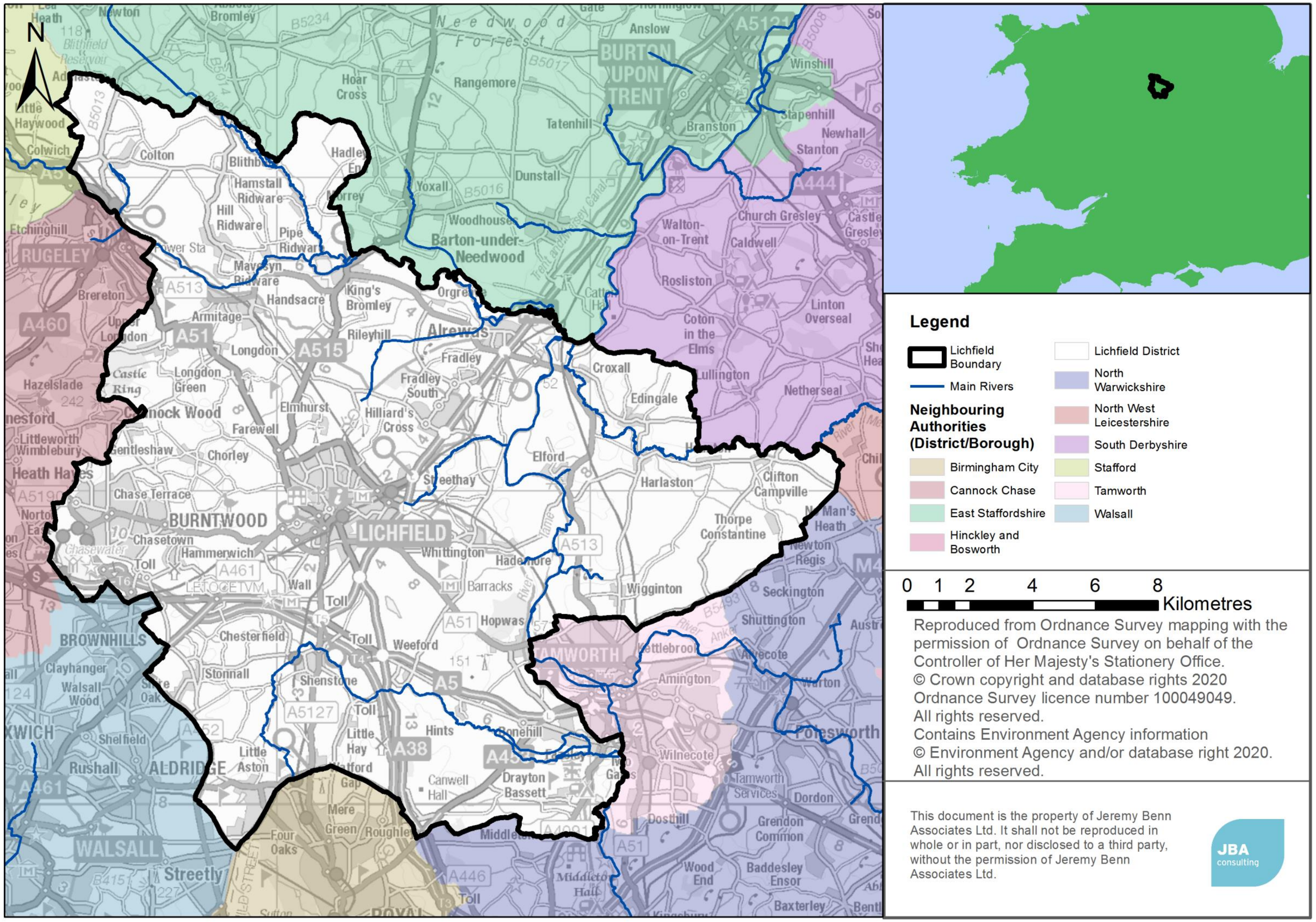
1.5 SFRA Study Area

Lichfield District covers an area of approximately 331km^2 and has a population of approximately 103,100. The District has two main urban areas – the City of Lichfield and Burntwood. There are a number of large and small villages and more isolated rural areas.

The main rivers in Lichfield are the River Tame, River Trent and River Mease. Other watercourses in the study area include the Curborough Brook, Leamonsley Brook, Pyford Brook, Bourne Brook, River Blythe, Mare Brook and Comberford Brook.

Lichfield is bounded by 9 authorities: Cannock Chase, Stafford Borough, East Staffordshire District, South Derbyshire District, North West Leicestershire District, North Warwickshire District, Tamworth Borough, Birmingham City and Walsall. An overview of the study area is shown in Figure 1-1.

Figure 1-1 Study area



1.6 Consultation

SFRAs should be prepared in consultation with other risk management authorities. The following parties (external to Lichfield District Council) have been consulted during the preparation of this Level 2 SFRA:

- Environment Agency
- Staffordshire County Council (LLFA)
- Other stakeholders were contacted as part of the Level 1 SFRA

1.7 How to use this report

The table below summarises the contents of each chapter of this report and outlines how each section should be used.

Table 1-1 SFRA report guide

Section	Contents	How to use
1. Introduction	Outlines the purpose and objectives of the Level 2 SFRA	For general information and context.
2. The Planning Framework and Flood Risk Policy	Includes information on the implications of recent changes to planning and flood risk policies and legislation, as well as documents relevant to the study.	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 Council 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. Sources of information used in preparing the L2 SFRA	Summarises the data used in the Level 2 assessments and GeoPDF mapping	Users should refer to this section in conjunction with the summary tables and GeoPDF mapping to understand the data presented. Developers should refer back to this section when understanding requirements for a site-specific FRA.
6. Level 2 Assessment Methodology	Summarises the sites taken forward to a Level 2 assessment and the outputs produced for each of these sites.	This section should be used in conjunction with the site summary tables and GeoPDF mapping to understand the data presented.
7. Flood risk management requirements for	Identifies the scope of the assessments that must be submitted in FRAs supporting	Developers should use this section to understand requirements for FRAs and what conditions/ guidance

developers	applications for new development. Refers back to relevant sections in the L1 SFRA for mitigation guidance.	documents should be followed. Developers should also refer to the L1 SFRA for further information on flood mitigation options.
8. Surface water management and SuDS	An overview of any specific local standards and guidance for Sustainable Drainage Systems (SuDS) from the Lead Local Flood Authority. Refers back to relevant sections in the L1 SFRA for information on SuDS and surface water management.	Developers should use this section to understand what national, regional and local SuDS standards are applicable. Hyperlinks are provided. Developers should also refer to the L1 SFRA for further information on types of SuDS, the hierarchy and management trains information.
9. Cumulative impact of development and strategic solutions	Builds on recommendations from the Level 1 SFRA, identifying the cumulative impact of development in the site catchments and providing recommendations for storage and betterment for all potential development sites in the catchment.	Planners should use this section to help develop policy recommendations for the sites specified. Developers should use this section to understand the potential storage requirements and betterment opportunities for the sites assessed.
10. Summary of Level 2 assessment and recommendations	Summarises the results and conclusions of the Level 2 assessment, and signposts to the L1 SFRA for planning policy recommendations.	Developers and planners should use this section to provide an overview of the Level 2 assessment. Planners should use this section to identify which potential site allocations have the least risk of flooding. Developers should refer to the Level 1 SFRA recommendations when considering requirements for site-specific assessments.
Appendix A: Level 2 assessment - Site summary tables and Interactive mapping	Provides a detailed summary of flood risk for sites requiring a more detailed assessment. The section considers flood risk, emergency planning, climate change, broadscale assessment of possible SuDS, exception test requirements and requirements for site-specific FRAs. Provides interactive PDF mapping for each Level 2 assessed site showing flood risk at and around the site.	Planners should use this section to inform the application of the Sequential and Exception Tests, as relevant. Developers should use these tables to understand flood risk, access and egress requirements, climate change, SuDS and FRA requirements for site-specific assessments. Planners and developers should use these maps in conjunction with the site summary tables to understand the nature and location of flood risk.

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

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

2 The Planning Framework and Flood Risk Policy

2.1 Introduction

The overarching aim of development and flood risk planning policy in the UK is to ensure that the potential risk of flooding is taken into account at every stage of the planning process. This section of the Level 2 SFRA provides an overview of the planning framework, flood risk policy and flood risk responsibilities, given the changes since the previous SFRA publications. In preparing the subsequent sections of this SFRA, appropriate planning and policy amendments have been acknowledged and taken into account.

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

2.2 Roles and responsibilities for Flood Risk Management in Lichfield

There are a number of different organisations in and around Lichfield District 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. 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 Staffordshire County Council as LLFA do have powers, but limited resources must be prioritised and targeted to where they can have the greatest effect.

Table 2-1 Roles and responsibilities for flood risk management within Lichfield

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 • Reservoirs	• Statutory consultee for development in Flood Zones 2 and 3
Staffordshire County Council as Lead Local Flood Authority (LLFA)	• Preliminary Flood Risk Assessment • Local Flood Risk Management Strategy	• Surface Water • Groundwater • Ordinary Watercourses (consenting and enforcement) • Ordinary watercourses (works)	• Statutory consultee for all major developments
Lichfield District Council as Local Planning	• Local Plans as Local Planning Authorities	• Determination of Planning Applications as	• As left

Authority		Local Planning Authorities • Managing open spaces under District Council ownership	
Water Companies: *Severn Trent Water* *South Staffordshire Water (supply only)*	• Asset Management Plans supported by Periodic Reviews (business cases) • Develop Drainage and Wastewater management plans	• Public sewers	• Non-statutory consultee
Highways Authorities: *Highways England (motorways and trunk roads)* *Staffordshire County Council (other adopted roads)*	• Highway drainage policy and planning	• Highway drainage	• Internal planning consultee regarding highways and design standards and options

2.3 Relevant legislation

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

- **Flood Risk Regulations (2009)** transpose the EU Floods Directive (2000) into UK law and require the Environment Agency and LLFAs to produce Preliminary Flood Risk Assessments (PFRAs) 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 a six-year cycle of work and the second cycle started in 2017.
- **Town and County Planning Act (1990)**, **Water Industry Act (1991)**, **Land Drainage Act (1991)**, Environment Act (2005) and **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.
- **Land Drainage Act (1991)** and **Environmental Permitting Regulations (2016)** 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.
- **Water Environment Regulations (2017)** transpose the European Water Framework Directive (2000) into law and require the Environment Agency to produces River Basin Management Plans (RBMPs). These aim to ensure that the water quality of aquatic ecosystems, riparian ecosystems and wetlands reach '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.

Relevant flood risk policy and strategy documents. Table 2-2 summarises some of the relevant national, regional and local flood risk policy and strategy documents and how these apply to development and flood risk. There are hyperlinks to the documents in the table. 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 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 Lichfield.
- 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	Information	Policy and measures	Development design requirements	Next update due
National	**Flood and Coastal Erosion Risk Management Strategy** (Environment Agency) 2011 published, updated version consulted on in 2019 and due in 2020	No	Yes	No	Update due to be published later in 2020
	National Planning Policy Framework and Guidance (MCHLG) 2018/2015	No	No	Yes	2019 updates to PPG
	Building Regulations Part H (MCHLG) 2010	No	No	Yes	-
Regional	**River Trent Catchment Flood Management Plan** (Environment Agency) 2009	Yes	Yes	No	-
	Humber Flood Risk Management Plan (Environment Agency) 2015	Yes	Yes	No	2021
	Humber River Basin Management Plan (Environment Agency) 2015	No	Yes	No	2021
	Climate Change guidance for development and flood risk (Environment Agency) 2019	No	No	Yes	2020 for fluvial and rainfall allowances
Local	**Local Flood Risk Management Strategy** (Staffordshire County Council) 2015	Yes	Yes	No	2021
	SuDS Handbook (Staffordshire County Council) 2017	Yes	No	Yes	-
	Drainage and Wastewater Management Plan (Severn Trent Water) due 2023	Yes	Yes	No	-
	Surface Water Management Plan Phase 1 (SSCs) 2010	Yes	Yes	Yes	-
	Surface Water Management Plan Phase 2, Lichfield City (Lichfield District Council and Staffordshire County Council) 2011	Yes	Yes	No	-

2.4 Relevant flood risk management studies and documents

2.4.1 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, today's growth and infrastructure resilient in tomorrow's climate and a nation ready to respond and adapt to flooding and coastal change. Measures include updating the national river, coastal and surface water flood risk mapping and the understanding of long term investment needs for flood and coastal infrastructure, trialling new and innovative funding models, flood resilience pilot studies, developing an adaptive approach to the impacts of climate change, seeking nature based solutions towards flooding and erosion issues, integrating natural flood management into the new Environmental Land Management scheme, considering long term adaptive approaches in Local Plans, maximising the opportunities for flood and coastal resilience as part of contributing to environmental net gain for development proposals, investing in flood risk infrastructure that supports sustainable growth, aligning long term strategic planning cycles for flood and coastal work between stakeholders, mainstreaming property flood resilience measures and 'building back better' after flooding, consistent approaches to asset management and record keeping, updating guidance on managing high risk reservoirs in light of climate change, critical infrastructure resilience, education, skills and capacity building, research, innovation and sharing of best practise, supporting communities to plan for flood events, develop world leading ways of reducing the carbon and environmental impact from the construction and operation of flood and coastal defences, development of digital tools to communicate flood risk and transforming the flood warning service and increasing flood response and recovery support.

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.

2.4.2 Staffordshire County Council Local Flood Risk Management Strategy (2015)

Staffordshire County Council is responsible for developing, maintaining, applying and monitoring a LFRMS. The **most recent Strategy** was published in 2015 and is used as a means by which the LLFA co-ordinates Flood Risk Management on a day-to-day basis. Once the new National Strategy has been published in 2020, LLFAs will need to update their Local Strategies so that they reflect how national objectives for flood risk management will be delivered locally.

The seven high-level objectives proposed in the strategy for managing flood risk are as follows, with further details in the Level 1 SFRA and LFRMS:

- Develop a strategic understanding of flood risk from all sources
- Promote effective management of drainage and flood defence systems
- Support communities to understand flood risk and become more resilient to flooding
- Manage local flood risk and new development in a sustainable manner
- Achieve results through partnership and collaboration
- Be better prepared for flood events
- Secure and manage funding for flood risk management in a challenging financial climate.

2.4.3 LLFAs, surface water and SuDS

The 2019 NPPF states that: 'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate' (Para 165). When considering planning applications, local planning authorities should consult the LLFA on the management of surface water in order to satisfy that:

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

Staffordshire Country Council's requirements for planners and developers on SuDS are set out on their **website**, alongside supporting documents. At the time of writing this SFRA, documents and policies relevant to SuDS and surface water in Lichfield are:

- **Sustainable Drainage Systems (SuDS) Handbook** (Staffordshire County Council, 2017);
- **Standing Advice** (Staffordshire County Council, 2015);
- **Sustainable Design Supplementary Planning Document** (Lichfield District Council, 2015);
- **Phase 1 SWMP** for Southern Staffordshire Councils (Southern Staffordshire Councils, 2010)

The 2019 NPPF states that flood risk should be managed "using opportunities provided by new development to reduce causes and impacts of flooding." As such, Lichfield District Council expects SuDS to be incorporated on minor development as well as major development.

2.4.4 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 an area and are intended to influence future capital investment, drainage maintenance, public engagement and understanding, land-use planning, emergency planning and future developments.

SWMPs for Southern Staffordshire councils cover Lichfield and are available on the Council's **website**. The SWMPs identify flooding hotspots and provide recommendations and objectives to reduce flooding in these areas. The SWMP was undertaken in 2010 and has been largely superseded by the latest national surface water modelling and mapping and the 2015 Local Flood Risk Management Strategy.

2.4.5 Updated Strategic Flood Risk Assessment guidance

There was an update to the **'How to prepare a Strategic Flood Risk Assessment guidance'** in August 2019, which had some key additions to both Level 1 and Level 2 assessments.

For the Level 2 assessment, the following key additional points were noted, compared to the previous Level 2 guidance:

- There should be greater clarity on conclusions of the site assessments and the likelihood of passing the Exception Test; how much of the site is really developable?
- Further information on data should be included on duration of flooding, development downstream of reservoirs and taking into account climate change on the design standard of flood defences.
- Where there is a high degree of flood risk, how can further information be used to apply the Sequential Test?
- There should also be a cumulative impact assessment, following on from the recommendations of the Level 1, focussing on site-level.
- The Level 2 SFRA should give recommendations on managing residual risk.
- Where windfall development is being relied on to meet housing targets, what further strategic information can be presented, and process is needed to help development control decisions?

3 Planning policy for flood risk management

3.1 National Planning Policy Framework and Guidance

The revised National Planning Policy Framework (**NPPF**) was published in February 2019, replacing the 2012 version. The NPPF sets out Government's planning policies for England. It must be taken into account 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.

3.2 The risk-based approach

The NPPF takes a risk-based approach to development in flood risk areas.

3.2.1 The Flood Zones

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 probability: less than a 0.1% chance of river and sea flooding in any given year
- Flood Zone 2: Medium probability: 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 probability: 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.

Important note on Flood Zone information in this SFRA

The Flood Zones presented in Appendix A Geo-PDFs are the same as those shown on the Environment Agency's '**Flood Map for Planning**' at the time of publication.
The Environment Agency Flood Zones do not cover all catchments or ordinary watercourses. As a result, whilst the Environment Agency Flood Zones may show an area is in Flood Zone 1, it may be that there is actually a degree of flood risk from smaller watercourses 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 20 years; where detailed hydraulic modelling exists. In the absence of detailed models at these 4 strategic sites, 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 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 Zone it is proposed for. **Table 2 of the NPPG** defines the vulnerability of different development types to flooding. **Table 3 of the NPPG** shows whether, having applied the Sequential Test first, that vulnerability of development is suitable for that Flood Zone and where further work is needed.

Figure 3-1: The Sequential Test

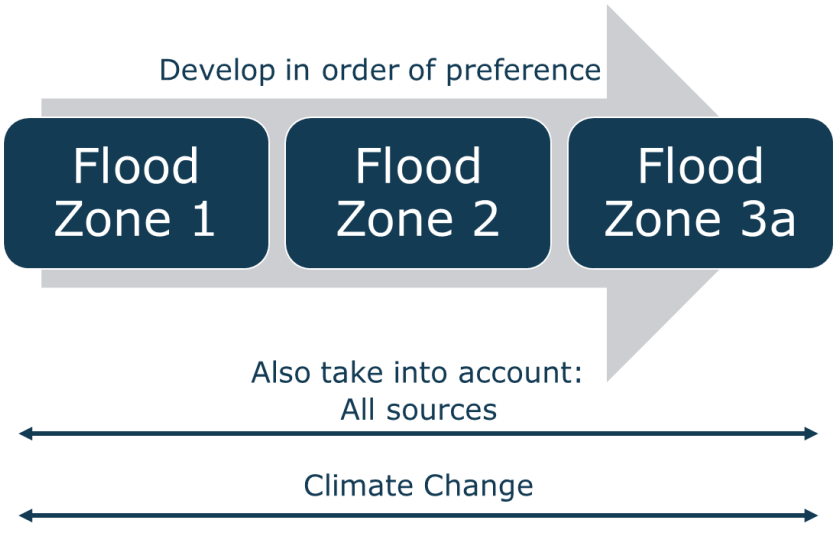
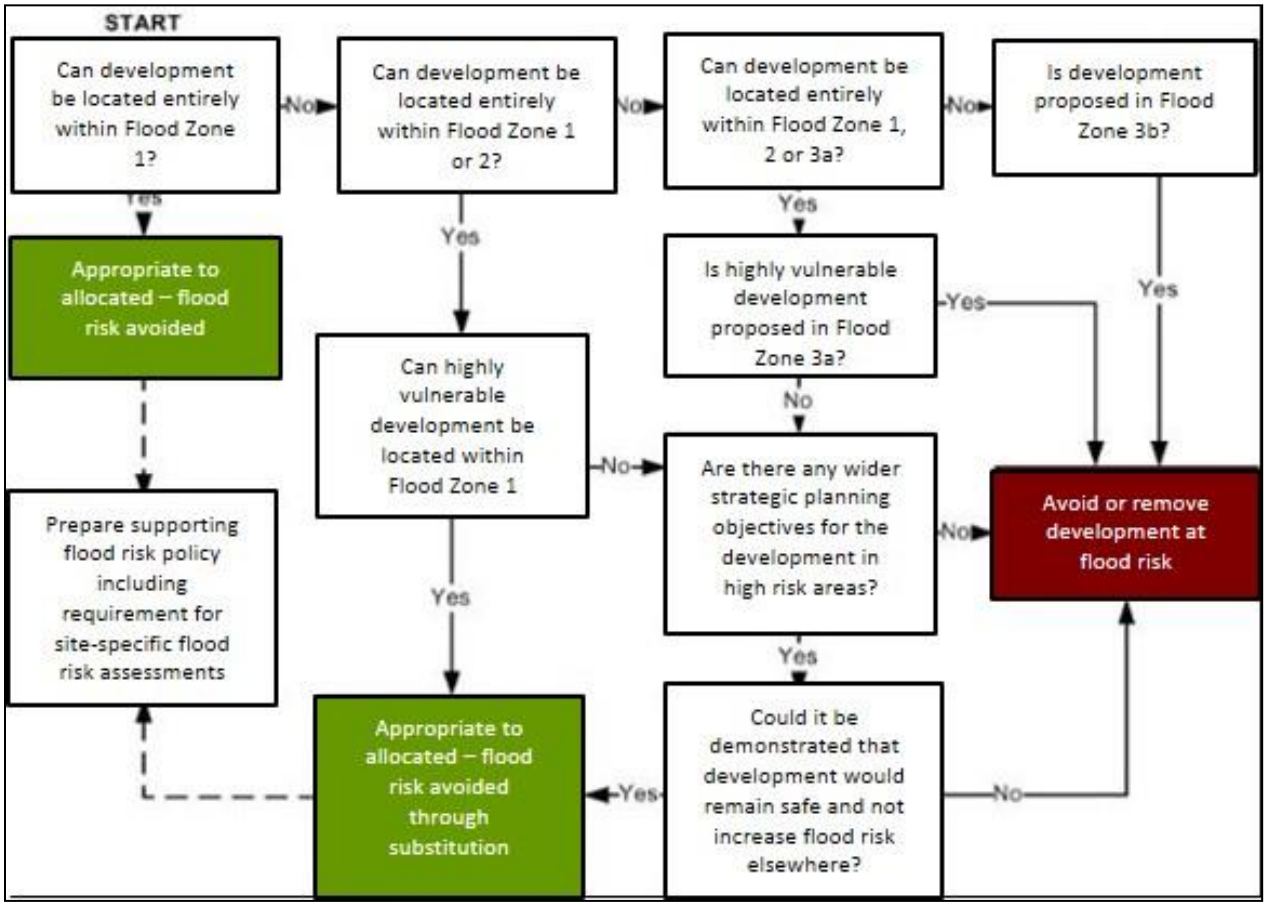


Figure 3-2 illustrates the Sequential and Exception Tests as a process flow diagram using the information contained in this SFRA to assess potential development sites against the EA's Flood Map for Planning flood zones and development vulnerability compatibilities.

This is a stepwise process, but a challenging one, as a number of the criteria used are qualitative and based on experienced judgement. The process must be documented, and evidence used to support decisions recorded.

In addition, the risk of flooding from outer sources and the impact of climate change must be considered when considering which sites are suitable to allocate.

Figure 3-2: Local Plan sequential approach to site allocation



3.2.3 The Exception Test

It will not always be possible for all new development to be allocated on land that is not at risk from 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. It applies in the following instances:

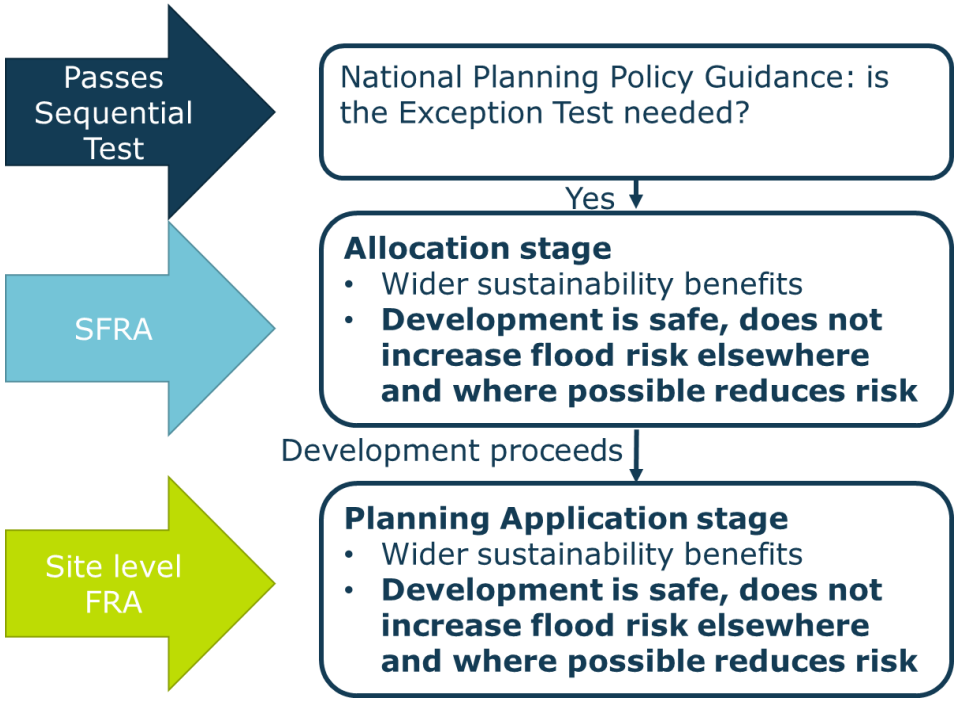
- More vulnerable in Flood Zone 3a
- Essential infrastructure in Flood Zone 3a or 3b
- Highly vulnerable in Flood Zone 2 (this is NOT permitted in Flood Zone 3a or 3b)

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 is appropriate 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: 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.*

A Level 2 SFRA is likely to be needed to inform the Exception Test in these circumstances for strategic allocations. 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.

3.2.4 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% chance flood in any year 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% chance flood in any year 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

Lichfield District 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.

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 out 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 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

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.

4.1 Revised climate change guidance

The Environment Agency published **updated climate change guidance** in 2019 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.

In 2018, the government published new UK Climate Projections (UKCP18). The Environment Agency are currently using these to update their climate change guidance for new developments with regards to updated fluvial and rainfall allowances. Developers should check on the government website for the latest guidance before undertaking a detailed Flood Risk Assessment. At the time of writing this report, this was reported to be due in late 2020, but is not yet released.

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 **NPPG**
- The likely lifetime of the development – in general 60 years is used for commercial development and 100 for residential, but this needs to be confirmed in a FRA
- The River Basin that the site is in – Lichfield District is situated in the Humber River Basin District.
- 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 Lichfield District

Table 4-1 shows the peak river flow allowances that apply to Lichfield District and Table 4-2 shows the peak rainfall intensity allowances that apply in Lichfield District.

Both the central and upper end allowances should be considered to understand the range of impact. The table below shows anticipated changes in extreme rainfall intensity in small and urban catchments:

Table 4-1 Peak river flow allowances by river basin district

River basin district	Allowance category	Total potential change anticipated for '2020s' (2015 to 39)	Total potential change anticipated for '2050s' (2040 to 2069)	Total potential change anticipated for '2080s' (2070 to 2115)
Humber	Upper end	20%	30%	50%

	Higher central	15%	20%	30%
	Central	10%	15%	20%

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

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

4.4 Representing climate change in the L2 SFRA

Climate change has been represented at the strategic sites using Flood Zone 2, for an indication of fluvial risk, and the 1,000-year surface water extent for an indication of surface water risk. This is due to an absence of detailed hydraulic models at the sites, and small watercourses which exhibit low risk to the sites.

More detailed hydraulic modelling in these areas will be required at site-specific Flood Risk Assessment stage to confirm flood risk and climate change impacts, using the percentage increases which relate to the proposed lifetime and the vulnerability classification of the development.

4.5 Adapting to climate change

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

- Considering future climate risks when allocating development sites to ensure risks are understood over the development's lifetime;
- Considering the impact of and promoting design responses to flood risk and coastal change for the lifetime of the development;
- Considering availability of water and water infrastructure for the lifetime of the development and design responses to promote water efficiency and protect water quality;
- Promoting adaptation approaches in design policies for developments and the public realm for example by building in flexibility to allow future adaptation if needed, such as setting new development back from watercourses; and
- Identifying no or low-cost responses to climate risks that also deliver other benefits, such as green infrastructure that improves adaptation, biodiversity and amenity, for example by leaving areas shown to be at risk of flooding as public open space.

5 Sources of information used in preparing the L2 SFRA

5.1 Data used to inform the SFRA

Table 5-1 provides an overview of the supplied data, used to inform the appraisal of flood risk for the Lichfield strategic sites.

Table 5-1 Overview of supplied data for Lichfield L2 SFRA

Source of flood risk	Data used to inform the assessment	Data supplied by
Historic (all sources)	Historic Flood Map and Recorded Outlines Hydraulic Modelling Reports, where provided	Environment Agency
	2018-19 L1 SFRA	Lichfield District Council
	Historic flood incidents/records	Staffordshire County Council Lichfield District Council Canals and River Trust
Fluvial (including climate change)	Flood Zones Risk of Flooding from Rivers and Sea	Environment Agency
Surface Water	Risk of Flooding from Surface Water dataset Local Flood Risk Management Strategy Communities at Risk	Environment Agency
Groundwater	Areas Susceptible to Groundwater Flooding dataset Bedrock geology/superficial deposits dataset	Environment Agency
Sewer	At Risk Register Historic flooding records	Severn Trent Water
Reservoir	National Inundation Reservoir Mapping	Environment Agency
Canal	Description of flood incidences	Canal and River Trust

5.2 Flood Zones 2 and 3a

The data used to prepare the fluvial mapping for this study is based on Environment Agency Flood Map for Planning Flood Zones, because there are no detailed hydraulic models covering the four sites.

5.2.1 Flood Zone 3b

Flood Zone 3b has been identified as land which would flood with an annual probability of 1 in 20 years (5% AEP). Where a hydraulic model is present, the 20-year defended modelled flood extent would be used; however, where no detailed models exist in this case, Flood Zone 3a has been used as an indication of Flood Zone 3b.

Note on the Environment Agency Flood Map for Planning

Where outlines are not informed by detailed hydraulic modelling, the Flood Map for Planning is based on generalised modelling to provide an indication of flood risk. Whilst the generalised modelling is generally accurate on a large scale, Flood Zones are not provided for specific sites or for land where the catchment of the watercourse falls below 3km^2.

For watercourses with smaller catchments, the Risk of Flooding from Surface Water map provides an indication of the floodplain of small watercourses and ditches. It is more accurate in upper to mid river valley locations (like the Upper Trent and Tame catchments) than lower valley locations near the coast. This is because it does not represent the floodplain for small watercourses as well in largely flat areas.

Even where more detailed models of Main Rivers have been used by the Environment Agency to inform the Flood Map for Planning, they will be largely based on remotely detected ground model data and not topographic survey.

For this reason, the Flood Map for Planning is not of a resolution to be used as application evidence to provide the details of possible flooding for individual properties or sites and for any sites with watercourses on, or adjacent to the site. Accordingly, for site-specific assessments it will be necessary to perform more detailed studies in circumstances where flood risk is an issue.

5.3 Climate change

There were no detailed hydraulic models available for this site assessment. The mapping therefore provides a strategic assessment of climate change risk using Flood Zone 2 as a fluvial indication of climate change, and the surface water 1,000-year extent as a surface water indication (and small watercourses not shown in the Flood Zones) for climate change. Developers should undertake detailed modelling of unmodelled watercourses and simulate climate change allowances as part of a site-specific FRA, following the **climate change guidance** set out by the Environment Agency.

5.4 Surface Water

Mapping of surface water flood risk in Lichfield District has been taken from the Environment Agency's Risk of Flooding from Surface Water (RoFfSW) mapping, which is a slightly more detailed resolution than that published online by the Environment Agency. Surface water flood risk is subdivided into the following four categories:

- **High**: An area has a chance of flooding greater than 1 in 30 (3.3%) each year.
- **Medium**: An area has a chance of flooding between 1 in 100 (0.1%) and 1 in 30 (3.3%) each year.
- **Low**: An area has a chance of flooding between 1 in 1,000 (0.1%) and 1 in 100 (1%) each year.
- **Very Low**: An area has a chance of flooding of less than 1 in 1,000 (0.1%) each year.

The results should be used for high level assessments such as SFRAs for local authorities. If a particular site is indicated in the Environment Agency mapping to be at risk from surface water flooding, a more detailed assessment should be required to more accurately illustrate the flood risk at a site-specific scale. Such an assessment will use the RoFSW in partnership with other sources of

local flooding information to confirm the presence of a surface water risk at that particular location.

Detailed surface water modelling was undertaken for the 2010 Surface Water Management Plan for Lichfield. However, the LLFA, Severn Trent Water and relevant District Councils have subsequently agreed that the latest assumptions in the national Risk of Flooding from Surface Water map mean that it is more representative of surface water flood risk for the District.

5.5 Groundwater

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

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

5.6 River networks

Main Rivers are represented by the Environment Agency's Statutory Main River layer. Ordinary Watercourses are represented by the Environment Agency's Detailed River Network Layer. Caution should be taken when using these layers to identify culverted watercourses which may appear as straight lines but in reality, are not. Developers should be aware of the need to identify the route of, and flood risk associated with culverts and model these/use CCTV where necessary.

5.7 Flood warning

Flood Warning Areas are represented by the Environment Agency's Flood Warning Area GIS dataset.

5.8 Reservoirs

The risk of inundation as a result of reservoir breach or failure of a number of reservoirs within the area has been identified from the Environment Agency's **Long Term Flood Risk Information website**.

5.9 Sewer flooding

Historical incidents of flooding are detailed by Severn Trent Water through their sewer flooding register. The sewer flooding register records incidents of flooding relating to public foul, combined or surface water sewers and displays which properties suffered flooding. Due to licencing and confidentiality restrictions, sewer flooding data has not been represented on the mapping.

5.10 Historic flooding

Historic flooding was assessed using the Environment Agency's Historic Flood Map, as well as any incidents picked up in the historic flooding register provided by Staffordshire County Council as LLFA.

5.11 Flood defences

Flood defences are represented by Environment Agency's Asset Information Management System (AIMS) Spatial Defences data set. Their current condition and standard of protection are based on those recorded in the tabulated shapefile data. None of the sites being assessed are formally protected by a flood defence.

5.12 Residual risk

The residual flood risk to sites is identified as where potential blockages or overtopping / breach of defences could result in the inundation of a site.

Potential culvert blockages that may affect a site were identified on OS Mapping and the Environment Agency's Detailed River Network Layer to determine where watercourses flow into culverts or through structures (i.e. bridges) in the vicinity of the sites. Any potential locations were flagged in the site summary tables. These may need to be considered by the developer as part of a site-specific Flood Risk Assessment.

5.13 Depth, velocity and hazard to people

The Level 2 assessment seeks to map the probable depth and velocity of flooding as well as the hazard to people during the defended fluvial 100-year event. However, in the absence of detailed hydraulic models, the Risk of Flooding from Rivers and Sea dataset has been used, as well as the Risk of Flooding from Surface Water datasets. The depth, hazard and velocity of the 100-year surface water flood event has been mapped and considered in this assessment. Hazard to people has been calculated using the below formula as suggested in Defra's FD2321/TR2 "Flood Risk to People". The different hazard categories are shown in Table 5-2.

Table 5-2 Defra's FD2321/TR2 "Flood Risks to People" classifications

Description of Flood Hazard Rating	Flood Hazard Rating	Classification Explanation
Very Low Hazard	< 0.75	Flood zone with shallow flowing water or deep standing water"
Danger for some (i.e. children)	0.75 - 1.25	"Danger: flood zone with deep or fast flowing water"
Danger for most	1.25 - 2.00	Danger: flood zone with deep fast flowing water"
Danger for all	>2.00	"Extreme danger: flood zone with deep fast flowing water"

As part of a site-specific FRA, developers will need to undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood depth, velocity and hazard based on the relevant 100-year plus climate change event as part of a site-specific FRA, using the relevant climate change allowance based on the type of development and its associated vulnerability classification. Not all of this information is known at the strategic scale.

5.14 Note on SuDS suitability

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

The assessment is based on catchment characteristics and additional datasets such as the AStGWF map and British Geological Survey (BGS) Soil maps of

England and Wales which allow for a basic assessment of the soil characteristics on a site by site basis. LIDAR data was used as a basis for determining the topography and average slope across each development site. Other datasets were used to determine other factors. These datasets include:

- Historic landfill sites
- Groundwater Source Protection Zones
- Detailed River Network
- Flood Zones derived as part of this L2 SFRA

This data was then collated to provide an indication of particular groups of SuDS systems which might be suitable at a site. SuDS techniques were categorised into five main groups, as shown in Figure 5-3. This assessment should not be used as a definitive guide as to which SuDS would be suitable but used as an indicative guide of general suitability. Further site-specific investigation should be conducted to determine what SuDS techniques could be used on a particular development, informed by detailed ground investigations.

Table 5-3: Summary of SuDS categories

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

The suitability of each SuDS type for the site options has been described in the summary tables, where applicable. The assessment of suitability is broadscale and indicative only; more detailed assessments should be carried out during the site planning stage to confirm the feasibility of different types of SuDS. Staffordshire County Council as LLFA should be consulted at an early stage to ensure SuDS are implemented and designed in response to site characteristics and policy factors. SuDS in Staffordshire must be designed so that they are in accordance with the Local SuDS Standards in the 2017 Staffordshire SuDS Handbook.

6 Level 2 assessment methodology

6.1 Site screening

For some Level 2 assessments, Councils may provide a number of sites, which would be screened against the flood risk datasets, to help confirm which would go forward to a Level 2 assessment. For this Level 2, four strategic sites were provided and assessed. The site boundaries were queried using GIS software against the flood risk information including Flood Zones, surface water and historic flood map.

Where sites are shown to be in Flood Zone 1, these were then checked against OS mapping for any drains or ordinary watercourses which may pose a risk, as well as the surface water mapping for further consideration (because their catchments may be <3km^2 and hence not represented in the Flood Map for Planning).

6.2 Strategic sites

Four site options have been provided by the Council to undergo Level 2 assessment. These sites are:

Table 6-1 Sites carried forward to a Level 2 assessment

Site code	Site name	Development type
SHA1	North of Lichfield	Residential
SHA2	Land west of Fazeley	Residential
SHA3	Land north and south of Hay End Lane	Residential
SHA4	Land off Huddlesford Lane	Residential

This Level 2 SFRA assessment helps to determine variations in flood risk across the site options, identifying site-specific FRA requirements and helping guide local policies to provide sustainable developments, as well as reducing flood risk to existing communities. This will help the Council to answer part of the Exception Test where sites are residential and in Flood Zone 3.

6.3 Site summary tables

As part of the Level 2 SFRA, detailed site summary tables have been produced for the sites listed above in Table 6-1. The summary tables can be found in Appendix A.

Using Flood Zones, climate change and Risk of Flooding from Surface Water (RoFfSW) extents, detailed site summary tables have been produced for the site options (see Appendix A). Each table sets out the following information:

- Basic site information
- Area, type of site, current land use (greenfield/ brownfield), proposed site use
- Sources of flood risk
    - Existing drainage features
    - Fluvial – proportion of site at risk including description from mapping/ modelling
    - Surface Water – proportion of site at risk including description from RoFfSW mapping
    - Reservoir
    - Canal

- Flood History
- Flood risk management infrastructure
    - Defences – type, Standard of Protection and condition (if known), and description
    - Description of residual risk (blockage scenarios)
- Emergency Planning
    - Flood Warning Areas
    - Access and egress
- Climate change
    - Summary of climate change allowances and increase in flood extent compared to Flood Zones
    - Description of implications to the site
- Requirements for drainage control and impact mitigation
    - Broadscale assessment of possible SuDS to provide indicative surface water drainage advice for each site assessed for the Level 2 SFRA.
    - Groundwater Source Protection Zone
    - Historic Landfill Site
- NPPF Planning implications
    - Exception Test requirements
- Requirements and guidance for site-specific FRA (including consideration of opportunities for strategic flood risk solutions to reduce flood risk)
- Mapping information – description of data sources for the following mapped outputs:
    - Flood Zones
    - Climate change
    - Surface water
    - Fluvial depth, velocity and hazard mapping
    - Surface water depth velocity and hazard mapping

6.3.1 Interactive Geo-PDF mapping

To accompany each site summary table, there is an Interactive Geo-PDF map, with all the mapped flood risk outputs per site. This is displayed centrally, with easy-to-use 'tick box' layers down the right-hand side and bottom of the mapping, to allow navigation of the data.

Flood risk information in the Geo-PDFs include:

- Site boundary and Council boundary
- Title bar showing area, grid reference, site name, proposed development use (e.g. residential/ employment) and percentage Flood Zone coverage
- Flood Zones 2, 3a and 3b (functional floodplain) and indicative FZ3b
- Risk of flooding from Rivers and Sea
- Surface water 100-year depth, velocity and hazard rating
- Indicative Climate change extents (FZ2)
- Flood risk from surface water dataset (30-years, 100-years and 1,000-years)
- Areas Susceptible to Groundwater Flooding

- Flood Warning and Flood Alert Areas
- Historic Landfill
- Defences (embankment and wall)
- Main Rivers/ Ordinary watercourses

7 Flood risk management requirements for developers

The report provides a strategic assessment of flood risk to four strategic sites in Lichfield District. Prior to any construction or development, site-specific assessments will need to be undertaken so all forms of flood risk and any defences at a site are considered in more detail. Developers should, where required, undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent (including latest climate change allowances), to inform the sequential approach within the site and prove, if required, whether the Exception Test can be satisfied.

A detailed Flood Risk Assessment (FRA) may show that a site 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.

7.1 Principles for new developments

Apply the Sequential and Exception Tests

Developers must provide evidence that the Sequential Test has been passed for windfall developments. If the Exception Test is needed, they must also provide evidence that all parts of the Test can be met for all developments, based on the findings of a detailed Flood Risk Assessment. For strategic allocations where the Exception Test has already been applied, this should focus on the flood risk element of the Exception Test.

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

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

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

Developers should consult with the Environment Agency, Staffordshire County Council as LLFA and Severn Trent Water as the water and sewerage company, at an early stage to discuss flood risk including requirements for site-specific FRAs, detailed hydraulic modelling and drainage assessment and design.

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

Ensure that development does not increase flood risk elsewhere and in line with the NPPF, seeks to reduce the causes and impacts of flooding

Chapter 6 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.

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.

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.

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.

Consider and contribute to wider flood mitigation strategy and measures in Lichfield 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 natural flood management or by contributing in kind by mitigating wider flood risk on a development site. Developers should demonstrate in an FRA how they are seeking to contribute to managing flood risk across the catchment the development is located in.

7.2 Requirements for site-specific Flood Risk Assessments

7.2.1 When is a 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.

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
- In an area of significant surface water flood risk.

7.2.2 Objectives of site-specific FRAs

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

- whether a proposed development will be at risk of flooding, from all sources, both now and in the future, taking into account climate change;
- 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, Lichfield District Council and Staffordshire County Council. Guidance and advice for developers on the preparation of site-specific FRAs include:

- **Standing Advice on Flood Risk** (Environment Agency);
- **Flood Risk Assessment for Planning Applications** (Environment Agency);
- **Standing Advice** (Staffordshire County Council, 2015)
- **Sustainable Design Supplementary Planning Document** (Lichfield District Council, 2015);
- **Site-specific Flood Risk Assessment: CHECKLIST** (NPPF PPG, Defra).

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

7.3 Local requirements for mitigation measures

The Level 1 SFRA provides details on the following mitigation measures in Section 8.3, and should be referred to alongside this report:

- Site layout and design (8.3.1)
- Modification of ground levels (8.3.2)
- Raised floor levels (8.3.3)
- Development and raised defences (8.3.4)
- Developer contributions (8.3.5)
- Resistance and resilience measures (8.4)

7.4 Reducing flood risk from other sources

Section 8.5 of the Level 1 SFRA discusses how to reduce flood risk from other sources, such as groundwater, ordinary watercourses, surface water and sewer flooding, culverted watercourses, canals and reservoirs.

7.5 Flood warning and emergency planning

Section 8.6 of the Level 1 SFRA discusses NPPF requirements and what Emergency Plan will need to consider. It also references the **Staffordshire LRF** and other relevant hyperlinks to emergency planning information.

7.6 Duration and onset of flooding

The duration and onset of flooding affecting a site depends on a number of factors:

- The position of the site within a river catchment, with those at the top of a catchment likely to flood sooner than those lower down. The duration of flooding tends to be longer for areas in lower catchments.
- The principal source of flooding. Where this is surface water, depending on the intensity and location of the rainfall, flooding could be experienced within 30 minutes of the heavy rainfall event e.g. a thunderstorm. Typically, the duration of flooding for areas at risk of surface water flooding or from flash flooding from small watercourses is short (hours rather than days).
- The preceding weather conditions prior to the flooding. Wet weather lasting several weeks will lead to saturated ground. Rivers respond much quicker to rainfall in these conditions.
- Whether a site is defended, noting that if the defences were to fail, a site could be affected by very fast flowing and hazardous water within 15 minutes of a breach developing (depending on the size of the breach and the location of the site in relation to the breach). There are no sites proposed that could be affected by a breach in flood defences within the Council area.
- Catchment geology, for example chalk catchments talk longer to respond than typical clay catchments.

Table 7-1: Guidelines on the duration of and onset of flooding

Principal source of flooding	Duration	Onset
Surface water	Up to 4 hours	Within 30 minutes
Fluvial	4 – 24* hours	Within 2 - 8 hours

*Depending on where in the catchment a site is located, flooding could be rapid and flashy in the upper catchment, and slower responding and longer in duration in the lower catchment.

It is recommended that a site-specific Flood Risk Assessment refines this information, based on more detailed modelling work where necessary.

8 Surface water management and SuDS

The Level 1 SFRA summarises guidance and advice on managing surface water runoff and flooding in Chapter 9. Below is a guide to what is included in sections not expanded on here, for reference alongside this Level 2 SFRA:

- Section 9.1 – Role of the LLFA and Local Planning Authority in surface water management
- Section 9.2 – Sustainable Drainage Systems (SuDS) – this section explains what SuDS are, what the requirements are and shows the SuDS 'management train' principle.

8.1 Sources of SuDS guidance

8.1.1 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.

8.1.2 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.

8.1.3 Lichfield Sustainable Drainage Design and Adoption Guide

The Council has produced a number of topic-based Supplementary Planning Documents that have been adopted for the purposes of development control. In 2015, the **Sustainable Design Supplementary Planning Document (SPD)** was published.

The guide highlights the need for Sustainable Drainage, together with the principles and practice used to design the systems. It considers the detailed design and management requirements of SuDS and contains an adoption process required by Lichfield District Council to take responsibility for SuDS in open space.

8.1.4 Staffordshire SuDS Handbook

The **Staffordshire SuDS Handbook** was published in February 2017 to provide guidance for developers and relevant professionals on the SuDS requirements within Staffordshire.

The guide sets out the planning, design and maintenance requirements for SuDS schemes with the aim of producing benefits for the environment and communities whilst enabling developers to achieve compliance with LLFA SuDS requirements to gain SuDS approval. The Local Standards are set out in Section 9.3.3 of the Level 1 SFRA.

The document is intended to be complementary to the National Standard for SuDS (2015) and The SuDS Manual (CIRIA C753).

8.2 Other surface water considerations

8.2.1 Discharge rates from brownfield sites

In line with the NPPF, Lichfield District Council seek to use opportunities provided by new development to reduce the causes and impacts of flooding. In order to provide this flood risk betterment, the surface water discharge rate from brownfield sites should ideally be reduced to replicate greenfield rates. As a minimum, the surface water discharge rate on brownfield sites should be

reduced by 40%, or the level set out in the latest Lichfield District/Staffordshire County Council guidance, whichever is greater.

8.2.2 Groundwater Vulnerability Zones

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

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.**

8.2.3 Groundwater Source Protection Zones (GSPZ)

The Environment Agency also defines Groundwater Source Protection Zones (SPZs) near groundwater abstraction points. These protect areas of groundwater used for drinking water. The Groundwater SPZ requires attenuated storage of runoff to prevent infiltration and contamination. Groundwater Source Protection Zones can be viewed on the **Defra website**.

Lichfield District falls within a Groundwater Source Protection Zone.

8.2.4 Nitrate Vulnerable Zones

Nitrate Vulnerable Zones (NVZs) are areas designated as being at risk from agricultural nitrate pollution. Nitrate levels in waterbodies are affected by surface water runoff from surrounding agricultural land entering receiving waterbodies. The level of nitrate contamination will potentially influence the choice of SuDS and should be assessed as part of the design process. The NVZ coverage can be viewed on the **Environment Agency's online maps**.

The entirety of Lichfield District is located within a Nitrate Vulnerable Zone.

9 Cumulative impact of development and strategic solutions

9.1 Introduction

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. 156), rather than just to or from individual development sites.

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

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, in theory they should not increase flood risk downstream.

The Level 1 SFRA assessed catchments within Southern Staffordshire to determine which catchments are at the highest risk from the cumulative impact of development and made recommendations based on the results. These are still valid for the catchments not covered by the Level 2 analysis.

This Level 2 SFRA has focussed on the catchments that the four large strategic sites are located in. It considers whether there is likely to be a cumulative impact from the development and if so, how that might be managed.

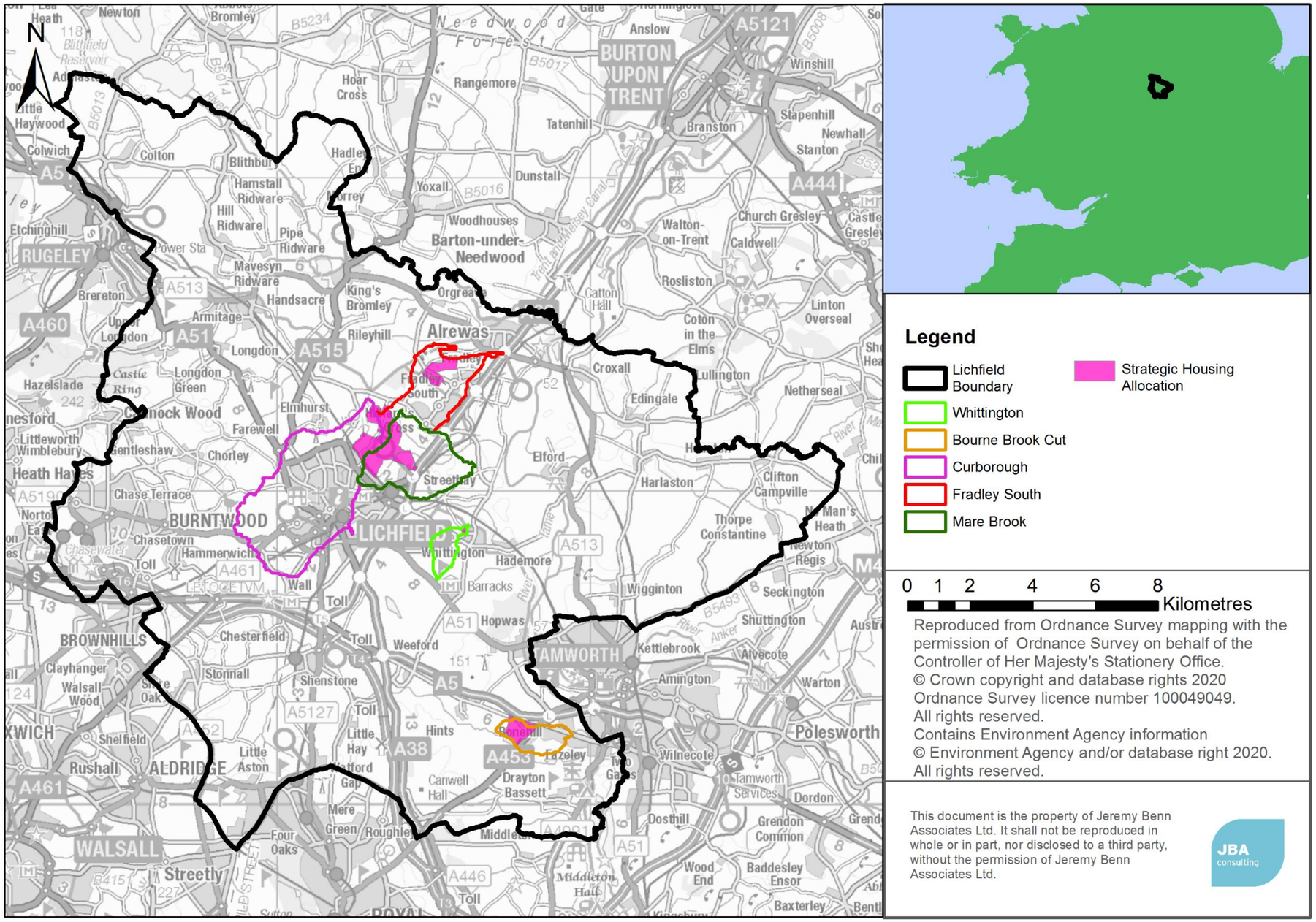
The catchments forming this cumulative impact assessment are shown in Figure 9-1. These include:

- Curborough Brook
- Whittington
- Mare Brook
- Bourne Brook Cut
- Fradley South

From the Level 1 Cumulative Impact Assessment, Mare Brook was within a Red catchment and Curborough Brook was within an Amber catchment which were classed as high and medium risk catchments respectively. For these catchments it was recommended that further consideration was made in a Level 2 SFRA regarding the potential for development sites to provide betterment to existing communities at flood risk downstream.

It was decided to look at all of these catchments for the Level 2 analysis because of the relatively large size of many of the proposed development sites. Catchment boundaries were redefined for the Level 2 SFRA using the FEH Web service so that they better represented the sub catchments that the developments are proposed for.

Figure 9-1 Map of catchments in Lichfield District



9.2 Proposed development in Lichfield

Four sites were provided by the Council to be taken forward to a Level 2 assessment. For these sites, the catchments they drain into have been collected from the FEH web service tool. Some of these sites lie only partially within these catchments whilst one of the sites (SHA1) partially falls within 3 of the catchments being considered. Table 9-1 displays the proposed development sites and the catchment that each site falls within.

Table 9-1 The main catchments covered by the strategic housing allocations

Site Reference	Catchment 1	Site area within catchment 1 (%)	Catchment 2	Site area within catchment 2 (%)	Catchment 3	Site area within catchment 3 (%)
SHA1	Curborough	29.2	Mare Brook	52.4	Fradley South	15.1
SHA2	Bourne Brook Cut	84.5	--	--	--	--
SHA3	Fradley Souh	99.1	--	--	--	--
SHA4	Whittington	89.0	--	--	--	--

9.3 Methodology

9.3.1 Assessing the impact of development at a catchment scale

To ascertain the impact of the proposed development on downstream flows, catchment descriptors from the FEH Webservice were downloaded for each catchment. The URBEXT (urban extent) value was increased in line with the total area of development proposed in the catchment. The imperviousness factor was assumed to be 0.4 across all catchments. This value assumes that 40% of all built up areas in the catchment is covered by impermeable surfaces.

From this information hydrographs showing the flood response in both a pre-development and post-development scenario in each catchment were generated for the 100-year flood event. It should be noted that these hydrographs have been derived from ReFH2 using catchment descriptors only, a detailed hydrological assessment to obtain these hydrographs has not been undertaken.

The pre- and post-development hydrographs produced with REFH2 were compared to calculate the additional volume of storm water passing through the catchment as a result of increased impermeable surfaces from development. This value represents the volume of storage required at a catchment scale to limit peak flow rates to the existing greenfield response.

9.3.2 Assessing the storage needs at development sites

The UK SuDS Website provides a variety of tools for the design and evaluation of sustainable drainage systems. The surface water storage volume estimation tool was used to provide estimates of storage volume requirements needed to meet best practice criteria from Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory technical standards for SuDS (Defra,

2015). It should be noted that the estimates from this tool should not be used for the detailed design of drainage systems and sewer modelling is recommended when designing a drainage scheme.

The tool works by selecting a point on a map for the calculation and entering characteristics for that site. For this assessment, the most downstream point of each site was selected, the site area was entered, and a developable area/ impermeable area was assumed based on council recommendations and similar values from neighbouring authority SHLAA methodologies. Of the total strategic housing site area, 60% was assumed to be developable.

All other variables in the tool were left as default, to avoid a large number of additional assumptions. The ReFH2 method to calculate surface water storage requirements was used.

Where a site only partially fell into a high risk catchment, storage estimations have been provided for two scenarios: the first assuming that the entire site will discharge into the chosen catchment and the second assuming only the proportion of the site within the catchment will discharge to this catchment, with the rest discharging to another catchment. In reality, a site will generally discharge all to one catchment and where a site will discharge to is not yet known, this should be considered at a site-specific stage.

9.4 Cumulative impact within the catchments

9.4.1 Whittington

SHA4 only falls partially within the boundaries of this catchment (Figure 9-2) covering a total of 2.5% of the catchment area.

Figure 9-2 Sites within the catchment draining towards the Coventry Canal at Whittington

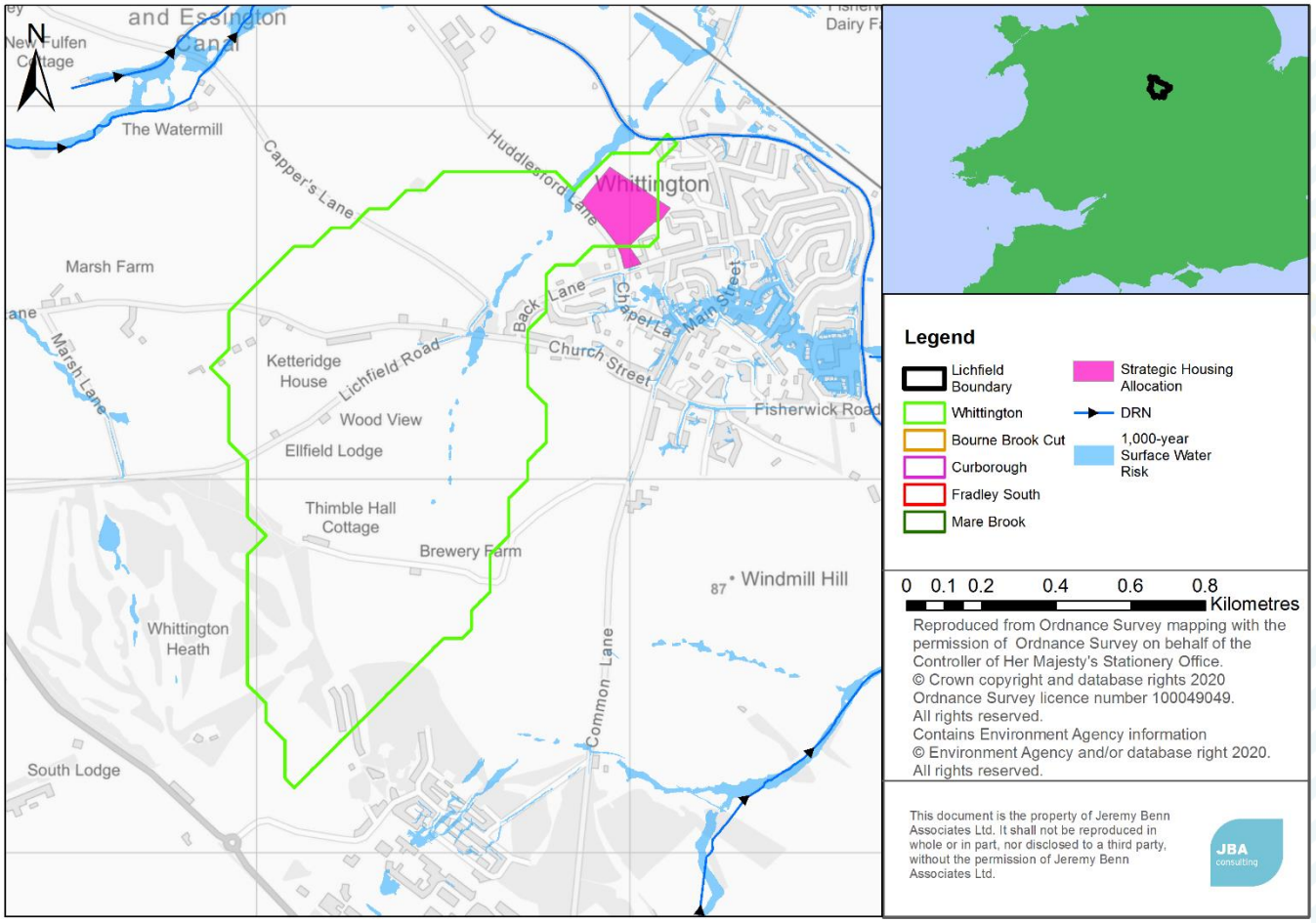


Figure 9-3 shows that with the proposed development in the catchment, peak flows downstream would increase slightly. An additional 173.9m^3 of water is estimated to pass through the hydrograph in the post-development scenario, a volume that should be mitigated through surface water management practices.

Direct runoff increases by 160m^3 post-development.

Figure 9-3 Pre- and post-development hydrographs for the catchment draining towards the Coventry Canal at Whittington

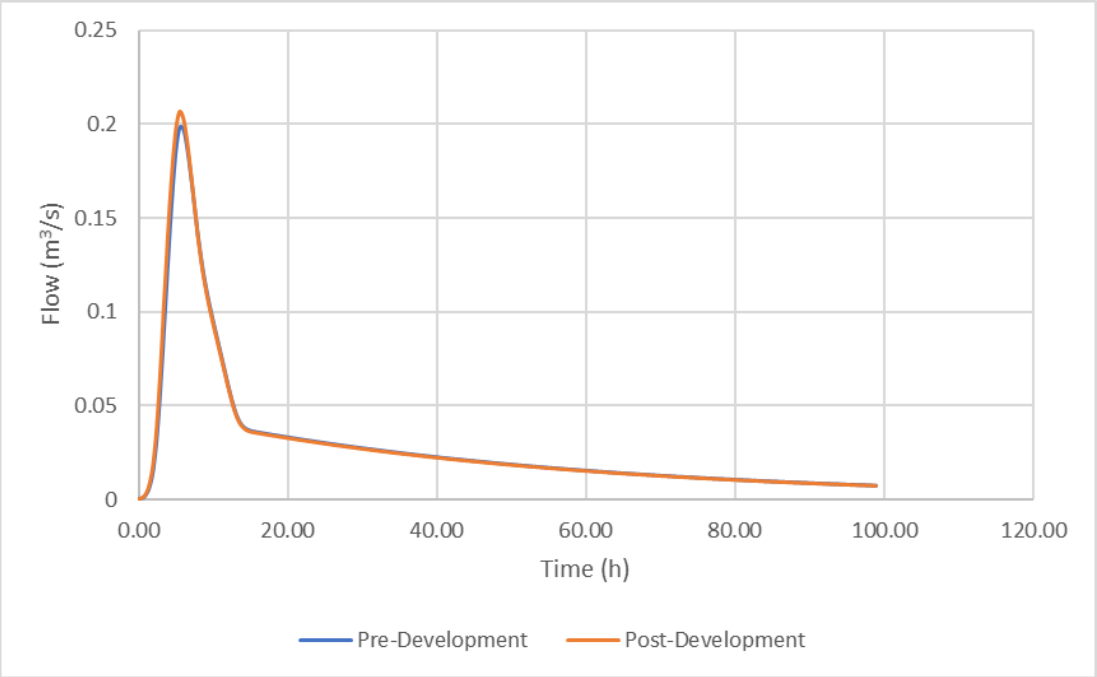


Table 9-2 describes the estimated storage volumes required at the site within the catchment draining towards the canal to limit the surface water runoff to existing greenfield runoff rates.

Table 9-2 Estimated storage volumes required at sites in the catchment draining towards the Coventry Canal at Whittington, taken from the UK SUDS website.

Catchment	Site	Attenuation storage 1 in 100 years (m3)	Long term storage 1 in 100 years (m3)	Total storage 1 in 100 years (m3)
Whittington	SHA4	3,211*	0*	3,211*
		2,745**	0*	2,745**

**Storage assuming entire site is discharged into the catchment draining towards the Coventry Canal at Whittington*

***Storage assuming only site area within the catchment draining towards the Coventry Canal at Whittington is being discharged to the catchment, with the remaining site area discharging to another catchment*

9.4.2 Bourne Brook Cut

Bourne Brook Cut catchment covers the northern bifurcation of the Bourne Brook river.

SHA2 development site falls partially within the west of Bourne Brook Cut catchment as is shown in Figure 9-4. This development covers 26.7% of the catchment.

Figure 9-4 Bourne Brook Cut catchment

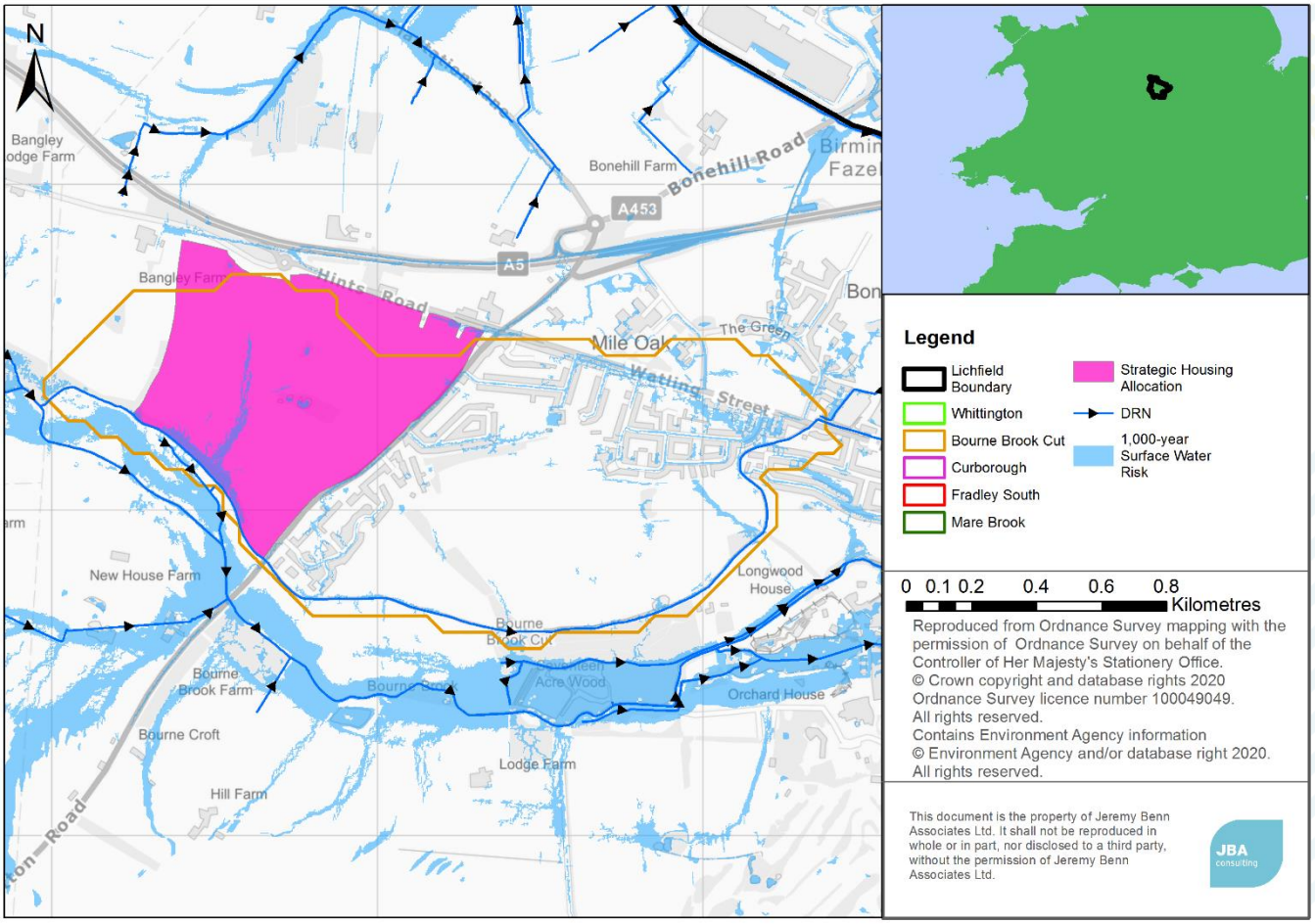


Figure 9-5 shows that with proposed development in the Bourne Brook Cut catchment results in a higher peak flow in the 100-year storm event, with the peak occurring earlier in the event. The flood peak also has a shorter duration showing that this catchment has a much flashier response in the post-development scenario. An additional volume of 3,180.6m^3 of water is estimated to pass through the catchment in the post-development scenario. This volume should be attenuated within the catchment to limit the runoff to greenfield rates.

Direct runoff increases by 1,130m^3 post-development.

Figure 9-5 Bourne Brook Cut catchment peak flows pre- and post-development

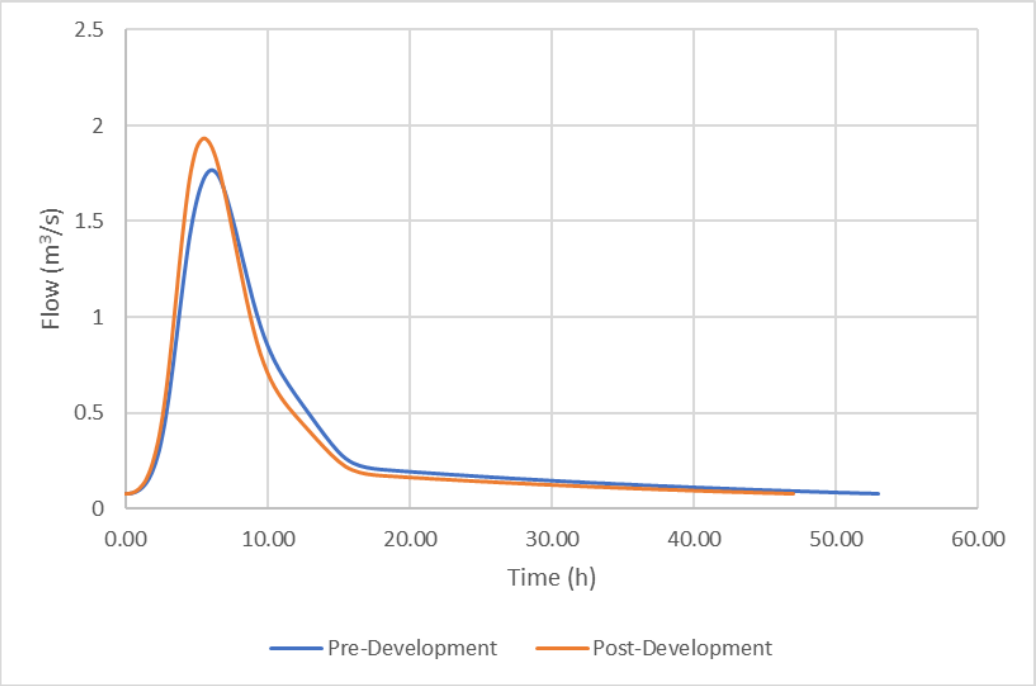


Table 9-3 displays the estimated volume of storage required at each proposed site to limit surface water runoff to the estimated existing greenfield rate.

Table 9-3 Estimated storage volumes required at sites in the Bourne Brook Cut catchment, taken from the UK SUDS website.

Settlement	Site	Attenuation storage 1 in 100 years (m3)	Long term storage 1 in 100 years (m3)	Total storage 1 in 100 years (m3)
Bourne Brook Cut	SHA2	6,403*	2,821*	9,224*
		4,691**	2,383**	7,074**

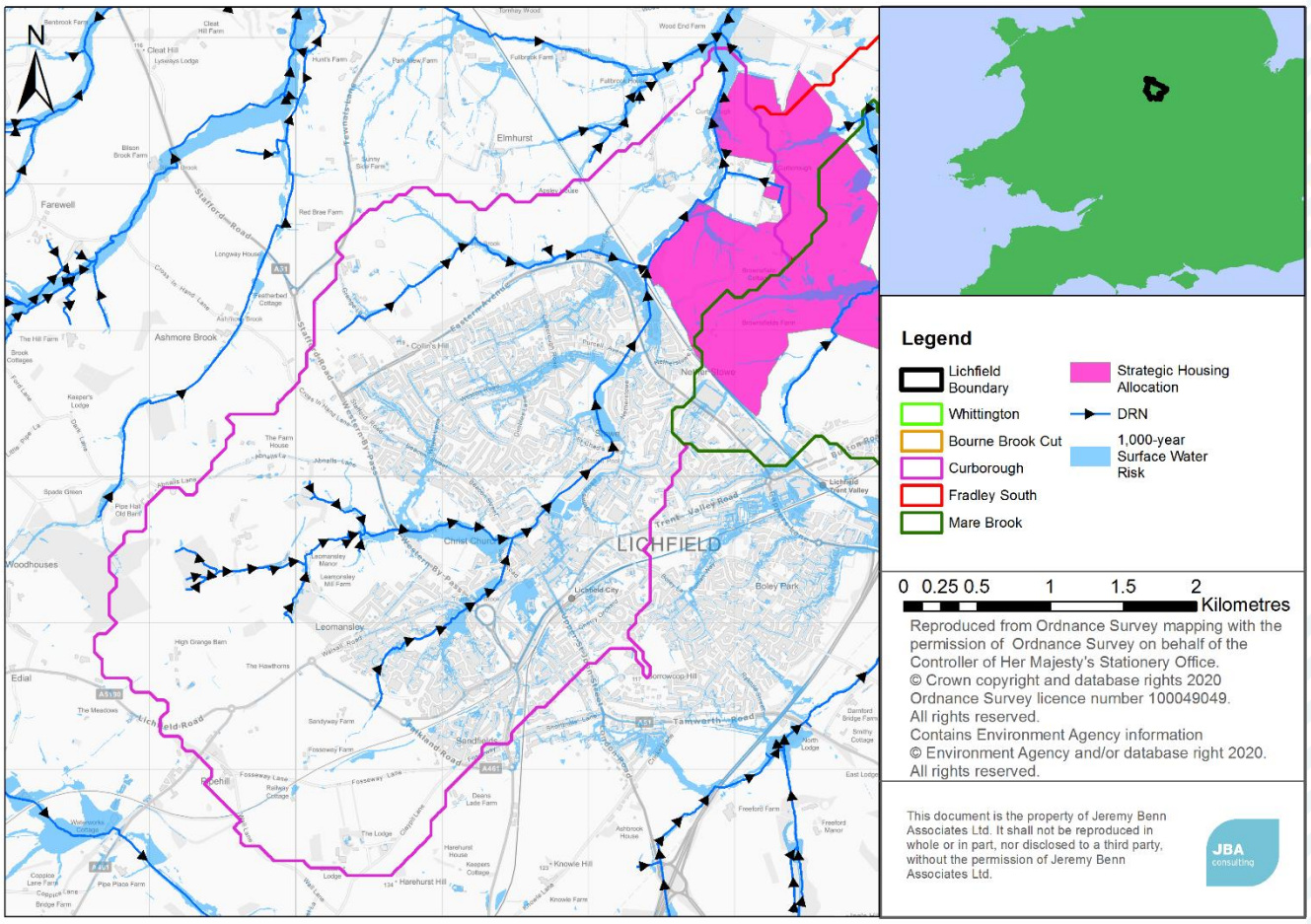
**Storage assuming entire site is discharged into the Bourne Brook Cut catchment*

***Storage assuming only site area within the Bourne Brook Cut catchment is being discharged to the catchment, with the remaining site area discharging to another catchment*

9.4.3 Curborough

SHA1 covers 4.8% of this catchment in the north as shown in Figure 9-6.

Figure 9-6 Curborough catchment



The impact on the hydrograph due to this proposed development can be seen in Figure 9-7. The peak flow at downstream in the catchment is slightly higher, with an estimated additional volume of 5,104.0m^3 moving through the catchment in the post-development scenario.

Direct runoff increases by 4,590m^3 post-development.

Figure 9-7 Curborough Brook hydrograph pre- and post-development

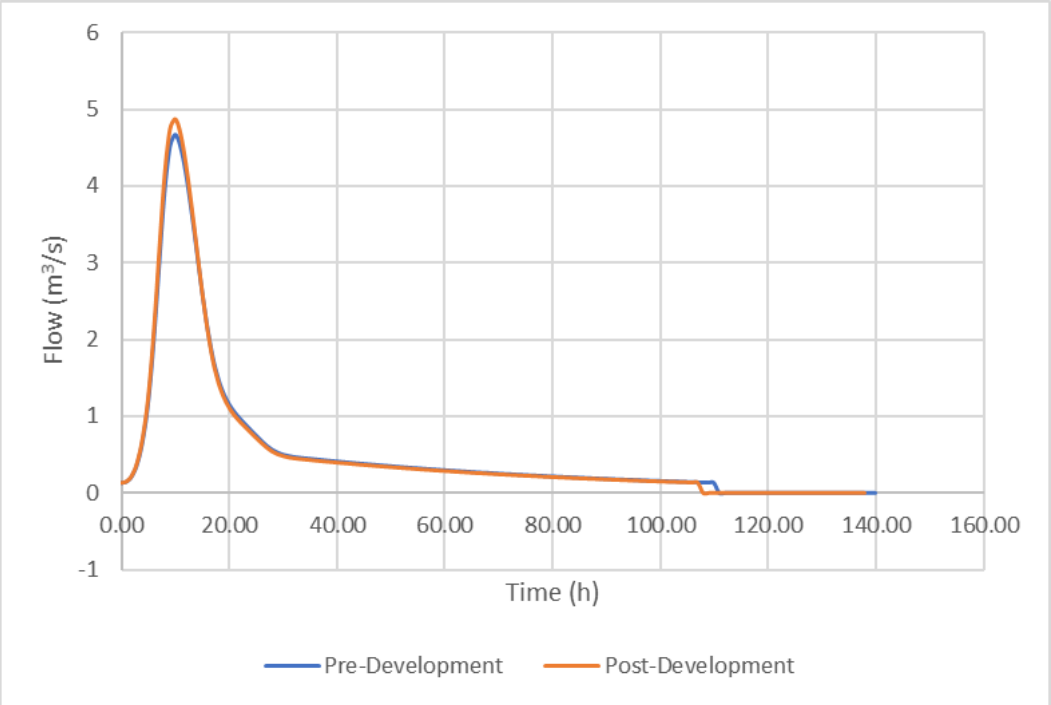


Table 9-4 describes the estimated storage required at each site to limit surface water runoff rates to existing greenfield rates.

Table 9-4 Estimated storage volumes required at sites in the Curborough Brook catchment, taken from the UK SUDS website.

Settlement	Site	Attenuation storage 1 in 100 years (m3)	Long term storage 1 in 100 years (m3)	Total storage 1 in 100 years (m3)
Curborough Brook	SHA1	35,321*	11,759*	47,080*
		2,908**	3,439**	6,347**

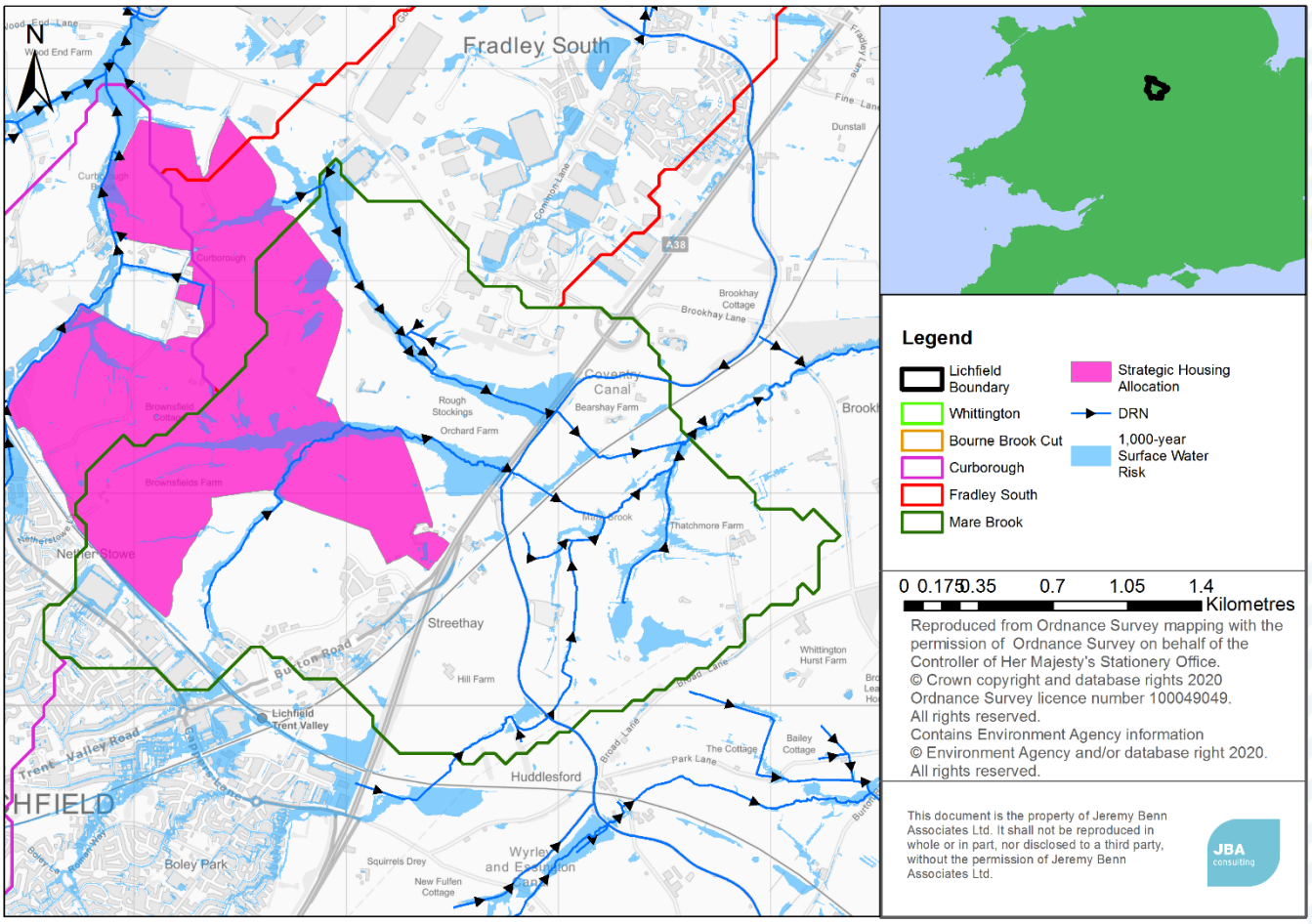
**Storage assuming entire site is discharged into the Curborough Brook catchment*

***Storage assuming only site area within the Curborough Brook catchment is being discharged to the catchment, with the remaining site area discharging to another catchment*

9.4.4 Mare Brook

SHA1 covers 20.3% of Mare Brook catchment in the western area as shown in Figure 9-8.

Figure 9-8 Mare Brook catchment



The pre- and post-development hydrograph for Mare Brook is shown in Figure 9-9. The proposed development in this catchment results in a higher peak in the hydrograph which forms earlier in the event than pre-development. A total additional volume of 8,654.8m^3 passing through the catchment during the 100-year design storm event would need to be stored within the catchment to maintain peak flows at current greenfield rates.

Direct runoff increases by 6,600m^3 post-development.

Figure 9-9 Mare Brook pre- and post-development hydrograph

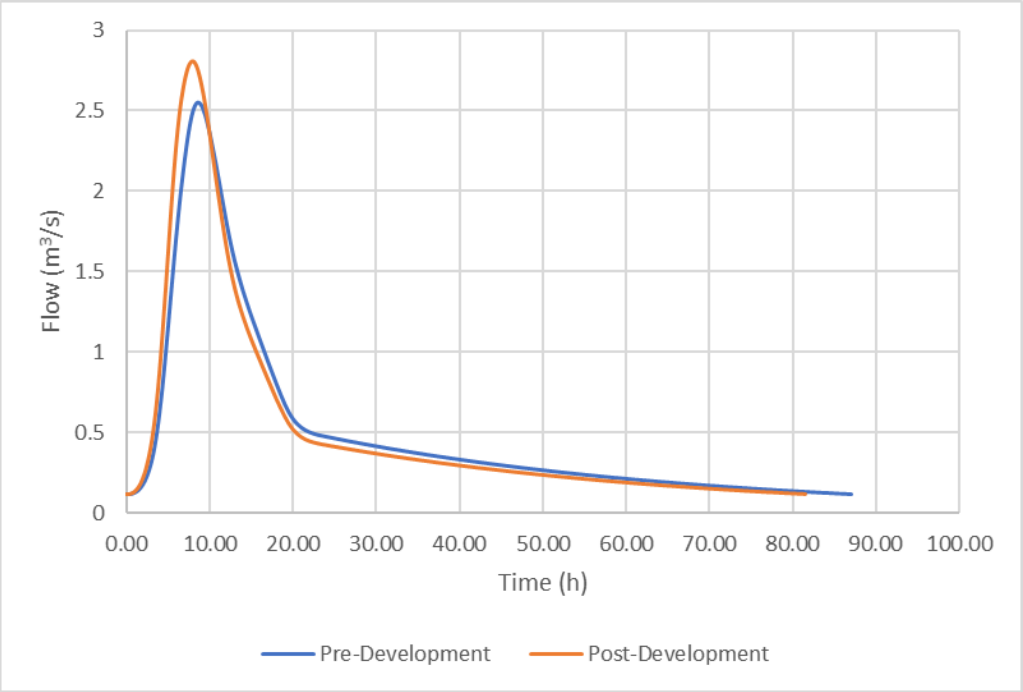


Table 9-5 provides an estimate of the long-term storage required at each site to reduce surface water runoff rates to greenfield rates.

Table 9-5 Estimated storage volumes required at sites in the Mare Brook catchment, taken from the UK SUDS website.

Settlement	Site	Attenuation storage 1 in 100 years (m3)	Long term storage 1 in 100 years (m3)	Total storage 1 in 100 years (m3)
Mare Brook	SHA1	50,719*	12,014*	62,733*
		19,471**	6,289**	25,760**

**Storage assuming entire site is discharged into the Mare Brook catchment*

***Storage assuming only site area within the Mare Brook catchment is being discharged to the catchment, with the remaining site area discharging to another catchment*

9.4.5 Catchment draining Fradley South

Two sites fall partially within catchment draining Fradley South, covering 17.5% of the catchment as shown in Figure 9-10. SHA1 partially covers the catchment in the south west and SHA3 covers an area in the north.

Figure 9-10 Catchment draining Fradley South

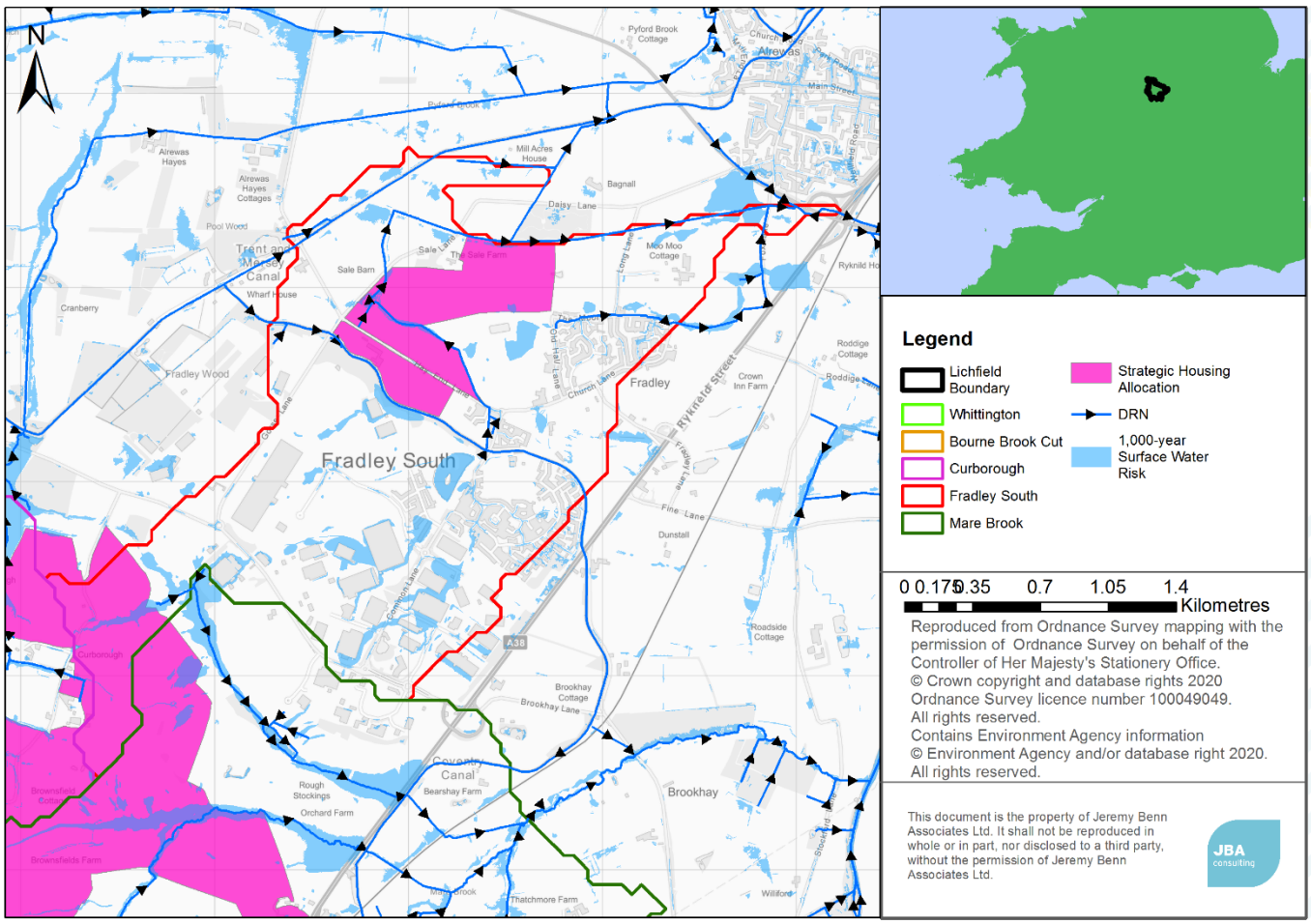


Figure 9-11 shows the impact to the hydrograph post-development in the catchment draining Fradley South. The proposed development in this catchment results in a higher peak in the hydrograph downstream. A total additional volume of 6,553.0m^3 passing through the catchment during the 100-year design storm event would need to be stored within the catchment to maintain peak flows at current greenfield rates.

Direct runoff increases by 5,820m^3 post-development.

Figure 9-11 Hydrographs pre- and post-development for the catchment draining Fradley South

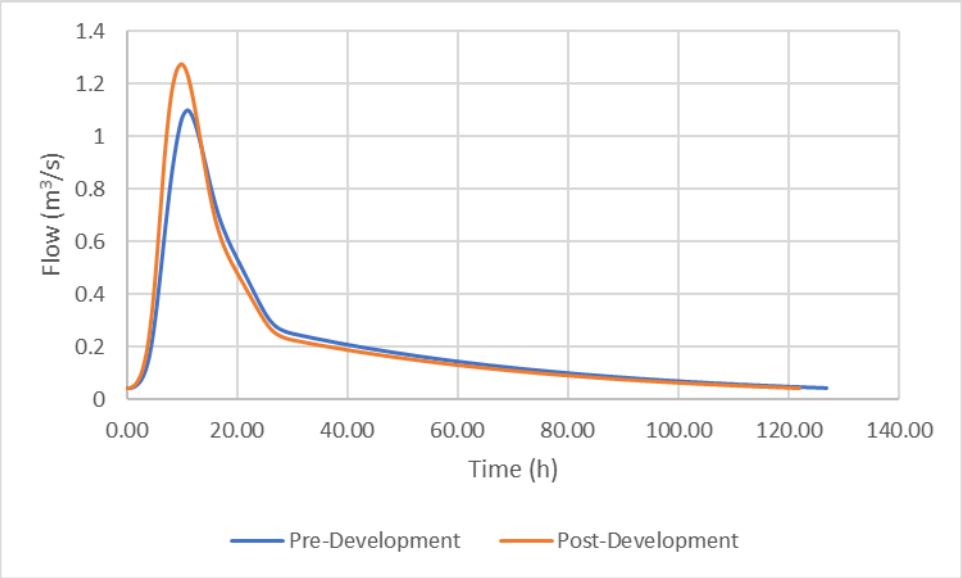


Table 9-6 provides an estimate of the long-term storage required at each site to reduce surface water runoff rates to greenfield rates. A total of 4,583m^3 of long-term storage capacity is required in this catchment.

Table 9-6 Estimated storage volumes required at sites in the catchment draining Fradley South, taken from the UK SUDS website

Settlement	Site	Attenuation storage 1 in 100 years (m3)	Long term storage 1 in 100 years (m3)	Total storage 1 in 100 years (m3)
Drain/Canal	SHA1	70,216*	7,917*	78,133*
		4,627**	1,843**	6,470**
	SHA3	8,889*	2,764*	11,653*
		8,770**	2,740**	11,510**

**Storage assuming entire site is discharged into the catchment draining Fradley South*

***Storage assuming only site area within the catchment draining Fradley South is being discharged to the catchment, with the remaining site area discharging to another catchment*

9.5 Approaches to managing the excess storage needed to account for an increase in impervious area

The cumulative impact analysis has highlighted the importance of managing both the rate and volume of surface water runoff from new developments to mitigate the impact of flood risk along our watercourses. Where reasonably practical, all new development shall control both the rate and volume of runoff to greenfield characteristics. Where the developer can demonstrate it is not reasonably practical,

runoff must be discharged at a rate that does not adversely affect flood risk. There are two general alternative approaches to meeting this requirement:

- Long Term Storage - the development shall discharge surface water for the 1 in 1 year rainfall event and the 1 in 100-year rainfall event at peak greenfield runoff rates for the same event and discharge the difference in runoff volume pre and post-development for the 100 year six hour event in long-term storage at a maximum rate of 2 l/s/ha.
- Restricted Discharge – the development shall discharge surface water at 2 l/s/ha or Qbar, whichever is greater, for all storms up to the critical 100-year event.

9.6 Water Cycle Study

In 2018, JBA Consulting were commissioned to carry out a Water Cycle Study (WCS) for the Southern Staffordshire Councils.

This study highlighted that SHA1, SHA2 and SHA3 would require early engagement between Lichfield District Council and Severn Trent Water due to the wastewater infrastructure not having enough capacity currently.

It was identified that SHA1 would require an odour assessment.

A sensitivity analysis was carried out on each of the sewerage catchments to check the impact on water quality in terms of ammonia, Biological Oxygen Demand (BOD) and phosphate to determine the impact from increased wastewater effluent. Each of the sensitivity checks increased by between 1-5% for the catchments which the sites in this analysis would lie.

The Water Framework Directive status for watercourses adjacent to the sites are as follows: Curborough Brook adjacent to SHA1 is at bad status, Bourne Brook adjacent to SHA2 is at poor status, Trent and Mersey Canal bordering the west of SHA3 is at good status and Coventry and Ashby Canal which runs through SHA3 and adjacent to SHA4 is at good status. Each of the watercourses have good chemical quality, with Bourne Brook and Curborough Brook failing to reach good status due to their ecological quality.

9.7 Strategic flood risk solutions

Lichfield District Council and Staffordshire County Council have a vision for the future management of flood risk and drainage in the district. This concerns flood risk management, alongside wider environmental and water quality enhancements. Strategic solutions may include upstream flood storage, integrated major infrastructure/ FRM schemes, new defences and watercourse improvements as part of regeneration and enhancing green infrastructure, with opportunities for natural flood management and retrofitting sustainable drainage systems.

The Level 1 SFRA and Chapter 2 sets out the strategic plans that exist for the district. The list below summarises the key outcomes these are seeking to achieve. This vision needs to be delivered by new development alongside retrofitting and enhancing green infrastructure and flood defence schemes in the existing developed area.

The strategic policy vision from the CFMP and RBMP focuses on re-naturalising watercourses, safeguarding the floodplains and the encouraging collaboration and creating new partnerships to reduce the risk of flooding and to enhance the natural environment. Within Lichfield District, strategic solutions encourage development to:

- Use sustainable flood storage and mitigation schemes to store water and manage surface water runoff in locations that provide overall flood risk reduction as well as environmental benefits.
- In areas where flood risk is being managed effectively, there will be a need in the future to keep pace with increasing flood risk as a result of climate change.

- Promote partnership working with all relevant stakeholders in the Humber River Basin. This includes working with land managers and farmers to reduce soil erosion from intensively farmed land.
- Assess long-term opportunities to move development away from the floodplain and create green river corridors through Lichfield District.
- Identify opportunities to use areas of the floodplain to store water during high flows, to reduce long term dependence on engineered flood defences located both within the borough and outside the borough.
- Safeguard the natural floodplain from inappropriate development.
- Where possible, land management change should be used to reduce run-off rates from the development whilst maintaining or enhancing the capacity of the natural floodplain to retain water. Land management and uses that reduce runoff rates in upland areas should be supported.
- Development should maintain conveyance of watercourses through hamlets and villages to help reduce the impact of the more frequently experienced floods and to improve the natural environment.
- Use SFRAs to inform future development and minimise flood risk from all sources.
- Implement upstream catchment management e.g. slow the flow and flood storage schemes could be implemented in upper catchments to reduce flooding downstream and across neighbouring authority boundaries; and
- Promote and consider SUDS at the earliest stage of site development.

The River Trent Catchment Flood Management Plan gives an overview of the flood risk in the River Trent catchment, and sets out plans for sustainable flood risk management across 10 sub areas. Lichfield District is covered by the Mid Staffordshire and Lower Tame Policy Option 6 – areas of low to moderate flood risk where action will be taken to store water or manage runoff in locations that provide overall flood risk reduction or environmental benefits.

9.8 Policy Considerations

Having analysed the catchments of the proposed development sites in detail and in discussion with the LLFA there are no strategic development sites proposed that have the potentially to provide a significant betterment to existing communities immediately downstream at high flood risk. This is largely due to the location of the sites e.g. SHA1 is downstream of Lichfield City and/ or the relative catchment size compared to the size of the proposed development site(s). However, all of these developments have the potential to increase flood risk offsite if both National and Local SuDS Standards are not applied and if runoff is not restricted to greenfield runoff. They also offer a great potential to enhance the wider Green and Blue Infrastructure of the local area through integrated planning for flood risk, sustainable drainage, biodiversity, amenity and sustainable transport provision.

In particular the CIA has highlighted the importance of implementing the following local SuDS standards to strategically approach flood risk management and sustainable drainage on these sites:

- Local Standard A – Phased Development and Drainage Strategies
- Local Standard C – Conformity with the SuDS Management Train Principles
- Local Standard D – Exceedance Flows
- Local Standard E – Climate Change
- Local Standard I – Watercourse Floodplains

- Local Standard J – Retention of Natural Drainage Features
- Local Standard O – Multiple Benefits

At the Flood Risk Assessment stage, developers should demonstrate how an integrated flood risk and sustainable drainage scheme for the site:

- Provides the level of storage required for the 1 in 100-year with climate change event, taking account of the latest government guidance on climate change in Flood Risk Assessments. Detailed drainage modelling should support the calculations for the amount of site storage and long term/ additional storage needed to ensure there is no impact on flood risk downstream. Where reasonably practical, all new development shall control both the rate and volume of runoff to greenfield characteristics. Where the developer can demonstrate it is not reasonably practical, runoff must be discharged at a rate that does not adversely affect flood risk.
- Conforms to the SuDS Management Train and provides a suitable amount of drainage at plot, street, phase (where appropriate) and site level. An approach that allows for rainwater harvesting, infiltration, conveyance and storage lends itself to a green infrastructure led approach to drainage design and can be integrated into green corridors and public open spaces throughout a development.
- Exceedance flows should be managed through a development and informed by more detailed modelling of the floodplain and surface water flow paths for a 1 in 100-year event (including an allowance for climate change). These areas can also be integrated into the green/ blue infrastructure on a development site, although sustainable drainage designs should be checked to ensure they are resilient against being overwhelmed by overland surface water flows. Natural drainage features should also be maintained and enhanced, and culverting resisted unless it is minimal, required for essential infrastructure crossings and consented outside the planning process by the LLFA.
- Developments should have a suitable threshold level such that they are resilient against a 1 in 1,000-year event allowing for climate change, with outbuildings such as garages having suitable flood resilient finishes below this level.
- By taking a blue/ green infrastructure led approach, the design of the site should be adaptable to climate change as well as providing multiple benefits besides solely flood risk. It is noted in particular that sites SHA1 and SHA2 are in catchments where water quality standards in receiving downstream watercourses/ canals are failing. Development of these sites in particular should seek to implement measures that improve water quality both on site and downstream.

A number of the proposed development sites are very large and are likely to be developed in phases. Therefore, it is essential that an outline drainage strategy for the entire site is provided before or at the same time as the first detailed planning application for any land parcel is submitted. This must set out how the drainage system will be constructed and operational such that it serves each phase of development prior to construction of that housing commences.

The Staffordshire SuDS Handbook provides full guidance on how to apply all the Local Standards for SuDS and accompanying proformas for developers to provide to the LLFA to demonstrate how they have met those standards. A design relying on oversized pipes leading to a storage pond is highly unlikely to be acceptable as it will fail to meet the wider objectives and vision for flood risk and drainage provision in the District.

Developers should also take into account the outcomes of the Staffordshire Environmental Infrastructure Investment Plan which is currently being developed by Staffordshire County Council and the Environment Agency when they are designing the Green and Blue Infrastructure for their development sites.

10 Summary of Level 2 assessment and recommendations

10.1 Assessment methods

As part of the Level 2 SFRA, detailed site summary tables have been produced for the four strategic sites.

The summary tables set out the flood risk to each site, including Flood Zone coverage, maps of surface water extent, depth and velocity of flooding as well as hazard mapping. Climate change mapping has also been produced using Flood Zone 2 as an indication as there are no detailed models available for which the latest climate change allowances could be simulated. Each table also sets out the NPPF requirements for the site as well as guidance for site-specific FRAs. A broadscale assessment of suitable SuDS options has been provided giving an indication where there may be constraints to certain sets of SuDS techniques. This assessment is indicative and more detailed assessments should be carried out during the site planning stage to confirm the feasibility of different types of SuDS. It may be possible that those SuDS techniques highlighted as possibly not being suitable can be designed to overcome identified constraints.

Interactive mapping is shown in Appendix A and should be viewed alongside the detailed site summary tables. There are no detailed fluvial hydraulic models available, so the Environment Agency's Flood Zones and Risk of Flooding from Rivers and Sea datasets have been used. Also, where the watercourses are smaller and not represented in the Flood Zones, the Risk of Flooding from Surface Water mapping datasets have been used.

10.2 Summary of key site issues

- The degree of flood risk varies between sites, with some sites being only marginally affected along their boundaries, and other sites being more significantly affected, which will require more detailed investigations on sequential site layouts, SuDS possibilities, safe access and egress etc.
- The majority of sites are at risk from surface water flooding, with more areas of ponding in the higher return period events. Surface water tends to follow topographic flow routes, for example along the watercourses or isolated pockets of ponding where there are topographic depressions. Surface water should be considered when assessing safe access and egress to and from the site.
- There were no detailed models available and so Flood Zone 2 was used as the fluvial indication of how climate change would affect the sites, and also the 1,000-year surface water extent for smaller unmapped watercourses. This extended upon areas of Flood Zone 3. The Council and the Environment Agency require developers to consider the 100-year plus 35% and 100-year plus 70% climate change scenarios in future developments.
- Potential culvert blockage locations were identified by visual inspection of the OS mapping and LIDAR in the vicinity of the site, to determine whether a structure upstream, downstream, or within the site could have an impact on the site. These are mentioned in the site tables and may need to be considered as part of a site-specific assessment.
- SHA4 is entirely within Groundwater Source Protection Zone 3, as is the southern area of site SHA1.
- The entire District is within a Nitrate Vulnerable Zone.
- No sites are covered by the Historic Landfill Sites map.

- A strategic assessment was conducted of SuDS options using regional datasets. A detailed site-specific assessment of suitable SuDS techniques would need to be undertaken at site-specific level to understand which SuDS option would be best.
- For a number of sites, there is the potential for safe access and egress to be impacted by fluvial or surface water flooding. Consideration should be made to these sites as to how safe access and egress can be provided during flood events, both to people and emergency vehicles.

10.2.1 Considering the Exception Test for the proposed sites in Lichfield District

In principle, it is possible for all sites assessed in the Level 2 SFRA to pass the flood risk element of the Exception Test, for example by:

- siting development away from the highest areas of risk into Flood Zone 1 (in the majority of sites assessed, the risk is along a site boundary, so steering away from this is advised),
- considering safe access/ egress in the event of a flood (from all parts of the site, if say the site is severed by a flood flow path),
- using areas in Flood Zone 2 for the least vulnerable parts of the development in accordance with Table 2 in the NPPF. Residential development should not be permitted in Flood Zone 3 and no development at all should be permitted in Flood Zone 3b (aside from essential infrastructure, such as a bridge crossing the lowest points of a site),
- testing flood mitigation measures if these are to be implemented, to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another),
- considering space for green infrastructure in the areas of highest flood risk.

If the strategic sites are split in future into smaller land parcels for development, and some of those parcels are in areas of flood risk, the Exception Test may need to be re-applied by the Developer at the planning application stage.

10.3 Planning Policy recommendations

The Planning Policy recommendations in the Level 1 SFRA still stand for the site allocations and any windfall development that comes forward. Recommendations in the L1 are made on:

- Reducing flood risk through site allocations and appropriate site design
- Promoting SuDS to mimic the natural drainage routes to improve water quality
- Reducing of surface water runoff from new developments and agricultural land
- Enhancing and restoring river corridors and habitats
- Mitigating against risk, improved emergency planning and flood awareness

Further site-specific recommendations have been made in the Level 2 regarding Cumulative Impact Assessment. These are made in Chapter 9.

10.4 Site-specific recommendations

Following the Level 2 assessment of the four sites, the following site-specific recommendations are made. Please also refer to Appendix A: Site Summary Tables.

Site	Key Messages
SHA1 – North of Lichfield	• Limit development to the 98% of the site located in Flood Zone 1 (avoiding western boundary) • Use Flood Zone 2 areas for least vulnerable parts of development • A more detailed hydraulic model will be required at Flood Risk Assessment stage, to confirm flood risk and flow paths, FZ3b and climate change extents, using channel topographic survey, from the Curborough Brook and the unnamed watercourse. • There is no detailed fluvial modelling available at the site, and therefore Flood Zone 2 has been used as a conservative indication of flood risk from climate change. This is limited to the western site boundary. As part of a site-specific Flood Risk Assessment, latest EA climate change allowances will need to be considered in a detailed hydraulic model, to confirm the impact in the site from the Curborough Brook and also the unnamed watercourse on the eastern boundary. • The drain discharging into Curborough Brook in the west of the site is culverted beneath Netherstowe Lane. Given the distance and the surrounding higher topography of the rail line, it is very unlikely to have an impact at the site downstream. • The south of the site is located within Source Protection Zone 3. As such infiltration techniques should only be used where there are suitable levels of treatment although it is possible that infiltration may not be permitted. Further site investigation should be carried out to assess potential for drainage by infiltration. Proposed SuDS should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints.
SHA2 – Mile Oak, Fazeley	• Steer development away from the channel at the southern boundary; whilst shown to be in Flood Zone 1, more detailed modelling may show a small encroachment into the site. • A more detailed hydraulic model of the Bourne Brook will be required at Flood Risk Assessment stage, to confirm flood risk and flow paths, FZ3b and climate change extents, using channel topographic survey. • There is no detailed fluvial modelling available at the site, and therefore Flood Zone 2 has been used as a conservative indication of flood risk from climate change. Flood Zone 2 does not encroach into the site, but climate change could increase the chance of flooding on the southern boundary (especially in the south-west) where the site is very close to the edge of Flood Zone 3. The current Flood Zone is misaligned with the Bourne Brook Cut, so there could be more risk along the boundary; however, this would be largely confined given the topography slopes away from the channel in the site. • The east of the site can gain access and egress from Sutton Road (A453) which is in Flood Zone 1 adjacent to the site and to the north, though to the south of the site the road is in Flood Zone 3. This road is at low surface water risk. Access to the south of the site near Bourne Brook should be avoided as the maximum depth increases to over 0.9m. • All forms of source control are likely to be suitable, apart from an area in the south of the site which is at higher groundwater flood risk (25-50%). Mapping suggests that permeable paving may have to use non-infiltrating systems given the possible risk from groundwater.

	Infiltration is also likely to be suitable. Mapping suggests a low risk of groundwater flooding; however, site investigations should be carried out to assess potential for drainage by infiltration. In the south, infiltration 'may' be suitable as mapping suggests a medium risk of groundwater flooding and underlying soils may be permeable. Further site investigation should be carried out to assess potential for drainage by infiltration.
SHA3 – Land north & south of Hay End Lane, Fradley	• Steer development to the 96% of the site in Flood Zone 1, avoiding the area surrounding the unnamed watercourse and the northern boundary. • Use Flood Zone 2 areas for least vulnerable parts of development • A more detailed hydraulic model may be required at Flood Risk Assessment stage, to confirm flood risk and flow paths from the unnamed watercourses, FZ3b and climate change extents, using channel topographic survey. • There is no detailed fluvial modelling available at the site, and therefore Flood Zone 2 has been used as a conservative indication of flood risk from climate change. This extends along the northern border of the site and following the unnamed watercourse flowing through the centre of the site. As part of a site-specific Flood Risk Assessment, latest EA climate change allowances will need to be considered in a detailed hydraulic model, to confirm the impact in the site. • Most source control techniques are likely to be suitable. Mapping suggests that permeable paving may have to use non-infiltrating systems given the possible risk from groundwater. There is a high risk of groundwater flooding at this location, therefore it is likely infiltration techniques will not be suitable. This should be confirmed via site investigations to assess the potential for infiltration. • The unnamed watercourse running through the centre of the site is culverted beneath Sale Lane in the west just outside of the site boundary. If this were to become blocked during a flood event, flood waters could encroach further into the site from the western boundary. • The canal to the south of the site is located at a higher elevation than the site, immediately bounding the southern boundary. As this is perched, there could be some residual risk and therefore a FRA would likely need to model overtopping and breach scenarios to analyse risk to the site from this.
SHA4 – Land off Huddlesford Lane, Whittington	• The flood risk element of the Exception Test is likely to be passed as there is little risk to the site from fluvial or surface water events and safe access and egress is possible. • Climate change needs to be considered for surface water events; at the site-specific stage, the 100-year +40% event is considered as part of surface water drainage strategies, or surface water modelling. • The entire site is within Source Protection Zone 3 and mapping indicates a medium-high risk at various parts of the site. As such infiltration techniques should only be used where there are suitable levels of treatment although it is possible that infiltration may not be permitted. Proposed SuDS should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints.

	• Most source control techniques are likely to be suitable. Mapping suggests that permeable paving may have to use non-infiltrating systems given the possible risk both to and from groundwater. Further site investigation should be carried out to assess potential for drainage by infiltration.

All sites	• The developments should be designed using a sequential approach. Development should be steered away from areas of fluvial flood risk and surface water flow routes, preserving these spaces as green infrastructure. Development must be in line with Table 3: flood risk vulnerability and Flood Zone compatibility of the NPPG.
	  ○ Development in FZ3b should be avoided unless appropriate use can be demonstrated in line with NPPF.
	  ○ Development in FZ3 may require floodplain compensation and this should be confirmed with the EA at FRA stage.
	• The depths, velocities, hazards, durations and speeds of onset of surface water and fluvial flooding along access/ egress routes should be investigated further in a site-specific assessment using more detailed modelling, to confirm whether access for emergency vehicles could still be obtained.
	• Climate change also needs to be considered for surface water events; at the site-specific stage, the 100-year +40% event is considered as part of surface water drainage strategies, or surface water modelling.
	• Developers should consider SuDS strategies to reduce the impacts of climate change from surface water in a detailed site-specific FRA.
	• Developers should refer to Staffordshire County Council's 'SuDS Handbook' as well as the Level 1 SFRA, for information on suitable types of SuDS, the management train and opportunities and constraints in site master-planning.
	• The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
	• Safe access and egress will need to be demonstrated in the 1 in 100-year plus climate change fluvial and rainfall events, using the depth, velocity and hazard outputs. Raising of access routes must not impact on surface water flow routes. Consideration should be given to the siting of access points with respect to areas of surface water flood risk.
	• Resilience measures will be required if buildings are situated in the flood risk area. Raising Finished Floor Levels above the design event may remove the need for resilience measures.
	• Ensure any flood mitigation measures do not displace water elsewhere, otherwise floodplain compensation may be required
	• Consider space for green infrastructure in areas of highest risk.

10.5 Use of SFRA data and future updates

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

The SFRA should be a 'living document', and as a result should be updated when new information on flood risk, flood warning or new planning guidance or legislation becomes available. New information on flood risk may be provided by Lichfield District Council, Staffordshire County Council, the Highways Authority, Canal and River Trust, Severn Trent Water and the Environment Agency. Such information may be in the form of:

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

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

Appendices

A Level 2 Assessment

A.1 Site summary tables

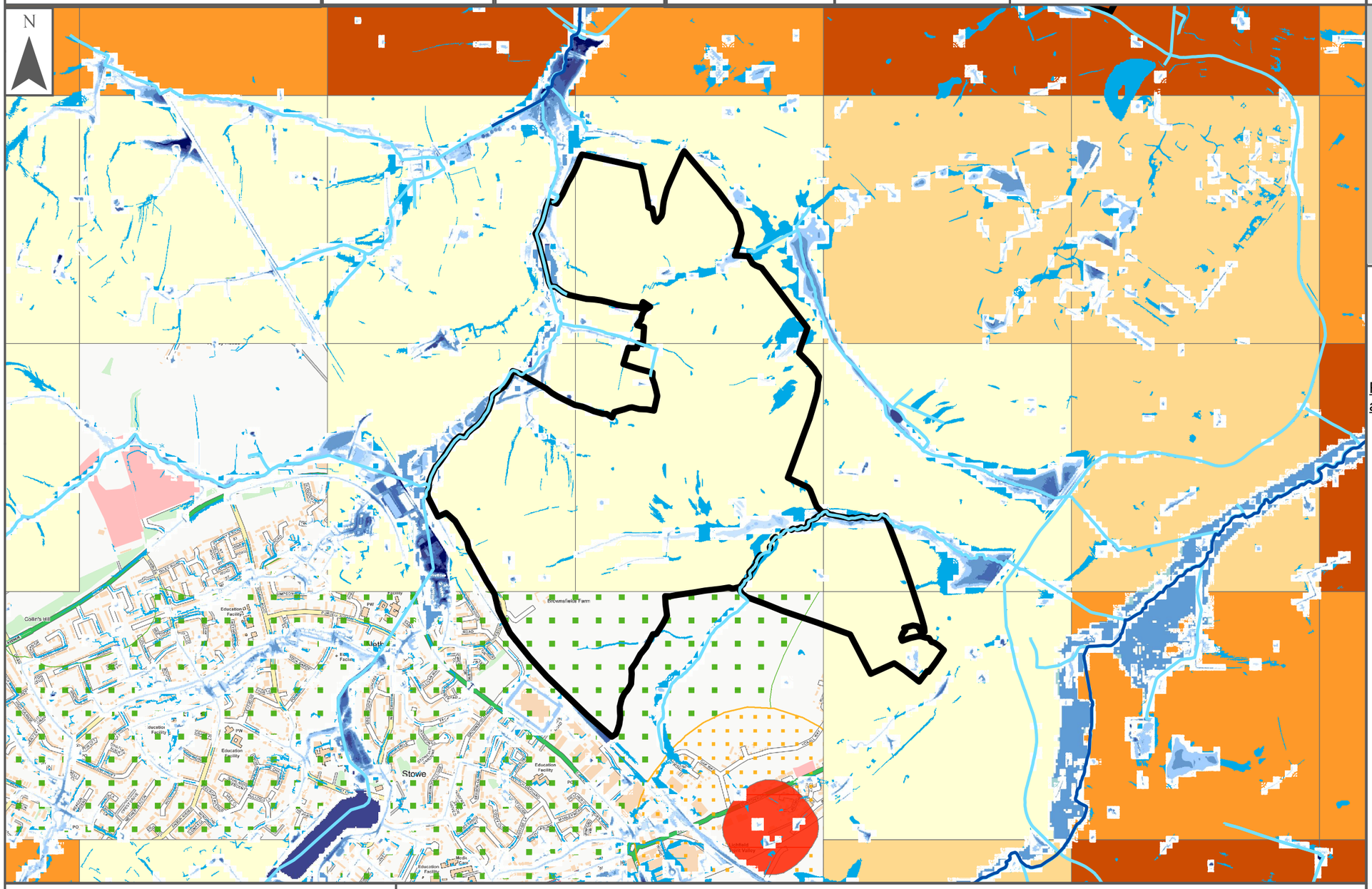
A.2 Geo-PDF mapping

Site ID: SHA1 - North of Lichfield

OSNGR: SK135105 | Area: 222.9 ha | Current land use: Greenfield

Flood Zone Coverage	FZ3b : 0.87%	FZ3a: 0.87%	FZ2: 1.07%	FZ1: 98.66%

Proposed Development Details: Strategic Housing

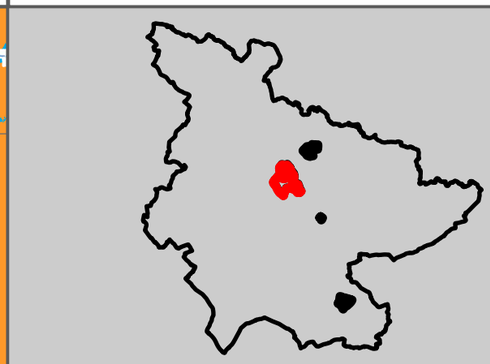


0 0.35 0.7 1.4 km

JBA consulting

LEVEL 2 SITE SUMMARY TABLES

LICHFIELD DISTRICT COUNCIL LEVEL 2 STRATEGIC FLOOD RISK ASSESSMENT



Please refer to Main Report and Site Summary Table for further information on the datasets

LEGEND

Flood Risk

Risk of Flooding from Rivers and Sea
- High
- Medium
- Low
- Very low

100-year surface water event Depth (m)
- 0.00 - 0.15
- 0.15 - 0.30
- 0.30 - 0.60
- 0.60 - 0.90
- 0.90 - 1.20
- > 1.20

Flood Zones
- Flood Zone 3b
- Indicative FZ3b
- Flood Zone 3a
- Flood Zone 2

Hazard Rating
- 0.50-0.75
- 0.75-1.25
- 1.25-2.00
- >2.00

Climate Change
- Indicative Climate Change (FZ2)

Velocity (m/s)
- 0.00 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- > 2.00

Surface Water Extent
- RoFfSW 30-year Extent
- RoFfSW 100-year Extent
- RoFfSW 1000-year Extent

LEGEND

Authority Information
- Council Boundary
- Potential Site Allocations
- Main Rivers
- Detailed River Network

Defences
- Defences

Flood Warning and Flood Alert Areas
- Flood Warning Area
- Flood Alert

Source Protection Zones
- SPZ 1
- SPZ 2
- SPZ 3

Other
- Historic Landfill

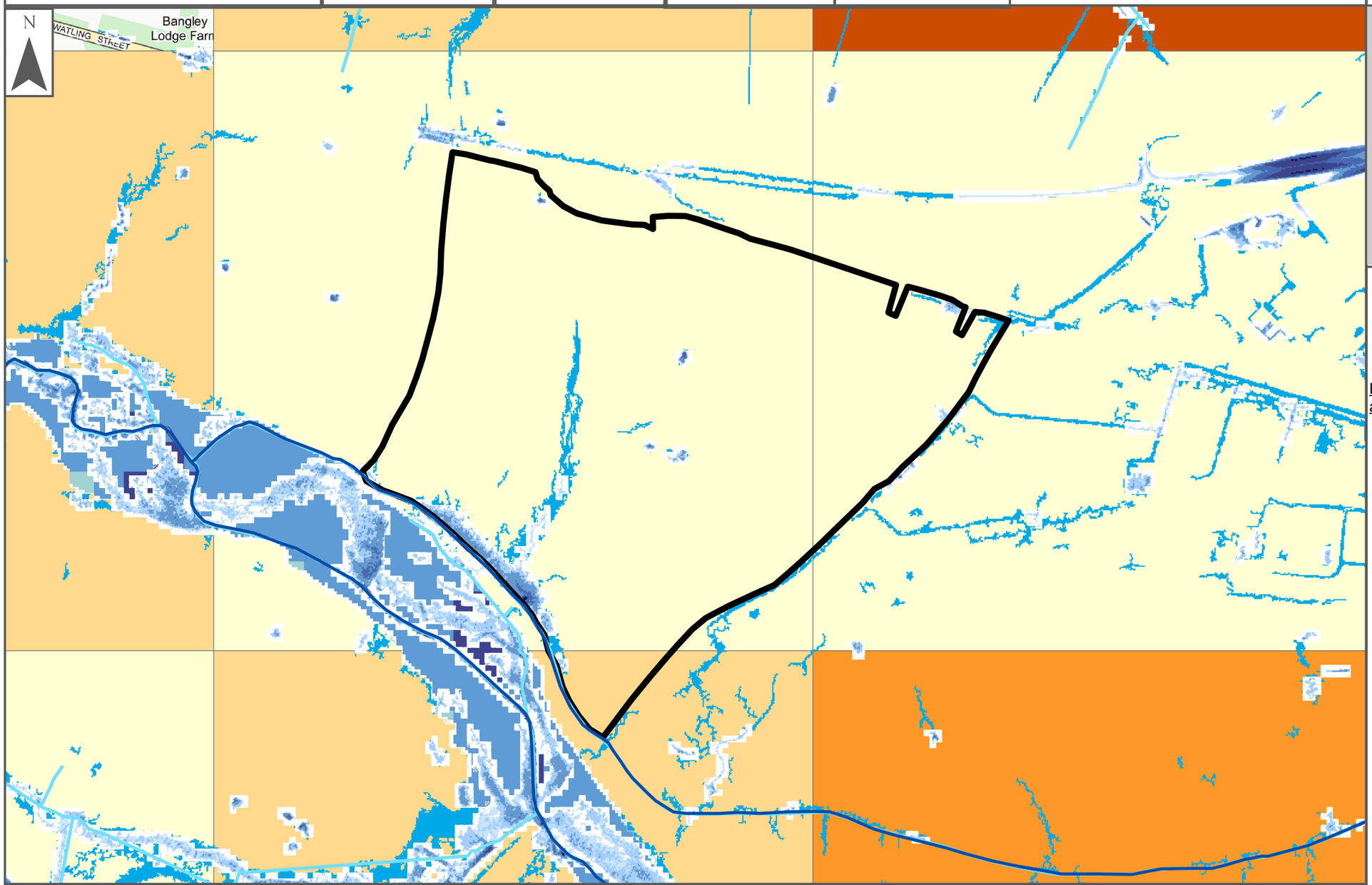
Areas Susceptible to Groundwater Flooding
- >= 75%
- >= 50% <75%
- >= 25% <50%
- < 25%

Site ID: SHA2 - Land west of Fazeley

OSNGR: SK177024 | Area: 53.9 ha | Current land use: Greenfield

Proposed Development Details: Strategic Housing

Flood Zone Coverage	FZ3b : 0%	FZ3a: 0%	FZ2: 0%	FZ1: 100%



0 0.15 0.3 0.6 km

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LEGEND

Authority Information
- Council Boundary
- Potential Site Allocations
- Main Rivers
- Detailed River Network

Defences
- Defences

Flood Warning and Flood Alert Areas
- Flood Warning Area
- Flood Alert

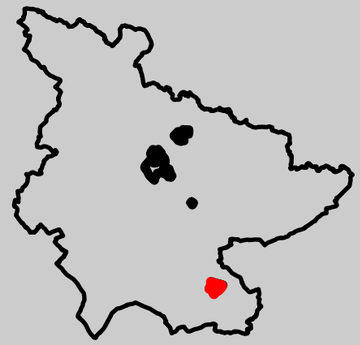
Source Protection Zones
- SPZ 1
- SPZ 2
- SPZ 3

Other
- Historic Landfill

Areas Susceptible to Groundwater Flooding
- >= 75%
- >= 50% <75%
- >= 25% <50%
- < 25%

LEVEL 2 SITE SUMMARY TABLES

LICHFIELD DISTRICT COUNCIL LEVEL 2 STRATEGIC FLOOD RISK ASSESSMENT



Please refer to Main Report and Site Summary Table for further information on the datasets

LEGEND

Flood Risk

Risk of Flooding from Rivers and Sea
- High
- Medium
- Low
- Very low

100-year surface water event Depth (m)
- 0.00 - 0.15
- 0.15 - 0.30
- 0.30 - 0.60
- 0.60 - 0.90
- 0.90 - 1.20
- > 1.20

Flood Zones
- Flood Zone 3b
- Indicative FZ3b
- Flood Zone 3a
- Flood Zone 2

Hazard Rating
- 0.50-0.75
- 0.75-1.25
- 1.25-2.00
- >2.00

Climate Change
- Indicative Climate Change (FZ2)

Velocity (m/s)
- 0.00 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- > 2.00

Surface Water Extent
- RoFfSW 30-year Extent
- RoFfSW 100-year Extent
- RoFfSW 1000-year Extent

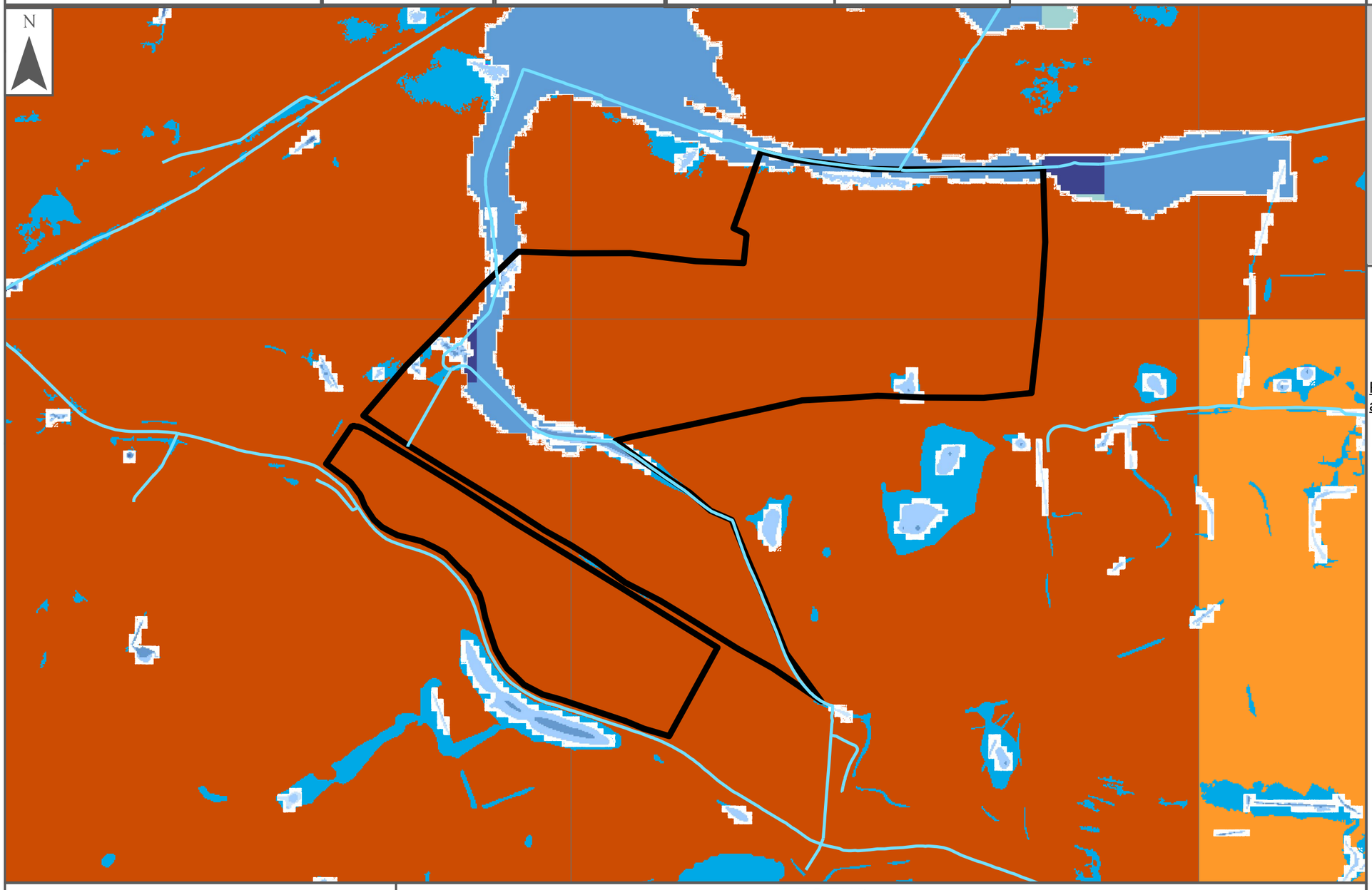
Site ID: SHA3 - Land north and south of Hay End Lane, Fradley

OSNGR: SK153138 | Area: 50.8 ha | Current land use: Greenfield

Flood Zone Coverage	FZ3b : 3.65%	FZ3a: 3.65%	FZ2: 4.34%	FZ1: 95.66%

Proposed Development Details:

Strategic Housing



0 0.125 0.25 0.5 km

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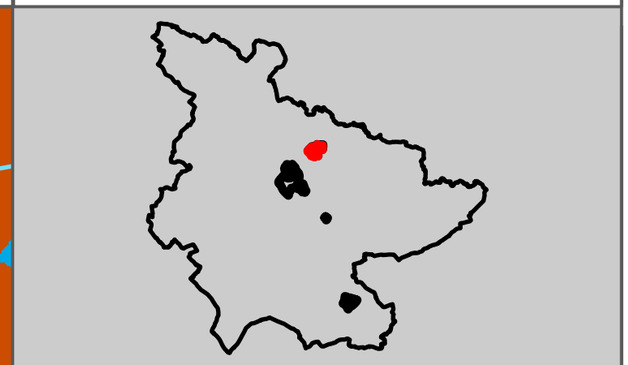
LEVEL 2 SITE SUMMARY TABLES

LICHFIELD DISTRICT COUNCIL LEVEL 2 STRATEGIC FLOOD RISK ASSESSMENT



Please refer to Main Report and Site Summary Table for further information on the datasets

LEGEND

Flood Risk

Risk of Flooding from Rivers and Sea
- High
- Medium
- Low
- Very low

100-year surface water event
Depth (m)
- 0.00 - 0.15
- 0.15 - 0.30
- 0.30 - 0.60
- 0.60 - 0.90
- 0.90 - 1.20
- > 1.20

Flood Zones
- Flood Zone 3b
- Indicative FZ3b
- Flood Zone 3a
- Flood Zone 2

Hazard Rating
- 0.50-0.75
- 0.75-1.25
- 1.25-2.00
- >2.00

Climate Change
- Indicative Climate Change (FZ2)

Velocity (m/s)
- 0.00 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- > 2.00

Surface Water Extent
- RoFfSW 30-year Extent
- RoFfSW 100-year Extent
- RoFfSW 1000-year Extent

LEGEND

Authority Information
- Council Boundary
- Potential Site Allocations
- Main Rivers
- Detailed River Network

Defences
- Defences

Flood Warning and Flood Alert Areas
- Flood Warning Area
- Flood Alert

Source Protection Zones
- SPZ 1
- SPZ 2
- SPZ 3

Other
- Historic Landfill

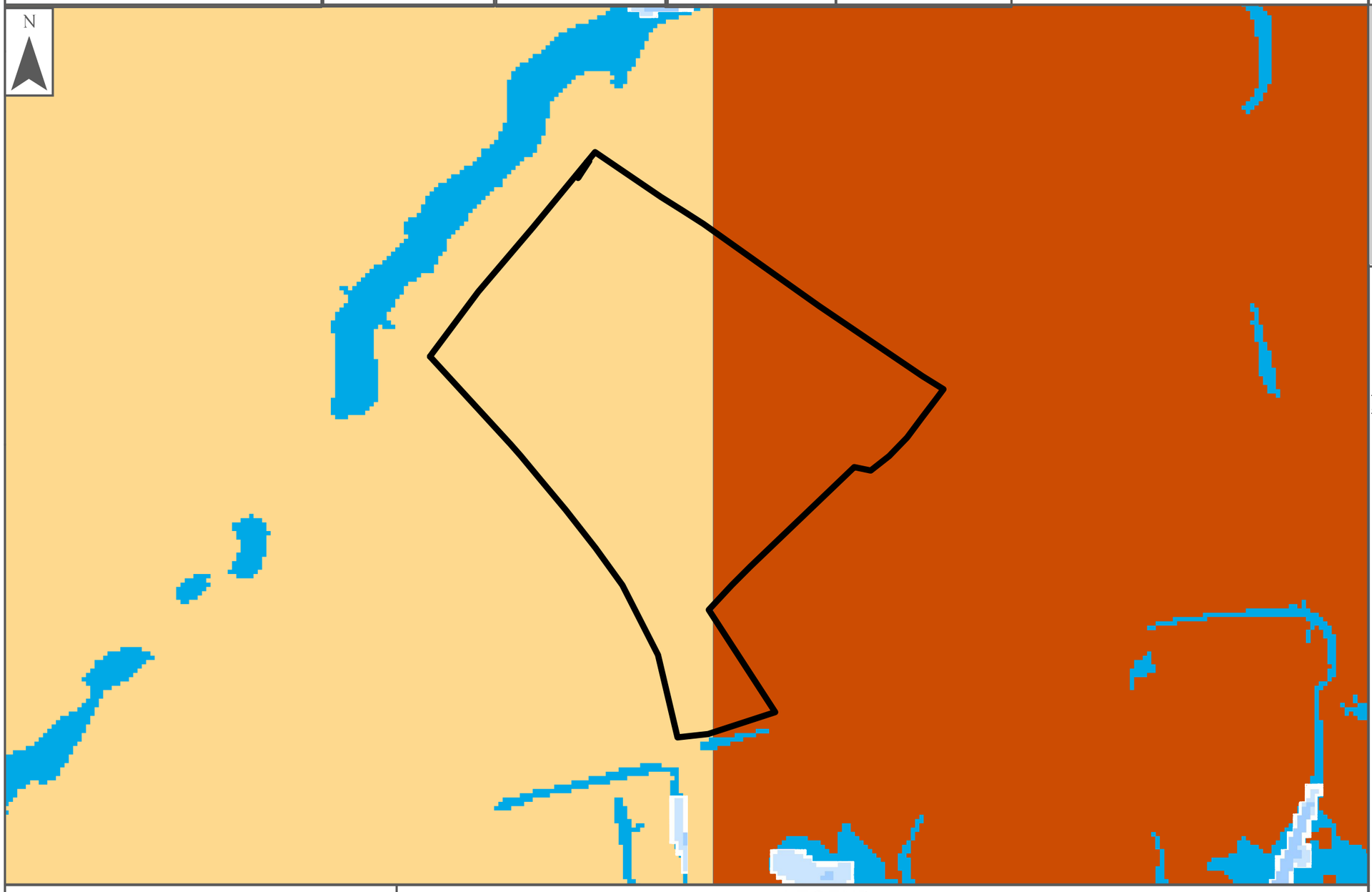
Areas Susceptible to Groundwater Flooding
- >= 75%
- >= 50% <75%
- >= 25% <50%
- < 25%

Site ID: SHA4 - Land off Huddlesford Lane, Whittington

OSNGR: SK159086 | Area: 2.9 ha | Current land use: Greenfield

Flood Zone Coverage	FZ3b : 0%	FZ3a: 0%	FZ2: 0%	FZ1: 100%

Proposed Development Details: Strategic Housing



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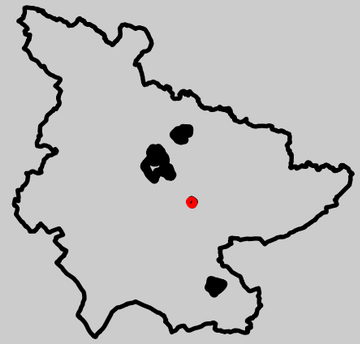
LEVEL 2 SITE SUMMARY TABLES

LICHFIELD DISTRICT COUNCIL LEVEL 2 STRATEGIC FLOOD RISK ASSESSMENT



Please refer to Main Report and Site Summary Table for further information on the datasets

LEGEND

Flood Risk

Risk of Flooding from Rivers and Sea
- High
- Medium
- Low
- Very low

100-year surface water event Depth (m)
- 0.00 - 0.15
- 0.15 - 0.30
- 0.30 - 0.60
- 0.60 - 0.90
- 0.90 - 1.20
- > 1.20

Flood Zones
- Flood Zone 3b
- Indicative FZ3b
- Flood Zone 3a
- Flood Zone 2

Hazard Rating
- 0.50-0.75
- 0.75-1.25
- 1.25-2.00
- >2.00

Climate Change
- Indicative Climate Change (FZ2)

Velocity (m/s)
- 0.00 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- > 2.00

Surface Water Extent
- RoFfSW 30-year Extent
- RoFfSW 100-year Extent
- RoFfSW 1000-year Extent

LEGEND

Authority Information
- Council Boundary
- Potential Site Allocations
- Main Rivers
- Detailed River Network

Defences
- Defences

Flood Warning and Flood Alert Areas
- Flood Warning Area
- Flood Alert

Source Protection Zones
- SPZ 1
- SPZ 2
- SPZ 3

Other
- Historic Landfill

Areas Susceptible to Groundwater Flooding
- >= 75%
- >= 50% <75%
- >= 25% <50%
- < 25%

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