Stratford on Avon District Level 1 Strategic Flood Risk Assessment

Final Report

April 2019

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Stratford on Avon District Council

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Project Manager

Joanne Chillingworth
The Library
St Philips Courtyard
Church Hill
Coleshill
Warwickshire
B46 3AD

Revision history

Revision Ref/Date	Amendments	Issued to
Draft Report v1.0/ October 2018	Draft Report	Fiona Blundell (Planning Policy Officer)
Draft Report v2.0/ February 2019	Addressed stakeholder comments, updated cumulative impact with latest sites	Paul Harris (Senior Planning Policy Officer) Matthew Neal (Planning Policy Officer)
Final Report v1.0/ April 2019	Final Report	Paul Harris (Senior Planning Policy Officer) Matthew Neal (Planning Policy Officer)

Contract

This report describes work commissioned by Fiona Blundell, on behalf of Stratford on Avon District Council, by a letter dated 22nd August 2018. Lucy Finch of JBA Consulting carried out this work.

Prepared by ..... Lucy Finch BSc
Assistant Analyst

Reviewed by ..... Joanne Chillingworth BSc MSc MCIWEM C.WEM
Principal Analyst

Hannah Coogan BSc MCIWEM C.WEM
Technical Director

Purpose

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

Acknowledgements

We would like to acknowledge the assistance of:

- Stratford on Avon District Council;
- Warwickshire County Council, including Highways;
- Environment Agency;
- Canals and River Trust;
- Severn Trent Water;
- Thames Water;
- Fire and Rescue; and
- Planners at the neighbouring authorities

Carbon footprint

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Executive summary

Introduction

The Level 1 Strategic Flood Risk Assessment (SFRA) 2019 document was created with the purpose of supporting the production of the District Council's Site Allocations Plan (SAP). This will provide an understanding of the risk from all types of flooding across the Stratford on Avon District and present clear and robust evidence. It will also provide useful information to inform future Infrastructure Planning and Neighbourhood Plans.

Strategic Flood Risk Assessment Objectives

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

- Inform Stratford on Avon District Council's SAP by assessing flood risk from all sources, current and future.
- Produce a comprehensive set of maps presenting flood risk from all sources that can be used as evidence base for use in the SAP.
- Take into account climate change.
- Assess the cumulative impact that development will have on flood risk.
- Provide information sufficiently detailed to allow the application of the Sequential Test.
- Identify whether development can be allocated outside the high, medium flood risk areas based on all sources of flooding.
- Identify whether application of the Exception Test is required.

Strategic Flood Risk Assessment Outputs

The outputs of the Level 1 SFRA are as follows:

- Identification of policy and technical updates.
- Identification of any strategic flooding issues which may have cross boundary implications.
- Appraisal of all potential sources of flooding, including Main River, ordinary watercourse, surface water, sewers, groundwater, reservoirs and canals.
- Mapping showing distribution of flood risk across all flood zones from all sources of flooding including climate change allowances.
- Review of historic flooding incidents.
- Identification of any specific locations within Stratford on Avon District at risk of sewer flooding.
- Reporting on the standard of protection provided by existing flood risk management infrastructure.
- Assessment of the potential increase in flood risk due to climate change.
- Assessment of surface water management issues, how these can be addressed through development management policies and the application of Sustainable Drainage Systems.
- Flood Risk Assessment guidance for developers.

- Recommendations of the criteria that should be used to assess future development proposals and the development of a Sequential Test and sequential approach to flood risk.
- Assessment of strategic flood risk solutions that can be implemented to reduce risks.
- Assessment of cumulative impacts of development on flood risk

Summary of Level 1 Assessment

Sources of flood risk

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

- *Fluvial flooding*: The primary fluvial flood risk is along the River Avon and its main tributaries. These present fluvial flood risk to rural communities as well as to the main urban centre of Stratford upon Avon. The floodplains of the watercourses are fairly well confined in the majority of the District, with wider extents along the River Avon due to lower lying, flat topography, notably through Stratford upon Avon and downstream of Bidford on Avon.
- *Surface water:* The Risk of Flooding from Surface Water map shows a number of prominent overland flow routes; these predominantly follow topographical flow paths of existing watercourses or dry valleys with some isolated ponding located in low lying areas.
- *Sewer*: The majority of sewers in Stratford on Avon District are managed by Severn Trent Water, with Thames Water and Anglian Water managing sewers in some limited areas. Thames Water provided their list of historical sewer flooding records which show 3 properties with historic incidents of sewer flooding. Severn Trent Water provided their 'At Risk Register' which denotes 143 properties at risk from sewer flooding.
- *Groundwater:* The Areas Susceptible to Groundwater Flooding map shows that in general, the majority of Stratford on Avon District is within the <25% susceptible classification, therefore it is at a lower risk of groundwater flooding. Parts of the centre of the District along the River Avon, and the west of the District along the River Arrow fall within higher susceptibility classifications and are therefore at higher risk from groundwater flooding.
- *Canals*: There are three canals in Stratford on Avon District: the Stratford-upon-Avon Canal, the Grand Union Canal, and the Oxford Canal. These have the potential to interact with other watercourses and become flow paths during flood events or in a breach scenario. There have been no recorded incidents of breach or overtopping in the District on any of the canals.
- *Reservoirs:* There is a potential risk of flooding from reservoirs both within the District and those outside. The level and standard of inspection and maintenance required under the Reservoirs Act means that the risk of flooding from reservoirs is relatively low. However, there is a residual risk of a reservoir breach and this risk should be considered in any site-specific Flood Risk Assessments (where relevant).

Defences

The main flood defences in the District are located in Alcester, Broom, Long Itchington, Wellesbourne, Wootton Wawen, Henley-in-Arden, Barton and Marcliff which are comprised of flood walls and embankments. The condition of these defences varies from poor to very good, with the Standard of Protection for all the defences being 100 year, apart from a 50-year defence in Wootton Wawen.

Development and flood risk

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

When necessary, development and redevelopment within Stratford on Avon District will require a Flood Risk Assessment appropriate to the scale of the development and to the scope as agreed with the Lead Local Flood Authority and/or Environment Agency. Flood Risk Assessments should consider flood risk from all sources including residual risk, along with promotion of Sustainable Drainage Systems to create a conceptual drainage strategy and safe access/egress at the development in the event of a flood. Latest climate change guidance (published in February 2016) should also be taken into account, for the lifetime of developments. The UK Climate Impacts Programme published new predictions for climate change in November 2018. The Environment Agency will, in due course, use this information to update their climate change guidance for planners. Planners and developers must ensure that modelling in line with the most up to date Environment Agency climate change guidance has been run.

Recommendations

The following recommendations are made for the Council to consider as part of their planning policy and flood risk management:

Sequential and Exception tests

Areas of the District are at high risk from river and/or surface water flooding. Stratford on Avon District Council should use the information in this SFRA when deciding which development sites to take forward in their Development Plan by applying the Sequential Test. Developers should consult Stratford on Avon District Council and the Environment Agency (where relevant), at an early stage to discuss flood risk including requirements for site-specific FRAs, detailed hydraulic modelling, and drainage assessment and design. A Level 2 SFRA is recommended, which will explore flood hazard in greater detail should sites be allocated in high flood risk areas and the Exception Test is required.

Site-specific Flood Risk Assessments

Developers should, where required, undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent (including latest climate change allowances), inform development zoning within the site and prove, if required, whether the Exception Test can be passed. Developers should include an assessment of the residual risk where developments are located in areas benefitting from defences. They should consider both the impact of breach, including the effect on safe access and egress, as well as potential for flood risk to increase in the future due to overtopping. Any improvements to defences should ensure they are in keeping with wider catchment policy.

The assessment should also identify the risk of existing flooding to adjacent land and properties to establish whether there is a requirement to secure land to implement strategic flood risk management measures to alleviate existing and future flood risk.

Drainage assessments and promotion of Sustainable Drainage Systems

Planners should be aware of the role of the Flood Risk and Water Management Team as a Statutory Consultee and refer to the guidance and standards in **Warwickshire County Council's Standing Advice on Flood Risk and Drainage** when assessing planning applications.

Strategic solutions

Developers should consult with Warwickshire County Council at pre-application stage to determine the latest progress with the programme of flood alleviation schemes and opportunities for Natural Flood Management (NFM), culvert day lighting and river restoration on/off site. RMAs should work together through flood risk studies for high priority locations to determine where land should be safeguarded for future flood alleviation works, such as flood storage, SuDS retrofit or NFM. The Environment Agency should also be consulted at pre-application stage if there are potential opportunities, particularly if there is land required to be safeguarded for potential schemes or where the development may incorporate flood risk measures to alleviate flood risk downstream. They encourage discussions in the early stages of development and offer both a preliminary free level response, and more detailed advice under a cost-recovery basis. Prospective applicants should contact **swwmplanning@environment-agency.gov.uk** for further information.

Cumulative Impact

The following Planning Policy recommendations have been made for the catchments where cumulative development is likely to have the greatest impact on flood risk:

For small catchments draining into settlements with known flood risk issues, the recommended policy is to:

- Undertake more detailed drainage strategy work as part of a Level 2 SFRA[1] or detailed local area Strategic Drainage Study to consider further how the cumulative effects of potential peak rates and volumes of water from development sites would impact on peak flows, duration of flooding and timing of flood peaks on receiving watercourses. Such studies could be used to justify greater restrictions/enforcement through Local Planning Policy development site runoff rates and volumes specific to each catchment that are over and above those required by National and Local SuDS Standards. They could also identify where there are opportunities with allocated sites to provide off-site betterment, e.g. online/offline flood storage, and where land should be safeguarded within proposed site allocations to fulfil this purpose. *
- Incorporate SuDS and provide details of adoption, ongoing maintenance and management on all development sites. Proposals will be required to provide reasoned justification for not using SuDS techniques, where ground conditions and other key factors show them to be technically feasible. Preference will be given to systems that contribute to the conservation and enhancement of biodiversity and green infrastructure in the District where practicable.
- Seek to provide wider betterment by demonstrating in site-specific Flood Risk Assessments and Surface Water Drainage Strategies what measures can be

[1] A Level 2 SFRA will be required should sites require the Exception Test. A Level 2 SFRA could also contain more detailed local area Strategic Drainage Strategy work.

put in place to contribute to a reduction in flood risk downstream. This may either be by provision of additional storage on site e.g. through oversized SuDS, natural flood management techniques, green infrastructure and green-blue corridors and/or by providing a Partnership Funding contribution towards any flood alleviation schemes. Consultation on the site-specific requirements should be undertaken with Stratford on Avon District Council and the Environment Agency at the earliest opportunity.

For larger rural catchments draining into settlements with known flood risk issues the recommended policy is to:

- Incorporate SuDS and provide details of adoption, ongoing maintenance and management on all development sites. Proposals will be required to provide reasoned justification for not using SuDS techniques, where ground conditions and other key factors show them to be technically feasible. Preference will be given to systems that contribute to the conservation and enhancement of biodiversity and green infrastructure in the District where practicable.
- Seek to provide wider betterment by demonstrating in site-specific Flood Risk Assessments and Surface Water Drainage Strategies what measures can be put in place to contribute to a reduction in flood risk downstream. This may either be by provision of additional storage on site e.g. through oversized SuDS, natural flood management techniques, green infrastructure and green-blue corridors and/or by providing a Partnership Funding contribution towards any flood alleviation schemes. Consultation on the site-specific requirements should be undertaken with Stratford on Avon District Council and the Environment Agency at the earliest opportunity.
- For the LPA to work closely with the Environment Agency and Warwickshire County Council as LLFA to identify areas of land that should be safeguarded for the future use of natural flood management features.

* This recommendation is more applicable to smaller catchments, because the proportion of new development to catchment area is likely to be greater and therefore the potential impact of development on flood risk greater. More detailed drainage strategy planning would entail building a small hydrological model of the catchment to provide a more specific information on the likely impact of those new developments. Doing this to cover a small catchment is more affordable and would yield more meaningful results than modelling much larger catchments, where in proportion to overall catchment size, new development would not have as much of an effect on flood risk elsewhere in those larger catchments.

Use of Strategic Flood Risk Assessment data

It is important to recognise that Level 1 Strategic Flood Risk Assessments are high-level strategic documents and, as such, do not go into detail on an individual site-specific basis. The primary purpose of this Strategic Flood Risk Assessment data is to provide an evidence base to inform Stratford on Avon District's Site Allocations Plan and any future flood risk policies. This SFRA is intended to help Stratford on Avon District Council in applying the Sequential Test for their site allocations and identify where the application of the Exception Test may be required via a Level 2 SFRA. The SFRA can also be used by private developers, as a starting point, to help appraise the flood risk to their proposed development or re-development site.

This 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. At the time of writing, this report was developed using the best available information but should be updated when new information on flood risk, new planning guidance or legislation becomes available.

It is recommended that the SFRA is reviewed internally on a quarterly basis, 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 Stratford on Avon District Council, Warwickshire County Council, the Highways Authority, Severn Trent Water, Thames Water, Anglian Water and the Environment Agency for any new information.

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Abbreviations and Glossary of Terms

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

Flood Map for Planning	The Environment Agency Flood Map for Planning (Rivers and Sea) is an online mapping portal which shows the Flood Zones in England. The Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences and do not account for the possible impacts of climate change.
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG (Welsh Assembly Government).
Flood Risk Regulations	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Floods and Water Management Act	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing surface water flood risk in England.
FWA	Flood Warning Area
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a River
FRA	Flood Risk Assessment - A site-specific assessment of all forms of flood risk to the site and the impact of development of the site to flood risk in the area.
FRM	Flood Risk Management
FRMP	Flood Risk Management Plan
FSA	Flood Storage Area
FWMA	Flood and Water Management Act
FWS	Flood Warning System
GI	Green Infrastructure – a network of natural environmental components and green spaces that intersperse and connect the urban centres, suburbs and urban fringe
Greenfield	Undeveloped parcel of land
Ha	Hectare
IDB	Internal Drainage Board
Indicative Flood Risk Area	Nationally identified flood risk areas based on the definition of 'significant' flood risk described by Defra and WAG.
JBA	Jeremy Benn Associates
Jflow	2D generalised hydrodynamic modelling software.
LFRMS	Local Food Risk Management Strategy
LIDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority - Local Authority responsible for taking the lead on local flood risk management
LPA	Local Planning Authority
m AOD	metres Above Ordnance Datum
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers
NFM	Natural Flood Management
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance

NRD	National Receptor Database
NRIM	National Reservoir Inundation Mapping
NVZs	Nitrate Vulnerability Zones
Ordinary Watercourse	All watercourses that are not designated Main River. Local Authorities or, where they exist, IDBs have similar permissive powers as the Environment Agency in relation to flood defence work. However, the riparian owner has the responsibility of maintenance.
PFRA	Preliminary Flood Risk Assessment
Pitt Review	Comprehensive independent review of the 2007 summer floods by Sir Michael Pitt, which provided recommendations to improve flood risk management in England.
Pluvial flooding	Flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (surface runoff) before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity.
PPS25	Planning Policy Statement 25: Development and Flood Risk – superseded by the NPPF and PPG
RBMP	River Basin Management Plan
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
SMP	Shoreline Management Plan
SoP	Standard of Protection - Defences are provided to reduce the risk of flooding from a river and within the flood and defence field standards are usually described in terms of a flood event return period. For example, a flood embankment could be described as providing a 1 in 100-year standard of protection.
SPD	Supplementary Planning Document
SPZ	(Groundwater) Source Protection Zone

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

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1 Introduction

1.1 Purpose of the Strategic Flood Risk Assessment

JBA Consulting were commissioned by Stratford on Avon District Council to prepare a Level 1 Strategic Flood Risk Assessment (SFRA). The purpose of this study is to provide a comprehensive and robust evidence base to inform the preparation of the Site Allocations Plan (SAP) and for future Development Plan documents. This SFRA replaces the "Stratford-on-Avon DC, Warwickshire CC, North Warwickshire BC & Rugby BC Level 1 SFRA Report", prepared by URS for the sub-regional group in September 2013.

The 2019 SFRA will be used in decision-making and to inform decisions on the location of future development and the preparation of sustainable policies for the long-term management of flood risk.

1.2 SFRA Objectives

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

- Inform Stratford on Avon District Council's SAP by assessing flood risk from all sources, current and future.
- Produce a comprehensive set of maps presenting flood risk from all sources that can be used as evidence base for use in the SAP.
- Take into account climate change.
- Assess the cumulative impact that development will have on flood risk.
- Provide information sufficiently detailed to allow the application of the Sequential Test.
- Identify whether development can be allocated outside the high, medium flood risk areas based on all sources of flooding.
- Identify whether application of the Exception Test is required.

1.3 Levels of SFRA

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

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

This update focuses on a Level 1 SFRA assessment. Should the Council be unable to place all development outside of Flood Zones 2 and 3, a Level 2 assessment may be required in the future.

1.4 SFRA outputs

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

- Identification of policy and technical updates.
- Identification of any strategic flooding issues which may have cross boundary implications.

- Appraisal of all potential sources of flooding, including Main River, ordinary watercourse, surface water, sewers, groundwater, reservoirs and canals.
- Mapping showing distribution of flood risk across all flood zones from all sources of flooding including climate change allowances.
- Review of historic flooding incidents.
- Identification of any specific locations within Stratford on Avon District at risk of sewer flooding.
- Reporting on the standard of protection provided by existing flood risk management infrastructure.
- Assessment of the potential increase in flood risk due to climate change.
- Assessment of surface water management issues, how these can be addressed through development management policies and the application of Sustainable Drainage Systems.
- Flood Risk Assessment guidance for developers.
- Recommendations of the criteria that should be used to assess future development proposals and the development of a Sequential Test and sequential approach to flood risk.
- Assessment of strategic flood risk solutions that can be implemented to reduce risks.
- Assessment of cumulative impacts of development on flood risk

1.5 SFRA Study Area

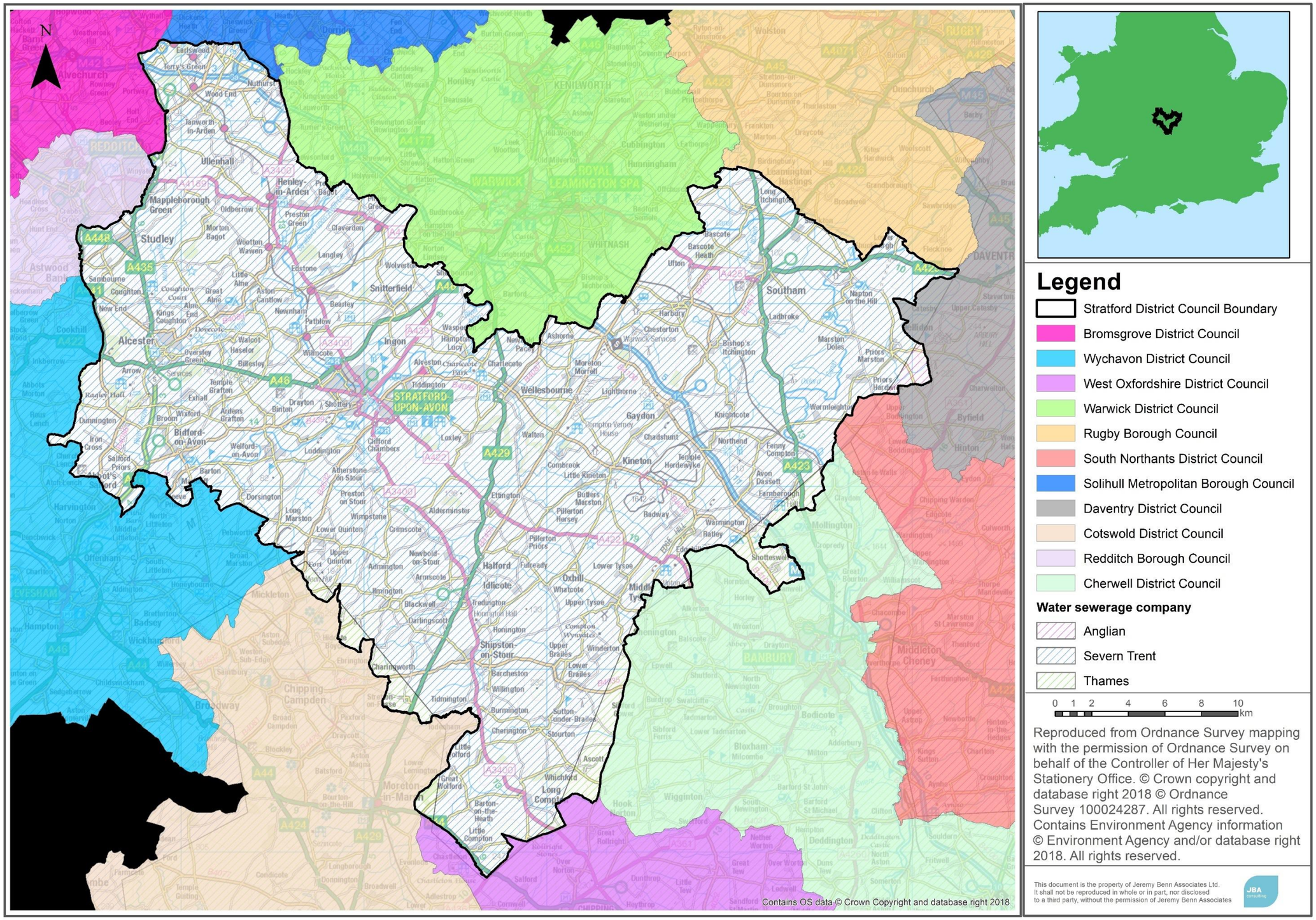
Stratford on Avon District lies within the county of Warwickshire and covers an area of approximately 977.9km^2 with a population of approximately 120,485 (2011 Census). The main urban centre within the District is Stratford upon Avon which has a population of around 26,000. Other main urban areas in the District include Alcester, Henley in Arden, Bidford on Avon, Southam, Shipston on Stour and Wellesbourne.

The main rivers in the District are the River Avon, River Arrow, River Alne, River Stour, River Itchen and the River Dene, with the Avon being the principal watercourse in the District.

The District is bounded by 11 other authorities; Bromsgrove District Council, Redditch Borough Council, Wychavon District Council, West Oxfordshire District Council, Warwick District Council, Rugby Borough Council, South Northants District Council, Solihull Metropolitan Borough Council, Daventry District Council, Cotswold District Council and Cherwell District Council.

An overview of the study area showing the neighbouring authorities and the areas covered by Severn Trent, Thames and Anglian Water 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 Stratford on Avon District Council) have been consulted during the preparation of this version of the SFRA:

- Environment Agency
- Warwickshire County Council (LLFA)
- Canal and River Trust
- Warwickshire Highways
- Warwickshire Fire and Rescue
- Severn Trent Water, Thames Water and Anglian Water
- Neighbouring authorities including:
    - Bromsgrove District Council
    - Redditch Borough Council
    - Wychavon District Council
    - West Oxfordshire District Council
    - Warwick District Council
    - Rugby Borough Council
    - South Northants District Council
    - Solihull Metropolitan Borough Council
    - Daventry District Council
    - Cotswold District Council
    - Cherwell District Council

1.7 Use of SFRA data

It is important to recognise that Level 1 SFRAs are high-level strategic documents and, as such, do not go into detail on an individual site-specific basis. The primary purpose of this SFRA data is to provide an evidence base to inform Stratford on Avon District Council's Development Plan, including its Site Allocations Plan and any future flood risk policies, as detailed in the objectives listed in Section 1.2. This SFRA is intended to aid Stratford on Avon District Council in applying the Sequential Test for their site allocations and identify where the application of the Exception Test may be required via a Level 2 SFRA.

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

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

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

Table 1-1 SFRA report contents

Section	Contents	Use of data
1. Introduction	Provides a background to the study, defines objectives, outlines the approach adopted and the consultation performed.	For users to understand the purpose, objectives and outputs of the study.
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.	There are other studies and policy/legislation that complement the SFRA and these may need to be referred to in the Development Plan and/or site-specific FRAs (where relevant).
3. The sequential, risk-based approach	Provides an overview of Flood Zones, application of the Sequential Approach and Sequential/Exception Test process.	Provides guidance for the Council on the application of the Sequential and Exception Test.
4. The impact of climate change	Outlines climate change guidance published by the Environment Agency in February 2016.	Updated climate change guidance must be considered in all new developments and planning applications.
5. Summary of SFRA mapping for all sources of flood risk and methodology	Outlines what information has been used in the preparation of the SFRA including any data gaps.	The methodology will provide users with an understanding of where broad-scale or detailed models have been used to identify the fluvial flood risk. Any data gaps identified may help to shape future strategic flood risk studies or indicate where studies need to be undertaken at a site-specific level.
6. Understanding flood risk in Stratford on Avon District	Gives an introduction to the assessment of flood risk and provides an overview of the characteristics of flooding affecting Stratford on Avon District including historical flooding incidents, flood risk from canals and reservoirs and flood warning arrangements.	The outputs (including mapping) will identify communities in the study area at flood risk and the potential sources. This will be used to help the Council apply the Sequential Test and if necessary, the Exception Test to site allocations proposed in the Development Plan. Private developers should consider the findings of this SFRA, particularly in relation to site-specific FRAs, the application of the Sequential and Exception Test, and/or drainage strategies. The Council should also review the findings in relation to any strategic flood emergency plans.
7. Flood defences and assets, residual risk	Assessment of residual risk from flood defences, including future protection from climate change and on-going flood defence schemes.	The residual risk must be considered in relation to new development, alongside how the residual risk is to be mitigated.
8. Cumulative impact of development and cross boundary issues	Broadscale assessment of areas where the cumulative impact of development may be detrimental to flood risk. An assessment of potential cross boundary flood risk issues as a result of future large-scale developments.	The Council and neighbouring authorities should consider the policy recommendations in this section.

9. Flood Risk Assessment and Surface Water Drainage Strategy requirements and guidance for developers	Outlines requirements for Flood Risk Assessments (FRAs) and Surface Water Drainage Strategies as well as providing guidance for developers	This section is intended to offer guidance for developers in preparation of site-specific FRAs and/or drainage strategies. It links to advice from the Environment Agency and Stratford on Avon District Council.
10. Surface water management and SuDS	Advice on managing surface water run-off, and how SuDS play an important role.	This section is intended to offer guidance for developers and the Council in the use of SuDS and the management of surface water at development sites. This complements but does not replace national or local SuDS/surface water guidance/requirements.
11. Strategic Flood Risk Solutions	Summary of Strategic Flood Risk Solutions.	The potential strategic flood risk solutions that could be considered by the Council and other flood management authority partners.
12. Summary and recommendations	Summarises sources of flood risk in the study area and outlines key planning policy recommendations	Key planning policy recommendations should be considered by the Council.
Appendix A: Level 1 SFRA mapping - GeoPDFs Appendix B: Cumulative Impact Maps		The appendices are intended to map the sources of flood risk in Stratford on Avon District and to help users identify whether a site is at flood risk and from what source. The appendices are intended to complement EA datasets and do not seek to replace these. Developers should refer to both the SFRA and EA datasets (where relevant). The SFRA outputs do not remove requirements for site-specific FRAs, drainage strategies or further detailed modelling at a site-specific level.

1.8 Future updates

This SFRA provides an overview of the flood risk to Stratford on Avon District and draws together all sources of flooding including surface water, reservoir, canal, sewer and groundwater. 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 Stratford on Avon District Council, Warwickshire County Council, the Highways Authority, Canal and River Trust, Severn Trent Water, Thames Water, Anglian Water, neighbouring authorities 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
- Relevant guidance e.g. on climate change
- New flood defence schemes etc.

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

2 The Planning Framework and Flood Risk Policy

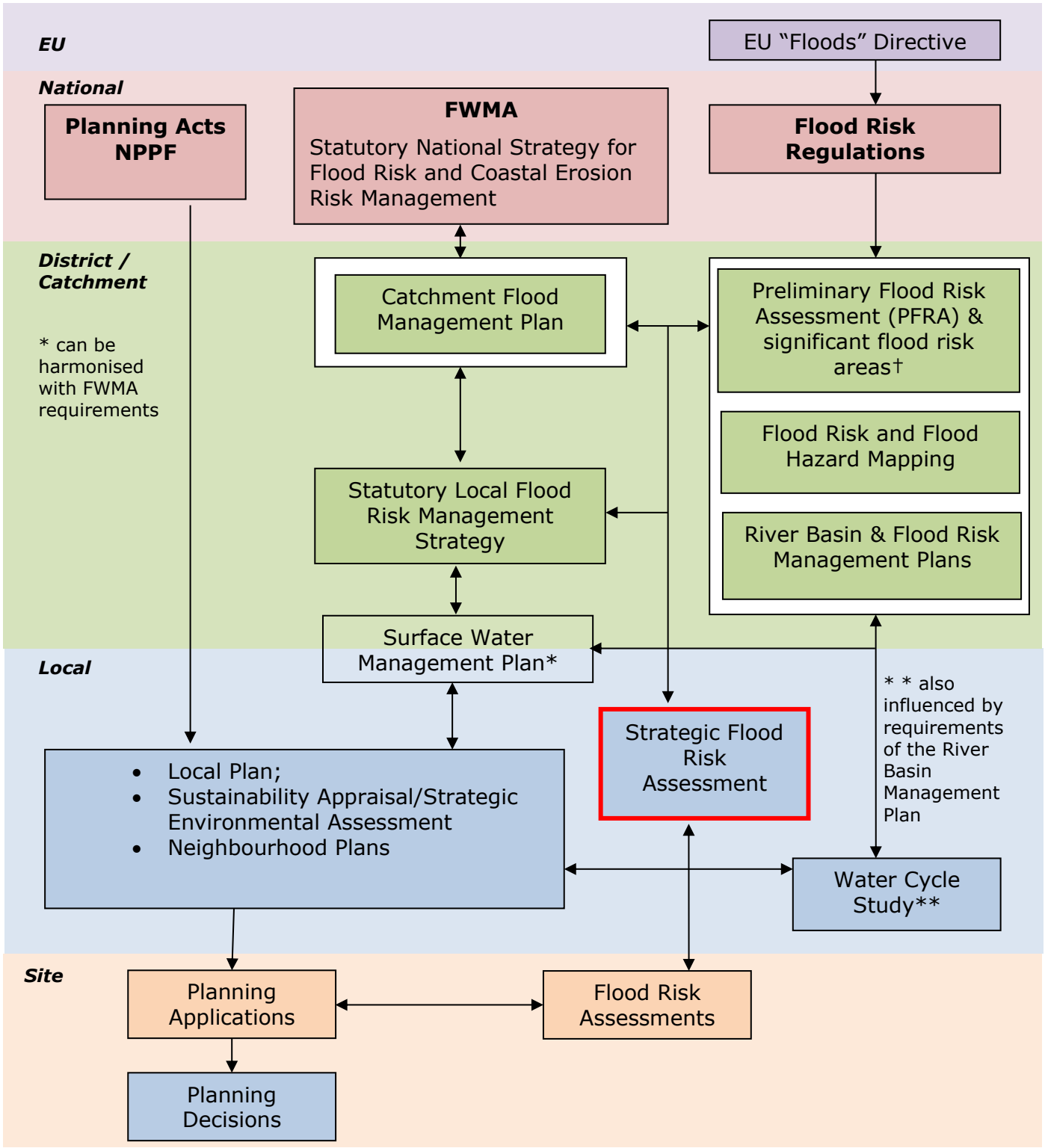
2.1 Introduction

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

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

Figure 2-1 outlines the key strategic planning links for flood risk management and associated documents. It shows how the Flood Risk Regulations and Flood and Water Management Act, in conjunction with the Localism Act's "duty to cooperate", introduce a wider requirement for the mutual exchange of information and the preparation of strategies and management plans.

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



Legend: Responsibilities are indicated using colour coding as follows

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

2.2 Roles and responsibilities for Flood Risk Management in Stratford on Avon District

There are a number of different organisations in and around Stratford on Avon 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 Warwickshire 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 in Stratford on Avon District

Risk Management Authority	Strategic Level	Operational Level
Environment Agency	• Strategic overview for all sources of flooding • National Strategy • Reporting and general supervision	• Main rivers • Reservoirs
Warwickshire 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)
Stratford on Avon District Council as Local Planning Authority	• Local Plans as Local Planning Authorities	• Determination of Planning Applications as Local Planning Authorities • Local Plan/ Development Plan Document preparation
Water Companies *Severn Trent Water* *Thames Water* *Anglian Water*	• Asset Management Plans supported by Periodic Reviews (business cases)	• Public sewers
Highways Authorities *Highways Agency (motorways*	• Highway drainage policy and planning	• Highway drainage

and trunk roads) *Stratford on Avon District Council (other adopted roads)*		

2.2.1 Warwickshire County Council as Lead Local Flood Authority

There are both strategic and operational elements to the role of Lead Local Flood Authority and these are set out in Table 2-2.

Table 2-2 Roles and responsibilities as a Lead Local Flood Authority

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

2.3 Relevant flood risk policy documents

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

2.3.1 Flood Risk Regulations (2009)

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

The Flood Risk Regulations direct the Environment Agency to do this work for river, sea and reservoir flooding. LLFAs must do this work for surface water, Ordinary

Watercourse and Groundwater flooding. This is a six-year cycle of work and the second cycle started in 2017.

The **Warwickshire County Council PFRA** (2011) provides information on significant past and future flood risk from localised flooding in Warwickshire. This was **updated in 2017**, and no nationally significant Flood Risk Areas for localised flooding have been identified in within the Stratford on Avon District.

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

2.4 Flood and Water Management Act (2010)

The Flood and Water Management Act (2010) (FWMA) aims to create a simpler and more effective means of managing flood risk and implements Sir Michael Pitt's recommendations following his review of the 2007 floods. The responsibilities for Warwickshire County Council as LLFA are covered in Table 2-2. Below is a summary of some of the work Warwickshire County Council has undertaken to date as a LLFA.

- **Warwickshire County Council's Local Flood Risk Management Strategy** was published in April 2016.
- Formal flood investigations have been undertaken for Drayton Avenue, Stratford upon Avon (draft stage) and Long Itchington (draft stage). These can be requested from Warwickshire County Council.
- Register of Flood Risk Features: LLFAs must establish and maintain a register of structures or features which, in their opinion are likely to have a significant effect on flood risk in the LLFA area. A Flood Asset Register has been prepared for Stratford on Avon District (see Section 7.4).

2.4.1 Warwickshire County Council Local Flood Risk Management Strategy (LFRMS) 2016

Warwickshire County Council is responsible for developing, maintaining, applying and monitoring a LFRMS. The **most recent Strategy** was published in April 2016 and is used as a means by which the LLFA co-ordinates Flood Risk Management on a day-to-day basis. The five high-level objectives proposed in the Strategy for managing flood risk include:

- Develop a better understanding of local flood risk in Warwickshire to better manage flood risk to people, property, infrastructure and the natural environment
- Seek to reduce local flood risk in Warwickshire in an economically, socially and environmentally sustainable way
- Adopt a collaborative approach to local flood risk management
- Promote community preparedness and resilience to local flood risk
- Enable planning decisions to take full account of local flood risk and seek to reduce local flood risk through development

The Action Plan in **Appendix D** of the Strategy sets out how the objectives will be delivered and by whom. The actions are monitored by a strategic Flood Risk Management Board.

2.4.2 LLFAs, surface water and SuDS

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

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

Warwickshire County Council's requirements for new 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 are:

- **Standing Advice on Flood Risk and Drainage**
- **Ordinary Watercourse Land Drainage Consents in Warwickshire Advice Note**
- **Surface Water Management Plan**
- **Stratford on Avon District Council Core Strategy** Policy CS.4 Water Environment and Flood Risk

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

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

The Strategy builds on existing approaches to flood and coastal risk management and promotes the use of a wide range of measures to manage risk. It describes how risk should be managed in a co-ordinated way within catchments and along the coast and balance the needs of communities, the economy and the environment. The Strategy is currently being updated and will be published in 2019.

2.5 Water Cycle Studies

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

Stratford on Avon DC Water Cycle Study Update was completed in 2015 and highlighted the following:

- *Water resources*: The study area mainly falls within Severn Trent Water's Strategic Grid water resource zone, with Thames Water and Anglian Water covering minor areas of the District. The sources are supplied by a mixture of river abstraction, groundwater boreholes/wells and from surface water reservoirs. The study concluded that there would be adequate water supply for the planned growth in the District to 2031, however long-term limitations on further abstraction from raw water resources were identified and the importance of achieving sustainability of water resources in Stratford on Avon District was outlined.

- *Wastewater and sewerage*: Public sewerage is mainly provided by Severn Trent Water. The report identified that two Wastewater Treatment Works (WwTWs) within the District did not have the capacity to accept the wastewater flow from the entirety of the proposed growth in Stratford on Avon District and a series of recommendations were put forward.
- *Water Quality*: With the predicted growth in the District, water quality can become an issue. Where it is predicted to be an issue, discharge to the watercourses should be limited to achieve no deterioration of water quality, as well as to demonstrate if growth will make it more difficult to achieve the requirements of the Water Framework Directive. The report identified and conducted water quality modelling on the WwTWs where permitted headroom would be exceeded after the proposed levels of growth.
- *Flood risk and drainage*: Surface and ground water sources are noted to be of flood risk across the Water Cycle Area. The report recommends a series of varying recommendations that are site-specific.

2.6 Surface Water Management Plans

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

2.7 Catchment Flood Management Plans

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

The **River Severn Catchment Flood Management Plan** is the one that is most relevant to Stratford on Avon District. The actions of this were brought forward into the 2015 Flood Risk Management Plan for the Severn.

2.8 The Water Framework Directive

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

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

Stratford on Avon District is made up of two catchments: the Avon Rural Rivers and Lakes and Avon Urban Rivers and Lakes. Of these catchments, there are several waterbodies within Stratford on Avon District which are not achieving 'good status' for the Water Framework Directive, including parts of the River Avon, River

Dene, River Itchen, River Stour, River Stowe, River Alne and River Arrow. The Environment Agency is working with its partners, businesses and the community to investigate improvements to the ecological status of these water bodies and techniques. Further information on the ecological status of waterbodies in Stratford on Avon District is available on the Environment Agency's **Catchment Data Explorer**.

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

2.8.1 River Basin Management Plans

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

Stratford on Avon District primarily falls within the Severn River Basin District, but in the north of the District its footprint reaches into the Humber River Basin District, and into the Thames River Basin District in the south of the District. The River Basin Districts management plans highlight a number of actions to a number of issues raised either within the District as a whole or in sub Districts. Further information can be found in the RBMP and the **Catchment Based Approach (CaBA) website**.

2.9 National Planning Policy and Guidance

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

The NPPF sets out the Government's requirements for the planning system and provides a framework within which local people and councils can produce distinctive local and neighbourhood plans to reflect the needs and properties of their communities. The NPPF must be taken into account by local planning authorities when preparing Local Plans and for applicants preparing planning submissions.

The key changes in the revised 2018 NPPF compared to the 2012 NPPF include:

- Strategic policies should also now consider the 'cumulative impacts in, or affecting, local areas susceptible to flooding' (para 156), rather than just to or from individual development sites;
- Future risk from climate change. The 'sequential approach should be used in areas known to be at risk now or in the future from any form of flooding' (para 158);
- Natural Flood Management. 'Using opportunities provided by new development to reduce the causes and impacts of flooding (where appropriate through the use of natural flood management techniques)' (para 157c);
- SuDS. 'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate' (para 165); and
- Emergency planning. Emergency plans are required as part of an FRA that includes the inclusion of safe access and egress routes (para 163e).

The Lord Taylor Review of Government Planning Practice Guidance was published in 2012. As part of the review over 7,000 pages of national planning guidance were reviewed. The review concluded that the system at the time was no longer fit for purpose. It recommended that formal planning guidance should be hosted in one place and be clearly understandable, referenced and regularly reviewed and updated. The government took on board the recommendations and the National Planning Policy Guidance is now hosted online on GOV.UK. There are no specific implications for this SFRA as it refers to Planning Practice Guidance that was last updated in 2015.

National Planning Practice Guidance (NPPG) was published in 2014 and sets out how the NPPF should be implemented. This will be updated in due course to reflect the changes to the NPPF. **NPPG: Flood Risk and Coastal Change** advises on how planning can account for the risks associated with flooding and coastal change in plan making and the application process. It sets out Flood Zones, the appropriate land uses for each Zone, flood risk assessment requirements, including the Sequential and Exception Tests and the policy aims for developers and authorities regarding each Flood Zone. Further details on Flood Zones and associated policy is provided in Chapter 3 and throughout this report. The Sequential and Exception tests are covered in greater detail in Sections 3.1 and 3.2.

The Sequential Test

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

(National Planning Practice Guidance, paragraph 019)

The Exception Test

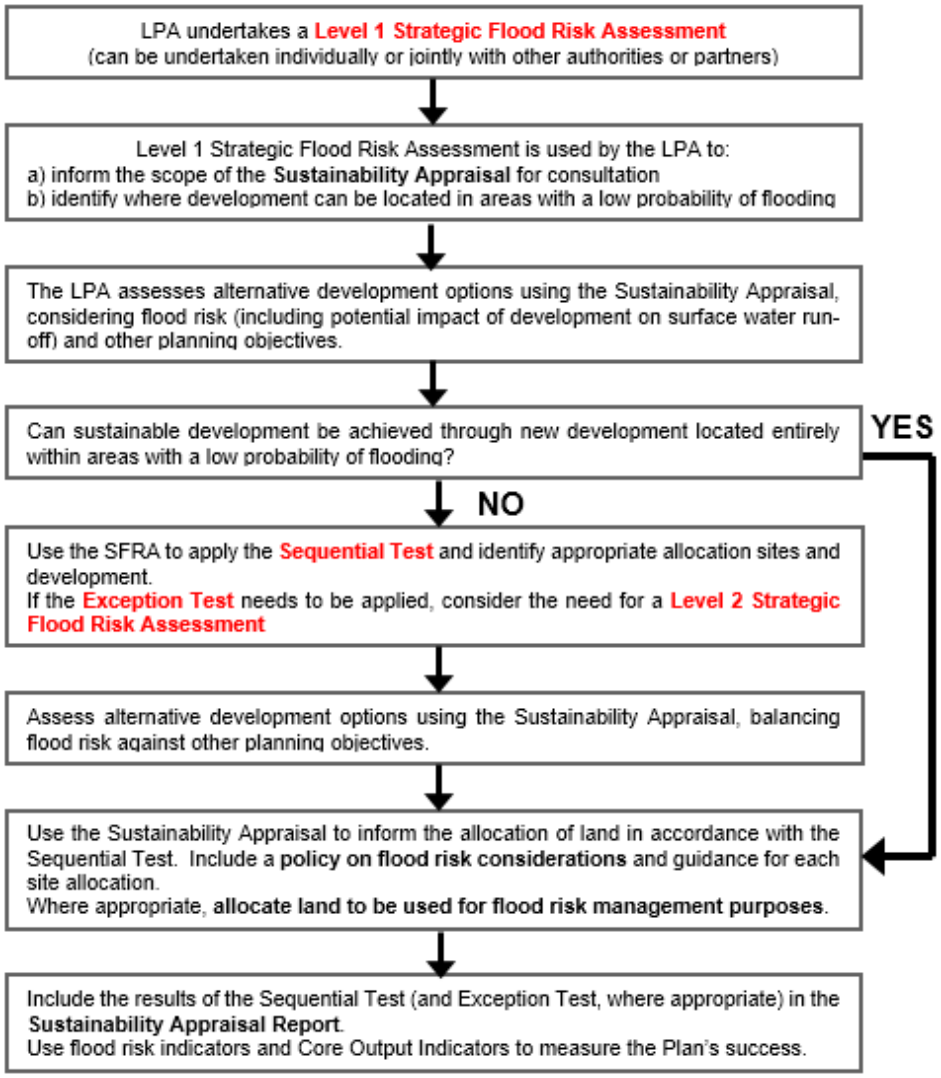
"The Exception Test, as set out in paragraph 160 of the NPPF, is a method to demonstrate and help ensure that flood risk to people and property will be managed satisfactorily, while allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available.

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

(National Planning Practice Guidance, paragraph 023)

A description of how flood risk should be taken into account in the preparation of Local Plans is outlined in Diagram 1 contained within the Planning Practice Guidance (Figure 2-2).

Figure 2-2 Flood Risk and the preparation of Local Plans†



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

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3 The sequential, risk-based approach

The NPPF advocates a sequential approach to development allocation via the Sequential Test. This approach is designed to ensure areas with little or no risk of flooding (from any source) are developed in preference to areas at higher risk, with the aim of keeping development outside of medium and high flood risk areas (Flood Zones 2 and 3) and other sources of flooding, where possible. The sequential approach can be applied both between and within Flood Zones. Table 3-1 describes the Flood Zones from the Environment Agency'sFlood Map for Planning.

The preference when allocating land is, whenever possible, to place all new development on land in Zone 1.

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

The risk from other sources, such as surface water, smaller watercourses and groundwater also needs to be considered. The information in this SFRA can be used to help screen for such issues. A site in Flood Zone 1 may still be at high risk from other sources.

Table 3-1 Flood Zone descriptions

Zone	Probability	Description
Zone 1	Low	This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
		All land uses are appropriate in this zone.
		For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a flood risk assessment.
Zone 2	Medium	This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (0.1% - 1%) or between 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.1% – 0.5%) in any year.
		Essential infrastructure, water compatible infrastructure, less vulnerable and more vulnerable land uses (as set out by NPPF) are appropriate in this zone. Highly vulnerable land uses are allowed as long as they pass the Exception Test.
		All developments in this zone require an FRA.
Zone 3a	High	This zone comprises land assessed as having a greater than 1 in 100 annual probability of river flooding (>1.0%) or a greater than 1 in 200 annual probability of flooding from the sea (>0.5%) in any year Developers and the local authorities should seek to

		reduce the overall level flood risk, relocating development sequentially to areas of lower flood risk and attempting to restore the floodplain and make open space available for flood storage.
		Water compatible and less vulnerable land uses are permitted in this zone. Highly vulnerable land uses are not permitted. More vulnerable and essential infrastructure are only permitted if they pass the Exception Test.
		All developments in this zone require an FRA.
Zone 3b	Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone in discussion with the LPA and the Environment Agency. The identification of functional floodplain should take account of local circumstances.
		Only water compatible and essential infrastructure are permitted in this zone and should be designed to remain operational in times of flood, resulting in no loss of floodplain or blocking of water flow routes. Infrastructure must also not increase flood risk elsewhere.
		All developments in this zone require an FRA.

Important note on Flood Zone information in this SFRA

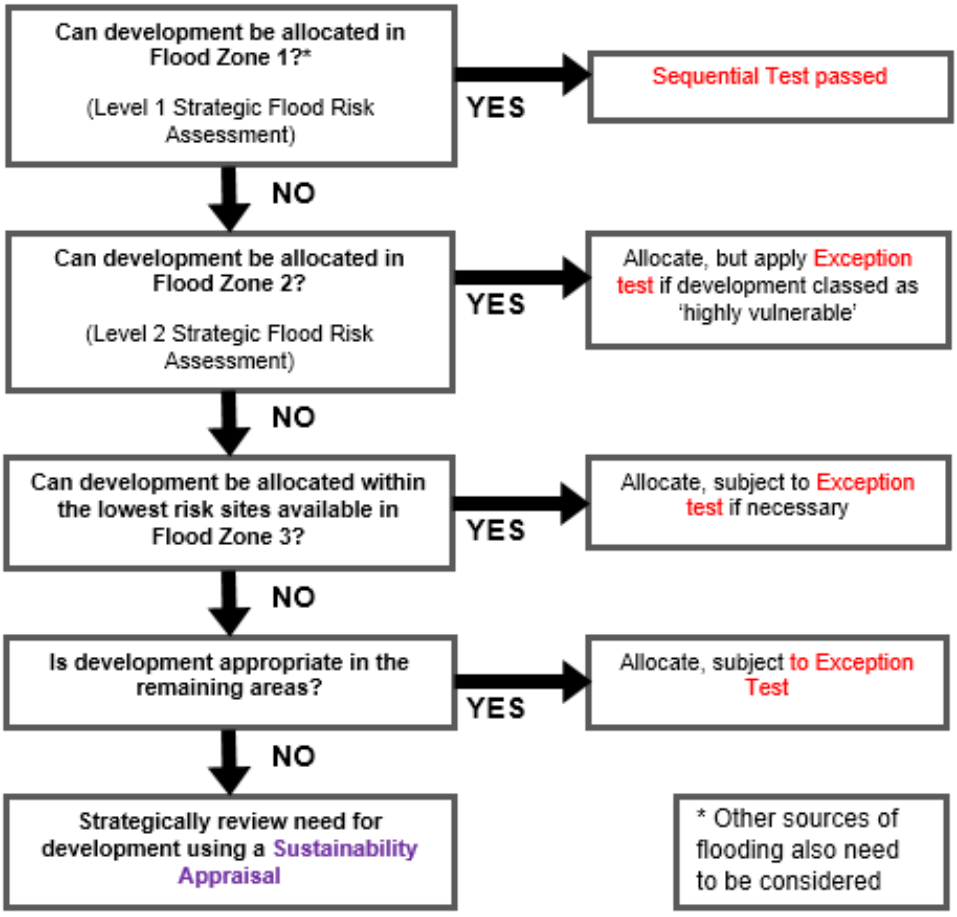
The Flood Zones presented in Appendix A Geo-PDFs are the same as those shown on the Environment Agency's 'Flood Map for Planning'.
The Environment Agency Flood Zones do not cover all catchments or ordinary watercourses. As a result, whilst the Environment Agency Flood Zones may show an area is in Flood Zone 1, it may be that there is actually a degree of flood risk from smaller watercourses not shown in the Flood Zones.
At the time of writing this SFRA, the Environment Agency's Flood Map for Planning did not incorporate all the latest modelling results in Stratford upon Avon, along the Racecourse and Shottery Brooks. Therefore, in this area, the 100-year and 1,000-year modelled flood extents were used to represent Flood Zones 3a and 2 respectively.
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. The 1 in 20-year flood extent has been used to represent Flood Zone 3b (or 1 in 25-year in the absence of 1 in 20-year), provided by the Environment Agency. For areas outside of the detailed model coverage, or where no outputs were available (River Dene and Bell Brook), this is represented by Flood Zone 3a 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.

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

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

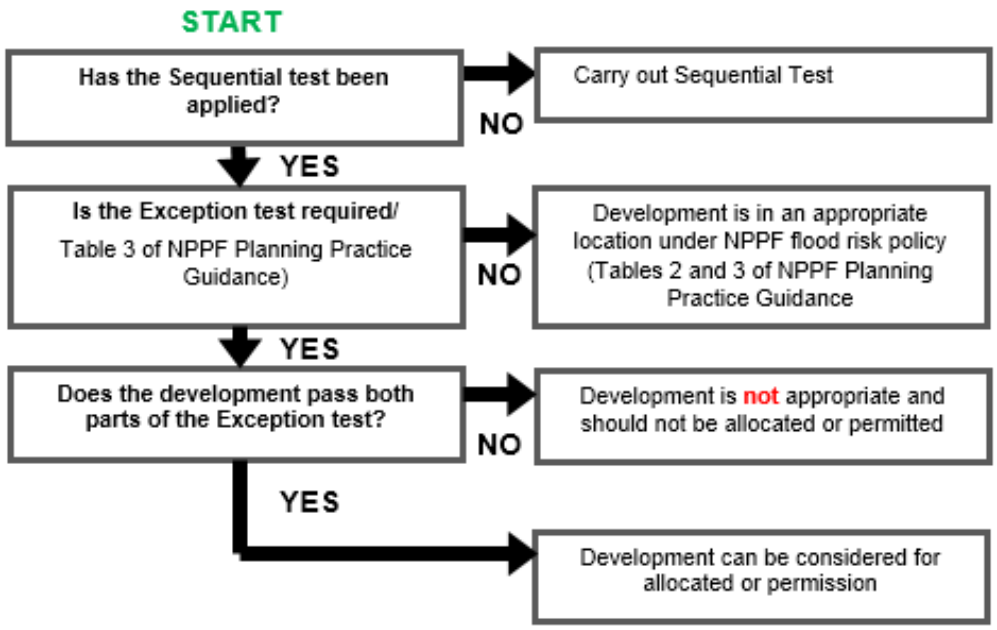
The Sequential Test should be applied to the whole Local Planning Authority area to increase the likelihood of allocating development in areas not at risk of flooding. The Sequential Test can be undertaken as part of a Local Plan Sustainability Appraisal. Alternatively, it can be demonstrated through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

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



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

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



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

3.2.1 Sequential Test

Local circumstances must be used to define the area of application of the Sequential Test (within which it is appropriate to identify reasonably available alternatives). The criteria used to determine the appropriate search area relate to the catchment area for the type of development being proposed. For some sites this may be clear, in other cases it may be identified by other Local Plan policies. A pragmatic approach should be taken when applying the Sequential Test.

Stratford on Avon District Council are responsible for considering the extent to which Sequential Test considerations have been satisfied and will need to be satisfied that the proposed development would be safe and not lead to increased flood risk elsewhere. The Environment Agency may provide advice to the Council regarding the most appropriate flood risk mapping to use to support the Sequential Test should the SFRA be out of date.

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

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

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

The NPPG provides further detailed guidance in their **Sequential Test for applicants** guidance.

3.2.2 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 deemed appropriate. The aim of the Exception Test is to ensure that more vulnerable property types, such as residential development, can be implemented safely and are not located in areas where the hazards and consequences of flooding are inappropriate. For the Test to be satisfied, both of the following elements have to be accepted for development to be allocated or permitted:

1. *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[2] .

2. *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 can be used to inform the Exception Test at planning allocation stage.

   At Planning Permission stage, a site-specific Flood Risk Assessment should demonstrate that the site will be safe, and the people will not be exposed to hazardous flooding from any source. The following should be considered[3:]

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

The NPPF and **NPPG** provide detailed information on how the Test can be applied.

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

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

3.3 Actual and residual flood risk

3.3.1 Actual flood risk

If it has not been possible for all future development to be situated in Zone 1 then a more detailed assessment is needed to understand the implications of locating proposed development in Zones 2 or 3. The assessment of actual risk takes account of the presence of flood defences and provides a picture of the safety of existing and proposed development. It should be understood that the standard of protection afforded by flood defences is not constant and it is presumed that the required minimum standards for new development are that residential development should be protected against flooding with an annual probability of river flooding of 1% (1 in 100-year chance of flooding) in any year.

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

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

3.3.2 Residual Flood Risk

Residual risk refers to the risks that remain in circumstances after measures have been taken to alleviate flooding (such as flood defences). It is important that these risks are quantified to confirm that the consequences can be safely managed.

Chapter 7 considers this risk in more detail.

3.4 Review of developer Flood Risk Assessments

The Council should consult the Environment Agency's 'Flood Risk Standing Advice (FRSA) for Local Planning Authorities', last updated 28 February 2017 and Warwickshire County Council's **'Flood Risk and Drainage Standing Advice'**, last revised in August 2017, when reviewing planning applications for proposed developments at risk of flooding. In addition to the LLFA's Flood Risk and Drainage Standing Advice, when considering planning permission for developments, planners may wish to consider the following:

- Will the natural watercourse system which provides drainage of land be adversely affected;
- Will a minimum 8m width access strip be provided adjacent to the top of both banks of any Main River (5m for Ordinary Watercourses), for maintenance purposes be appropriately landscaped for open space and biodiversity benefits;
- Will the development ensure no loss of open water features through draining, culverting or enclosure by other means and will any culverts be opened up;
- Have sustainable drainage systems been given priority to manage surface water flood risk;
- Will there be a betterment in the surface water runoff regime; with any residual risk of flooding, from drainage features either on or off site not placing people and property at unacceptable risk; and
- Have flood risk reduction opportunities been sought/improved in the proposed flood risk regime?

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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** on 19 February 2016, which must now be considered in all new developments and planning applications.

These allowances are based on UK Climate Impacts predictions from 2009 which informed the peak river flow allowances published by the Environment Agency in February 2016. The UK Climate Impacts Programme published new predictions for climate change in November 2018. The Environment Agency will, in due course, use this information to update their climate change guidance for planners. Planners and developers must ensure that the most up to date Environment Agency climate change guidance has been applied to more detailed site-specific work.

The peak river flow allowances show the anticipated changes to peak flow by river basin district within which the subject watercourse resides. Once this is determined, guidance on uplift in peak flows are assigned for three allowance categories, Central, Higher Central and Upper End which are based on the 50th, 70th and 90th percentiles respectively. The allowance category to be used is based on the vulnerability classification of the development and the Flood Zones within which it resides.

These allowances (increases) are provided for three climate change 'epochs':

- Total potential change anticipated for '2020s' (2015 to 2039)
- Total potential change anticipated for '2050s' (2040 to 2069)
- Total potential change anticipated for '2080s' (2070 to 2115)

One or two of the percentiles are provided for each combination of vulnerability and flood zone, which in the latter case provides a 'range' of allowances. The peak river flow allowances show the anticipated changes to peak flow by river basin district, for three future epochs and percentiles, as shown in Table 4-1. The majority of the district lies within the Severn river basin district.

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)
Severn	Upper end	25%	40%	70%
	Higher central	15%	25%	35%
	Central	10%	20%	25%

4.1.1 High ++ allowances

High++ allowances only apply in assessments for developments that are very sensitive to flood risk and that have lifetimes beyond the end of the century. Further information is provided in the Environment Agency publication, **Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities.**

4.1.2 Which peak river flow allowance to use?

The flood zone and flood risk vulnerability classification should be considered when deciding which allowances apply to the development or the plan. The guidance states the information in the tables below. Note that developments should consider the range of allowances identified for each vulnerability classification.

Flood Zone 2

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

Flood Zone 3a

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

Flood Zone 3b

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

4.2 Peak rainfall intensity allowance

Increased rainfall affects river levels and land and urban drainage systems. The table below shows anticipated changes in extreme rainfall intensity in small and urban catchments.

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

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

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

4.3 Using climate chance allowances

To help decide which allowances to use to inform the flood levels that the flood risk management strategy will be based on for a development or development plan allocation, the following should be considered:

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

4.4 Impact of climate change in Stratford on Avon District

The types of climate change impact relevant to Stratford on Avon District are:

- Milder wetter winters
- Hotter drier summers
- Increased rainfall intensity in summer months
- Faster responding catchments/sites
- Surcharging of piped systems and flooding as a result of poor capacity of structures is expected to increase
- Pressure on existing sewer systems effectively reducing their design standard, leading to more frequent flooding
- The prospect of droughts may increase

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

The impact of an event with a given probability is also likely to become more severe. For example, as water depths, velocities and flood hazard increase, so will the risk to people and property. Although qualitative statements can be made as to whether extreme events are likely to increase or decrease over the UK in the future, there is still considerable uncertainty regarding the magnitude of the localised impact of these changes.

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

Important note on Climate Change mapping in this SFRA

For this SFRA update, the existing hydraulic models provided by the Environment Agency (River Arrow and Alne, River Leam, Bell Brook, River Stour, Middle Avon Tributaries, Racecourse and Shottery Brooks, River Dene and River Avon) were re-run for climate change scenarios to account for the new climate change guidance.

It should be noted that different mapping techniques have been applied, depending on the type of hydraulic model (e.g. 1D-2D or 1D-only). LIDAR ground levels will have updated in some places along with newer model software versions since some of the much older models were originally run, and hence mapped outputs may differ slightly in some areas compared against the original studies.

Three scenarios were modelled to reflect the three climate change allowances for the '2080s' timeframe in the Severn River Basin District, therefore the 100-year plus 25%, 35% and 70%. The climate change mapping reflects the defended scenario.

Where no detailed hydraulic models are present, or where existing hydraulic models failed to run (Bell Brook), Flood Zone 2 has been used as a proxy. More detailed hydraulic modelling in these areas may be required at site-specific Flood Risk Assessment stage to confirm flood risk and climate change impacts.

This modelling was undertaken to assist the Council with the preparation of their Local Plan. Developers will need to undertake a more detailed assessment of climate change as part of the planning application process when preparing FRAs.

Climate change mapping has been provided in Appendix A: Geo-PDFs. The Indicative Flood Zone 2 layer provided under the climate change sub-heading should be viewed in conjunction with the modelled climate change outlines. The Indicative FZ2 extent has been provided where climate change models are not available or could not be run, to serve as an indication of possible extents.

It is recommended that the impact of climate change on a proposed site is considered as part of a detailed Flood Risk Assessment, using the percentage increases which relate to the proposed lifetime and the vulnerability classification of the development. The Environment Agency should be consulted to provide further advice for developers on how best to apply the new climate change guidance.

5 Sources of information used in preparing the 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 Stratford on Avon District.

Table 5-1 Overview of supplied data for Stratford on Avon District 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	Environment Agency
	2013 SFRA	Warwickshire County Council
	Historic flood incidents/records	Warwickshire County Council Stratford on Avon District Council Canals and River Trust Highways
	Historic sewer flooding records	Thames Water
Fluvial (including climate change)	Rivers Arrow and Alne (2009, Halcrow Group Ltd) River Leam (2010, JBA) River Avon (2010, Halcrow Group Ltd, JBA) Middle Avon Tributaries (2015, Capita, AECOM) Racecourse and Shottery Brook (2019, AECOM) Wellesbourne (2008, JBA) Bell Brook (2016, *model not used*) River Stour (2010, Capita)	Environment Agency
Surface Water	Risk of Flooding from Surface Water dataset	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 Thames Water
Reservoir	National Inundation Reservoir Mapping	Environment Agency
Canal	Description of flood incidences	Canal and River Trust

Mapping of surface water flood risk in Stratford on Avon 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 1in 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.

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

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

Historical incidents of sewer flooding are detailed by Thames Water in Table 6-2 and properties at risk from sewer flooding provided by Severn Trent Water are detailed in Table 6-3. For confidentiality reasons this data has been supplied on a postcode basis.

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, they are not provided for specific sites or for land where the catchment of the watercourse falls below 3km^2. 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. Where the Flood Map for Planning is based on generalised modelling, developers should undertake a more detailed analysis and assessment of the flood risk at the planning application stage.

All of the mapping can be found in the appendices to this SFRA. More details of the mapping structure can be found in Table 1-1.

5.1.1 Other relevant flood risk information

Users of this SFRA should also refer to other relevant information on flood risk where available and appropriate. The Planning Framework and Flood Risk Policy chapter includes information on the implications of recent changes to planning and flood risk policies and legislation, as well as documents relevant to this study.

6 Understanding flood risk in Stratford on Avon District

6.1 Historical flooding

Stratford on Avon District has a history of documented flood events with the main source being from fluvial and surface water sources. Significant historic flood events are highlighted in Table 6-1.

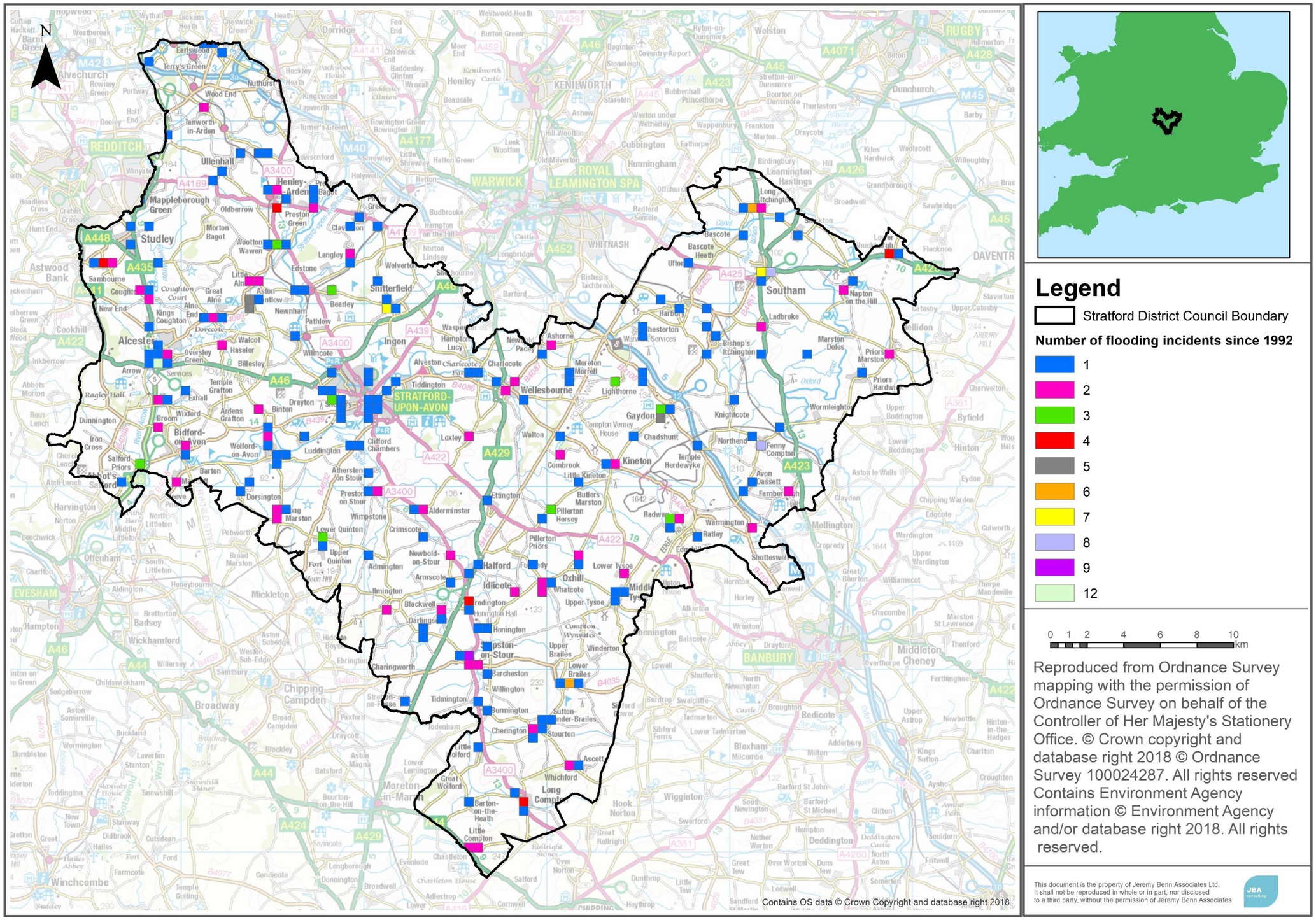
Table 6-1 Documented Historic Flood Records in Stratford on Avon District

Location	Date	Record Source	Additional Information
Stratford upon Avon	March 1947	Recorded flood outlines	Fluvial flooding from the Avon
Alcester	1960	Recorded flood outlines	Fluvial flooding from the Rivers Alne and Arrow
River Avon	July 1968	Recorded flood outlines	Fluvial flooding from the River Avon affecting Stratford upon Avon, Bidford on Avon, Wellesbourne, Tiddington, Alveston and Welford on Avon
Hampton Lucy	February 1979	Recorded flood outlines	Fluvial flooding from the River Avon
District wide along the River Avon and River Itchen	January 1985	Recorded flood outlines	Fluvial flooding along the River Avon and River Itchen
Stratford upon Avon	January 1992	Recorded flood outlines Warwickshire CC historic flood records	Fluvial and surface water flooding
District wide	Easter 1998	Recorded flood outlines Warwickshire CC historic flood records **Met Office**	Fluvial and surface water flooding. Heavy rainfall causing District wide flooding, seriously affecting Stratford upon Avon and along the River Avon
District wide	July 2007	Recorded flood outlines **Flooding in Stratford on Avon District Recovery Plan**	Heavy rain on the 9th July caused the River Avon to rise flooding 33 homes Heavy rain caused pluvial flooding on 20th July leading to fluvial flooding from the River Avon, River Stour, River Alne and River Arrow until the 23rd of July. More than 60 roads were closed during the flooding, and the settlements most severely affected included Alcester, Southam, Welford on Avon, Bidford on Avon, Shipston on Stour and Wellesbourne

District wide	December 2008	Warwickshire CC historic flood records	
Stratford on Avon	November 2012	**BBC News**	Fluvial flooding from the River Avon and surface water flooding due to heavy rainfall
District wide	March 2016	Warwickshire CC historic flood records **Warwickshire CC website**	Flooding due to heavy rainfall causing the River Avon to reach its highest level since monitoring equipment was installed in 1973 on the 9th March.
District wide	June 2016	Warwickshire CC historic flood records **Warwickshire CC website**	Flooding District wide due to heavy rainfall.

Flooding records relating to flooding incidents since January 1992, provided by Warwickshire County Council are shown in Figure 6-1. The records do not specify the source of flooding. The flooding incidents are widespread throughout the District; however, there are notable clusters of flooding history in the main urban areas in the District: Stratford upon Avon, Southam, Alcester, Long Itchington and Shipston on Stour. There are notable dates which have a high frequency of recorded incidents; Easter 1998 (104 incidents), June/July 2007 (133 incidents), 2012 (75 incidents) and 9th March 2016 (34 incidents).

Figure 6-1 Historic flooding incidents in Stratford on Avon District



6.2 Topography, geology, soils and hydrology

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

6.2.1 Topography

The topography of Stratford on Avon District is mainly characterised by lower elevations in centre of the District, around the town of Stratford upon Avon and in the areas surrounding the river valleys of the River Avon, River Alne, River Arrow and the River Stour. From these valleys, elevations increase to the east of the District where the edge of the Cotswold Hills fall into the District boundary, and to the north-west. The topography of the study area is shown in Figure 6-2.

6.2.2 Geology and Soils

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

Figure 6-3 shows the bedrock (solid permeable) formations in Stratford on Avon District and Figure 6-4 shows the superficial (permeable, unconsolidated (loose) deposits. These are classified as the following:

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

The eastern and southern parts of the District are mainly comprised of secondary undifferentiated bedrock, which is unattributable to either permeable or lower permeability layers. The central and northern parts of the District are comprised mainly of Secondary B bedrock formations, largely lower permeability which store limited amounts of groundwater, interspersed with Secondary A formations where storage is possible at local levels. There are a few small areas, primarily on the southern border of the District where the bedrock is formations are highly permeable principal layers where high levels of water can be stored, surrounded by lower permeability unproductive layers.

The majority of the study area is not overlain by superficial deposits, those areas which have superficial deposits tend to be in river valleys. The superficial deposits that are present in the District are mainly higher permeability Secondary A deposits, with some areas of undifferentiated deposits.

Figure 6-2 Topography of Stratford on Avon District

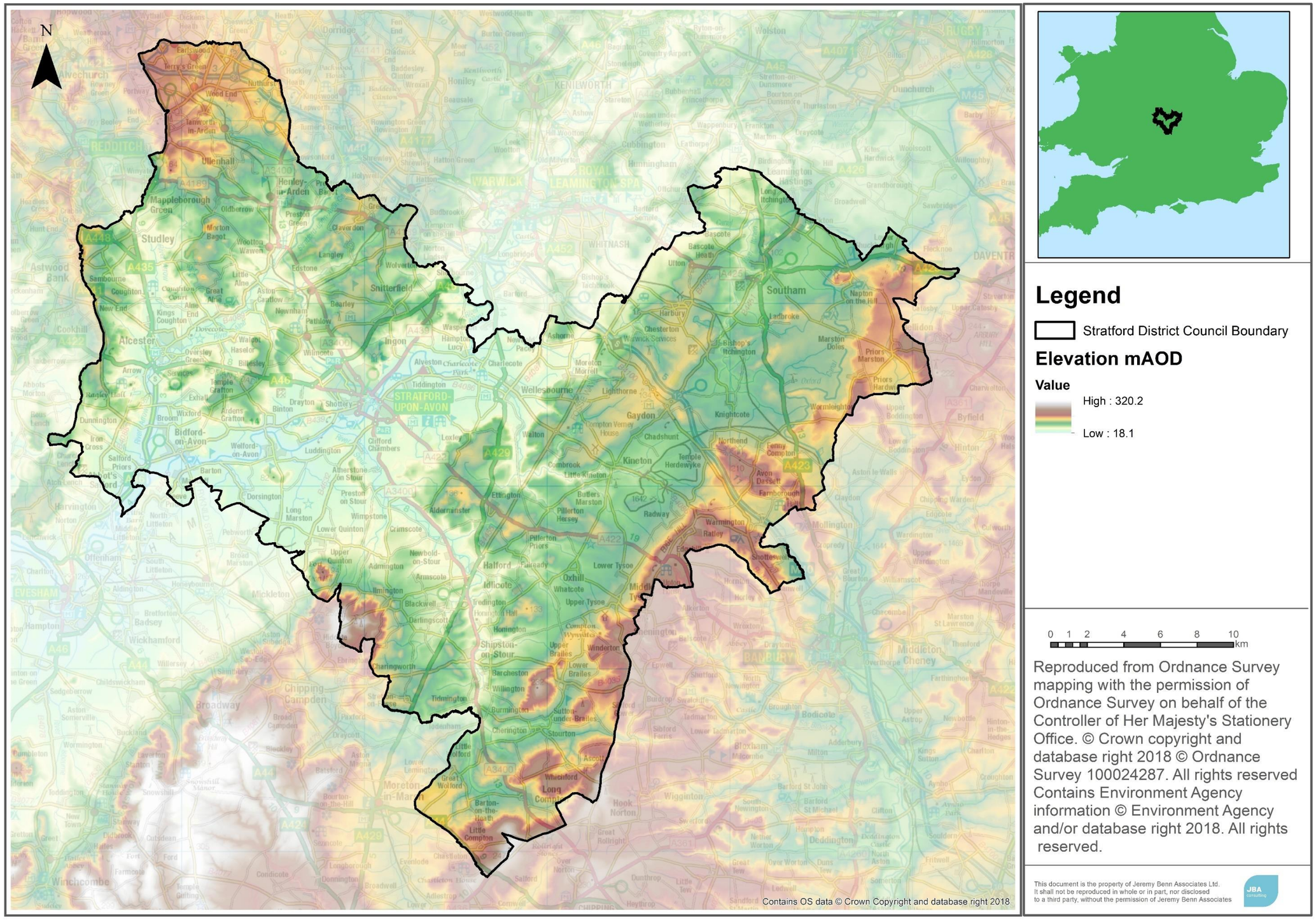


Figure 6-3 Bedrock formations in Stratford on Avon District

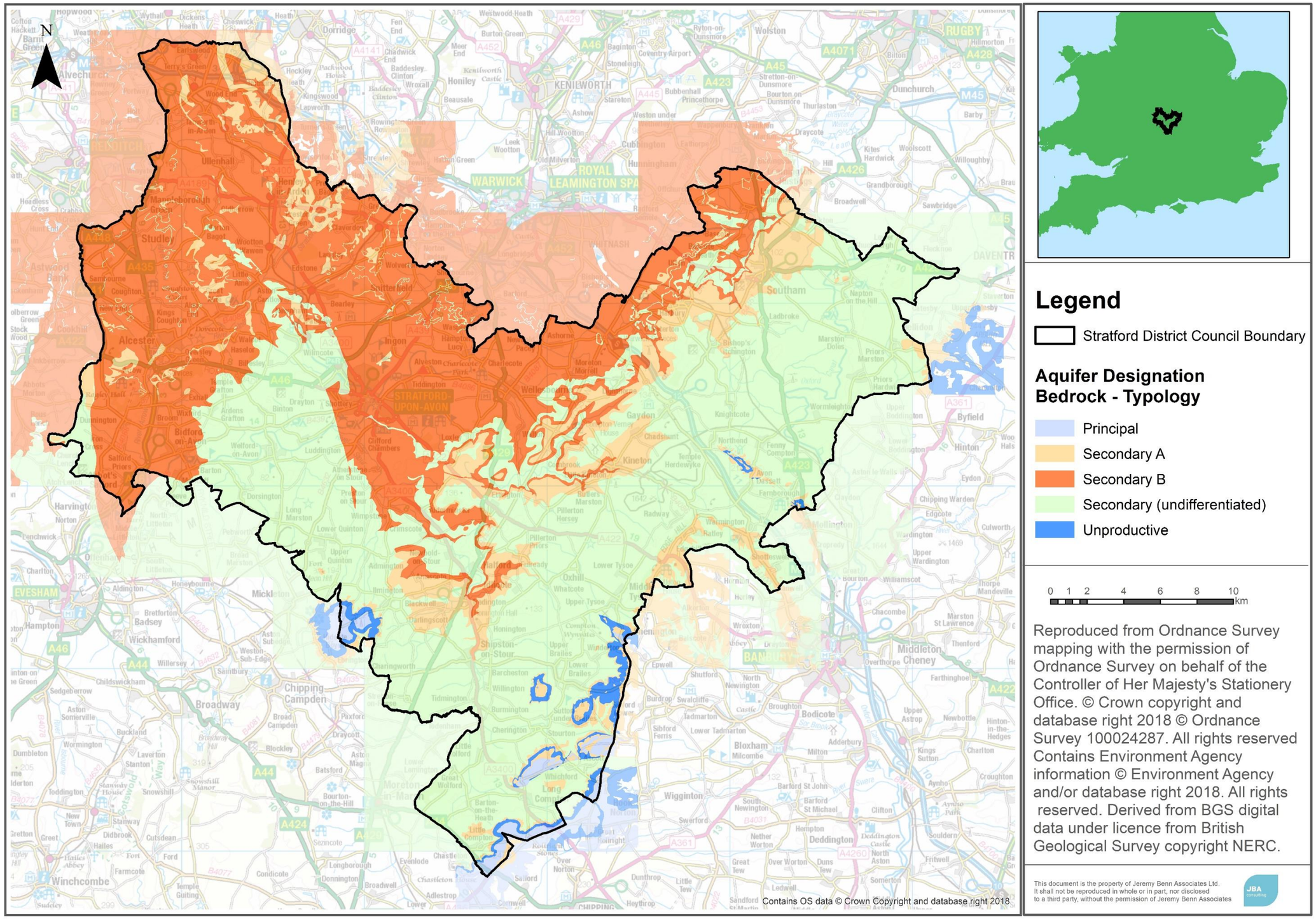
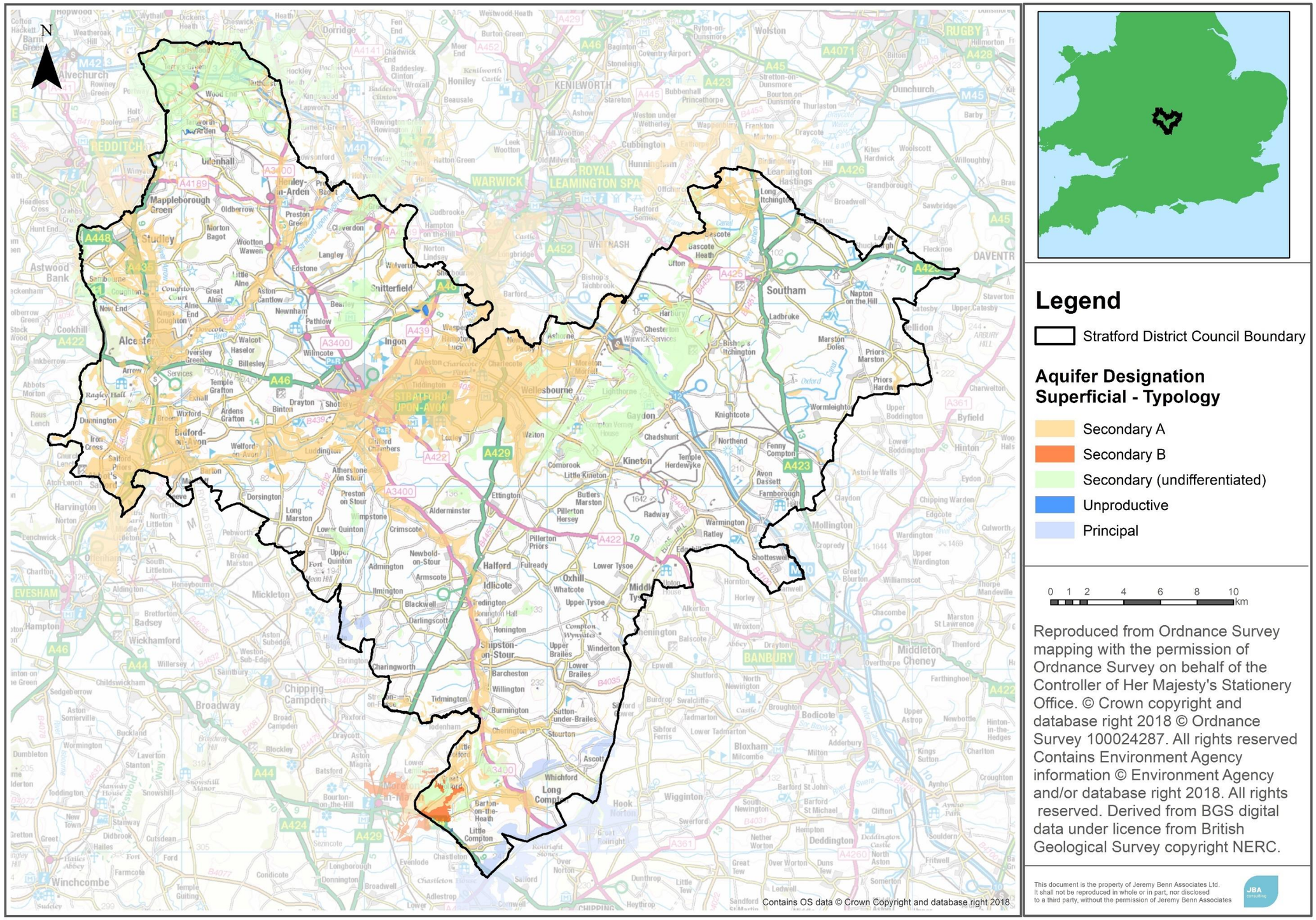


Figure 6-4 Superficial deposits in Stratford on Avon District



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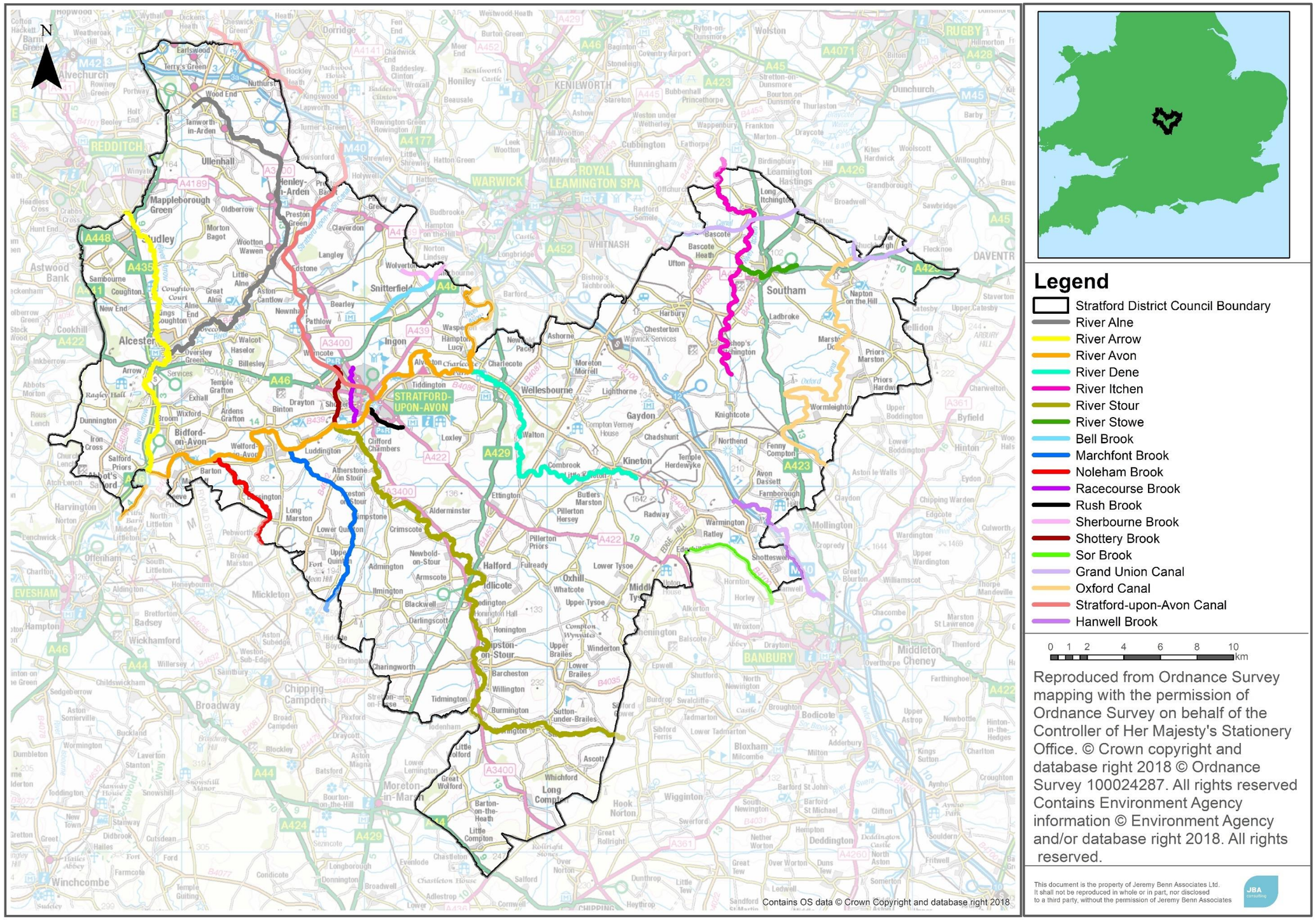
6.2.3 Hydrology

The principal watercourses flowing through the SFRA study area are:

- River Avon
- River Alne
- River Arrow
- River Stour
- River Stowe
- River Itchen
- River Dene
- Shottery Brook
- Marchfont Brook
- Noleham Brook
- Racecourse Brook
- Rush Brook
- Bell Brook
- Sherbourne Brook
- Hanwell Brook
- Sor Brook

Tributaries of these watercourses include smaller ordinary watercourses and numerous unnamed drains. There are also a number of ponds and lakes within the study area. A summary of the key watercourses in the SFRA are provided in Figure 6-5. Mapping indicating the location of the key watercourses can be found in Appendix A.

Figure 6-5 Key watercourses in Stratford on Avon District



6.3 Fluvial flood risk

The primary fluvial flood risk is along the River Avon and its main tributaries. These present fluvial flood risk to rural communities as well as some of the main urban centres including, but not exclusively, Alveston, Tiddington, Stratford upon Avon, Welford on Avon, Bidford on Avon, Alcester and Henley in Arden. The fluvial flood extents are fairly well confined in the majority of the District, with wider extents along the River Avon due to lower lying, flat topography, notably through Stratford upon Avon and downstream of Bidford on Avon.

The Flood Zone maps for Stratford on Avon District are provided in Appendix A: Geo-PDFs, split into Flood Zones 2, 3a and 3b (including an 'indicative 3b' where FZ3a acts as FZ3b in the absence of detailed model data). The flood risk associated with the major locations in Stratford on Avon District are detailed in Table 6-5. Please note that this table does not cover all locations at risk and the reader should refer to the mapping for further information on other locations.

6.4 Surface water flooding

Flooding from surface water runoff (or 'pluvial' flooding) is usually caused by intense rainfall that may only last a few hours and usually occurs in lower lying areas, often where the natural (or artificial) drainage system is unable to cope with the volume of water. Surface water flooding problems can be inextricably linked to issues of poor drainage, or drainage blockage by debris, and sewer flooding. This can be made worse by local insufficient drainage capacity. Where discharge is directly to a watercourse, locally high-water levels can cause back-up and prevent drainage taking place.

The Risk of Flooding from Surface Water mapping (RoFfSW) provided by the Environment Agency via Stratford on Avon District Council shows that a number of communities are at risk of surface water flooding, as discussed in Table 6-5. In general, the RoFfSW shows that surface water predominantly follows topographical flow paths of existing watercourses or dry valleys with some isolated ponding located in low-lying areas. Whilst in the majority of cases the risk is confined to roads, there are notable prominent run-off flow routes around properties, e.g. properties situated at the foot of surrounding hills. The RoFfSW mapping for Stratford on Avon District can be found in Appendix A.

6.5 Groundwater flooding

In comparison to fluvial flooding, current understanding of the risks posed by groundwater flooding is limited and mapping of flood risk from groundwater sources is in its infancy. Groundwater level monitoring records are available for areas on Major Aquifers; however, for lower lying valley areas, which can be susceptible to groundwater flooding caused by a high water table in mudstones, clays and superficial alluvial deposits, very few records are available. Additionally, there is increased risk of groundwater flooding where long reaches of watercourse are culverted as a result of elevated groundwater levels not being able to naturally pass into watercourses and be conveyed to less susceptible areas.

Groundwater susceptibility mapping of Stratford on Avon District has been provided in Appendix A. The majority of the District is shown to be within the <25% susceptible classification, at a lower probability of groundwater flooding. Areas with higher susceptibilities and more likely to flood from groundwater are found in the centre of the District along the River Avon and in the west of the District along the River Arrow.

6.6 Flooding from sewers

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

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

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

The majority of sewers in Stratford on Avon District are managed by Severn Trent Water, with Thames Water and Anglian Water also managing sewers in some areas.

Historical incidents of flooding recorded by Thames Water are shown in Table 6-2. Severn Trent's DG5 register of historic sewer flooding incidents has recently been replaced by the 'At Risk Register', which gives properties a risk based on incident likelihood and impact on customer. Settlements with properties at risk on Severn Trent's 'At Risk Register' are set out in Table 6-3.

For confidentiality reasons this data has been supplied on a postcode basis. The datasets were supplied on the 05/10/2018 and 03/10/2018 respectively. While Anglian Water also manage sewers in the District, they only cover a very small, rural area (approximately 0.5km^2) to the east of Priors Marston in the north-east of the District, therefore they were not contacted to provide sewer flooding history. Developers should contact Anglian Water for any proposed development in that area.

Table 6-2 Recorded sewer flooding incidents (Thames Water)

Post Code	Recorded flood incidents
CV47 2	1
OX17 1	2
	Total=3

Table 6-3 Properties at risk from sewer flooding (Severn Trent Water)

Post code	Locality associated with post code	Number of properties at risk
CV36 4	Ilmington, Tredington, Blackwell	25
CV35 0	Lighthorne, Gaydon, Butlers Marston, Oxhill, Upper Tysoe, Middle Tysoe, Kineton	20
CV37 6	Stratford upon Avon	18
CV37 9	Stratford upon Avon, Binton, Wilmcote	14
CV37 8	Armscote, Newbold on Stour, Lower Quinton, Broad Marston, Wilmcote, Long Marston	12
CV37 0	Snitterfield, Stratford upon Avon	10
CV36 5	Long Compton, Cherington, Great Wolford	8
CV35 9	Wellesbourne, Moreton Morrell, Loxley	8
CV47 1	Southam	7
CV35 8	Claverdon	5
CV47 2	Southam, Fenny Compton, Bishops Itchington	5
CV47 8	Stockton, Napton on the Hill	4
CV47 9	Long Itchington, Southam	3
CV37 7	Loxley, Stratford upon Avon	2
CV47 7	Priors Hardwick	1
CV47 0	Southam	1
		Total=143

A total of 143 properties are at risk from sewer flooding within the District, the highest risk localities include Stratford upon Avon, Southam, Ilmington, Tredington and Blackwell.

6.7 Flooding from canals

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

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

- Culvert collapse
- Overtopping
- Animal burrowing

Flooding from a breach of a canal embankment is largely dictated by canal and ground levels, canal embankment construction, breach characteristics and the volume of water within the canal that can discharge into the lower lying areas behind the embankment. The volume of water released during a breach is dependent on the upstream pound length (i.e. the distance between locks) and how quickly the operating authorities can react to prevent further water loss, for example by the fitting of stop boards to restrict the length of the canal that can empty through the breach, or repair of the breach. The Canal and River Trust monitor embankments at the highest risk of failure.

There are three canals in Stratford on Avon District: the Stratford on Avon Canal, the Oxford Canal and the Grand Union Canal. The Canal and River Trust were

consulted to identify any instances of breaches and overtopping of each of the canals.

- The **Stratford on Avon Canal** comes into the District at Preston Bagot, just to the east of Henley-in-Arden. It travels in a southerly direction through the District to Stratford on Avon, where it joins the River Avon. There are no instances of breach or overtopping on the Stratford upon Avon Canal within the District.
- The **Oxford Canal** enters Stratford and converges with the Grand Union Canal on the north-eastern corner at Lower Shuckburgh. Just inside the District boundary just north of Napton on the Hill, the canal splits again. The Oxford Canal then travels in a southerly direction to leave the District at Claydon. There are no instances of breach or overtopping on the Oxford Canal within the District.
- The **Grand Union Canal** after splitting from the Oxford Canal travels north and back out of the District boundary at Napton Reservoirs. Approximately 3km further along the canal it re-enters Stratford on Avon District, just north of Stockton, where it travels west for approximately 5.5km, leaving Stratford on Avon District at Welsh Road, north-west of Southam. There are no instances of breach or overtopping on the Grand Union Canal within the District.

Whilst there have been no instances of breach or overtopping from the canals within the Stratford on Avon District, the canals have the potential to interact with other watercourses in the study area, including the River Itchen, River Alne, River Avon, Shottery Brook and Racecourse Brook. These have the potential to become flow paths if these canals were overtopped or breached. Any development proposed adjacent to a canal should include a detailed assessment of how a canal breach would impact the site, as part of a site-specific Flood Risk Assessment. Guidance on development near canals is available from the **Canal and River Trust.**

6.8 Flooding from reservoirs

Reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975 and are listed on a register held by the Environment Agency. The level and standard of inspection and maintenance required under the Act means that the risk of flooding from reservoirs is very low. Recent changes to legislation under the Flood and Water Management Act require the Environment Agency to designate the risk of flooding from reservoirs over 25,000 cubic metres.

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

The risk of inundation to Stratford on Avon District as a result of reservoir breach or failure of a number of reservoirs within the area was assessed as part of the National Inundation Reservoir Mapping (NIRIM) study. There are 22 reservoirs shown to affect Stratford on Avon District; this includes reservoirs located within the District and a number of reservoirs outside of the area whose inundation mapping is shown to affect Stratford on Avon District. The reservoirs inundation

extents provided by the Environment Agency can be found on the Environment Agency's **Long term flood risk map for England**.

The Environment Agency maps represent a credible worst-case scenario. In these circumstances it is the time to inundation, the depth of inundation, the duration of flooding and the velocity of flood flows that will be most influential.

Table 6-4 Reservoirs that may potentially affect Stratford on Avon District in the event of a breach

Reservoir	Location (grid reference)	Reservoir owner	Is the reservoir located within the study area?	Local Authority Area
Walton Hall Lake	428540, 252728	The Hotel Collection	Yes	Warwickshire County Council
Upper Compton Verney	431036, 252617	Cariss	Yes	
Lower Compton Verney	430695, 251934	Cariss	Yes	
Ventnor Marina – Sunrise Basin	446101, 263753	Castle Marina	No – Rugby Borough	
Napton	446513, 262930	Canal & River Trust	Yes	
Earlswood Lakes – Terry's Pool	410910, 274030	Canal & River Trust	Yes	
Earlswood Lakes – Windmill Pool	411531, 274147	Canal & River Trust	Yes	
Earlswood Lakes – Engine Pool	411399, 274291	Canal & River Trust	Yes	
Ragley Hall Lake	407835, 255205	Hertford	Yes	
New Waters, Warwick Castle	428538, 263427	C & S Taylor LLP	No – Warwick District	
Warren Chase Water	416910, 256944	King	Yes	
Coombe Pool	438310, 279216	Coventry City Council	No – Rugby Borough	
Edstone Lake	417589, 261657	Slater	Yes	
Wormleighton	444952, 251509	Canal & River Trust	Yes	
Draycote Water	445110, 270060	Severn Trent Water	No – Rugby Borough	
Ingot Manor Reservoir	420624, 258403	Cantella Farms Limited	Yes	
Wootton Pool	415647, 263720	Haimes	Yes	
Cofton	400675, 275621	Canal & River Trust	No – Bromsgrove District	Worcestershire County Council
Bittell Upper	401778, 274937	Canal & River Trust	No – Bromsgrove District	
Bittell Lower	402019, 273969	Canal & River Trust	No – Bromsgrove District	
Lodge Pool	404942, 266646	Severn Trent Water	No – Redditch District	

Naseby	466673, 277975	Canal & River Trust	No – Daventry District	Northampton-shire County Council

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

- Developers should seek to contact the reservoir owner to obtain information which may include:
  - reservoir characteristics: type, dam height at outlet, area/volume, overflow location;
  - operation: discharge rates/maximum discharge;
  - discharge during emergency drawdown; and
  - inspection/maintenance regime.
- Developers should apply the sequential approach to locating development within the site.
- Consult with relevant authorities regarding emergency plans in case of reservoir breach.
- The reservoir owners are contacted to confirm the Reservoir Risk Designation (if determined) and the inspection and maintenance regime of the reservoir.
- Consider the impact of a breach and overtopping, particularly for sites proposed to be located immediately downstream of a reservoir. This should consider whether there is sufficient time to respond.
- The EA and NRW online Reservoir Flood Maps contain information on the extents, depths and velocities following a reservoir breach (note: only for those reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975). For proposed sites located within the extents, consideration should be given to the extent, depths and velocities shown in these online maps.
- In addition to the risk of inundation, those considering development in areas affected by breach events should also assess the potential hydraulic forces imposed by the rapid flood event and check that that the proposed infrastructure fabric can withstand the loads imposed on the structures by a breach event.

6.9 Flood warning and emergency planning

6.9.1 Emergency planning

Emergency planning enables Emergency Responders to respond effectively before, during and after a flood. Emergency Planners also work with local businesses to increase their resilience to flooding through business continuity and local communities on Community Emergency Plans.

The **Warwickshire Local Resilience Forum** brings Emergency Responders together in Warwickshire to plan for flooding. A Multi Agency Flood Plan has previously been produced for Warwickshire by the Coventry, Solihull and Warwickshire Resilience Team and was reviewed in September 2018. It is recommended that the information in this SFRA is used to inform any further reviews to the document. **The Warwickshire Community Flood Resilience**

Pathfinder Project Final Report was published in 2015 and aims to assist communities in helping themselves to become more resilient to flooding.

Safety is a key consideration for any new development, and this includes the residual risk of flooding i.e. behind flood defences, the availability of flood warnings, safe access and egress routes and evacuation procedures. There are currently 11 Flood Alert Areas (FAA) and 25 Flood Warning Areas (FWAs) covering significant parts of the Stratford on Avon District. These are shown in Appendix A. Flood Warnings are supplied by the Environment Agency for river flooding via the Flood Warning System service, to homes and businesses within Flood Zones 2 and 3.

The revised 2018 NPPF requires that LPAs assess Planning Applications to ensure that:

- any residual risk can be safely managed; and
- safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

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

- Camping and caravan sites, holiday accommodation and where there are transient occupants e.g. hostels
- Buildings that will be occupied below a design flood level i.e. basements

In addition to the flood warning and evacuation plan considerations in the NPPG, developers should also consider:

- How to manage the consequences of events that are un-foreseen or for which no warnings can be provided e.g. managing the residual risk of a flood defence breach or failure.
- That proposed new development that places additional burden on the existing response capacity of the Council will not normally be considered appropriate.
- Encouraging those owning or occupying developments, where flood warnings can be provided, to sign up to receive them. This applies even if the development is defended to a high standard.
- The vulnerability of site occupants.
- Situations may arise where occupants cannot be evacuated (e.g. prisons) or where it is safer to remain "in-situ" and/or move to a higher floor or safe refuge area (e.g. developments located immediately behind a defence and at risk of a breach).

Table 6-5 Summary of Flood Risks in Stratford on Avon District

Settlement	Fluvial flood risk	Existing or proposed defences	Surface water flood risk	Susceptibility to Groundwater flood risk				Reservoir inundation risks	Historic, recorded flood events
				<25%	>=25% <50%	>=50% <75%	>=75%		
Alcester	The confluence of the Rivers Arrow and Alne is located in Alcester and the Spittle Brook flows south on the western edge of the town. Given the low, flat topography of the land surrounding the rivers, Alcester is likely to flood from fluvial sources. Some properties in the town are located within Flood Zone 3, to the west of the River Arrow and to the north of the River Alne. Properties located within the bounds of School Road, Priory Road and High Street lie almost entirely within Flood Zone 2 and partially within Flood Zone 3.	Wall/embankment along right bank of the River Arrow, ~380m behind houses on School Road, ~275m behind Gas House Lane and Stratford Road and ~665m adjacent to Bleachfield Street and Newport Drive	The surface water risk in the town is largely confined to overland flow routes via local roads. There are some properties at risk of flooding in the 30-year event, along the B4089, Adams Way, Meadow Road and Seymour Road. The majority of roads in the town are flow routes in the 1,000-year event affecting a large number of properties.		✓	✓	✓	Alcester is partially located within the reservoir inundation extents of Bittell Upper, Bitell Lower, Edstone Lake, Cofton, Lodge Pool and Wootton Pool reservoirs.	Fluvial events: 1960, 2007
Alveston	The River Avon flows past the eastern boundary of Alveston, before meandering around the north of the village and back past the west of it. A large area of flat fields lies between Alveston and the River Avon to the north and the west, which is almost entirely within the Flood Zone 2 and 3 extents. Only a few properties are located in Flood Zone 3, along Mill Lane and Ferry Lane. More properties are located within Flood Zone 2, along Alveston Lane, Church Lane and The Rookery. Given the location and topography of the village, Alveston is likely to flood from fluvial sources.	None	The 30-year surface water flood risk is largely confined to the river channel and rural parts of the village, with no properties affected. The 100-year flood extents affect some roads in the village; however, only a small number of properties may be affected, along the Rookery and Church Close. In the 1,000-year surface water event, Church Lane, Alveston Lane, The Rookery and Kissing Tree Way become flow routes affecting a small number of properties.			✓		Alveston is partially located within the reservoir inundation extents of Walton Hall Lake, Upper Compton Verney, Lower Compton Verney, Naseby, Draycote Water and Ingon Manor reservoirs.	
Bidford-on-Avon	The southern edge of Bidford on Avon lies along the River Avon, and the Small Brook bounds the north and west of the village. The majority of Bidford on Avon lies on higher ground within Flood Zone 1, and only a small number of properties lie within Flood Zones 2 and 3, along High Street, Grange Road, the B4085 and The Pleck on the River Avon, and Victoria Road, Steppes Piece and Burnell Close which lies along the Small Brook.	None	Given the high topography of Bidford on Avon north of the River Avon, a large number of roads in the village become overland flow routes in the 1,000-year event. The 30-year surface water flood extent is largely confined to the channels and the B439, with small pockets of surface water extents spread elsewhere in the village.		✓	✓	✓	Bidford on Avon is partially located within the reservoir inundation extents of Draycote Water, Ragley Hall Lake and Bittell Upper reservoirs.	Fluvial events: 1968, 1998, 2007, 2012, 2016
Henley-in-Arden	The River Alne flows through the centre of Henley-in-Arden and an unnamed watercourse flows south of Henley-in-Arden to join the River Alne. The topography of the town is low-lying and flat, therefore it is more likely to flood from fluvial sources. East of the A3400, west of Arden Road, the A4189 and Glenhurst Road are largely located within Flood Zone 2 with a number of properties located within it. Properties along Glenhurst Road, the A4189, Brook End Drive, Prince Harry Road, Riverside Gardens, Beaudesert Lane, Alne Close and the A4300 lie within the extent of Flood Zone 3.	~140m of wall/embankment along the right bank of the River Alne past William James Way	The A3400, A4189 and Glenhurst Road are major flow routes for the 30-year surface water event with small isolated pockets elsewhere in the town. A large extent lies in the fields north of Beaudesert Lane. A small number of properties are affected by the 30-year and 100-year events, with a significant number of properties east of the A3400 affected in the 1,000-year event.	✓	✓	✓		None	
Kineton	Kineton lies along the River Dene, which flows west past the southern edge of the village. The village lies on high ground relative to the River Dene, therefore almost all of the village is located in Flood Zone 1. Small parts of the B4086 in the east of the village are located within Flood Zones 2 and 3.	None	The 30-year surface water extents are largely confined to the River Dene and the unnamed watercourse on the western edge of the village, with isolated pockets of flooding elsewhere in the village, and a major flow route over low ground on the northern edge of the village. A small number of properties are at risk of surface water flooding from the 30-year and 100-	✓				None	

			year events, including along Brookhampton Lane, Geden Close, Mill Street and Gardiner Road. The B4086, Southam Street, Green Farm End, Greenacres and St Peters Road become flow routes in the 1,000-year event.						
Long Itchington	Long Itchington lies along the River Itchen which poses a large fluvial flood risk to the village due to its relatively low, flat topography. Parts of Bascote Road, Stonebridge Lane, Church Road and Thorn Way lie within Flood Zone 3, with Flood Zone 2 also extending to Galanos and Leamington Road. Given the lower elevations of the village, it is more likely to flood from fluvial sources.	~370m of wall/embankment along the right bank of the River Itchen, adjacent to Church Road passing past Bascote Road	Parts of Church Road and the A423 become major surface water flow routes in the 30-year and 100-year events, with large pockets of flooding in the fields to the north of the village and areas around Marton Road Farm. The 1,000-year surface water flood extent entirely covers Church Road and a number of properties in the village are at risk from flooding.	✓	✓	✓		Long Itchington is partially located within the reservoir inundation extents of Ventor Marina and Napton reservoirs.	Fluvial events: 1985
Shipston on Stour	The River Stour flows through the eastern edge of Shipston on Stour and the town notably slopes from higher ground in the west, to lower ground in the east, meaning that the majority of Shipston on Stour lies outside of Flood Zones 2 and 3. Properties along the A3400, B4035 and Mill Court are located within Flood Zone 3, with Flood Zone 2 extents also reaching Telegraph Street, Market Place and Sheep Street.	None	Due to the topography of the town, the majority of surface water flood risk in Shipston on Stour is runoff from the higher ground in the west towards the River Stour. The B4035, Telegraph Street, Station Road and surrounding roads are notable flow routes in the 30-year and 100-year events with a number of isolated pockets of flooding elsewhere in the town. The majority of roads in the town become flow routes in the 1,000-year event putting a number of properties at risk from flooding.	✓	✓			None	Fluvial events: 2007
Southam	The majority of Southam lies on much higher ground relative to the River Stowe, therefore the majority of the town lies within Flood Zone 1. The extent of Flood Zone 3 reaches properties along Banbury Road, Tattle Bank, Brown's Bridge Road, Stowe Drive, Spire Bank and Welsh Road East with Flood Zone 2 also reaching properties on Abbey Lane, Pound Way and Warwick Street. The proposed HS2 route will cross the River Itchen to the south-west of the town. Any works to the river will be undertaken in accordance with technical standards and consent will be needed from the appropriate land drainage authority. Hence HS2 should not have an adverse effect on flood risk.	None currently. HS2 is primarily a scheme for a rail line and not a flood defence scheme. However, the EA and WCC are working with HS2 and the various designers to look at opportunities for betterment.	The surface water flood extents in the 30-year and 100-year events are largely isolated pockets of flooding, affecting a small number of properties along Parkfields, Stowe Drive, Abbey Lane, Flying Fields Road, the industrial estate on Kineton Road and nursery on St James Road. Many roads in the town become flow routes in the 1,000-year event as water runs off from the higher ground towards the River Stowe.	✓				Southam is partially located within the reservoir inundation extents of Ventor Marina and Napton reservoirs.	Fluvial events: 2007
Stratford upon Avon	A number of watercourses flow through Stratford, posing a fluvial flood risk: the River Avon, Rush Brook, Racecourse Brook and the Shottery Brook. Along the A3400 and the surrounding roads from Maybrook Road to Ash Grove are located within the Flood Zones of the Racecourse Brook and properties in close proximity to the Shottery Brook also lie within the Flood Zones. The extents of the Flood Zones of the River Avon through Stratford are very wide, which largely cover adjacent fields and car park areas; however, a large number of properties also lie within the Flood Zones. The topography of Stratford is relatively low and flat, and as there are several watercourses flowing through the town, this makes Stratford more likely to flood from fluvial sources.	None	The 30-year surface water flood extents are mainly isolated small pockets of flooding affecting a small number of properties. Along the Racecourse Brook from Rye Close to Park Road along the A3400, a number of properties are affected by the 30-year event. A large area upstream of Stratford Parkway train station is covered by the 30-year surface water extent. A large number of roads become overland flow routes in the 1,000-year surface water event.	✓	✓	✓	✓	Stratford upon Avon is partially located within the reservoir inundation extents of Walton Hall Lake, Naseby, Warren Chase Water, Draycote Water and Ingon Manor reservoirs.	Fluvial events: 1947, 1968, 1985, 1992, 2007, 2012, 2016

Studley	West of the B4093 and A435 in Studley is located on higher ground, which slopes away east of these roads towards the River Arrow. The topography of the town means that the majority of Studley is located in Flood Zone 1. Only a small number of properties in Studley are located within Flood Zones 2 or 3, along Wickham Road, Riverside, Thane Close and Castle Road.	None	The 30-year surface water extent in the town is largely isolated pockets of flooding with Castle Road being a notable flow route. The 100-year surface water extent is largely similar with Toms Town Lane, Bell Lane, Crooks Lane and Littlewoods Green also becoming flow routes. Many roads in the town become flow routes in the 1,000-year event as water runs off from the higher ground towards the River Arrow.	✓	✓	✓		Studley is partially located within the reservoir inundation extents of Cofton, Bittell Upper, Bittell Lower and Lodge Pool reservoirs.	
Tiddington	As the majority of Tiddington is located on higher ground, the majority of the village is located in Flood Zone 1. Small parts of School Lane, Dark Lane and Carters Lane lie within the Flood Zone 2 extent. The Riverside Caravan park is almost entirely located in Flood Zone 3.	None	The surface water flood extents in Tiddington are largely isolated pockets of flooding in the 30 and 100-year events, with very few affected properties. The 1,000-year extent is more widespread, notably at the Riverside Caravan park and the major roads in the village.				✓	Tiddington is partially located within the reservoir inundation extents of Walton Hall Lake, Upper Compton Verney, Lower Compton Verney, Naseby, Draycote Water and Ingon Manor reservoirs.	
Welford on Avon and Weston on Avon	Welford on Avon is largely located on higher ground, which slopes to the north, west and east towards the River Avon, therefore the majority of the village is located in Flood Zone 1. Properties located within Flood Zone 3 are situated along Binton Road, Boat Lane and Mill Lane, with Flood Zone 2 also reaching properties on Duck Lane and Church Lane. Some properties in neighbouring Weston-on-Avon are also located within Flood Zones 2 and 3.	None	The 30 and 100-year surface water extents are largely isolated pockets of flooding within the villages including potential flooding to properties on High Street, Headland Road, Barton Road, Cress Hill Meadow and Chapel Street. Chapel Street, Duck Lane, Boat Lane and Church Street see notable flow routes in the 1,000-year event.		✓	✓		Welford on Avon and Weston on Avon are partially located within the reservoir inundation extents of Warren Chase Water and Draycote Water reservoirs.	Fluvial events: 1968, 1998, 2016
Wellesbourne	The River Dene flows north-west through the centre of Wellesbourne, with higher ground to the north east and south west of the river. An unnamed watercourse flows parallel to the Dene on the northern edge of Wellesbourne also providing a fluvial flood risk to the B4087, Mountford Close, Hopkins Way, Whitehead Drive, Mordaunt Road, St Peter's Road and Lawrence Mackie Gardens. The River Dene poses a fluvial risk to properties on Lowes Lane, Chapel Street, Bridge Street, Church Walk and Willow Drive.	~590m of wall/embankment along the left bank of the River Dene from behind Chapel Street to behind Church Walk and ~81m of wall along the right bank behind Willow Drive	The 30-year surface water extent is mainly isolated pockets of flooding, affecting a small number of properties in the village. Notable areas of surface water flooding in the 30-year event are Wellesbourne Distribution Park, roads surrounding Walton Road and Copeland Avenue. A significant area south of the unnamed watercourse is also largely covered by surface water flood extents.				✓	Wellesbourne is partially located within the reservoir inundation extents of Walton Hall Lake, Upper Compton Verney, Lower Compton Verne and Draycote Water reservoirs.	Fluvial events: 1968, 1998, 2007, 2016

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7 Flood defences and assets

7.1 Flood defences and standard of protection

The residual risk of flooding in an extreme flood event or from failure of defences should be carefully considered. The condition of existing flood defences and whether they will continue to be maintained and/or improved in the future is a factor that needs to be considered as part of the risk-based sequential approach and, in light of this, whether proposed land allocations are appropriate and sustainable.

Developers should also consider the Standard of Protection (SoP) provided by defences and residual risk as part of a site-specific FRA. Site-specific FRAs will need to thoroughly explore the condition of defences, especially where these defences are informal and demonstrate a wide variation of condition grades. It is important that all of these assets are maintained to a good condition and their function remains unimpaired.

Standard of Protection

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

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

7.1.1 Defence Conditions

Formal structural defences are given a rating based on a grading system for their condition. A summary of the grading system used by the Environment Agency for condition is provided in Table 7-1.

The Environment Agency and Local Authorities have permissive powers to maintain and improve Main Rivers and Ordinary Watercourses, respectively. There is no legal duty to maintain watercourses, defences or assets and maintenance and improvements are prioritised based on flood risk. The ultimate responsibility for maintaining watercourses rests with the landowner.

Highways Authorities have a duty to maintain public roads, making sure they are safe, passable and the impacts of severe weather have been considered. Water Companies have a duty to effectually drainage their area. What this means in practice is that assets are maintained to common standards and improvements are prioritised for the parts of the network that do not meet this standard e.g. where there is frequent highways or sewer flooding.

There is potential for the risk of flooding to increase in areas where flood alleviation measures are not maintained regularly. Breaches in raised flood defences are most likely to occur where the condition of a flood defences has degraded over time. Drainage networks in urban areas can also frequently become blocked with debris and this can lead to blockages at culverts or bridges.

Developers should not assume that any defence, asset or watercourse is being or will continue to be maintained throughout the lifetime of a development. They should contact the relevant RMA about current and likely future maintenance

arrangements and ensure future users of the development are aware of their obligations to maintain watercourses.

The Environment Agency endeavour to ensure that as many flood defence assets as possible are at the required condition and keep a record of those assets which fall below the required condition. As of January 2019, within Stratford on Avon District the Environment Agency are aware that there are below required condition assets within Stratford upon Avon and Wootton Wawen. However, all planning applicants should contact the Environment Agency to check if there are any below required condition assets on or within close vicinity of the application of the site as the Environment Agency would like to discuss the potential requirement for works to be undertaken to repair, replace or remove any such asset as part of any proposed development.

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

Table 7-1 Defence asset condition rating

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

Source: Condition Assessment Manual – Environment Agency 2006

Table 7-2 Formal Flood Defences in Stratford on Avon District

Watercourse	Location	NGR	Type	Design SoP (year)	Approximate Length (m)	Condition rating	Comments
River Arrow	Alcester	408931, 257749	Wall/ embankment	100	382	Poor to good	Right bank, behind houses on School Road
River Arrow	Alcester	409126, 257245	Wall/ embankment	100	277	Fair to good	Right bank only, behind Gas House Lane and Stratford Road
River Arrow	Alcester	408836, 256831	Wall/ embankment	100	664	Fair to good	Right bank, adjacent to Bleachfield Street and Newport Drive
River Arrow	Broom	408721, 253451	Wall/ embankment	100	572	Very good	Left bank
River Itchen	Long Itchington	441095, 265107	Wall/ embankment	100	373	Fair to good	Right bank only, adjacent to Church Road passing Bascote Road
River Dene	Wellesbourne	427903, 255199	Wall/ embankment	100	591	Fair to good	Left bank
River Dene	Wellesbourne	427952, 255223	Wall	100	80.5	Very good	Right bank
River Alne	Wootton Wawen	415748, 263698	Embankment	50	1000	Poor to fair	Right bank
River Alne	Henley-in-Arden	415281, 266567	Wall/ embankment	100	138	Good	Right bank
River Avon	Barton	410824, 251269	Wall / embankment	100	810	Fair	Left bank
River Avon	Marcliff	409501, 250647	Wall	100	309	Good to very good	Left bank

Source: AIMS dataset, Environment Agency

7.2 Residual flood risk

The risk of rapid inundation following defence overtopping or breach is limited in Stratford on Avon District to areas of Alcester, Broom, Long Itchington, Wellesbourne, Wootton Wawen, Henley-in-Arden, Marcliff and rural areas protected by minor defences.

7.3 Flood alleviation schemes

More information on the current programme of Flood Alleviation Schemes can be found in Chapter 11.2.

7.4 LLFA Asset Register

Warwickshire County Council has compiled a Flood Risk Asset Register for the County under Section 21 of the FWMA (2010).

Figure 7-1 and Figure 7-2 show the assets listed on the Warwickshire County Council Asset Register located within Stratford on Avon District. Warwickshire County Council should be contacted for further information on these assets.

When culverts fail - Snitterfield case study

There are 35 properties at risk of flooding in Snitterfield. Flooding occurs from watercourses and surface water following heavy rainfall. The Bell Brook flows through the village and was culverted for the majority of its length beneath properties along The Green. Part of the 150-year old culvert collapsed in January 2015, causing property flooding, partial blocking of the Bell Brook and a large hole in a residential garden. The culvert had been heavily modified over time on an adhoc basis, leading to numerous sections being culverted to varying dimensions, construction methods and standards, most of which had deteriorated over time.

Following this, a new culvert was constructed along the field at the rear of the properties on The Green to cross open land. The existing culvert along the Green was also stabilised and additional gullies were installed to improve the drainage of surface water runoff from the road. The scheme was formally opened in July 2017.

A significant issue with the development of the scheme was that no single authority had sufficient funding to meet the expected cost of the proposed culvert diversion, which was nearly £3 million. A collaborative approach from the Environment Agency, Warwickshire County Council, Stratford District Council and the Local Parish Council was required to cover the cost of the proposed works and external funds for emergency works were secured from national Flood Defence Grant in Aid.

Figure 7-1 Map of LLFA Asset Register within Stratford on Avon District

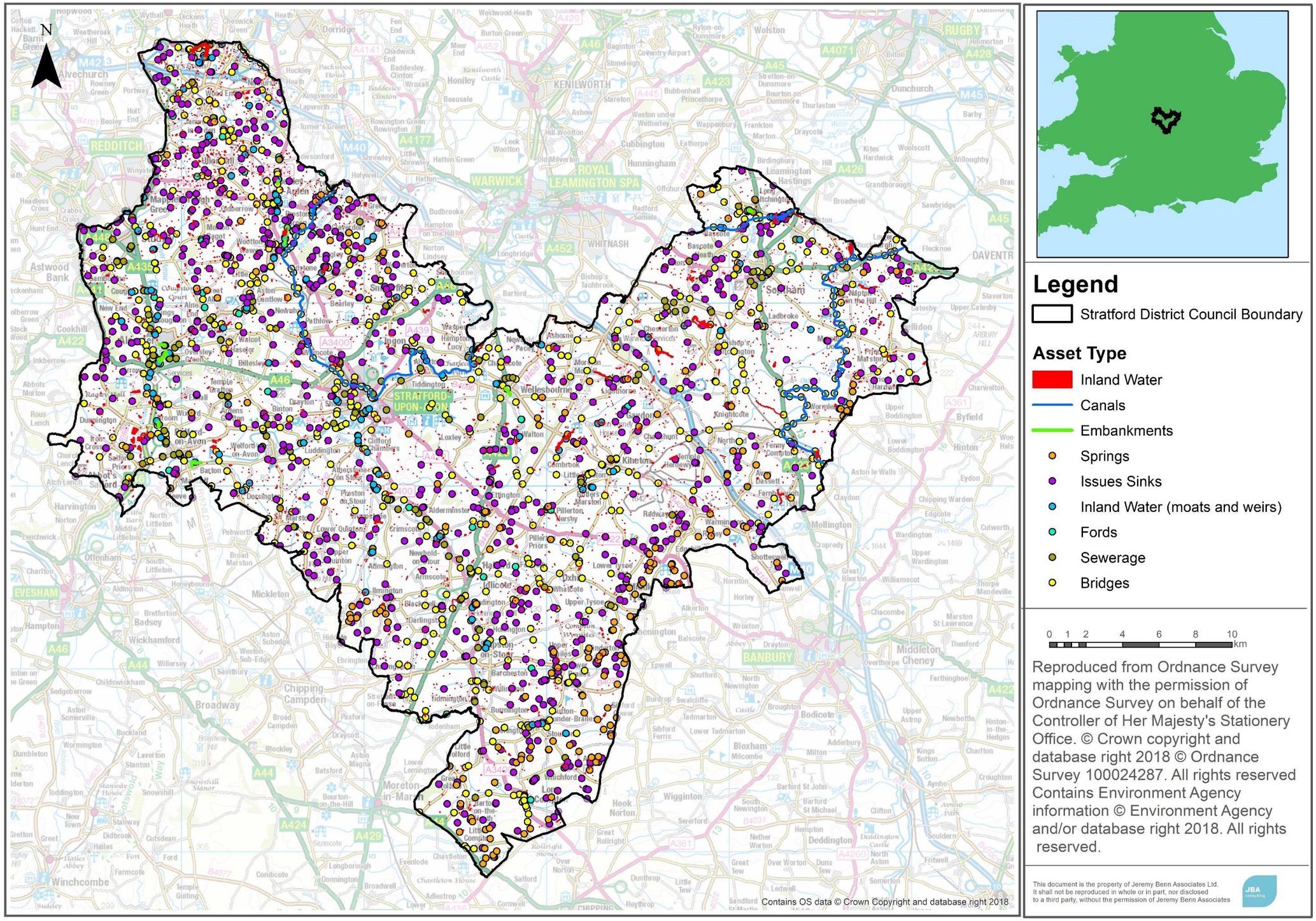
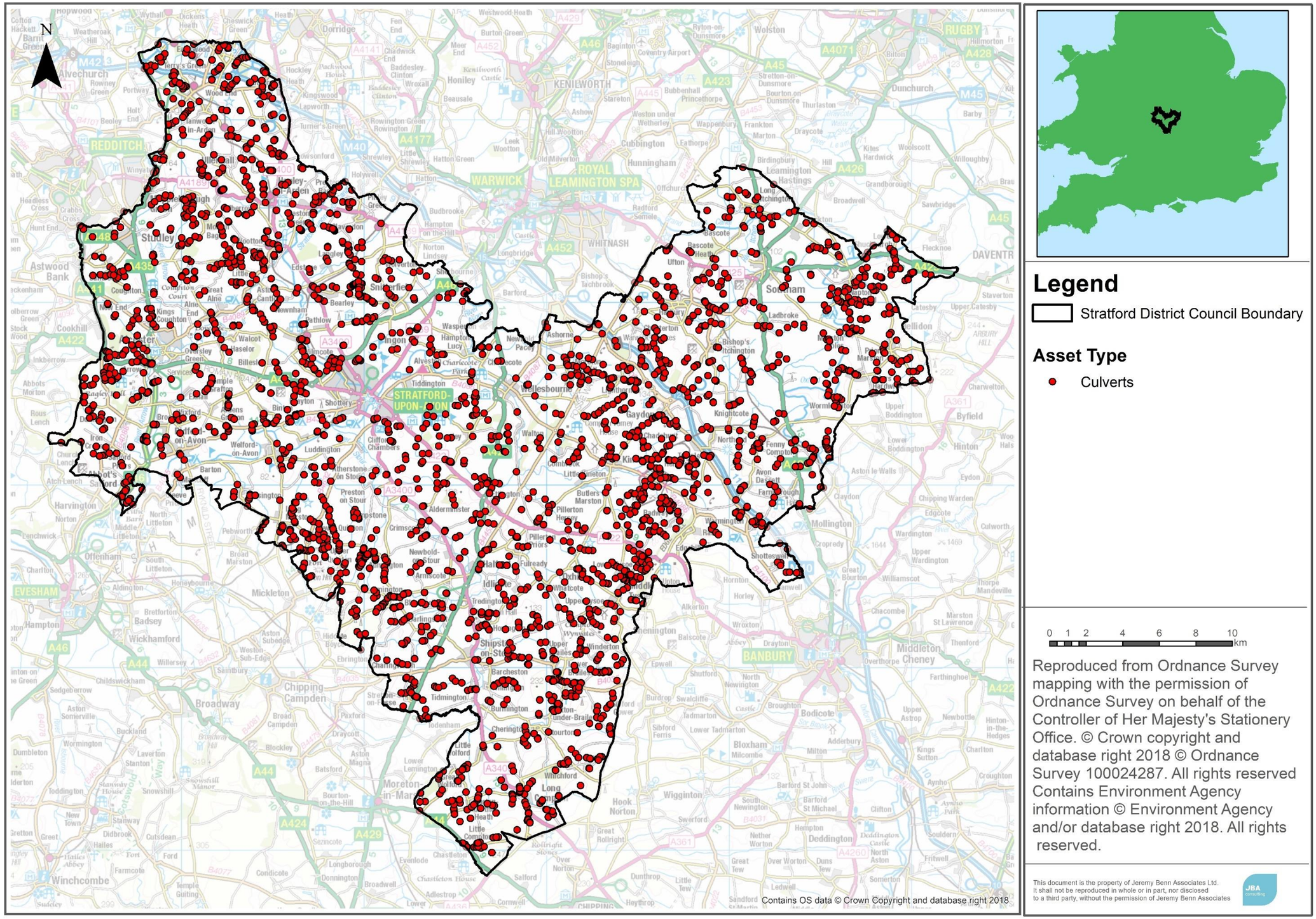


Figure 7-2 Map of LLFA Asset Register (culverts) within Stratford on Avon District



8 Cumulative impact of development and cross-boundary issues

8.1 Cumulative impact of development

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

To understand the impact of future development on flood risk in Stratford on Avon District, the potential change in developed area and the communities at risk from the 1 in 100-year surface water flooding event within each river catchment have been identified. This identifies the catchments where development may have the greatest impact on flood risk, and further assessment may be required within a Level 2 Strategic Flood Risk Assessment (SFRA) or site-specific Flood Risk Assessment (FRA).

The information will also be useful for the LLFA and other Risk Management Authoritiess, who may wish to use this information, alongside the high priority flood hotspot information in the Local FRM Strategy, to inform a long-term pipeline of flood alleviation studies.

Where catchments have been identified as sensitive to the cumulative impact of development, the assessment concludes with recommended strategic planning policy suggestions to manage the risk.

8.1.1 Method of assessing cumulative impact

To assess the cumulative impact within Stratford on Avon District, the surface water flood risk and number of historic flooding events in each catchment was assessed along with the potential change in developed area of each river catchment to identify the catchments at greatest risk. Figure 8-1 shows the methodology used and Table 8-1 summarises the datasets used within the Stratford on Avon District cumulative development scenario.

Figure 8-1 Overview of the method used within the Cumulative Impacts Assessment

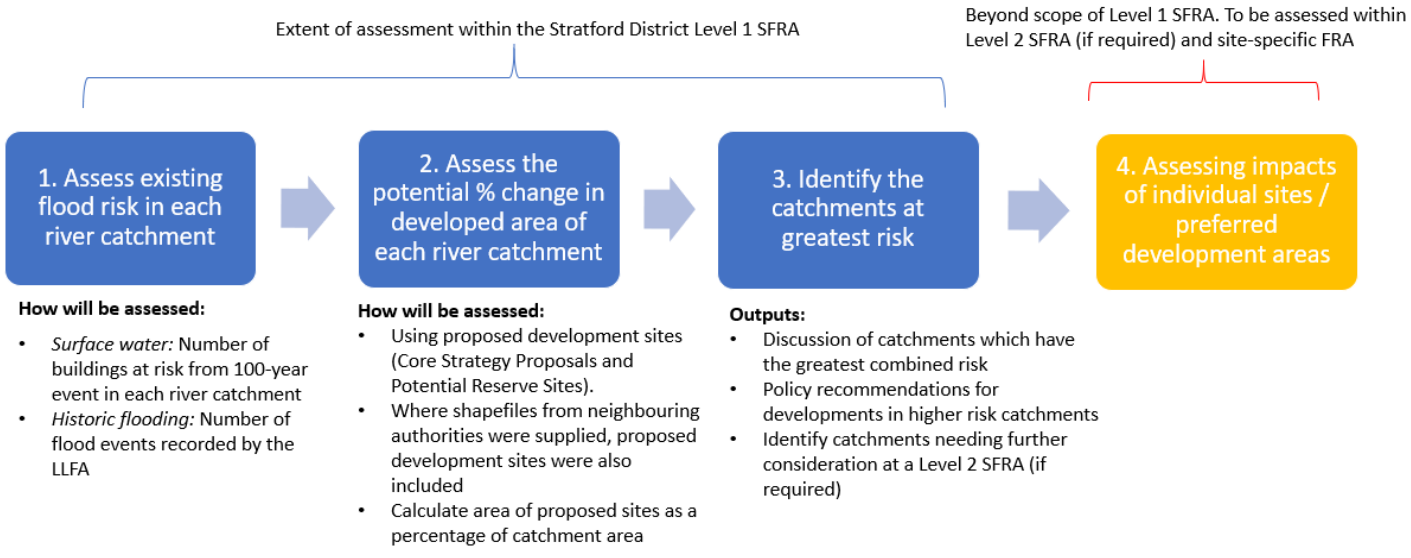


Table 8-1 Summary of datasets used within the Cumulative Impact Assessment

Dataset	Coverage	Source of data	Use of data
Catchment boundaries	Stratford on Avon District study area	Water Framework Directive (WFD) catchments	Defining catchment boundaries
Sub-catchment boundaries	Stratford on Avon District study area	FEH CD-ROM	Defining catchment boundaries
Stratford on Avon District current and potential development sites	Stratford on Avon District study area	Stratford on Avon District Council	Determining % area of catchment where development has been proposed
Neighbouring Local Plan developments	Neighbouring authorities	Neighbouring authorities	Determining % area of catchment where development has been proposed
Historic flooding incidents	Stratford on Avon District study area	Warwickshire County Council	Assessing the number of historic flooding records in each catchment
OS MasterMap	Stratford on Avon District study area	Ordnance Survey supplied by Stratford on Avon District Council	Location of buildings in the District for assessing those at risk from surface water flooding
Risk of flooding from surface water map (RoFSW) 100-year extent	Stratford on Avon District study area	Environment Agency	Assessing the number of properties within the 100-year surface water flooding extent

8.1.2 Assessing existing surface water flood risk

To understand the surface water flood risk in each catchment, the OS MasterMap data was used to locate building outlines within the District, these outlines were then taken intersected with the 100-year surface water flood extent to determine how many buildings were at risk from surface water flooding in each catchment.

8.1.3 Assessing historic flood risk

Historic flooding records provided by Warwickshire County Council were used to determine the number of flooding incidents within each catchment in Stratford on Avon District. The historic incidents data was provided as the number of flooding incidents per 500 x 500m grid square.

8.1.4 Assessing potential future development

Stratford on Avon District Council provided GIS data of sites currently under development, sites with planning permission and sites that could potentially be developed (all >5 dwellings). The latter relate to sites that have been identified in the Strategic Housing Land Availability Assessment (SHLAA) which is being produced to inform the identification of reserve housing sites in the Site Allocations Plan. This data was used to determine the area of potential development within each river catchment, as a percentage of the total area of the catchment. Where data regarding potential development in neighbouring authorities was available

from the relevant authorities, this was also used in calculating the potential percentage change.

8.1.5 Assessment assumptions and limitations

The study has been undertaken using the best available data. The assumptions made in assessing and ranking the impacts of cumulative development on catchments within Stratford on Avon District are summarised in Table 8-2.

Table 8-2 Assumptions and limitations of the assessment

Assessment aspect	Assumption made	Details of limitation in method	Justification of method used
Development scenarios	Inclusion of all sites currently under development, sites with planning permission and sites that could potentially be developed received from Stratford on Avon District Council from work being undertaken to produce the Site Allocations Plan .	The study assessed the potential impact of all sites received during the Local Plan process. The study assessed the impact of potential housing development sites identified through the District Council's emerging Strategic Housing Land Availability Assessment. It is possible that not all of the sites eventually identified in its Site Allocations Plan will need to be released for development. On that basis, it presents a 'worst case' assessment of the scale of development and is likely to overestimate the risk within each catchment.	Although the method was a very conservative estimate, it identified settlements and catchments with the greatest potential for growth.
	Assumption of housing density and impermeable areas	As potential development densities were not known for all of the sites, it was assumed that the entire area of the site would contribute surface water runoff to the wider catchment. In reality, landscaping and requirements for SuDS within sites lessen the impacts of new development.	The assessment considered the 'worst case' development scenario, if surface water runoff was not controlled from new developments. With housing densities and proportions of undeveloped areas not known, the approach was conservative.
	Inclusion of development sites from neighbouring authorities	Development from neighbouring authorities was only considered where GIS data was available and where neighbouring	GIS data provided the most accurate results for the % of a catchment that was covered by proposed development. Where GIS

		development had a significant impact on the % of proposed development within a catchment. For those authorities where GIS data is unavailable (South Northants Council, West Oxfordshire District Council and Wychavon District Council), new development in these areas may potentially contribute to downstream flood risk in Stratford on Avon District, however this is unlikely as the majority of watercourses in these neighbouring authorities drain away from the study area.	files from neighbouring authorities were not provided, neighbouring development could not be considered.
Surface water flood risk	Buildings	Assumption that all properties have been included in the in the OS MasterMap. It may not include all new build properties.	This was the most up to date and accurate data available updated in July 2018
Historic flood events	Location of flooding incidents	The number of flooding incidents was provided on 500 x 500m grid squares. This meant that in some places one historic flooding incident square would fall into multiple catchments. As the exact locations of the flooding events were unknown, the total number of flooding incidents per grid square was used in the sum for each individual catchment, regardless of the number of catchments the square covered. This may lead to an overestimate of historic food risk.	It was considered most conservative to take the number of flooding incidents per grid square and add that to the sum for each individual catchment, regardless of the number of catchments the square covered. For example, if one 500 x 500m square denoting 4 historic flooding incidents covered 3 separate catchments, 4 historic incidents would be added to the total number of historic events for each of the catchments the square covered.

The assessment was initially conducted on the WFD River Catchments as described above; however, some of the catchments seen as 'high risk' were large catchments along the River Avon where any site development would be unlikely to have a significant effect on such a large river. Following the initial assessment, two of the high-risk catchments (River Avon – Stratford upon Avon to Evesham and River Avon – Warwick to Stratford upon Avon) were split into smaller sub-catchments using the FEH CD-ROM to produce more locally specific results for the cumulative impact of development.

Catchments were ranked based on the three factors: historic flood risk, surface water flood risk and proposed development. The Top 10 ranked catchments for each of these assessments are shown in Table 8-3, Table 8-4 and Table 8-5. These rankings were then combined to provide an overall ranking of the Top 10 at risk catchments in the District as shown in Table 8-6. Catchments where greater than 15% of the catchment area is proposed for development are also considered to be high risk and has been included in this table. An overview of the highest ranked catchments in Stratford on Avon District by policy recommendations is shown in Figure 8-2 and Figure 8-3. Detailed maps of each high-risk catchment are shown in Appendix B.

Table 8-3 Top 10 ranked catchments for proposed development

Catchment	% of catchment covered by proposed development
Rush Brook – draining towards Stratford upon Avon*	19.2
Marchfont Brook, including Lower and Upper Quinton	12.1
Tach Brook, draining towards Warwick	10.9 (includes development from Warwick District)
Racecourse Brook, draining towards Stratford upon Avon*	8.4
Shottery Brook, draining towards Stratford upon Avon*	7.5
Thelsford Brook, including Lighthorne, draining towards Hampton Lucy	6.2
Small Brook, Bidford on Avon*	6.0
River Blythe, draining towards Solihull	4.4 (includes development from Solihull District)
Radford Brook, draining towards Leamington	3.4 (includes development from Warwick District)
Salford Priors	3.2

*Catchment is sub-catchment originally part of larger WFD catchment

Table 8-4 Top 10 ranked catchments for historic flood events

Catchment	Number of historic flooding events
River Stour, draining towards Shipston on Stour and Tredington	33
River Arrow, south of Alcester, draining towards Salford Priors	28
River Itchen, draining towards Southam	27
River Alne, draining towards Alcester	24
River Dene, draining towards Butlers Marston	21
River Stowe, draining towards Southam	20
Wagtail Brook, including Upper, Middle and Lower Tysoe and Oxhill	20
River Stour, including Upper and Lower Brailes	19
River Dene, draining towards Wellesbourne	17
River Stour draining towards Clifford Chambers	17

Table 8-5 Top 10 ranked catchments for surface water flood risk

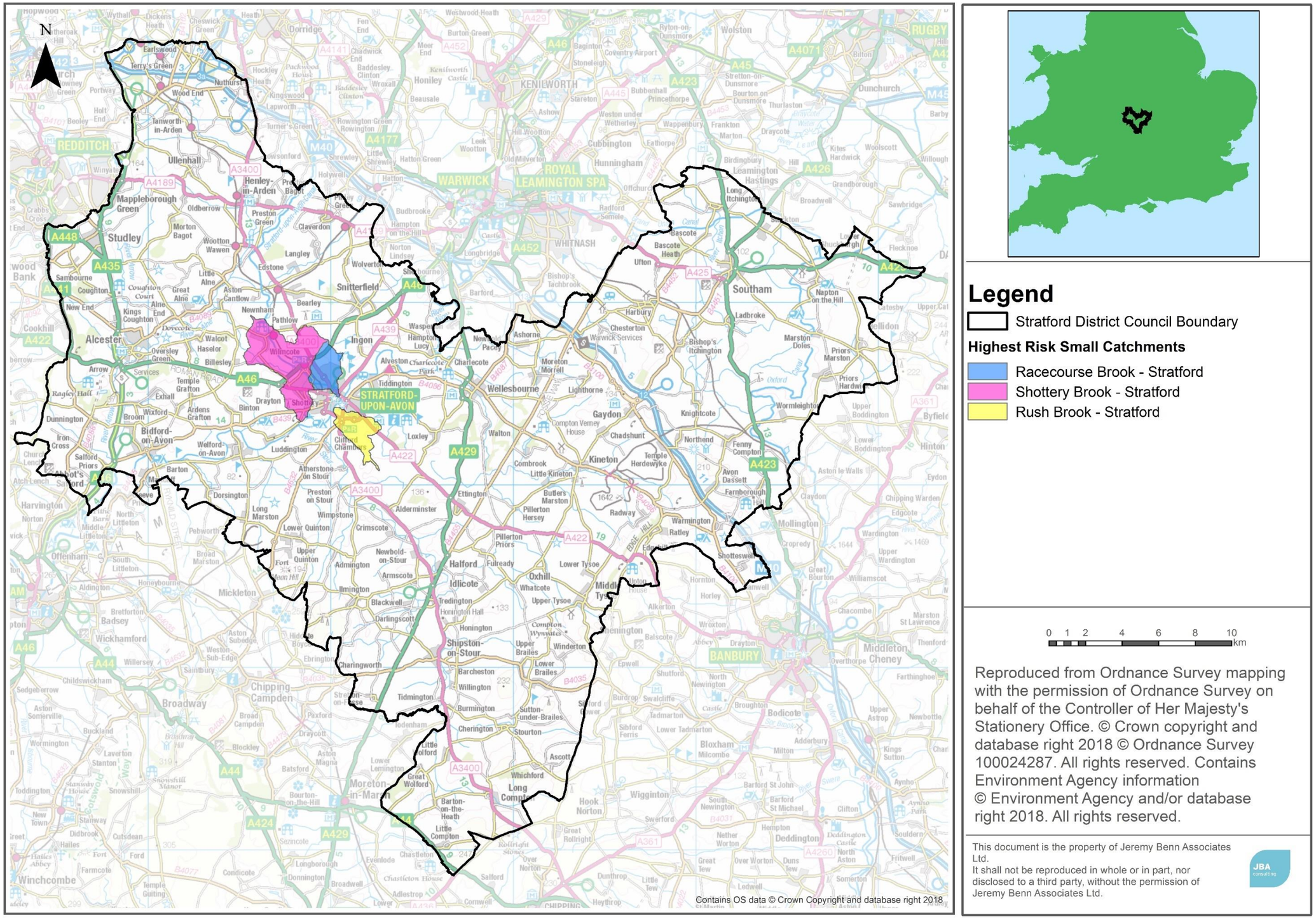
Catchment	Number of properties located in the 100-year surface water flood extent
Racecourse Brook, draining towards Stratford upon Avon*	639
River Stour, draining towards Shipston on Stour and Tredington	586
River Dene, draining towards Butlers Marston	479
River Alne, draining towards Henley in Arden	476
River Itchen, draining towards Southam	455
River Dene, draining towards Wellesbourne	436
Marchfont Brook, including Lower and Upper Quinton	357
River Stour, draining towards Clifford Chambers	349
Shottery Brook, draining towards Stratford upon Avon*	292
River Itchen, Southam and Long Itchington	287

Table 8-6 Overall ranked high-risk catchments

Catchment	Final ranking
Marchfont Brook, including Lower and Upper Quinton	1
Racecourse Brook, draining towards Stratford upon Avon	2
River Stour, draining towards Shipston on Stour and Tredington	=3
River Itchen, draining towards Southam	=3
Shottery Brook, draining towards Stratford upon Avon	5
River Stowe, draining towards Southam	6
River Dene, draining towards Butlers Marston	7
River Itchen, Southam and Long Itchington	8
River Arrow, draining towards Alcester	9
River Dene, draining towards Wellesbourne	10
Rush Brook, draining towards Stratford upon Avon**	20

**Catchment considered to be high risk as >15% of the catchment area is covered by proposed development.

Figure 8-2 Map of highest risk catchments in Stratford on Avon District – Small catchments draining into settlements with known flood risk issues



Legend

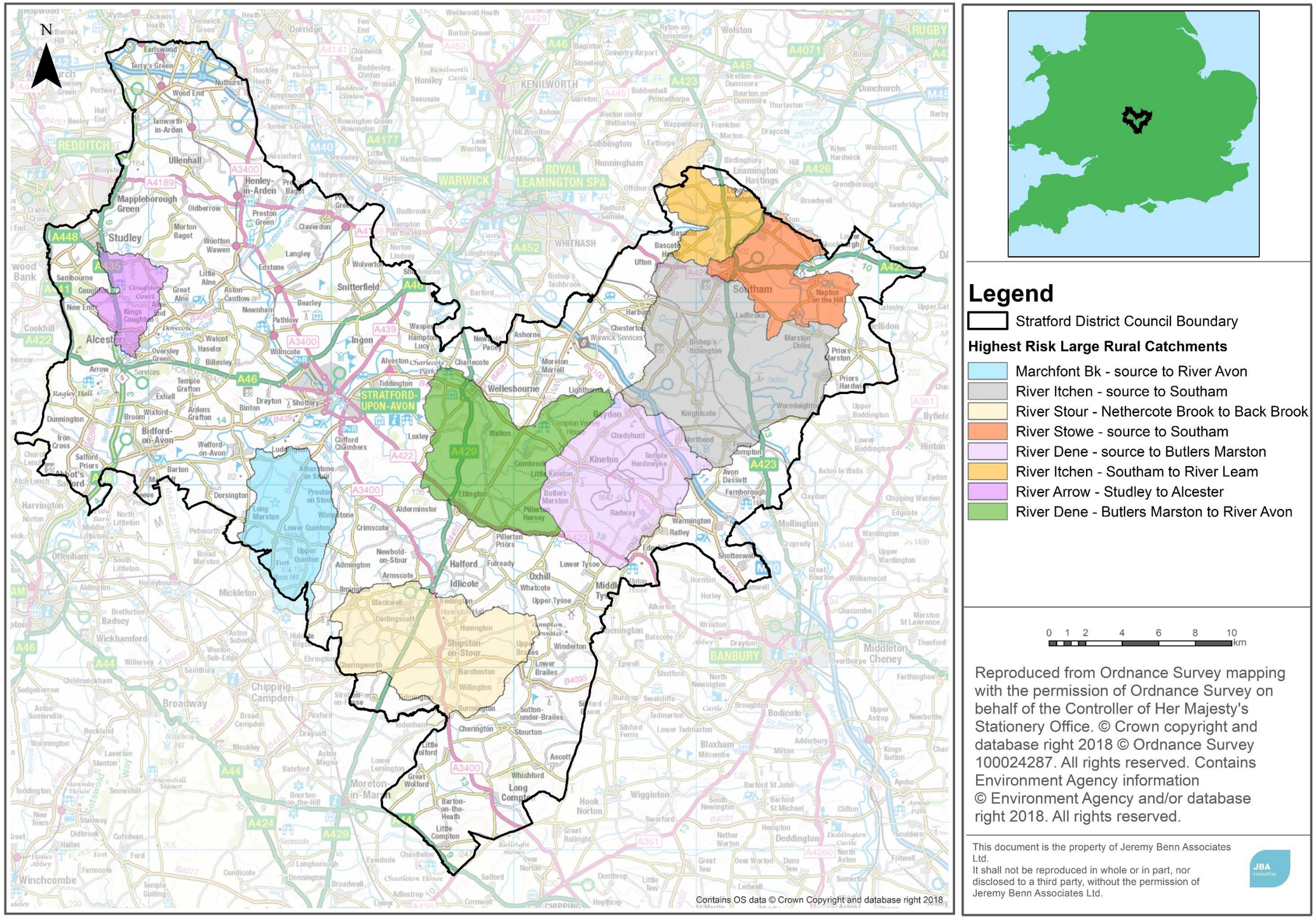
Stratford District Council Boundary

Highest Risk Small Catchments

- Racecourse Brook - Stratford
- Shottery Brook - Stratford
- Rush Brook - Stratford

0 1 2 4 6 8 10 km

Figure 8-3 Map of highest risk catchments in Stratford on Avon District – larger rural catchments with some localised flood risk issues



Legend

Stratford District Council Boundary

Highest Risk Large Rural Catchments

- Marchfont Bk - source to River Avon
- River Itchen - source to Southam
- River Stour - Nethercote Brook to Back Brook
- River Stowe - source to Southam
- River Dene - source to Butlers Marston
- River Itchen - Southam to River Leam
- River Arrow - Studley to Alcester
- River Dene - Butlers Marston to River Avon

0 1 2 4 6 8 10 km

8.1.7 Planning Policy Considerations for Catchments

The following Planning Policy recommendations have been made for the catchments where cumulative development is likely to have the greatest impact on flood risk.

8.1.8 Small catchments draining into settlements with known flood risk issues

- Catchments of the Rush Brook, Shottery Brook and Racecourse Brook draining towards Stratford upon Avon.

In these areas the recommended policy is to:

- Undertake more detailed drainage strategy work as part of a Level 2 SFRA[4] or detailed local area Strategic Drainage Study to consider further how the cumulative effects of potential peak rates and volumes of water from development sites would impact on peak flows, duration of flooding and timing of flood peaks on receiving watercourses. Such studies could be used to justify greater restrictions/enforcement through Local Planning Policy development site runoff rates and volumes specific to each catchment that are over and above those required by National and Local SuDS Standards. They could also identify where there are opportunities with allocated sites to provide off-site betterment e.g. online/offline flood storage, and where land should be safeguarded within proposed site allocations to fulfil this purpose. *
- Incorporate SuDS and provide details of adoption, ongoing maintenance and management on all development sites. Proposals will be required to provide reasoned justification for not using SuDS techniques, where ground conditions and other key factors show them to be technically feasible. Preference will be given to systems that contribute to the conservation and enhancement of biodiversity and green infrastructure in the District where practicable.
- Seek to provide wider betterment by demonstrating in site-specific Flood Risk Assessments and Surface Water Drainage Strategies what measures can be put in place to contribute to a reduction in flood risk downstream. This may either be by provision of additional storage on site e.g. through oversized SuDS, natural flood management techniques, green infrastructure and green-blue corridors and/or by providing a Partnership Funding contribution towards any flood alleviation schemes. Consultation on the site-specific requirements should be undertaken with Stratford on Avon District Council and the Environment Agency at the earliest opportunity.

It is also recommended that the Environment Agency, in consultation with Stratford on Avon District Council, should consider whether to formally designate these catchments as Critical Drainage areas. This would mean that a detailed Flood Risk Assessment would be required for all developments that are proposed, regardless of their size.

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

[4] A Level 2 SFRA will be required should sites require the Exception Test. A Level 2 SFRA could also contain more detailed local area Strategic Drainage Strategy work.

* This recommendation is more applicable to smaller catchments, because the proportion of new development to catchment area is likely to be greater and therefore the potential impact of development on flood risk greater. More detailed drainage strategy planning would entail building a small hydrological model of the catchment to provide a more specific information on the likely impact of those new developments. Doing this to cover a small catchment is more affordable and would yield more meaningful results than modelling much larger catchments, where in proportion to overall catchment size, new development would not have as much of an effect on flood risk elsewhere in those larger catchments.

8.1.9 Larger rural catchments with some localised flood risk issues

- Catchment of the River Arrow draining towards Alcester
- Catchment of the River Dene draining towards Butlers Marston and Wellesbourne
- Catchments of the River Stowe and River Itchen draining towards Southam and Long Itchington
- Catchment of the River Stour draining towards Shipston on Stour and Tredington
- Marchfont Brook, including Lower and Upper Quinton

In these areas the recommended policy is:

- To incorporate SuDS and provide details of adoption, ongoing maintenance and management on all development sites. Proposals will be required to provide reasoned justification for not using SuDS techniques, where ground conditions and other key factors show them to be technically feasible. Preference will be given to systems that contribute to the conservation and enhancement of biodiversity and green infrastructure in the District where practicable.
- To seek to provide wider betterment by demonstrating in site-specific Flood Risk Assessments and Surface Water Drainage Strategies what measures can be put in place to contribute to a reduction in flood risk downstream. This may either be by provision of additional storage on site e.g. through oversized SuDS, natural flood management techniques, green infrastructure and green-blue corridors and/or by providing a Partnership Funding contribution towards any flood alleviation schemes. Consultation on the site-specific requirements should be undertaken with Stratford on Avon District Council and the Environment Agency at the earliest opportunity.
- For the LPA to work closely with the Environment Agency and Warwickshire County Council as LLFA to identify areas of land that should be safeguarded for the future use of natural flood management features.

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

8.2 Cross-boundary issues

Future large-scale development, both within and outside Stratford on Avon District, can have the potential to affect the flood risk to existing development and surrounding areas. Stratford on Avon District has boundaries with the following local authorities:

- Bromsgrove District Council
- Wychavon District Council
- West Oxfordshire District Council
- Warwick District Council
- Rugby Borough Council
- South Northants District Council
- Solihull Metropolitan Borough Council
- Daventry District Council
- Cotswold District Council
- Redditch Borough Council
- Cherwell District Council

Eight of the neighbouring authorities (Bromsgrove District Council, Warwick District Council, Rugby Borough Council, Solihull Metropolitan Borough Council, Daventry District Council, Cotswold District Council, Redditch Borough Council and Cherwell District Council) supplied information on their Strategic Site Allocations within their Local Plans, which have been included in the cumulative impact assessment in section 8.1. In the vast majority of cases, if appropriate drainage and SuDS are adopted, development in these neighbouring authorities is unlikely to affect flood risk in Stratford on Avon District. The neighbouring authorities respective Local Plans are being updated alongside the evidence base (i.e. SFRAs, Sustainability Appraisals etc.) and therefore, their flood risk and drainage policies are not yet formalised. However, it is very likely that to ensure compliance with the NPPF, appropriate sustainable drainage and flood risk policies will be proposed. It is recommended that Stratford on Avon District Council consults neighbouring authorities, particularly during the consultation phases of their respective Local Plans, to identify and review potential cross-boundary issues.

8.3 Water quality considerations

In addition to cross-boundary issues regarding flood risk, there are also cross-boundary issues relating to water quality. Development or changes to land management practices in the upper catchments of watercourses that flow across boundaries into Stratford on Avon District can potentially impact on the quality of watercourses within the study area. Development should consider the quality of the water that is released from sites and the impact it may have on the water quality on any receiving waterbodies. Future development should ensure there is no adverse impact on the quality of watercourses within the District administrative area. Any impacts identified should then be considered in relation to the WFD Ecological, Hydromorphological and Chemical Status of the waterbody and the status objectives. Opportunities to improve the status of watercourses should also be considered. This is particularly important for Stratford on Avon District as there are several watercourses within the area which have not achieved a good status, primarily due to diffuse pollution and phosphate levels mainly from agriculture and rural land management, the water industry and transport and urban activities.

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9 Flood Risk Assessment requirements and guidance for developers

9.1 Over-arching principles

This SFRA focuses on delivering a strategic assessment of flood risk within Stratford on Avon District. Prior to any construction or development, site-specific assessments will need to be undertaken so all forms of flood risk at a site are fully addressed. It should be acknowledged that a detailed Flood Risk Assessment (FRA) may show that a site is not appropriate for development of a particular vulnerability or even at all. Where the FRA shows that a site is not appropriate for a particular usage, a lower vulnerability classification may be appropriate.

9.1.1 Planning consultees

There are a number of statutory consultees for planning matters; key stakeholders are listed below (note, this list is not exhaustive):

- Stratford on Avon District Council decides all planning matters, including those related to flood risk, in their decision whether or not to grant planning permission.
- Warwickshire County Council are a statutory consultee on surface water drainage proposals for all major development. As the Lead Local Flood Authority, they provide technical advice on surface water drainage strategies and designs put forward for 'major' developments.
- The Environment Agency is a statutory consultee for applications in Flood Zones 2 and 3 and any development within 20m of a Main River.

9.2 Requirements for site-specific Flood Risk Assessments

9.2.1 What are site-specific FRAs?

Site-specific FRAs are carried out by (or on behalf of) developers to assess all sources of flood risk to and from a site. They are submitted with planning applications and should demonstrate how flood risk will be managed over the development's lifetime, taking into account climate change and vulnerability of users.

9.2.2 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 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.

A FRA may also be required for some specific situations:

- If the site may be at risk from the breach of a local defence (even if the site is actually in Flood Zone 1)
- Where the site is intended to discharge to the catchment or assets of a water management authority which requires a site-specific FRA

- Where the site's drainage system may have an impact on an IDB's system
- Where evidence of historical or recent flood events have been passed to the LPA
- In an area of significant surface water flood risk.

9.2.3 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 and Stratford on Avon District 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);
- **Warwickshire Council flood risk advice to developers;** and
- **Site-specific Flood Risk Assessment: CHECKLIST** (NPPF PPG, Defra)

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

9.3 Flood risk management guidance - Mitigation measures

Mitigation measures should be seen as a last resort to address flood risk issues. Consideration should first be given to minimising risk by planning sequentially across a site. Once risk has been minimised as far as possible, only then should mitigation measures be considered.

9.3.1 Site layout and design

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

The NPPF states that a sequential, risk-based approach should be applied to try to locate more vulnerable land use away from flood zones, to higher ground, while more flood-compatible development (e.g. recreational space) can be located in higher risk areas. The Sequential approach is followed to steer development into areas with the lowest probability of flooding and any assessment should take into account the flood risk vulnerability of land uses.

Waterside areas, or areas along known flow routes, can act as Green Infrastructure, being used for recreation, amenity and environmental purposes, allowing the

preservation of flow routes and flood storage, and at the same time providing valuable social and environmental benefits contributing to other sustainability objectives. Landscaping should ensure safe access to higher ground from these areas and avoid the creation of isolated islands as water levels rise.

Making space for water

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

The provision of a buffer strip can 'make space for water', allow additional capacity to accommodate climate change and ensure access to the watercourse, structures and defences is maintained for future maintenance purposes. It also enables the avoidance of disturbing riverbanks, adversely impacting ecology and having to construct engineered riverbank protection. Building adjacent to riverbanks can also cause problems to the structural integrity of the riverbanks and the building itself, making future maintenance of the river much more difficult. An 8m easement must be provided from the top of bank of any Main River. This also applies to culverted watercourses.

9.3.2 Raised floor levels

The raising of floor levels within a development avoids damage occurring to the interior, furnishings and electrics in times of flood.

If raised floor levels are proposed, these should be agreed with Stratford on Avon District Council and the Environment Agency. Warwickshire County Council as LLFA recommends that all developments where possible should set finished floor levels to a minimum of 150mm above surrounding ground levels, in order to mitigate the risk of any overland or exceedance flows from drainage systems from inundating properties. Where this is not possible, such as level thresholds being required for disabled access, this should be evidenced by developers to Stratford on Avon District Council where appropriate.

The Environment Agency usually require finished floor levels to be raised to a minimum of 600mm above the maximum water level caused by a 1 in 100-year fluvial flood event including an appropriate allowance for climate change. The additional height that the floor level is raised above the maximum water level is referred to as the "freeboard". Additional freeboard may be required because of risks relating to blockages to the channel, culvert or bridge and should be considered as part of an FRA.

The minimum Finished Floor Level (FFL) may change depended on the vulnerability and flood risk of the development, hence this should be agreed with the LPA and EA.

Reference to the latest climate change guidance will be made when considering the FFL. Many areas currently situated within Flood Zone 2 may become part of Flood Zone 3a in the future because of climate change, therefore it is essential that the potential risk of flooding in the future is considered when planning development.

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

Single storey buildings such as ground floor flats or bungalows are especially vulnerable to rapid rise of water (such as that experienced during a breach). This risk can be reduced by use of multiple storey construction and raised areas that provide an escape route. However, access and egress would still be an issue, particularly when flood duration covers many days. All sleeping accommodation in Flood Zone 2 and 3a must be located above the recommended flood level. No sleeping accommodation should be located in Flood Zone 3b, as is in line with the **NPPF Table 3** vulnerability classifications, which states that no more or less vulnerable infrastructure should be permitted in Flood Zone 3b.

Similarly, the use of basements should be avoided. Habitable uses of basements within Flood Zone 3 should not be permitted, whilst basement dwellings in Flood Zone 2 will be required to pass the Exception Test.

9.3.3 Access and egress

Safe access and egress will need to be demonstrated at all development sites. For residential developments, a minimum dry pedestrian access should be provided to and from the development without crossing through the 1 in 100-year plus climate change floodplain. Vehicular access to the site should be achievable, taking into account extreme events.

If dry access and egress cannot be achieved, the Defra/EA Technical Report: **FD2320: Flood Risk Assessment Guidance for New Development** should be referred to, to determine the hazard to people posed along the access route. This can also be used to inform a Flood Warning and Evacuation Plan for the site.

Emergency vehicular access should be possible during times of flood.

9.3.4 Modification of ground levels

Modifying ground levels to raise the land above the required flood level is an effective way of reducing flood risk to a particular site in circumstances where the land does not act as conveyance for flood waters. However, care must be taken at locations where raising ground levels could adversely affect existing communities and property. In most areas of fluvial flood risk, raising land above the floodplain would reduce conveyance or flood storage in the floodplain and could adversely impact flood risk downstream or on neighbouring land.

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

For compensatory flood storage to be effective and not require hydraulic modelling, it must be provided on a level for level, volume for volume basis on land which does not already flood and is within the site boundary. Where land is not within the site boundary, it must be in the immediate vicinity, in the applicant's ownership/control and linked to the site. Floodplain compensation should be considered in the context of the 1% annual probability (1 in 100 year) flood level including an allowance for climate change. When designing a scheme flood water must be able to flow in and out unaided. An FRA should demonstrate that there is no loss of flood storage capacity and include details of an appropriate maintenance regime to ensure mitigation continues to function for the life of the development. Guidance on how to address floodplain compensation is provided in Appendix A3 of the CIRIA Publication C624.

Raising levels can also create areas where surface water might pond during significant rainfall events. Any proposals to raise ground levels should be tested to ensure that it would not cause increased ponding or build-up of surface runoff on third party land. Cut-off and embankment drainage should be provided in any location where land raising causes embankments to be created for any development plateau.

9.3.5 Development and raised defences

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

Temporary or demountable defences are not considered acceptable for new developments. Any new development must ensure that flood risk is managed and mitigated as part of the development and will not increase flood risk elsewhere.

Where development is located behind, or in an area benefitting from, defences, consideration should be given to the potential safety of the development, finished floor levels and the potential for safe access and egress in the event of rapid inundation of water due to a defence breach with little warning.

9.3.6 Developer contributions

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

Developers cannot contribute towards schemes which will enable development on land which they otherwise could not develop on. Any new development must ensure that flood risk is managed and mitigated as part of the development and will not increase flood risk elsewhere. The Environment Agency recommend early conversations between themselves and developers in close proximity to potential future schemes to work together. Contributions may be required from developers where the development is located near to future schemes to ensure flood risk is not increased.

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

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

Information on current and future flood alleviation schemes can be obtained from the Environment Agency and Warwickshire County Council as LLFA.

9.4 Flood risk management guidance - Resistance measures

There may be instances where flood risk to a development remains despite implementation of such planning measures as those outlined above. For example,

where the use is water compatible, where an existing building is being changed, where residual risk remains behind defences, or where floor levels have been raised but there is still a risk at the 1 in 1,000-year scenario. In these cases, (and for existing development in the floodplain), additional measures can be put in place to reduce damage in a flood and increase the speed of recovery.

These measures should not normally be relied on for new development as a mitigation method. Most of the measures should be regarded as reducing the rate at which flood water can enter a property during an event and considered an improvement on what could be achieved with sand bags. They are often deployed with small-scale pumping equipment to control the flood water that does seep through these systems. The effectiveness of these forms of measures are often dependant on the availability of a reliable forecasting and warning system. The following measures are often deployed:

Permanent barriers

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

Temporary barriers

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

Community resistance measures

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

Non-return valves

Non-return valves can be installed to prevent waste water from being forced up appliances e.g. lavatories, washing machines, sinks etc.

9.5 Flood risk management guidance - Resilience measures

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

- electrical circuitry installed at a higher level with power cables being carried down from the ceiling rather than up from the floor level;
- water-resistant materials for floors, walls and fixtures.

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

9.6 Reducing flood risk from other sources

9.6.1 Groundwater

Groundwater flooding has a very different flood mechanism to any other and for this reason many conventional flood defence and mitigation methods are not suitable. The only way to fully reduce flood risk would be through building design

(development form), ensuring floor levels are raised above the water levels caused by a 1 in 100-year plus climate change event. Site design would also need to preserve any flow routes followed by the groundwater overland to ensure flood risk is not increased downstream.

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

All new sites should undertake ground investigation as early in the planning process as possible to inform the design in relation to groundwater and SuDS design.

9.6.2 Surface water and sewer flooding

Developers should discuss public sewerage capacity with the water utility company at the earliest possible stage. The development must improve the on-site drainage infrastructure to reduce flood risk on the site and the wider area. It is important that a drainage impact assessment shows that this will not increase flood risk elsewhere, and that the drainage requirements regarding runoff rates and SuDS for new development are met.

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

Developers should refer to **Warwickshire County Council's Standing Advice on Flood Risk and Drainage** for guidance on how to design new developments to take surface water flood risk into account.

9.6.3 Sustainable Drainage Systems

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

Developers should refer to **Warwickshire County Council's Standing Advice on Flood Risk and Drainage** for guidance on how to design SuDS systems for new developments to meet Local SuDS standards.

9.7 Key considerations for developers

Stratford on Avon District Council, Warwickshire County Council, the Environment Agency and Severn Trent Water have highlighted common challenges that can arise for site-specific developments. Table 9-1 sets these out and outlines how developers should address these issues:

Table 9-1 Key considerations for developers

Common challenge	Consideration for developers
Sites in Flood Zone 1 are at risk of flooding from other sources	Developers should use the information in the SFRA, the national surface water mapping and WCC SWMP to identify if sites are subject to other sources of flooding. If Ordinary Watercourses run through, or along the boundary of a site, these will require modelling and an independent review (if requested) to be submitted to the LLFA to demonstrate the level of flood risk present.
Overland flow paths and SuDS features are not considered at an early enough stage of design. This leads to a lack of space for well-designed features and large amounts of open space being taken up by SuDS areas in developments, affecting the amount of genuine open space being secured.	Flow paths and SuDS should be considered at pre-application stage. SuDS should be incorporated into the landscaping as an integral part of a masterplan for the development site. A holistic approach to working with water should be taken to gain multiple benefits rather than "hiding" it below ground to save space. WCC as LLFA do not consider below ground tanks or oversized pipes in isolation as SuDS.
Large amounts of open space are being taken up by SuDS in developments. They are nearly always dry-balancing ponds which still end up being fenced off as a result of safety assessments. This is having impacts on the amount of publicly accessible open space being provided on developments.	Flow paths and SuDS should be considered at pre-application stage and designed with best practices in mind. SuDS should be incorporated into the landscaping as an integral part of a masterplan for the development site.
The SuDS management train is often not used effectively, and large, single features are proposed instead of dealing with flows at the source using multiple features to maximise surface water treatment.	The C753 CIRIA SuDS manual should be used to incorporate all stages of the SuDS management train and design features in line with best practice.
Planning applications are submitted without an adequate level of detail on flood risk and drainage e.g. FRA or Drainage Strategy, a viable outfall, site run-off calculations, suitably detailed drawings, exceedance routes, section drawings, maintenance information and infiltration testing.	Developers should ensure that these are provided as appropriate. Depending on the type of application and stage of development, the LLFA and LPA will need satisfactory information that a site can be drained and will not be at unacceptable risk of flooding or increase flood risk elsewhere. It will not always be acceptable to condition this information being provided at a later stage. For example, to prove a drainage system is workable, ground investigations will be needed at outline stage where infiltration methods are proposed. The **WCC Standing Advice** provides further guidance.
Proposed downstream outfalls are in poor condition.	All proposed outfalls should be fully investigated to ensure connectivity with a downstream waterbody and ensure that they are in a sufficient condition to convey flows.
Culverts on site or taking flows from the site are in poor condition.	Re-naturalisation and de-culverting of watercourses that flow through redevelopment

	schemes should be considered at pre-application stage. The requirement and cost of such work should be reflected in the price of acquiring land to ensure that such works are financially viable.
New development can have a significant impact on the ability for STW/Thames Water/Anglian Water to maintain assets and continue to provide their services where there are intersections between water mains and sewers.	Where existing infrastructure is protected by easements, they should not be built over or located in private gardens where access is restricted and existing sewer/water mains should be located in highways or public open space. Early consultation with Severn Trent/Thames Water/Anglian Water by planners and developers will ensure that intersections between water mains and sewers are accounted for, minimising delays and associated abortive costs.
The drainage discharge hierarchy for disposing of surface water discharge is not being followed.	The developer should provide evidence that they have considered discharging water in order of preference to: Groundwater via infiltration Watercourse (including an offsite watercourse) Surface water sewer Combined sewer
Development is proposed that encroaches on the watercourse banks.	Developer to ensure that the following easements are used to ensure there is access for maintenance: Main River 8m Ordinary Watercourse 6m (minimum, see **WCC Standing Advice** for further guidance)
Sewers on new developments do not always meet the required standards.	If developers are looking for STW/Thames Water/Anglian Water to adopt responsibility for a new sewer it will need to be approved in advance of it being built and adopted post an inspection to ensure that it meets standards. Any new sewers and pumping stations should be constructed in accordance with the Sewers for Adoption standards by following the process and application forms for **Severn Trent Water**, **Thames Water**, **Anglian Water** as appropriate.
During the construction of sites, runoff is not being adequately managed, causing local surface water and siltation issues.	Measures should be put in place to prevent siltation washing into watercourses/culverts/sewers/gullies during construction, caused by increased run-off after top-soil strip. On completion of construction works, wet features are to be desilted and if applicable culverts/sewers are to be CCTV surveyed.

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10 Surface water management and SuDS

10.1 What is meant by Surface Water Flooding?

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

Surface water flooding includes:

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

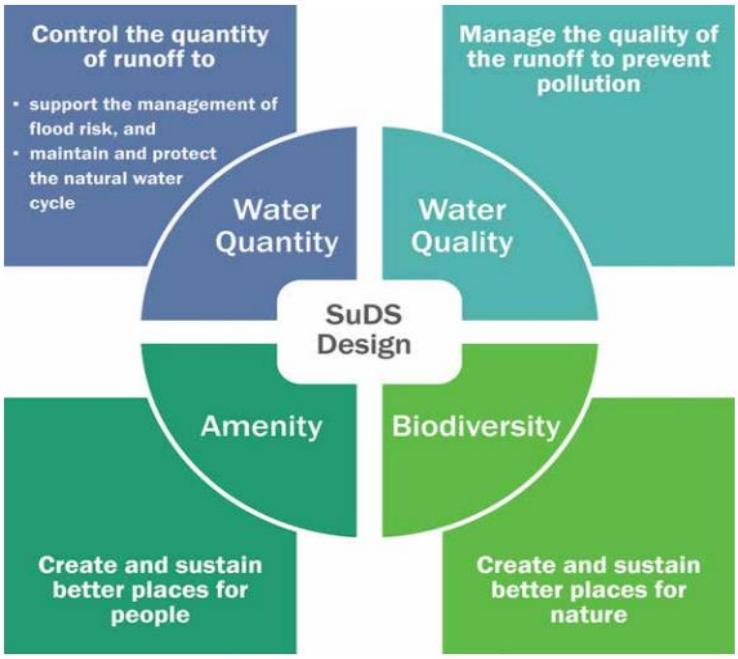
10.2 Role of the LLFA and Local Planning Authority in surface water management

In April 2015 Warwickshire County Council was made a statutory consultee on the management of surface water and, as a result, provides technical advice on surface water drainage strategies and designs put forward for major development proposals.

When considering planning applications, Stratford on Avon District Council should seek advice from the relevant flood risk management authorities, principally Warwickshire County Council on the management of surface water (including what sort of SuDS they would consider to be reasonably practicable), satisfy themselves that the development's proposed minimum standards of operation are appropriate and ensure through the use of planning conditions or planning obligations, that there are clear arrangements for on-going maintenance over the lifetime of the development. Judgement on what SuDS system would be reasonably practicable is through reference to **Defra's Non-Statutory Technical Standards for SuDS** and the Local SuDS Standards in **Warwickshire County Council's Standing Advice on Flood Risk and Drainage**.

It is essential that developers consider sustainable drainage at an early stage of the development process – ideally at the master-planning stage. This will assist with the delivery of well designed, appropriate and effective SuDS. Proposals should also comply with the key SuDS principles regarding solutions that deliver multiple long-term benefits. These four principles are shown in Figure 10-1.

Figure 10-1 Four pillars of SuDS design



Source: The SuDS Manual (C753)

10.3 Sources of SuDS guidance

10.3.1 Warwickshire County Council Flood Risk and Drainage Standing Advice

Warwickshire County Council's **Flood Risk and Drainage Standing Advice** was updated in August 2017 and gives advice on SuDS and flood risk for new developments.

10.3.2 C753 CIRIA SuDS Manual (2015)

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

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

Non-Statutory Technical guidance has been developed by Defra to sit alongside PPG to provide non-statutory standards as to the expected design and performance for SuDS.

In March 2015, the latest guidance was released providing amendments as to what is expected by the LPA to meet the National Standards. The guidance provides a valuable resource for developers and designers outlining peak flow control, volume control, structural integrity of the SuDS, and flood considerations both within and outside the development as well as maintenance and construction considerations.

The LPA will make reference to these standards when determining whether proposed SuDS are considered reasonably practicable.

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

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

10.4 Other surface water considerations

10.4.1 Groundwater Vulnerability Zones

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

Two maps are available:

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

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

10.4.2 Groundwater Source Protection Zones (GSPZ)

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

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

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

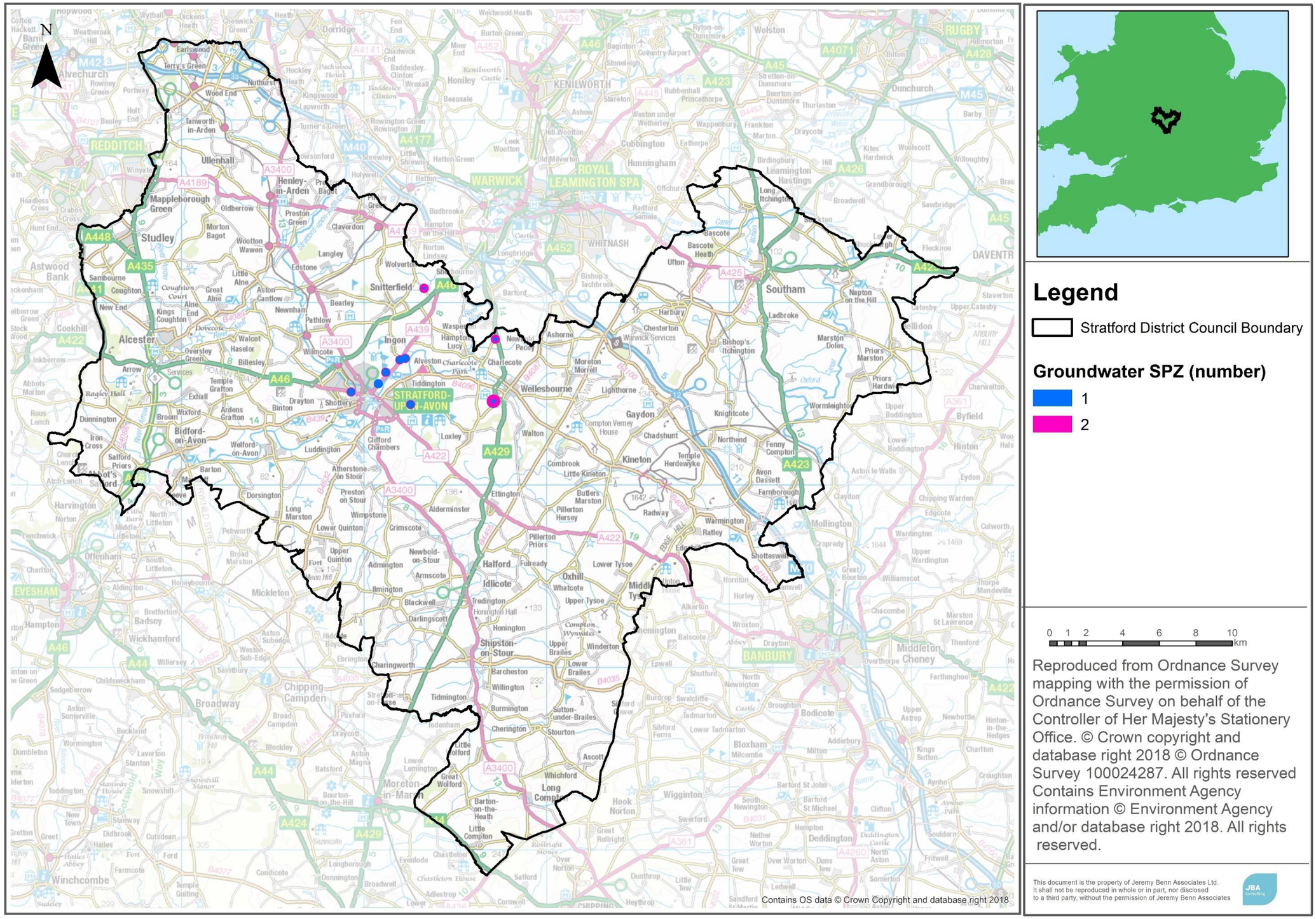
- **Zone 4 (Zone of special interest)** – A fourth zone SPZ4 or 'Zone of Special Interest' usually represents a surface water catchment which drains into the aquifer feeding the groundwater supply (i.e. catchment draining to a disappearing stream). In the future this zone will be incorporated into one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

The location of the Groundwater SPZs in relation to Stratford on Avon District are shown in Figure 10-2.

The vast majority of Stratford on Avon District is not located within a Groundwater SPZ. Areas within a Groundwater SPZ are predominantly located in Stratford upon Avon, with other SPZ areas in Wellesbourne and Snitterfield.

Due to the permeable nature of the bedrock classified as Principal, infiltration may not be a suitable SuDS technique in areas underlain by this bedrock. For SuDS techniques that are designed to encourage infiltration, it is imperative that the water table is low enough and a site-specific infiltration test is conducted early on as part of the design of the development. Infiltration should be considered with caution within areas of possible subsidence or sinkholes. Where sites lie within or close to Groundwater Source Protection Zones (GSPZs) or aquifers or near areas of contaminated land/areas of former mining works, further restrictions may be applicable, and guidance should be sought from the LLFA.

Figure 10-2 Groundwater Source Protection Zones



10.5 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.

Stratford on Avon District is located entirely within a surface water NVZ. A small amount of the District is located within a Groundwater NVZ, predominantly on the eastern border of the District around Farnborough and Warmington and to the south of Long Compton.

The NVZ coverage can be viewed on the **Environment Agency's online maps**.

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11 Strategic flood risk solutions

11.1 Introduction

Strategic flood risk solutions offer the opportunity to reduce flood risk in Stratford on Avon District. The Local FRM Strategy and Severn Flood Risk Management Plan set out specific actions for the District. New development has the potential to contribute towards strategic solutions, either by the provision of on-site measures that contribute towards a wider strategic approach or by financially contributing to offsite measures that can reduce flood risk to developments and/or help to offset the cumulative impact of development.

11.2 Current programme of Flood Alleviation Schemes

Figure 11-1 shows a map of the current and potential future schemes lead by the Environment Agency, Warwickshire County Council and Severn Trent Water. Some of these schemes are outlined in more detail below.

There is more certainty over some schemes than others. This is due to the level of investigation that has gone into a scheme so far and the availability of funding. In particular, all Severn Trent Water schemes, and WCC schemes for Clifford Chambers, Gaydon, Coughton, Long Itchington and Shottery, should be considered as indicative at this time. The organisation leading the scheme should be contacted for up to date information on scheme progression.

11.2.1 Fenny Compton

Warwickshire County Council are looking to develop a scheme based on upstream storage. Geotechnical investigations have been undertaken to understand the best ways to maximise the benefit of the existing storage feature.

11.2.2 Cherington

Cherington is located in a steep-sided catchment and is therefore at high risk of surface water flooding. Property Level Resilience (PLR) including flood doors and flood defender barriers were installed at a number of properties in the village in 2018.

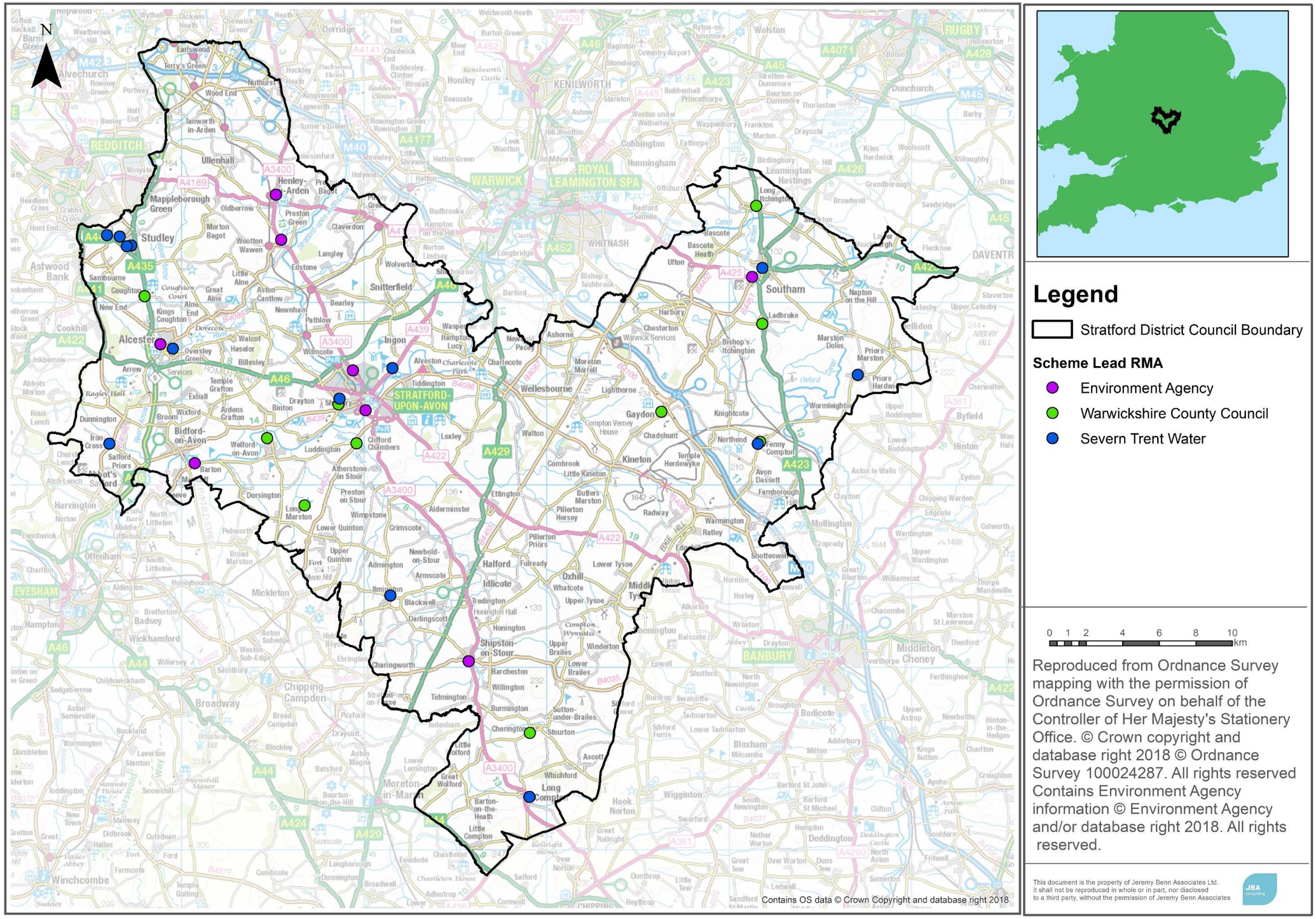
11.2.3 Ladbroke

PLR including flood defender barriers and waterproof external walls were installed in a number of properties in the village in 2018.

11.2.4 Racecourse Brook

An Environment Agency Flood Risk Management Scheme along the Racecourse Brook in Stratford on Avon has been proposed, which plans to better protect 47 homes from flooding by scheme completion in 2021.

Figure 11-1 Current and future flood alleviation schemes



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11.3 Natural flood management (NFM)

NFM is used to protect, restore and re-naturalise the function of catchments and rivers to reduce flood risk. A wide range of techniques can be used that aim to reduce flooding by working with natural features and processes in order to store or slow down flood waters before they can damage flood risk receptors (e.g. people, property, infrastructure, etc.). NFM involves taking action to manage flood and coastal erosion risk by protecting, restoring and emulating the natural regulating functions of catchments, rivers, floodplains and coasts. Techniques and measures, which could be applied in Stratford on Avon District include:

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

In 2017, the Environment Agency published an **online evidence base** to support the implementation of NFM and maps showing locations with the potential for NFM measures. These maps are intended to be used alongside the evidence directory to help practitioners think about the types of measure that may work in a catchment and the best places in which to locate them. There are limitations with the maps; however, it is a useful tool to help start dialogue with key partners.

There are areas within Stratford on Avon District whereby removing existing defences and reconnecting the floodplain could create areas for potential without causing risk to properties. Areas where such opportunities could potentially be considered includes along the Rivers Avon, Stour, Alne and Arrow. Reconnecting the river with its floodplain and naturalising the river itself should lead to reduced peak flood levels which will protect properties and infrastructure in settlements downstream.

NFM measures are designed to reduce the flow of floodwater to minimise the risk of flooding to areas downstream. Tree planting can play a vital role in reducing flood risk within an area. Increased rainfall interception and infiltration may reduce surface water runoff and therefore increase the potential of NFM in the area. Areas in Stratford on Avon District where tree planting could potentially be considered as an NFM measure are most notably along the River Avon and River Alne.

Natural flood management measures have been implemented in the Stour catchment in 2017 and 2018, along the Knee Brook and its tributaries, by the Shipston Area Flood Action Group (SAFAG). 'Slow the flow' measures such as ponds, bunds and woody dams have been installed, mainly on upstream farmland, to reduce flood risk to Shipston on Stour and surrounding villages during flooding events. Warwickshire County Council are currently working with SAFAG and the National Flood Forum on the Stour Catchment Partnership to obtain further funding to implement NFM features in the wider Stour catchment, to benefit villages including Brailes, Cherington and Long Compton.

11.4 Flood storage

Flood storage schemes aim to reduce the flows passed downriver to mitigate downstream flooding and detain additional runoff from increased impermeable areas in the catchment due to development by releasing it downstream at a slower rate. Methods to provide these schemes include:

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

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

The construction of new upstream storage schemes as part of upstream catchment-based approaches on watercourses could provide one potential strategic solution to flood risk. Watercourses which are rural in their upper reaches but have high levels of flood risk to urban areas in the downstream reaches are potential candidates, as the open land in the upper reaches can potentially provide the space for an attenuation area, providing benefit to the urban area downstream.

11.5 Catchment and floodplain restoration

Floodplain and river restoration represent the most sustainable form of strategic flood risk solution, by allowing watercourses to return to a more naturalised state. The following measures could be adopted:

- Restoring watercourses and allowing them to act as green corridors/ infrastructure;
- removal of redundant structures i.e. weirs and sluices no longer used or needed, to reconnect the river and the floodplain; and
- apply the Sequential Approach to avoid new development within currently undefended floodplain.

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

By using the Sequential Approach and by locating development away from these watercourses it will ensure the watercourse retains connectivity to its floodplain. Loss of floodplain connectivity in the upper reaches of watercourses could potentially increase flooding downstream. This could help to negate any need to build flood defences for proposed development downstream.

11.6 Culverts

Culverted watercourses were often constructed to enable the efficient drainage of an area and allow land to become developable. However, culverted watercourses require regular maintenance to ensure that they function correctly. In most cases they also require trash screens at their entrance to ensure they do not become blocked by large debris, further adding to the maintenance requirements.

Where practical, the de-culverting and re-naturalisation of watercourses restoring to open channel should be encouraged. De-culverting can bring many benefits including reducing the need for regular maintenance and trash screens, reducing blockages and enhancing the river environment by providing a more varied habitat.

In some cases, small sections of open channel can be beneficial for flood risk management allowing for flood water to disperse naturally and thus slowing the movement of flood water downstream.

Works to alter culverts on Ordinary Watercourses would require an **Ordinary Watercourse Land Drainage Consent** from Warwickshire County Council as LLFA.

Further information is provided in the '**Trash and Security Screen Guide 2009**', published by the Environment Agency/Defra, which should be used as evidence for any culvert assessment, improvement or structure retention. The reader should refer to the CIRIA website, as this document is currently being updated.

12 Summary and policy recommendations

12.1 Sources of flood risk

Parts of Stratford on Avon District are at risk from the following sources; fluvial, surface water, groundwater, sewers, reservoir inundation and canal overtopping/breaches. This study has shown that the most significant sources of flood risk in Stratford on Avon District are fluvial and surface water.

- *Fluvial flooding*: The primary fluvial flood risk is along the River Avon and its main tributaries. These present fluvial flood risk to rural communities as well as to the main urban centres of the District. The floodplains of the watercourses are fairly well confined in the majority of the District, with wider extents along the River Avon due to lower lying, flat topography, notably through Stratford upon Avon and downstream of Bidford on Avon.
- *Surface water:* The Risk of Flooding from Surface Water map shows a number of prominent overland flow routes; these predominantly follow topographical flow paths of existing watercourses or dry valleys with some isolated ponding located in low lying areas.
- *Sewer*: The majority of sewers in Stratford on Avon District are managed by Severn Trent Water, with Thames Water and Anglian Water managing sewers in some areas. Thames Water provided their list of historical sewer flooding records which show 3 properties with historic incidents of sewer flooding. Severn Trent Water provided their 'At Risk' Register which denotes 143 properties at risk from sewer flooding.
- *Groundwater:* The Areas Susceptible to Groundwater Flooding map shows that, in general, the majority of Stratford on Avon District is within the <25% susceptible classification, therefore it is at a lower risk of groundwater flooding. Parts of the centre of the District along the River Avon, and the west of the District along the River Arrow, fall within higher susceptibility classifications and are therefore at higher risk from groundwater flooding.
- *Canals*: There are three canals in Stratford on Avon District: the Stratford-upon-Avon Canal, the Grand Union Canal, and the Oxford Canal. These have the potential to interact with other watercourses and become flow paths during flood events or in a breach scenario. There have been no recorded incidents of breach or overtopping in the District on any of the canals.
- *Reservoirs:* There is a potential risk of flooding from reservoirs both within the District and those outside. There are no records of flooding from reservoirs in the study area. The level and standard of inspection and maintenance required under the Reservoirs Act means that the risk of flooding from reservoirs is relatively low. However, there is a residual risk of a reservoir breach and this risk should be considered in any site-specific Flood Risk Assessments (where relevant).

12.2 Planning policy recommendations

Reduction of flood risk through site allocations and appropriate site design

- In line with the Sequential Test, to locate new development in areas of lowest risk, taking into account all sources of flood risk. If a Sequential Test is undertaken and a site at flood risk is identified as the only appropriate site for development, the Exception Test shall be undertaken, should it apply.

- A Level 2 SFRA should be conducted where the Exception Test is required and also for any site where the ability to provide adequate floodplain compensation is questionable, i.e. employment sites largely affected by Flood Zone 3.
- After application of the Sequential Test (and Exception Test if required), a sequential approach to site design should be used to reduce risk, by placing the least vulnerable parts of the site in the highest flood risk areas.
- Both the actual and residual risk of flooding should be taken into account, by ensuring that appropriate mitigation measures are put in place and that in an extreme event, the users of the development will be safe from flooding.

Contribute to wider infrastructure improvements

- Assess the condition of existing drainage assets and upgrade, if required, to ensure that the infrastructure can accommodate pressures/flows for the lifetime of the development.
- Contribute to reducing flood risk off site wherever feasible.
- Ensure the whole life costs and maintenance of any engineering works to reduce the flood risk to the site have been accounted for.

Protect and promote areas for future flood alleviation schemes

- Safeguard functional floodplain from future development.
- Develop appropriate policies for brownfield sites which lie in functional floodplain to reduce risk and to provide flood risk betterment.
- Positively contribute towards the wider vision for flood risk management and drainage in the District, as set out in the Warwickshire Local Flood Risk Management Strategy and supporting Surface Water Management Plan, Severn Flood Risk Management Plan and emerging Severn Trent and Thames Water Drainage and Wastewater Management Plans.
- Identify opportunities to help fund future flood risk management through developer contributions to reduce risk for surrounding areas.
- Seek opportunities to make space for water to accommodate climate change.

Implement Sustainable Drainage Systems as standard on all developments

- SuDS should be considered at the earliest possible stage and designed in accordance with local and national requirements.
- SUDS should have multiple and documented benefits for the wider water environment, including water quality, amenity and biodiversity
- SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.
- SuDS should be designed with the SuDS management train in mind and preference should be taken to dealing with flows at the source using multiple features to maximise surface water treatment over large, single features.

Enhance and restore river corridors and habitats

- Natural drainage features should be maintained and enhanced.

- Culverted watercourses should be opened up and new culverting resisted. De-culverting should be considered at the earliest stage of development proposals/planning to avoid financial constraints.
- Identify opportunities for river restoration/enhancement to make space for water.
- Adopt a catchment partnership working approach to promote natural flood management and green infrastructure improvements.

Improve emergency planning and flood awareness

- New developments should not increase the resource burden on emergency responders during an event and should seek betterment for brownfield sites, e.g. by providing safe access and egress during a flood/ a safe place of refuge.
- Emergency (Flood Warning and Evacuation Plans) will be needed as part of a Flood Risk Assessment for sites within Flood Zone 2 or 3. The key elements of these plans should be communicated to future users of the site. This includes raising awareness of the risk of flooding (even if it is residual) and what to do in the event of a flood.
- Emergency plans need to be integrated into wider Multi Agency Flood Plans and regularly exercised.

Manage the cumulative impact of development

For small catchments draining into settlements with known flood risk issues, the recommended policy is to:

- Undertake more detailed drainage strategy work as part of a Level 2 SFRA[5] or detailed local area Strategic Drainage Study to consider further how the cumulative effects of potential peak rates and volumes of water from development sites would impact on peak flows, duration of flooding and timing of flood peaks on receiving watercourses. Such studies could be used to justify greater restrictions/enforcement through Local Planning Policy development site runoff rates and volumes specific to each catchment that are over and above those required by National and Local SuDS Standards. They could also identify where there are opportunities with allocated sites to provide off-site betterment e.g. online/offline flood storage and where land should be safeguarded within proposed site allocations to fulfil this purpose. *
- Incorporate SuDS and provide details of adoption, ongoing maintenance and management on all development sites. Proposals will be required to provide reasoned justification for not using SuDS techniques, where ground conditions and other key factors show them to be technically feasible. Preference will be given to systems that contribute to the conservation and enhancement of biodiversity and green infrastructure in the District where practicable.
- Seek to provide wider betterment by demonstrating in site-specific Flood Risk Assessments and Surface Water Drainage Strategies what measures can be put in place to contribute to a reduction in flood risk downstream. This may either be by provision of additional storage on site e.g. through oversized SuDS, natural flood management techniques, green infrastructure

[5] A Level 2 SFRA will be required should sites require the Exception Test. A Level 2 SFRA could also contain more detailed local area Strategic Drainage Strategy work.

and green-blue corridors and/or by providing a Partnership Funding contribution towards any flood alleviation schemes. Consultation on the site-specific requirements should be undertaken with Stratford on Avon District Council and the Environment Agency at the earliest opportunity.

For larger rural catchments draining into settlements with known flood risk issues the recommended policy is to:

- Incorporate SuDS and provide details of adoption, ongoing maintenance and management on all development sites. Proposals will be required to provide reasoned justification for not using SuDS techniques, where ground conditions and other key factors show them to be technically feasible. Preference will be given to systems that contribute to the conservation and enhancement of biodiversity and green infrastructure in the District where practicable.
- Seek to provide wider betterment by demonstrating in site-specific Flood Risk Assessments and Surface Water Drainage Strategies what measures can be put in place to contribute to a reduction in flood risk downstream. This may either be by provision of additional storage on site e.g. through oversized SuDS, natural flood management techniques, green infrastructure and green-blue corridors and/or by providing a Partnership Funding contribution towards any flood alleviation schemes. Consultation on the site-specific requirements should be undertaken with Stratford on Avon District Council and the Environment Agency at the earliest opportunity.
- For the LPA to work closely with the Environment Agency and Warwickshire County Council as LLFA to identify areas of land that should be safeguarded for the future use of natural flood management features.

* This recommendation is more applicable to smaller catchments, because the proportion of new development to catchment area is likely to be greater and therefore the potential impact of development on flood risk greater. More detailed drainage strategy planning would entail building a small hydrological model of the catchment to provide a more specific information on the likely impact of those new developments. Doing this to cover a small catchment is more affordable and would yield more meaningful results than modelling much larger catchments, where in proportion to overall catchment size, new development would not have as much of an effect on flood risk elsewhere in those larger catchments.

Appendices

A Stratford on Avon District Council Level 1 SFRA Geo-PDF mapping

Important note on Flood Zone information in the Geo-PDFs

The Environment Agency's Flood Map for Planning does not incorporate latest modelling results in Stratford upon Avon, along the Racecourse and Shottery Brooks, at the time of writing this SFRA. Therefore, in this area, the 100-year and 1,000-year model results were used to represent Flood Zones 3a and 2 respectively. This model was being updated by the Environment Agency, therefore developers should contact the Environment Agency to ensure the most up to date data is being used.

B Cumulative Impact Assessment – High Risk Catchments Maps

Offices at

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

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