Stoke-on-Trent Level 1 Strategic Flood Risk Assessment Final Report January 2020

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Stoke-on-Trent

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Revision History

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Contract

This report describes work commissioned by Karl Conyon on behalf of Stoke-on-Trent City Council via Faithful & Gould in accordance with the PAGABO professional framework services on the 20th July 2018. Hannah Hogan, Freyja Scarborough and Erin Holroyd of JBA Consulting carried out this work.

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Purpose

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Acknowledgements

We would like to acknowledge the assistance of:

- Stoke-on-Trent City Council;
- Environment Agency;
- Severn Trent Water;
- Staffordshire County Council;
- Newcastle-under-Lyme Borough Council;
- The Canal and Rivers Trust; and,
- Planning Officers at the neighbouring authorities.

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Executive summary

About this report

This report provides a comprehensive and robust evidence base on flood risk issues to support the production of the joint Local Plan for Stoke-on-Trent and Newcastle-under-Lyme to 2033. This is a Level 1 Strategic Flood Risk Assessment (SFRA) and it will be used to inform decisions on the location of future development and the preparation of sustainable policies for the long-term management of flood risk. This report covers the City of Stoke-on-Trent. A separate report covers Newcastle-under-Lyme Borough Council.

Introduction

This Strategic Flood Risk Assessment (SFRA) document replaces the 2008 Level 1 SFRA. The study provides a comprehensive and robust evidence base to support the new Joint Local Plan for Newcastle-Under-Lyme and Stoke-on-Trent. The key objectives are:

- To understand flood risk from all sources and to investigate and identify the extent and severity of flood risk throughout the city. This assessment will enable Stoke-on-Trent City Council (SoTCC) to apply the Sequential Test in the preparation of the Local Plan, steer development away from those areas where flood risk is considered greatest, ensuring that areas allocated for development can be developed in a safe, cost effective and sustainable manner.
- To form part of the evidence base and inform the council's Joint Local Plan.
- To provide guidance for developers and planning officers dealing with applications and planning requirements as well as to enable SoTCC to fulfil their role as LLFA including advice on the application of SuDS.
- To ascertain if land will be required for current and future flood management that should be safeguarded as set out in the NPPF.
- To reflect current national policy documentation including the NPPF and its accompanying Flood Risk and Coastal Change Planning Practice Guidance to enable SoTCC to meet its obligations as defined by the NPPF.
- To supplement current policy guidelines and to provide a straightforward risk-based approach to development management in the area.
- To make recommendations on the suitability of potential development sites based on flood risk for SoTCC Local Plan.
- To assess surface water flood risk, using the Environment Agency's (EA) third generation surface water flood map, the Risk of Flooding from Surface Water map (RoFSW).
- To develop a report that forms the basis of an informed development management process that also provides guidance on the potential risk of flooding associated with future planning applications and the basis for site-specific Flood Risk Assessments (FRAs) where necessary.
- To consider a precautionary approach to climate change.
- To provide a suite of interactive GeoPDF flood risk maps.
- To assess any strategic flooding issue which may have cross boundary

implications and investigate any strategic solutions which can be implemented to reduce the risk
- To consider and make recommendations to reduce the impact of the cumulative impact of developments.

Summary of flood risk

Stoke-on-Trent is a densely populated and in places, steeply sloping urban area. This makes it prone to rapid surface water flooding following heavy rainfall and flooding from smaller watercourses that are tributaries of the River Trent. The industrial legacy leaves complex urban drainage challenges, with many watercourses that heavily modified and culverted in places, providing little if any biodiversity benefit and making them prone to blockage. Stoke-on-Trent has experienced flooding from multiple sources in the past and flood risk mapping shows areas that could be at risk from future events:

- Trentham, Goms Mill, Stoke town centre, Cliff Vale, Bucknall, Ford Green and Norton Green are the areas most at risk of fluvial (river) flooding.
- Stoke-on-Trent has experienced a number of historic surface water flooding incidents. Hotspots for localised flooding have been identified at Baddeley Edge, Milton Road, Fenn Park, Eaves Lane, Norton Green, Hilton Road, Uffington Parade and Weston Coyney.
- The majority of the Stoke-on-Trent area is at no to low risk of flooding from groundwater, although there are scattered areas predominately in the south of the City, showing high risk from ground waterflooding.
- There are three reservoirs which would affect Stoke-on-Trent in the event of a breach. There are no records of flooding from reservoirs affecting the City. The level and standard of inspection and maintenance required under the Reservoirs Act (1975) means that the risk of flooding from reservoirs is extremely low.
- Meir Hay, Weston Coyney, Parkhall and Adderley Green have previously been affected by sewer flooding.
- There are historic records of canal breaches on the Trent and Mersey canal and the Caldon Canal.

SFRA outputs

The following outputs are available:

- Identification of policy and technical updates.
- 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 the potential increase in flood risk due to climate change.
- Review of historic flooding incidents.
- Appraisal of all potential sources of flooding, including Main River, ordinary watercourse, surface water, overland flows - considering both flood routes/paths and storage, sewers, groundwater (including interactions between the aquifers and perched water tables), reservoirs, canals, infrastructure failure and any other significant bodies of water.
- Mapping showing distribution of flood risk across all Flood Zones from all

sources of flooding including surface water flooding and climate change allowances.
- Reporting on the standard of protection provided by existing flood risk management infrastructure.
- Identification of any strategic flooding issues which may have cross boundary implications.
- Assessment of strategic flood risk solutions that can be implemented to reduce risks.
- Flood Risk Assessment guidance for developers.
- Guidance for developers on the use of Sustainable Drainage Systems.

The Local Planning Authority (LPA) provided its latest potential Preferred Option site data and information for assessment. An assessment of flood risk to all 113 sites is provided to assist the LPA in its decision-making process for sites to take forward as part of the Joint Local Plan. The following tables comes from.
Table 1-1 summarises the number of sites at risk from each Flood Zone as per the Environment Agency's Flood Map for Planning, Table 1-2 those at risk of flooding from surface water in the Environment Agency's RoFSW and Table 1-3 those at risk of flooding from surface water according to the Stoke-on-Trent Local Surface Water Modelling. Please see section 6.1.1 for more information about where the data in the following tables comes from.

Table 1-1: Number of Potential Development Sites affected by the Flood Map for Planning (National Planning Policy Guidance Flood Zones)

Potential Development Site	Flood Zone 1*	Flood Zone 2	Flood Zone 3a	Flood Zone 3b
Residential	69	8	8	1
Employment	26	10	9	6
Total	95	18	17	7
*Sites with 100% area within Flood Zone 1				

Table 1-2: Number of Potential Development Sites at risk of flooding from surface water

Potential Development Site	3.3% AEP	1% AEP	0.1% AEP
Residential	38	51	65
Employment	21	26	33
Total	59	77	98

Table 1-3: Number of Potential Development Sites at risk based on Local Surface water risk

Potential Development Sites with more than 10% affected by local surface water	3.3% AEP	1% AEP	0.1% AEP
Residential	4	5	15
Employment	0	2	4
Total	4	7	19

Strategic recommendations, in Section 8.1 of this report, are made for each site at risk, as follows:

- Strategic Recommendation A - consider withdrawing the site based on significant level of fluvial flood risk;
- Strategic Recommendation B - Exception Test required if site passes Sequential Test;
- Strategic Recommendation C - consider site layout and design around the identified flood risk, if site passes Sequential Test;
- Strategic Recommendation D - site can be permitted on flood risk grounds due to limited perceived risk, subject to consultation with the LPA / LLFA;
- Strategic Recommendation E - can be allocated on flood risk grounds subject to consultation with the LPA / LLFA.

Included along with this report as part of the SFRA are:

- Detailed interactive GeoPDF maps showing all available flood risk information - Appendix A;
- Development Site Assessment spreadsheet detailing the risk to each site with recommendations on development - Appendix B;
- Further information regarding the data sources used in this SFRA – Appendix C;
- A list of relevant flood risk studies – Appendix D;
- Detailed tabulation and mapping of the Environment Agency Flood Warning and Flood Alerts – Appendix E;
- A summary of flood risk across the City – Appendix F;
- Surface Water Management hotspot analysis – Appendix G; and
- Stoke-on-Trent City Councils Sustainable Drainage Systems Handbook - Appendix H.

Policy recommendations

Local Plan policy recommendations have been made regarding the risk-based approach to allocating development, sustainable drainage, developments at surface water flood risk and developments with a watercourse. Specific policy recommendations with regards to the cumulative impact of development on flood risk have been developed for the Fowlea Brook catchment and the catchments

draining towards local flooding hotspots.

Recommendations for future work in a Level 2 SFRA

To further inform the site allocations and development of local planning policies, a Level 2 SFRA could be used to:
Assist the application of the Exception Test, where necessary. If residential development is to be allocated in Flood Zone 3 then the Exception Test will be required (unless the site boundary is amended to remove the area at risk);
Provide further information on sites that are at significant risk from surface water flooding and the possibilities for surface water mitigation measures on sites at high risk of surface water flooding, linked to work on the Surface Water Management Plan and other ongoing flood studies; and
Provide further information on sites that are vulnerable to a significant increase in flood risk in future due to climate change on flood hazard.

Table 1-4 highlights which Preferred Option sites would benefit from a Level 2 assessment:

Table 1-4 sites recommended for Level 2 Strategic Flood Risk Assessment

Site code	Site name	In Flood Zone 3	Significant surface water risk (National)	Significantly affected by climate change
10355/9756/New12	63-65 Birches Head Road, Hanley, Stoke on Trent, Staffs	YES	YES	YES
10294/10295	New House Abattoir, Werrington Road, Bucknall, Stoke on Trent, Staffs	YES		
02020/CFS20	Former Tunstall Sewage Works	YES	YES	YES
New5	Former Brownhills Tileries, Harewood Street, Tunstall	YES		
CFS4	Former Ravensdale Sportsfield, Land off Chemical Lane, Tunstall	YES		
New2	Etruria Valley Phases 3a and 3b, Forge Lane, Etruria	YES		

351	Land between Huntilee Road and Scotia Road, Scotia Road, Tunstall	YES		
331 – Under Construction	Land at, Trentham Lakes, Stanley Matthews Way, Stoke-on-Trent	YES		
375	Land off, Magdalen Road, Blurton	YES	YES	
539 – Under construction	Victoria Ground, Boothen Old Road, Stoke	YES		YES
426 – Planning permission granted	Minton Hollins (land) (employment), Shelton Old Road, Stoke	YES		YES
415	Mitchell High School, Bucknall, Stoke on Trent, ST2 9EY.	YES		
292	Land at, Berryhill	YES		
0	New Inn Lane	YES	YES	YES
CFS5	Land at Whieldon Road	YES		
N/A	Land Adjacent to Brownwhills Road, Tunstall, Stoke on Trent	YES		
N/A	Trentham Lakes South (Area 3)	YES		
10148	Land at, Brownley Road, Newford, Stoke on Trent, Staffs		YES	YES

Site code	Site name	In Flood Zone 3	Significant surface water risk (National)	Significantly affected by climate change

675 – Under Construction	Wedgwood Estate (Phase2 The Village), Wedgwood Drive, Trentham, Stoke-on-Trent, ST12 9ER		YES	
410	Melville Street/Wooliscroft Factory, Berryhill and Hanley East, Stoke on Trent, Staffordshire, ST1 3LY		YES	
562	Land at Umberleigh Road, Blurton, and other land, ST3 3ND and Public Open Space at Newstead		YES	
163	Corner of, Nursery Lane, Baddeley Green		YES	

For high risk catchments in Stoke-on-Trent (Fowlea Brook and SWMP hotspot catchments) and Newcastle-under-Lyme where they drain towards Stoke-on-Trent (Lyme Brook, Park Brook and Ford Green Brook catchments) it is recommended that more detailed drainage strategy work is undertaken as part of a Level 2 SFRA 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/ enforce 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, integrate SuDS features into wider green infrastructure provision and where land should be safeguarded within proposed site allocations to fulfil this purpose.

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Abbreviations

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) with known urban drainage issues, designated by the Environment Agency
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), 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.
FRCC-PPG	Flood Risk and Coastal Change [National] Planning Policy Guidance
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
HFRR	Hydraulic Flood Risk Register
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 Flood Risk Management Strategy
LIDAR	Light Detection and Ranging

LLFA	Lead Local Flood Authority - Local Authority responsible for taking the lead on local flood risk management
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
NULBC	Newcastle-under-Lyme Borough Council
NVZs	Nitrate Vulnerability Zones
Ordinary Watercourse	All watercourses that are not designated Main River. Local Authorities or, where they exist, IDBs have similar permissive powers as the Environment Agency in relation to flood defence work. However, the riparian owner has the responsibility of maintenance.
PFRA	Preliminary Flood Risk Assessment
Pitt Review	Comprehensive independent review of the 2007 summer floods by Sir Michael Pitt, which provided recommendations to improve flood risk management in England.
Pluvial flooding	Flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (surface runoff) before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity.
PPS25	Planning Policy Statement 25: Development and Flood Risk – superseded by the NPPF and PPG
RBMP	River Basin Management Plan
RFCC's	Regional Flood and Coastal Committee
RFRSM	Risk of Flooding from Rivers and Sea Map
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Resistance Measures	Measures designed to keep flood water out of properties and businesses; could include flood guards for example.
Return Period	Is an estimate of the interval of time between events of a certain intensity or size, in this instance it refers to flood events. It is a statistical measurement denoting the average recurrence interval over an extended period of time.
Riparian owner	A riparian landowner, in a water context, owns land or property, next to a river, stream or ditch.

Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
Risk Management Authority	Operating authorities who's remit and responsibilities concern flood and / or coastal risk management.
RoFfSW	Risk of Flooding from Surface Water (formerly known as the Updated Flood Map for Surface Water (uFMfSW))
Sequential Test	Set out in the NPPF, the Sequential Test is a method used to steer new development to areas with the lowest probability of flooding.
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
SFRA	Strategic Flood Risk Assessment
SMP	Shoreline Management Plan
SoP	Standard of Protection - Defences are provided to reduce the risk of flooding from a river and within the flood and defence field standards are usually described in terms of a flood event return period. For example, a flood embankment could be described as providing a 1 in 100-year standard of protection.
SoTCC	Stoke on Trent City Council
SPD	Supplementary Planning Document
SPZ	(Groundwater) Source Protection Zone
Stakeholder	A person or organisation affected by the problem or solution or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.
SuDS	Sustainable Drainage Systems - Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques
Surface water flooding	Flooding as a result of surface water runoff as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity, thus causing what is known as pluvial flooding.
SWMP	Surface Water Management Plan - The SWMP plan should outline the preferred surface water management strategy and identify the actions, timescales and responsibilities of each partner. It is the principal output from the SWMP study.

WFD	Water Framework Directive – Under the WFD, all waterbodies have a target to achieve Good Ecological Status (GES) or Good Ecological Potential (GEP) by a set deadline. River Basin Management Plans (RBMPs) set out the ecological objectives for each water body and give deadlines by when objectives need to be met.

1 Introduction

JBA Consulting was commissioned by Stoke-on-Trent City Council (SoTCC) to prepare a Strategic Flood Risk Assessment (SFRA) for the City Council and Newcastle-under-Lyme Borough Council. This study provides a comprehensive and robust evidence base to support the production of the Joint Stoke and Newcastle Local Plan to 2033. It replaces the 2008 Strategic Flood Risk Assessment (SFRA) undertaken by Halcrow.

The 2019 SFRA will be used to inform decisions on the location of future development and the preparation of sustainable policies for the long-term management of flood risk. This report covers the city of Stoke-on-Trent. A separate report covers Newcastle-under-Lyme Borough Council.

The Joint Local Plan will set out the long-term land allocations and other planning policies that will guide development proposals in the city and will be used to determine planning applications. This SFRA update will help to provide the evidence base in making decisions on where to direct new development to ensure development is located in sustainable locations, in terms of flood risk, enabling SoTCC to initiate the sequential risk-based approach to the allocation of land for development and to identify whether the application of the Exception Test is likely to be necessary.

This update has been carried out in accordance with the Government's latest development planning guidance including the National Planning Policy Framework (NPPF) and flood risk and planning guidance called the Flood Risk and Coastal Change Planning Practice Guidance (FRCC-PPG). The latest guidance is available online.

Other parts of the National Planning Practice Guidance that are relevant to flood risk management include guidance on:

Water Supply, Wastewater and Water Quality, including measures to ensure the Local Plan contributes to a catchment-based approach to water and supports the Humber River Basin Plan:
Water Supply, Wastewater and Water Quality Government Guidance

Natural Environment and Green Infrastructure, measures to encourage green infrastructure can help improve drainage and manage flooding and water resources):
Natural Environment Government Guidance

Climate change (ID6), including considering the impact of and promoting design responses to flood risk and coastal change for the lifetime of the development:
Climate Change Government Guidance

1.1 Stoke-on-Trent City Council Level 1 SFRA Update

This updated SFRA makes use of the most up-to-date flood risk datasets to assess the extent of risk, at a strategic level to potential development allocation sites identified by Stoke-on-Trent City Council (SoTCC). Included within the SFRA are appendices containing: SFRA maps showing the most up-to-date flood risk information from all sources and considering the impact of climate change; and a Development Site Screening spreadsheet indicating the level of flood risk to each site following a strategic assessment of risk. This information will allow SoTCC to identify the strategic development options that may be

applicable to each site and to inform on the need for the application of the Sequential Test.
The Planning Practice Guidance identifies the following two levels of SFRA:

- Level 1: where flooding is not a major issue in relation to potential site allocations and where development pressures are low. The assessment should be of sufficient detail to enable application of the Sequential Test.
- Level 2: where land outside Flood Zones 2 and 3 cannot appropriately accommodate all necessary development, creating the need to apply the NPPF'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 Level 1 SFRA is intended to aid SoTCC 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.

1.1.1 Scope and Objectives:

The objectives of this Level 1 SFRA update are:

- To update on the previous 2008 SFRA using new or updated flood risk information including the climate change allowances.
- To understand flood risk from all sources and to investigate and identify the extent and severity of flood risk throughout the city. This assessment will enable SoTCC to apply the Sequential Test in the preparation of the Local Plan, steer development away from those areas where flood risk is considered greatest and ensure that areas allocated for development can be developed in a safe, cost effective and sustainable manner.
- To form part of the evidence base and inform the council's Joint Local Plan.
- To provide guidance for developers and planning officers dealing with applications and planning requirements as well as to enable Stoke-on-Trent city council to fulfil their role as LLFA including advice on the application of SuDS.
- To provide a reference document (this report) to which all parties involved in development planning and flood risk can reliably turn to for initial advice and guidance.
- To ascertain if land will be required for current and future flood management that should be safeguarded as set out in the NPPF.
- To reflect current national policy documentation including the NPPF and its accompanying Flood Risk and Coastal Change Planning Practice Guidance to enable SoTCC to meet its obligations as defined by the NPPF.
- To supplement current policy guidelines and to provide a straightforward risk-based approach to development management in the area.
- To make recommendations on the suitability of potential development sites based on flood risk for SoTCC's Local Plan.
- To assess surface water flood risk, using the Environment Agency's (EA) third generation surface water flood map, the Risk of Flooding from Surface Water map (RoFSW) and the results from the Surface Water Management Plan (SWMP).
- To develop a report that forms the basis of an informed development management process that also provides guidance on the potential risk of

flooding associated with future planning applications and the basis for site-specific Flood Risk Assessments (FRAs) where necessary.
- To consider a precautionary approach to climate change.
- To provide a suite of interactive GeoPDF flood risk maps.
- To assess any strategic flooding issue which may have cross boundary implications and investigate any strategic solutions which can be implemented to reduce the risk.
- To consider and make recommendations to reduce the impact of the cumulative impact of developments.
- To recommend opportunities offered by new development to reduce the causes and impacts of flooding including to reduce flood risk to existing communities and developments through better management of surface water, provision for conveyance and of storage for flood water.

This report begins by outlining the connections between the planning framework and flood risk policy thus discussing legislation, planning policy, flood risk management policy and the roles and responsibilities of key stakeholders. All available sources of flood risk within the local authority area are then examined before an assessment of flood risk to the potential development sites. Conclusions and recommendations are cited at the end of the report.

1.2 SFRA outputs

The following outputs are available:
- Identification of policy and technical updates.
- 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 the potential increase in flood risk due to climate change.
- Review of historic flooding incidents.
- 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.
- Reporting on the standard of protection provided by existing flood risk management infrastructure.
- Identification of any strategic flooding issues which may have cross boundary implications.
- Assessment of strategic flood risk solutions that can be implemented to reduce risks.
- Consideration of the cumulative impact of new development on flood risk.
- Flood Risk Assessment guidance for developers.
- Guidance on the use of Sustainable Drainage Systems.

Consultation

The following parties (external to Stoke-on-Trent City Council) were consulted to inform the SFRA:
- Environment Agency
- Staffordshire County Council

- Canal & River Trust
- Severn Trent Water & United Utilities
- Staffordshire Moorlands District Council
- Newcastle-under-Lyme Borough Council
- Stafford Borough Council

1.3 Use of SFRA data

Advice to users has been highlighted in Red throughout the document. Hyperlinks to external guidance documents/websites are provided in Blue throughout the SFRA.

Level 1 SFRAs are high-level strategic documents and do not go into detail on an individual site-specific basis. The primary purpose is to provide an evidence base to inform the Local Plan and any future flood risk policies.
Developers will still be required to undertake site specific Flood Risk Assessments to support Planning Applications. Developers will be able to use the information in the SFRA to scope out the sources of flood risk that will need to be explored in more detail at site level.
On the date of publication, the SFRA contains the latest flood risk information. Over time, new information will become available to inform planning decisions, such as updated hydraulic models (which then update the Flood Map for Planning), flood event information, new defence schemes and updates to policy and legislation. Developers should check the online Flood Map for Planning in the first instance to identify any major changes to the Flood Zones.

1.4 SFRA Study Area

Stoke-on-Trent City Council's administrative area covers an area of approximately 93.45km^2 and has a population of approximately 261,302 (2016 census).
Stoke-on-Trent is bound by Staffordshire Moorlands District Council, Newcastle-Under-Lyme Borough Council and Stafford Borough Council. Stoke-on-Trent is made up of six towns with a rural periphery.
The main rivers in the study area are the River Trent, Fowlea Brook and Lyme Brook. The River Trent is the principal watercourse in the study; all of the watercourses in the City drain to this river. The River Trent flows from the north of Stoke-on-Trent in a south westerly direction through Stoke-on-Trent into Staffordshire at the south west boundary. There are also a number of ponds and lakes within the study area. There is a map of the key watercourses in Figure 1-1 and also as part of Appendix A.

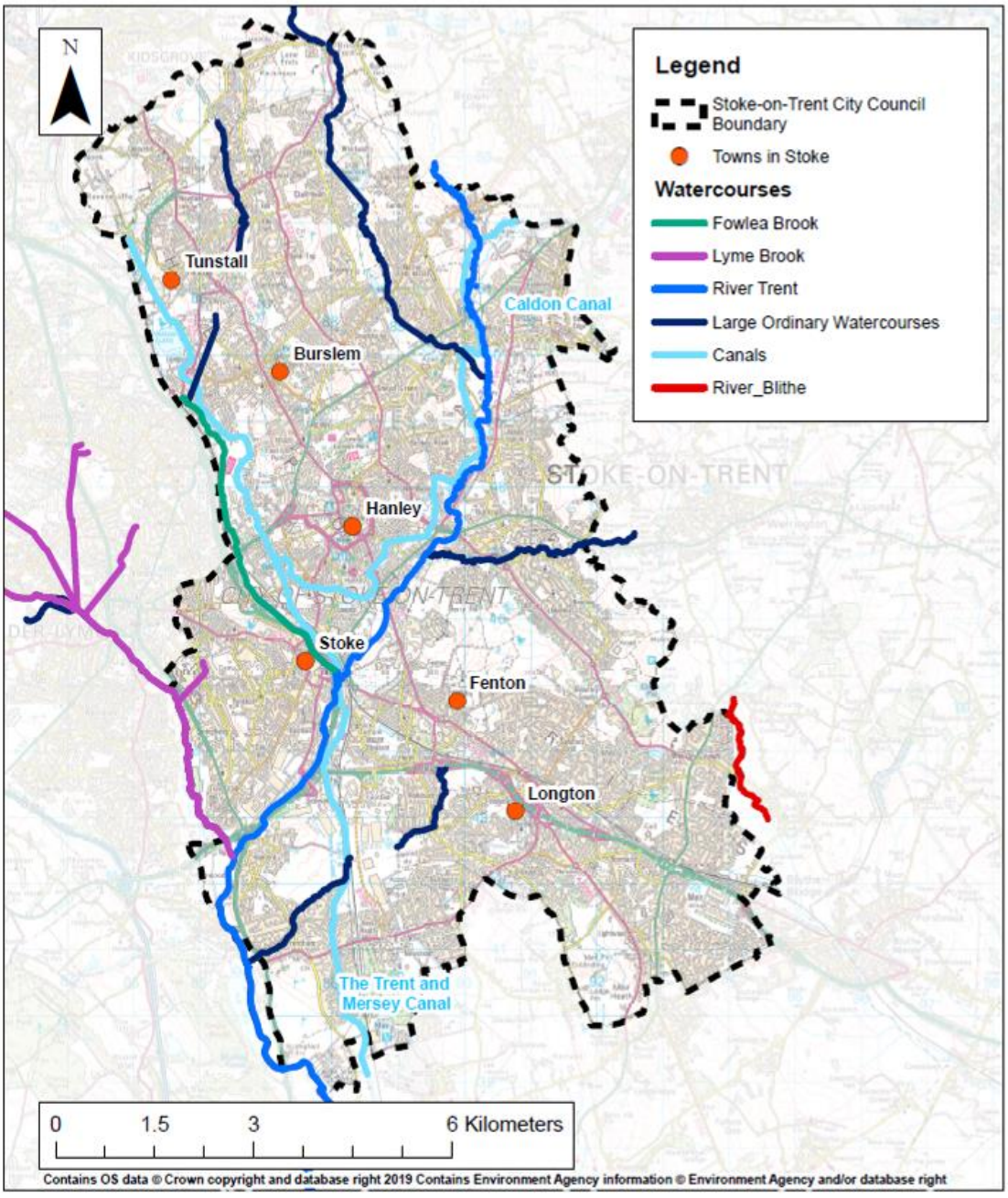


Figure 1-1: Stoke-on-Trent City Council SFRA study area

2 The Planning Framework and Flood Risk Policy

2.1 Introduction

The main purpose of this section of the SFRA is to provide an overview of the key planning and flood risk policy documents that have shaped the current planning framework.

Figure 2-1 illustrates the links between legislation, national policy, statutory documents and assessment of flood risk. The figure shows that whilst the key pieces of legislation and policy are separate, they are closely related, and their implementation should aim to provide a comprehensive and planned approach

to asset record keeping and improving flood risk management within communities.
It is intended that the non-statutory SWMPs and SFRAs can provide much of the base data required to support local authorities to develop capacity, effective working arrangements and inform Local Flood Risk Management Strategies (LFRMS) and Local Plans, which in turn help deliver flood risk management infrastructure and sustainable new development at a local level. This SFRA should be used to support the Local Plan and to help inform planning decisions.

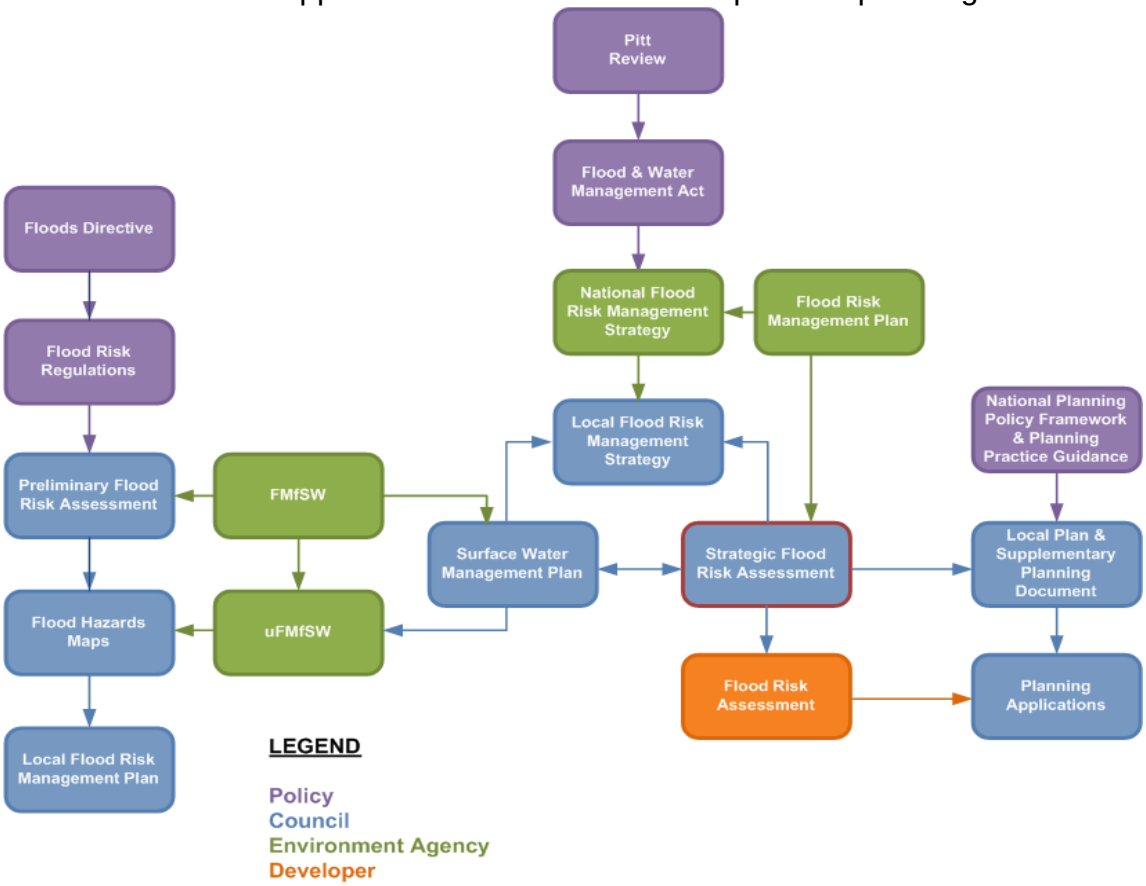
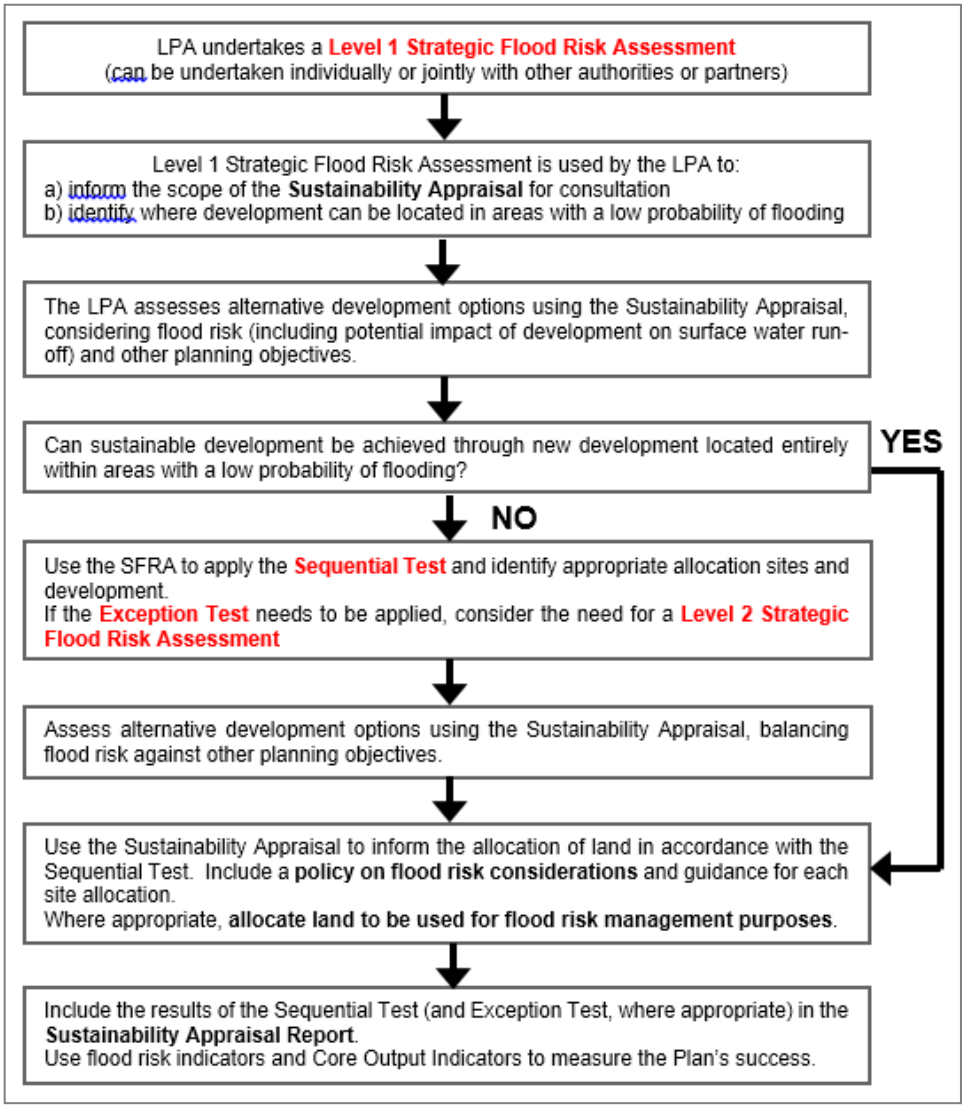


Figure 2-1: Key documents and strategic planning links with flood risk

2.2 National Planning Policy Framework and Guidance

The revised National Planning Policy Framework (NPPF) was published in July 2018 and updated in February 2019, replacing the 2012 version. The NPPF sets out Government's planning policies for England. It must be taken into account in the preparation of local plans and is a material consideration in planning decisions. The NPPF defines Flood Zones, how these should be used to allocate land and flood risk assessment requirements. The NPPF states that: "*Strategic policies should be informed by a strategic flood risk assessment and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards*". Diagram 1 in the NPPG sets out how flood risk should be considered in the preparation of Local Plans, as seen in Figure 2-2.



† Based on Diagram 1 of NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 004, Reference ID: 7-005-20140306) March 2014

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

2.2.1 Flood Risk and Coastal Change Planning Practice Guidance (FRCC-PPG)

As above, on 6 March 2014, the Department for Communities and Local Government (DCLG) launched their planning practice guidance, including guidance for flood risk and coastal change, which replaces the previous Technical Guidance. This new guidance is available as a web-based resource, which is accessible to all and is regularly updated. Whilst the NPPF concentrates on high level national policy, the FRCC-PPG is more detailed. The practice guidance advises on how planning can take account of the risks associated with flooding and coastal change in plan making and the development management process. This is in respect of Local Plans, SFRAs, the sequential and exception tests, permitted development, site-specific flood risk, Neighbourhood Planning, flood resilience and resistance techniques and the vulnerability of development to make development safe from flooding. The national PPG also includes guidance for water supply, wastewater and

water quality. The Local Plan will need to contend with the contribution that can be made to a 'catchment-based approach' to water.
The Flood Risk and Coastal Change Planning Practice Guidance (FRCC-PPG) sits alongside the NPPF and sets out detailed guidance on how this policy should be implemented. It is due to be updated in 2019 to reflect the changes to the NPPF section on flooding and coastal change in 2018. The revised NPPG was not available at the time this SFRA was prepared.

2.3 The risk-based approach

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

2.3.1 The Flood Zones

The definition of the Flood Zones is provided below. The Flood Zones do not take into account defences. This is important for planning long term developments as long-term policy and funding for maintaining flood defences over the lifetime of a development may change over time.
The Flood Zones do not take into account surface water, sewer or groundwater flooding or the impacts of canal or reservoir failure. They do not consider climate change. Hence there could still be a risk of flooding from other sources and that the level of flood risk will change over time during the lifetime of a development.
The Flood Zones are:

- Flood Zone 1: Low probability: less than a 0.1% chance of river and sea flooding in any given year.
- Flood Zone 2: Medium probability: between a 1% and 0.1% chance of river flooding in any given year or 0.5% and 0.1% chance of sea flooding in any given year.
- Flood Zone 3a: High probability: greater or equal to a 1% chance of river flooding in any given year or greater than a 0.5% chance of sea flooding in any given year. Excludes Flood Zone 3b.
- Flood Zone 3b: Functional Floodplain: land where water has to flow or be stored in times of flood. SFRAs identify this Flood Zone in discussion with the LPA and the Environment Agency. The identification of functional floodplain takes account of local circumstances. Only water compatible and essential infrastructure are permitted in this zone and should be designed to remain operational in times of flood, resulting in no loss of floodplain or blocking of water flow routes.

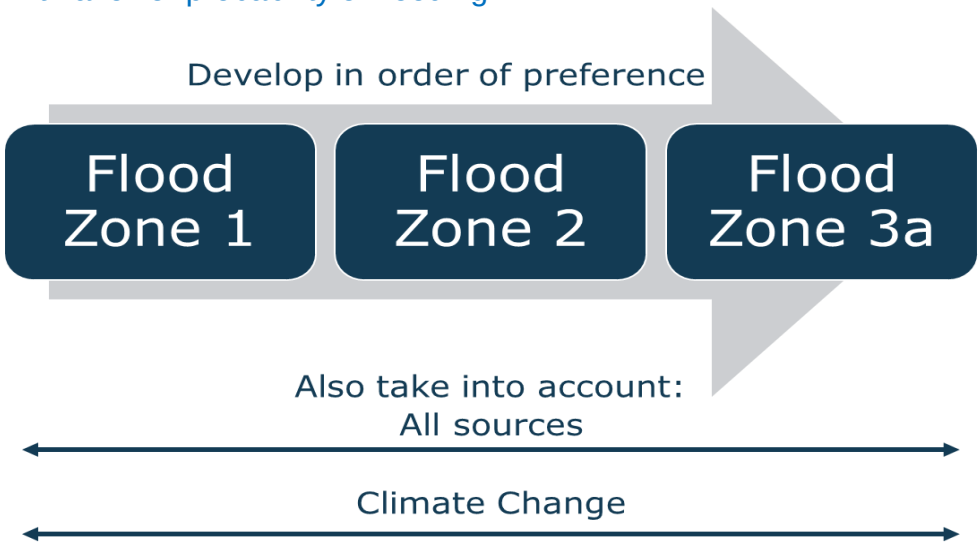
The Environment Agency's Flood Zone maps do not cover every watercourse (for example if <3km2 catchment area), or Ordinary Watercourses. Hydraulic modelling may be required for more detailed Flood Risk Assessment studies, or as part of a Level 2 SFRA, to provide the required detail to support a site's development. If a watercourse or drain is shown on OS mapping but is not covered by a Flood Zone, this does not mean there is no potential flood risk. A model would likely be required at a site-specific level to confirm the flood risk to the site.

The Flood Zones in the Appendix A Geo-PDFs are largely the same as those shown on the Environment Agency's 'Flood Map for Planning', with the exception of the Fowlea Brook which is based on the latest flood modelling output.

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, but there may be a flood risk from smaller watercourse not shown in the Flood Zones.
Functional floodplain (Flood Zone 3b) is land which would flood with an annual probability of 1 in 20 years; where detailed modelling exists, the 1 in 20-year flood extent has been used to represent Flood Zone 3b (provided by the Environment Agency).
For areas outside of the detailed model coverage, this is represented by Flood Zone 3a (indicative Flood Zone 3b) 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.

2.3.2 The Sequential Test

The Sequential Test must be performed when considering the placement of future development and for planning application proposals. The Sequential Test is used to direct all new development to locations at the lowest probability of flooding. It states that development should not be permitted or allocated if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding.



* All sources includes: minor watercourse flooding, surface water/pluvial flooding, groundwater flooding, sewer flooding, canal breach or overtopping and reservoir flooding.

Figure 2-3: The Sequential Test

Firstly, land at the lowest risk of flooding and from all sources should be considered for development. A test is applied called the 'Sequential Test' to do this. Figure 2-3 summarises the Sequential Test. The LPA will apply the Sequential Test to strategic allocations. For all other developments, developers must supply evidence to the LPA, with a Planning Application, that the development has passed the test.

The LPA should work with the Environment Agency to define a suitable area of search for the consideration of alternative sides in the Sequential Test. The Sequential Test can be undertaken as part of a Local Plan Sustainability Appraisal. Alternatively, it can be demonstrated through a free-standing document, or as part of Strategic Housing Land or Employment Land Availability

Assessments.
Table 2 of the NPPG defines the vulnerability of different development types to flooding. Table 3 of the NPPG shows whether, having applied the Sequential Test first, that vulnerability of development is suitable for that Flood Zone and where further work is needed. Whether any further work is needed to decide if the land is suitable for development will depend on both the vulnerability of the development and the Flood Zone it is proposed for.

2.3.3 The Exception Test

It will not always be possible for all new development to be allocated on land that is not at risk from flooding. To further inform whether land should be allocated, or Planning Permission granted, a greater understanding of the scale and nature of the flood risks is required. In these instances, the Exception Test will be required.
The Exception Test should only be applied following the application of the Sequential Test. It applies in the following instances:

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

Figure 2-4 summarises the Exception Test. An LPA should apply the Exception Test to strategic allocations. For all developments, developers must supply evidence to the LPA, with a Planning Application, that the development has passed the test. This is because when a site-specific Flood Risk Assessment is done, more information on the exact measures that can manage the risk is available.

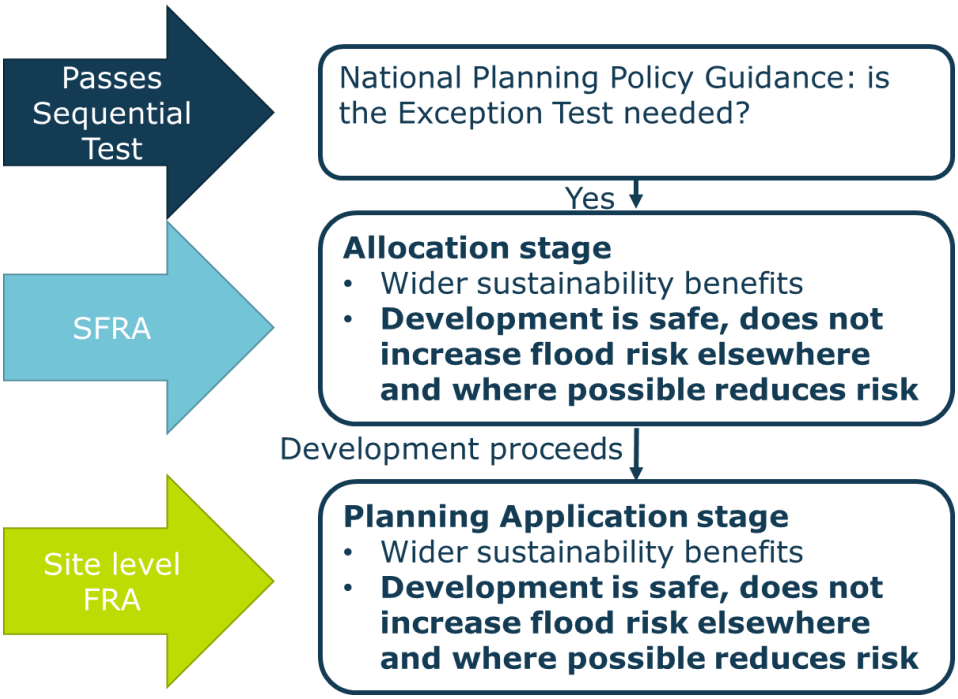


Figure 2-4 The Exception Test
There are two parts to demonstrating a development passes the Exception Test:

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

Local planning authorities will need to consider what criteria they will use to

assess whether this part of the Exception Test has been satisfied and give advice to enable applicants to provide evidence to demonstrate that it has been passed. If the application fails to prove this, the Local Planning Authority should consider whether the use of planning conditions and / or planning obligations could allow it to pass. If this is not possible, this part of the Exception Test has not been passed and planning permission should be refused.

- Demonstrating that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

A Level 2 SFRA is likely to be needed to inform the Exception Test in these circumstances for strategic allocations. At Planning Application stage, a site-specific Flood Risk assessment will be needed. Both would need to consider the actual and residual risk and how this will be managed over the lifetime of the development.

2.4 Local Plans

A Local Plan is a statutory document prepared in consultation with the local community. It is designed to promote and deliver sustainable development. Local Plans have to set out a clear vision, be kept up to date and to set out a framework for future development of the local area, addressing needs and opportunities in relation to housing, the economy, community facilities and infrastructure as well as safeguarding the environment and adapting to climate change and securing good design.
Local plans set the context for guiding decisions and development proposals and along with the NPPF, set out a strategic framework for the long-term use of land and buildings, thus providing a framework for local decision making and the reconciliation of competing development and conservation interests. The aim of a Local Plan is to ensure that land use changes proceed coherently, efficiently, and with maximum community benefit. Local plans should indicate clearly how local residents, landowners, and other interested parties might be affected by land use change. They are subject to regular periods of intensive public consultation, public involvement, negotiation and approval. The Local Plan should be the starting point when considering planning applications.

2.4.1 The Newcastle and Stoke-on-Trent Local Plan

The joint Newcastle and Stoke-on-Trent Local Plan, which is currently in the Production phase, is scheduled for consultation in Autumn 2019 and will look ahead to the year 2033. The previous Local Plan was published October 2003. The aim of the Local Plan is to establish a planning framework for future development, identifying how much land is available and where such land should be provided for new homes and employment, alongside associated infrastructure.
The Draft Local Plan will set strategic objectives relating to business, people, place and infrastructure, which will provide a basis for the policies of the Local Plan.

Flood risk policy and strategy

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 strategic documents and flood risk responsibilities.

2.5 Relevant legislation

The following legislation is relevant to development and flood risk across Stoke-on-Trent

- **Flood Risk Regulations (2009)** – these transpose the European Floods Directive (2000) into law and require the Environment Agency and LLFAs to produce Preliminary Flood Risk Assessments and identify where there are nationally significant Flood Risk Areas. For the Flood Risk Areas, detailed flood maps and a Flood Risk Management Plan is produced. This is done in a six-year cycle and Stoke-on-Trent sits within the wider Flood Risk Management Plans that were led by the Environment Agency for the wider catchments.
- **Town and Country Planning Act (1990), Water Industry Act (1991), Land Drainage Act (1991), Environment Act (2005), Flood and Water Management Act (2010)** – as amended and implanted via secondary legislation. These set out the roles and responsibilities for organisations that have a role in FRM.
- The **Land Drainage Act (1991, as amended) and Environmental Permitting Regulations (2016)** also set out where developers will need to reply for additional permission (as well as Planning Permission) to undertake works to an Ordinary Watercourse or Main River.
- The **Water Environment Regulations (2017)** – these transpose the European Water Framework Directive (2000) into law and require the Environment Agency to produce River Basin Management Plans (RBMPs). These aims to ensure that the water quality of aquatic ecosystems, riparian ecosystems and wetlands reaches 'good status'.
- Other environmental legislation such as the Habitats Directive (1992), Environmental Impact Assessment Directive (2014) and Strategic Environmental Assessment Directive (2001) also apply as appropriate to strategic and site-specific developments to guard against environmental damage.

2.6 Roles and responsibilities for Flood Risk Management in Stoke-on-Trent

There are different organisations that cover Stoke-on-Trent that have responsibilities for flood risk management, known as Risk Management Authorities (RMAs). These are shown on Table 0-1 with an overview of their responsibilities.

Table 0-1: Risk Management Authorities

Risk Management Authority	Strategic Level	Operational Level	Planning role
Environment Agency	Strategic overview for all sources of flooding National Strategy Reporting and general supervision	Main rivers (e.g. River Trent, Fowlea Brook) Reservoirs	Statutory consultee for development in Flood Zones 2 and 3
Stoke-on-Trent City Council as Lead Local Flood Authority (LLFA)	Preliminary Flood Risk Assessment Local Flood Risk Management Strategy	Surface Water Groundwater Ordinary Watercourses (consenting and enforcement) Ordinary watercourses (works)	Statutory consultee for major developments
Stoke-on-Trent City Council as Local Planning Authority	Local Plans as Local Planning Authorities	Determination of Planning Applications as Local Planning Authorities	As left
Water Companies: Severn Trent Water	Asset Management Plans, supported by Periodic Reviews (business cases) Develop Drainage and Wastewater management plans	Public sewers	Non-statutory consultee
Highways Authorities Highways England (motorways and trunk roads) SoTCC (other adopted roads)	Highway drainage policy and planning	Highway drainage	External planning consultee regarding highways design standards and adoptions

2.7 Roles and Responsibilities

The responsibilities for the Risk Management Authorities (RMA) are summarised further below.

2.7.1 EA as RMA

- Has a strategic overview role for all forms of flooding;
- Has the power to request information from any partner in connection with its risk management functions;
- Must exercise its flood or coastal erosion risk management functions in a

manner consistent with the National Strategy and Local Strategies;
- Must be consulted on Local Strategies, if affected by the strategy, by the LLFA;
- Must help advise on sustainable development.

2.7.2 Stoke-on-Trent City Council Local Planning Authority as a RMA

- Has a duty to act in a manner that is consistent with the National Strategy and have regard to Local Strategies;
- Must be consulted on Local Strategies, if affected by the strategy, by the LLFA;
- Has a duty to be subject to scrutiny from the LLFA;
- Has a duty to cooperate and share information with other RMAs.

2.7.3 Stoke-on-Trent City Council Lead Local Flood Authority as a RMA

- Must develop, maintain, apply and monitor a strategy for local flood risk management. This must be consulted on with all RMAs, the public and all other partners with an interest in local flood risk, and must comply with the National Strategy;
- Is required to coordinate and share information on local flood risk management between relevant authorities and partners;
- Is empowered to request information from others when it is needed in relation to its flood risk management functions;
- Must investigate significant flooding incidents in its area where it considers it necessary or appropriate;
- Has a duty to establish and maintain a record of structures within its area that it considers to have a significant impact on local flood risk;
- Is empowered to designate structures and features that affect flooding;
- Has powers to undertake works to manage flood risk from surface runoff, groundwater and ordinary watercourses;
- Must exercise its flood and coastal erosion risk management functions in a manner consistent with the National Strategy and the Local Strategy;
- Is permitted to agree the transfer of responsibilities for risk management functions (except the production of a Local Strategy) to other RMAs;
- Must aim to contribute to sustainable development;
- Should consider flooding issues that require collaboration with neighbouring LLFAs and other RMAs;
- The LLFA is a statutory consultee of the planning process and provides advice on major planning applications.

Table 0-2 provides an overview of the key LLFA responsibilities under the FWMA.

Table 0-2: Key LLFA Duties under the FWMA
(Latest changes to FWMA legislation)

FWMA Responsibility	Description of duties and powers	SoTCC LLFA Status

Local Strategy for Flood Risk Management	A LLFA has a duty to develop, maintain, apply and monitor a local strategy for flood risk management in its area. The local strategies will build on information such as national risk assessments and will use consistent risk-based approaches across different LA areas and catchments. The local strategy will not be secondary to the national strategy; rather it will have distinct objectives to manage local flood risks important to local communities.	Published March 2016 as a 'living document'
Duty to contribute to sustainable development	The LLFA has a duty to contribute towards the achievement of sustainable development.	Stoke-on-Trent as LLFA statutory consultee and Highways
Duty to comply with national strategy	The LLFA has a duty to comply with national flood and coastal risk management strategy principles and objectives in respects of its flood risk management functions.	Consistent with aims and objectives such as community focus and proportionate risk-based approach to achieve multiple benefits
Investigating Flood Incidents	The LLFA, on becoming aware of a flood in its area, has (to the extent it considers necessary and appropriate) to investigate and record details of "locally significant" flood events within their area. This duty includes identifying the relevant risk management authorities and their functions and how they intend to exercise those functions in response to a flood. The responding risk management authority must publish the results of its investigation and notify any other relevant risk management authorities.	Formal S19 investigations procedures for flood incidents that fall under the remit of the LLFA
Asset Register	A LLFA has a duty to maintain a register of structures or features, which it considers to have a significant effect on flood risk, including details on ownership and condition as a minimum. The register must be available for inspection and the Secretary of State will be able to make regulations about the content of the register and records.	Development and ongoing update to asset register with details of any flood defence schemes and any drainage schemes

Duty to co-operate and Powers to Request Information	The LLFA must co-operate with other relevant authorities in the exercise of their flood and coastal erosion management functions.	LFRMS provides a structured approach to fulfil and deliver its duty to manage and reduce flood risk within the city in partnership with others and share data.
Ordinary Watercourse Consents	A LLFA has a duty to deal with enquiries and determine watercourse consents where the altering, removing or replacing of certain flood risk management structures or features that affect flow on ordinary watercourses is required. It also has provisions or powers relating to the enforcement of unconsented works.	Consenting works for ordinary watercourses including guidance on culverts and surface water flood risk.
Works Powers	The Act provides a LLFA with powers to undertake works to manage flood risk from surface runoff and groundwater, consistent with the local flood risk management strategy for the area. The City Council can also undertake works on Ordinary Watercourses.	Permissive powers to undertake works on an ordinary watercourse to alleviate flooding and powers to serve notice on riparian owners, for the removal of any blockage to an ordinary watercourse.
Designation Powers	The Act provides a LLFA with powers to designate structures and features that affect flooding or coastal erosion. The powers are intended to overcome the risk of a person damaging or removing a structure or feature that is on private land and which is relied on for flood or coastal erosion risk management. Once a feature is designated, the owner must seek consent to alter, remove, or replace it.	Powers to designate assets, structures or features for inclusion in the Asset Register which have a significant effect on flood risk.
Emergency Planning	A LLFA supports the Local Resilience Forum with emergency planning and recovery after a flood event.	Stoke-on-Trent City Council has a duty to ensure the City is prepared to respond to an emergency, under the Civil Contingencies Act 2004.

Community Involvement	A LLFA can engage local communities in local flood risk management issues. This might include the training of community volunteers, the development of local flood action groups and the preparation of community flood plans and general awareness raising around roles and responsibilities.	Engage with communities to help them understand the risks, and encourage them to have direct involvement in decision-making and risk management actions
Planning Requirements for SuDS	Sustainable Drainage Systems (SuDS) are a planning requirement for major planning applications of 10 or more residential units or equivalent commercial development schemes with sustainable drainage. The LLFA is now a statutory planning consultee and it will be between the LPA and the LLFA to determine the acceptability of these proposed sustainable drainage schemes subject to exemptions and thresholds. Approval must be given before the developer can commence construction. Planning authorities should use planning conditions or obligations to make sure that arrangements are in place for ongoing maintenance of any SuDS over the lifetime of the development.	Production of the SuDS Handbook to provide the LPA and Developers with consistent flood risk advice on sustainable drainage systems across Stoke-on-Trent and north Staffordshire

2.7.4 Severn Trent Water / United Utilities as a RMA

- Has a duty to act in a manner that is consistent with the National Strategy and have regard to Local Strategies;
- Must be consulted on Local Strategies, if affected by the strategy, by the relevant LLFA;
- Has a duty to be subject to scrutiny from LLFAs;
- Has a duty to cooperate and share information with other RMAs;
- Is responsible for managing the risks of flooding from water and foul or combined sewer systems providing drainage from buildings and yards.

2.7.5 Highways Authority (Stoke-on-Trent City Council) and Highways England as RMAs

- Have a duty to act consistently with the National Strategy and Local Strategies;
- Have responsibility for ensuring effective drainage of local roads in so far as ensuring drains and gullies are maintained;
- Must be consulted on Local Strategies, if affected by the Strategy, by the LLFA;
- Have a duty to be subject to scrutiny from LLFAs.

2.7.6 The Local Community

- Must be consulted on Local Strategies by the LLFA;
- Has a key role in ensuring local strategies are capable of being successfully delivered within the community. They should actively participate in this process and be engaged by the LLFA.

2.7.7 Riparian Owners

A riparian owner is someone who owns land or property alongside a river or other watercourses. A watercourse is any natural or artificial channel through which water flows including flow through a culvert, ditch, drain, cut, dyke, sluice or private sewer.

Riparian owners have statutory responsibilities, including:

- Maintaining watercourses;
- Allowing the flow of water to pass without obstruction;
- Controlling invasive alien species.

Further guidance for riverside property owners can be found in on the government website.

2.8 Key legislation

2.8.1 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 Stoke-on-Trent PFRA (2010) provides information on significant past and future flood risk from localised flooding in Shropshire. This was updated in 2017, and no nationally significant Flood Risk Areas for localised flooding have been identified in Stoke-on-Trent.

In 2018, the Environment Agency undertook a PFRA for river, sea and reservoir flooding which identified nationally significant Flood Risk Areas for these sources.

2.8.2 Flood and Water Management Act (FWMA), 2010

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

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

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

2.8.3 Planning Act, 2008

This act predominantly applies to streamlining the approval of major national

infrastructure development. However, this act also allowed for the streamlining of planning appeals for minor developments by allowing appeals to be heard and considered by a panel of local councillors rather than by a planning inspector. The Community Infrastructure Levy (CIL) was also formed from the Planning Act whereby a local authority could place a levy on a new development to help finance local infrastructure projects designed to benefit the local area, such as a new school, health centre or park improvements.

2.8.4 Water Framework Directive & Water Environment Regulations

The purpose of the Water Framework Directive (WFD), which was transposed into English Law by the Water Environment Regulations (2003), is to deliver improvements across Europe in the management of water quality and water resources through a series of plans called River Basin Management Plans (RBMP). The SoTCC area is covered by the River Trent and North West River Basin Management Plans, managed by the EA and published in 2015. Water quality and flood risk can go hand in hand in that flood risk management activities can help to deliver habitat restoration techniques. The Trent RBMP, 2015, includes such examples whereby land management techniques have been designed to reduce flood risk whilst also reducing sediment loss and improving water quality.

The EA is responsible for monitoring and reporting on the objectives of the WFD on behalf of Government. They work with Government, Ofwat, local government, non-governmental organisations (NGOs) and a wide range of other stakeholders including local businesses, water companies, industry and farmers to manage water.

The second management cycle of the WFD has already begun and the second river basin management plans were completed in 2015, building upon the first set of RBMPs completed in 2009.

The main responsibility for SoTCC is to work with the EA to develop links between river basin management planning and the development of Local Authority plans, policies and assessments. In particular, the programme of actions (measures) within the RBMP highlights the need for:

- Water Cycle Studies to promote water efficiency in new development through regional strategies and local development frameworks;
- Surface Water Management Plan implementation;
- Considering the WFD objectives (achieving good status or potential as appropriate) in the spatial planning process, including LDDs and Sustainable Community Strategies; and
- Promoting the wide scale use of Sustainable Drainage Systems (SuDS) in new development.

The joint Stoke-on-Trent and Newcastle-Under-Lyme Water Cycle Study, published 2019 (see Section 3.5.6) will assist the council to select and develop sustainable development allocations where there is minimal impact on the environment, water quality, water resources, infrastructure and flood risk.

The Stoke-on-Trent area is supplied by the North Staffordshire Water Resource Zone. Assessment shows that, without any further investment, the WRZ will face a supply / demand shortfall over the next 25 years. In order to meet the supply needs, there are several proposals in place, with the aim of preventing the deficits. Severn Trent Water stated that they would have adequate water resource for all proposed development sites and that no limitations on the

provision of water supply infrastructure were identified. Within a Phase 2 Water Cycle Study, consideration should be paid to river systems those which already have a 'poor' or 'bad' status and for catchments forecast for increased growth.

2.9 Key national, regional and local policy document and strategies

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

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

The Strategy is currently being updated and is due to be published in 2020, following a public consultation in 2019.

2.9.2 River Basin Management Plans

The Humber River Basin District River Basin Management Plan (RBMP), written by the EA, has been updated since the first cycle in 2009. The latest version was published in December 2015. Water quality and flood risk can go hand in hand in that flood risk management activities can help to deliver habitat restoration techniques. The Humber RBMP includes such examples whereby land management techniques have been designed to reduce flood risk whilst also reducing sediment loss and improving water quality. The plans include an assessment of river basin characteristics, a review of the impact on human activity, statuses of water bodies, and an economic analysis of water use and progress since the first plan in 2009. The Plans are currently being reviewed.

2.9.3 Flood Risk Management Plans

Flood Risk Management Plans (FRMPs) are part of the six-year cycle of assessment, mapping and planning required under the Flood Risk Regulations.

The Environment Agency led the development of the Humber FRMPs, which were published in 2015. The FRMPs summarise the flooding affecting the area and describes the measures to be taken to address the risk in accordance with the Flood Risk Regulations. The FRMPs draw on policies and actions identified in Catchment Flood Management Plans and Local Flood Risk Management Strategies. The Plans will be updated as part of the new cycle of the Flood Risk Regulations and are due to be published in December 2021.

2.9.4 Catchment Flood Management Plans

Catchment Flood Management Plans (CFMPs) are a high-level strategic plan providing an overview of flood risk across each river catchment. The Environment Agency use CFMPs to work with other key-decision makers to identify and agree long-term policies for sustainable flood risk management. The River Trent Catchment Flood Management Plan covers the study area. The actions of this were brought forward into the 2015 Humber Flood Risk Management Plan.

Stoke-on-Trent Local Flood Risk Management Strategy

The Stoke-on-Trent LFRMS was adopted in 2016. The Strategy sets out how Stoke-on-Trent will manage flood risk from surface water runoff, groundwater and ordinary watercourses for which they have a responsibility as LLFA, and other types of flooding where local agents can play a supporting role to lead agencies.

The Local FRM Strategy sets out SoTCC's aims and objectives for managing local flood risk and policies on:

- When the LLFA will investigate flooding incidents
- How the LLFA will collate data on flood risk assets
- Where the LLFA will designate third party assets affecting flood risk
- How the LLFA will respond to planning applications
- How the LLFA will work with others to develop flood risk schemes
- How the LLFA will preserve watercourses in their natural state
- When the LLFA will take land drainage enforcement action
- How the LLFA will seek to improve the environment

The Strategy notes that the council will seek to deliver sustainable drainage systems (SuDS) as part of new development in its roles as statutory consultee for major planning applications and non-statutory consultee for non-major planning applications.

2.9.5 Water Cycle Studies

Water Cycle Studies (WCS) – scoping, outline and detailed – assist Councils to select and develop sustainable development allocations in locations where there is minimal impact on the environment, water quality, water resources, infrastructure, and flood risk. WCS's provide the required evidence, and an agreed strategy, to ensure that planned growth occurs within environmental constraints (and where possible contributes to environmental improvements), with the appropriate infrastructure in place in a timely manner so that planned allocations are deliverable. This is undertaken by identifying areas where there may be conflict between any proposed development, the requirements of the environment and by recommending potential solutions to these conflicts.

A joint WCS for Stoke-on-Trent and Newcastle-Under-Lyme will be published in 2019 and will assist the council to select and develop sustainable development

allocations where there is minimal impact on the environment, water quality, water resources, infrastructure, and flood risk.

2.9.6 Surface Water Management Plans

A Surface Water Management Plan (SWMP) is a study to understand the flood risks that arise from local flooding, which is defined by the Flood and Water Management Act 2010 as flooding from risk from surface runoff, groundwater, and ordinary watercourses. SWMPs are led by a partnership of flood risk management authorities who have responsibilities for aspects of local flooding, including the City Council, Local Authority, Sewerage Undertaker and other relevant authorities. The purpose of a SWMP is to identify what the local flood risk issues are, what options there may be to prevent them or the damage they cause and who should take these options forward. This is then presented in an Action Plan that the stakeholders and partners agree.
There is a SWMP for Stoke-on-Trent that will be published in 2020. The analysis of localised flooding in the City has been included in the SFRA.

2.10 Partnership working in Stoke-on-Trent

Figure 0-1 shows the how partnership working between Risk Management Authorities is structured in Stoke-on-Trent.

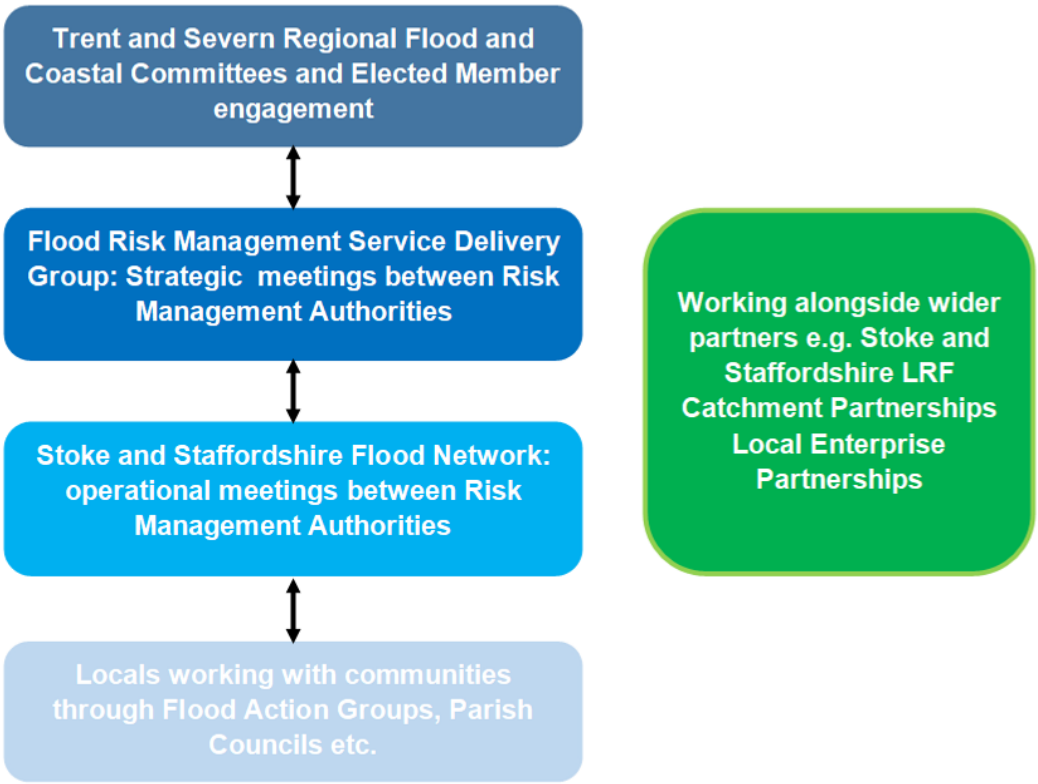


Figure 0-1 Partnership working in Stoke-on-Trent
Key water environment partnership projects have been set out below.

2.10.1 River Trent Headwaters Project

As part of the Staffordshire Trent Valley Catchment Partnership, the Headwaters project aims to identify locations and opportunities where the rivers and brooks, which encompass the Trent Headwaters, can be improved to create better

environments for people and wildlife across Stoke-on-Trent and Newcastle-under-Lyme. The headwaters of the Trent flow through grazing land before entering Stoke-on-Trent and Newcastle-under-Lyme. The urban environment has a major impact on the morphology, ecology and water quality of the River Trent with diffuse pollution from roads along with misconnections and intermittent discharges from sewage systems being reported as a significant reason for failure within this catchment in addition to physical modifications to the water courses. The project has been identified as key to achieving objectives for 2027 within the Humber River Basement Management Plan, and the techniques deployed will deliver valuable morphological and ecological improvements to the benefit of all river biota. Projects and enhancements have taken place on the Scotia Brook, Ford Green Brook, Causley Brook, Fowlea Brook, the Lyme Brook and Cockster / Longton Brooks, which all feed into the headwaters of the River Trent upstream of Trentham Estate.

2.10.2 SUNRISE

The Trent SUNRISE (Stoke and Urban Newcastle Rediscovering Its Secret Environments) project has identified a programme of works to link, buffer, restore and recreate habitats across Stoke-on-Trent and the urban area of Newcastle, with a special focus on improving riverside areas and grassland restoration and a range of interventions to improve watercourses. This includes SuDS retrofit options, barrier removal, restoration, re-routeing channels and pond creation. The project entails work at numerous locations such as Ford Green Brook, Milton, Fowlea Brook, Cromer Road, Bucknall Park, Causeley Brook, Trent Mill, Victoria Ground, and a SuDS Retrofit Project over the City area. Measures include the installation of woody debris and berms to encourage Rivers and brooks to meander, enhancements to riparian environment and to protect existing geomorphological features, the grassland restoration of several areas along the brook and control of invasive species such as Himalayan Balsam. The project, led by Stoke-on-Trent City Council, will be delivered in the main by Staffordshire Wildlife Trust and will see work take place across Stoke-on-Trent and Newcastle-under-Lyme until 2021, focusing on watercourses and urban green spaces.

2.10.3 Stoke-on-Trent Integrated Catchment Strategy (SoTICS)

Stoke-on-Trent City Council is working in partnership on a national Pilot with the Environment Agency and Severn Trent Water, to establish a long term strategic framework for aligning investment and infrastructure delivery in water management. The framework will to help with the shared ambition to improve and transform the City to support resilient sustainable economic growth and has led to the emerging draft Stoke-on-Trent Integrated Catchment Strategy (SoTICS).

The SoTICS approach seeks to embed an evidence led approach to water infrastructure planning and delivery as an integral part of local place shaping, and will:

- identify and deliver efficient shared outcomes;
- enable robust and effective investment decision making, maximising environmental, social and economic returns;
- help to drive forward sustainable local economic growth that goes beyond just environmental protection;

- Advocate an approach that delivers climate resilient infrastructure.

The SoTICS approach supports both a national and local step change around water infrastructure and climate resilience. There is increasing recognition that alongside the site based mitigation measures required for new development through the current planning framework (NPPF) to consider and manage site based risks, consideration needs to be given to the cumulative impact of growth across places, including land use, infrastructure and community and business resilience, to deliver betterment and climate change adaptation in the most efficient and coordinated way. In so doing, the SoTICS approach seeks to underpin the emerging objectives in the Draft National Flood and Coastal Erosion Risk Management Strategy for England and assists Stoke on Trent City Council in implementing a suite of actions around the recently announced Climate Emergency.

2.10.4 Stoke-on-Trent City Council Flood Protection Capital Programme

Through the City Council's Capital Investment Programme, a programme of flood protection works was developed in 2016. These works seek to reduce the likelihood of flooding to people, property and land, and to improve the drainage infrastructure across the city. The works that have been identified have been measured against criteria such as: corporate priorities; meeting the objectives set out in the Local Flood Risk Management Strategy; reducing flood risk to people, property and business and the highway network; providing a more flood resilient drainage network; delivering multiple benefits from single schemes; targeting known flood risk hotspots; being based on most recent flood risk information; addressing health and safety concerns and seeking partnership funding, where available.

3 Understanding flood risk in Stoke-on-Trent

This is a strategic summary of the risk. Developers should use this Section to scope out the flood risk issues they need to consider in greater detail in a site-specific Flood Risk Assessment to support a Planning Application.
Table 3 2 contains a list of the sources of data used in the SFRA and Appendix C contains further details regarding data sources and key datasets.

3.1 Sources of Flooding

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

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

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

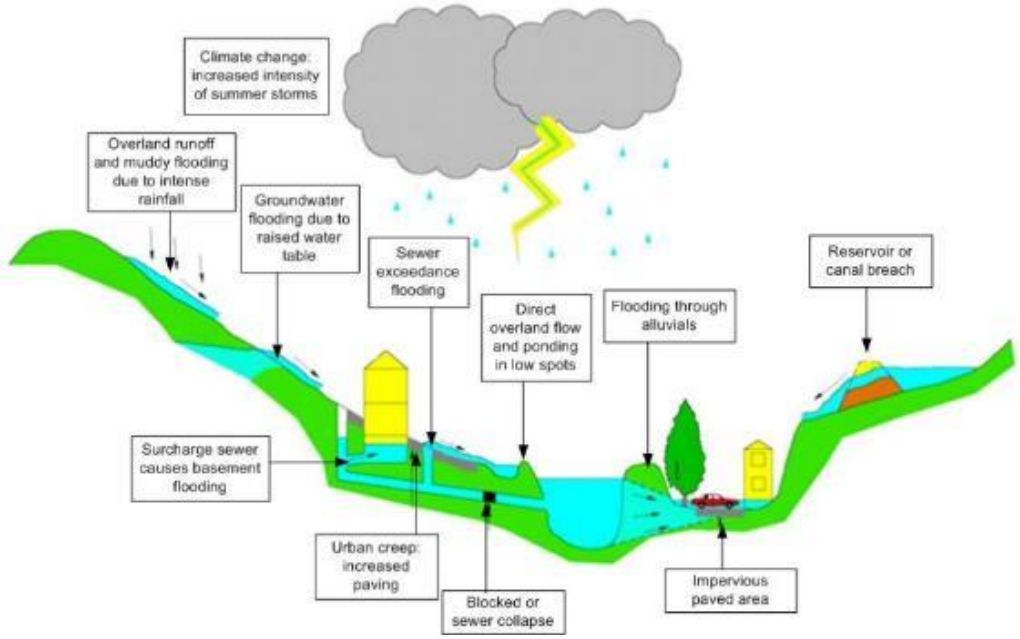


Figure 3-1: Flooding from all sources

3.2 Likelihood and Consequence

Flood risk is a combination of the likelihood of flooding and the potential consequences arising. It is assessed using the source – pathway – receptor model as shown in Figure 3-2 below. This is a standard environmental risk model common to many hazards and should be the starting point of any assessment of flood risk. However, it should be remembered that flooding could occur from many different sources and pathways, and not simply those shown in the illustration below.

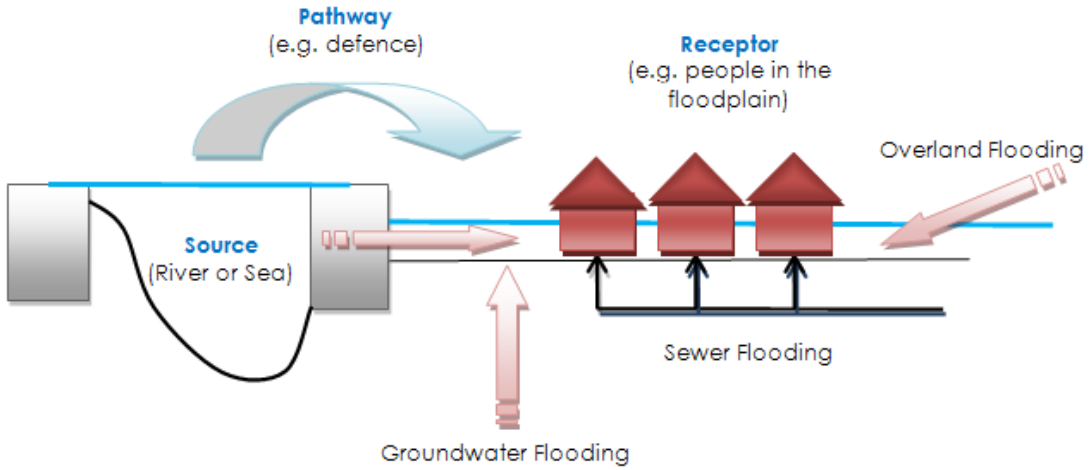


Figure 3-2: Source-Pathway-Receptor Model

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

3.2.1 Likelihood

Likelihood of flooding is expressed as the percentage probability based on the average frequency measured or extrapolated from records over a large number of years. A 1% probability indicates the flood level that is expected to be reached on average once in a hundred years, i.e. it has a 1% chance of occurring in any one year, not that it will occur once every hundred years. Table 3-1 provides an example of the flood probabilities used to describe Flood Zones as defined in the FRCC-PPG and as used by the EA in their Flood Map for Planning (Rivers and Sea).

Table 3-1: NPPF Flood Zones

Flood Zone	Annual Probability of Flooding
Zone 1 - Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the EA. (Not separately distinguished from Zone 3a on the Flood Map)

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

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

3.2.2 Consequence

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

Flood Risk = **Probability of flooding** x **Consequence of flooding**

3.3 Risk

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

3.3.1 Actual and residual flood risk

A Level 2 SFRA (for strategic allocations) or developer site specific flood risk assessment will need consider the actual and residual flood risk due to the presence of flood and drainage assets in greater detail.

3.3.2 Actual flood risk

This is the risk to the site considering existing flood mitigation measures and any planned to be provided through new development. Note that it is not likely to be acceptable to allocate developments in existing undefended areas on the basis that they will be protected by developer works, unless there is a wider community benefit that can be demonstrated.

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

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

3.3.3 Residual risk

Residual risk is the risk that remains after the effects of flood risk infrastructure have been taken into account. It is important that these risks are quantified to confirm that the consequences can be safely managed. The residual risk can be:

- The effects of a larger flood than defences were designed to alleviate (the ‘design flood’). This can cause overtopping of flood banks, failure of flood gates to cope with the level of flow or failure of pumping systems to cope with the incoming amount of water.
- Failure of the defences or flood risk management measures, such as

breaches in embankments or walls, failure of flood gates to open or close or failure of pumping stations.

- Culverted watercourses and ageing drainage systems across Stoke-on-Trent pose a hidden flood risk. In many areas, especially in older Victorian areas, there is noted interaction between the public sewer networks and culverted watercourses and many historic culverts are still unknown or untraced.

A wall adjacent the River Trent along the A500 between Shelton and Mount Pleasant is a section of formal flood defence for protection against fluvial flooding. Consequently, there are areas vulnerable to rapid inundation in the event of a breach / failure. The assessment of the residual risk from any formal or defacto flood defence should take into account the following:

- The flood hazard, depth and velocity that would result from overtopping or breach of defences. Flood gate or pumping station failure and/ or culvert blockage (as appropriate). The Environment Agency can provide advice at site-specific development level for advice on breach/ overtopping parameters for flood models.
- The design of the development to take account of the highest risk parts of the site e.g. allowing for flood storage on parts of the site and considering the design of the development to keep people safe e.g. sleeping accommodation above the flood level.
- A system of warning and a safe means of access and egress from the site in the event of a flood for users of the site an emergency service.

3.4 Flood Risk Datasets

This section of the SFRA provides a strategic overview of flood risk from all sources within the city. The information contained is the best available at the time of publication and is intended to provide Stoke-on-Trent City Council with an overview of risk. Where further detail is available, then the source of information is provided. Table 3-2 provides a summary of the key datasets used in this SFRA according to the source of flooding, further details regarding the sources of the SFRA data can be found in Appendix C.

Table 3-2: Flood source and key datasets

Flood Source	Datasets / Studies
Fluvial	Environment Agency (EA) Flood Map for Planning (Rivers and Sea)
	EA Risk of Flooding from Rivers and the Sea Map
	EA Flood Risk Mapping Studies (See Appendix D)
	Historic evidence – EA Historic Flood Map
	Trent Catchment Flood Management Plans
Pluvial (surface water runoff)	EA Risk of Flooding from Surface Water (RoFfSW)
	Stoke-on-Trent City Council Preliminary Flood Risk Assessment
	Stoke-on-Trent City Council Detailed flood modelling outputs
	Stoke-on-Trent City Council Surface Water Management Plan outputs
Sewer	Historic Flood Risk Register
	Drainage Area Zones

Groundwater	JBA Groundwater Flood Risk Map
Canal	Canal & River Trust Open Data
Reservoir	EA Reservoir Flood Maps (available online)
All sources	Stoke-on-Trent City Council Local Flood Risk Management Strategy
	Staffordshire Fire Brigade historic flood incident data
	Trent River Basin Management Plan
	Trent Flood Risk Management Plan
	Stoke-on-Trent Surface Water Management Plan
	Stoke-on-Trent City Council Level 1 SFRA (2008)
Flood risk management infrastructure	EA flood defence data

3.4.1 Data Gaps

A review of the supplied data has indicated potential further assessment areas or data gaps, which could be facilitated through flood modelling. Recommendations have been made for more detailed modelling work or future investigations, which would provide a greater level of flood risk information and more confidence in results. This has been undertaken by reviewing the Environment Agency's Flood Zone mapping in those areas not covered by existing detailed hydraulic models:

- The Environment Agency's Flood Zone maps do not cover every watercourse (for example if <3km2 catchment area), or Ordinary Watercourses. Hydraulic modelling may be required for more detailed Flood Risk Assessment studies, or as part of a Level 2 SFRA, to provide the required detail to support a site's development. If a watercourse or drain is shown on OS mapping but is not covered by a Flood Zone, this does not mean there is no potential flood risk. A model would likely be required at detailed site-specific level to confirm the flood risk to the site.
- Locations where surface water flooding is the predominant flood risk could be investigated further by use of surface water hydraulic modelling, or in combination with fluvial modelling, to assess the interactions between the two in more detail. Similarly, for any locations which suffer from sewer flooding or sewer capacity issues; this data can be incorporated into hydraulic models to more accurately represent the surface water system.
- It is known that there are inconsistencies and/or uncertainties in the Flood Zones:
- Flood Zone 3b has been represented as the 1 in 20-year flood extent where detailed hydraulic modelling outputs were available. Outside of detailed model coverage, Flood Zone 3b has been represented by Flood Zone 3a (this is called the "indicative Flood Zone 3b" and provides a conservative indication. Flood Zone 3b in these locations would need to be confirmed as part of a more detailed site-specific assessment by developers.
- Whilst it is acknowledged that the Flood Zones in these areas are inconsistent, these should not be dismissed. The existing Flood Zone dataset should be used in conjunction with anecdotal evidence to establish the fluvial flood risk. Guidance and requirements for developers

concerning FRAs are discussed in Section 10.1.3.

- An objective of the SFRA was to identify any specific locations within Stoke-on-Trent at risk of sewer flooding and if so, to consider whether there is a need for hydraulic modelling to be undertaken. The data used to inform the sewer flood risk was the HFRR Register supplied by Severn Trent Water; however, this register is not a comprehensive 'at risk register' and consequently, specific locations within Stoke-on-Trent at risk of sewer flooding cannot be identified solely based on this dataset without a caveat, e.g. the register does not account for blockages and only represents a snapshot in time. Flood risk management authorities may consider investigating this source of flooding further if it is deemed to pose a flood risk, to assist with the identification of at-risk communities / areas. It should be noted that Severn Trent Water may record flooding occurrences differently and may not note inundation of open space or fields as a flooding incident. If deemed relevant, flood risk management authorities may consider developing a combined surface water / sewer model for urban settlements in Stoke-on-Trent which have experienced such flooding.
- The lack of anecdotal or historic records of flood events in an area should not be taken as evidence that flooding does not occur in that area.
- At site-specific level, any developments shown to be at residual flood risk, for example from a breach or overtopping scenario (e.g. reservoir, canal, perched watercourse), may require modelling if deemed required by the Environment Agency.

3.5 Topography, Geology and Soils

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

Topography

Stoke-on-Trent is at the top of the River Trent catchment and sits close to the Peak District National Park. There are some fairly steep river valleys, which combined with the density of development and heavily modified drainage network in the city, can cause a flashy and rapid response to rainfall. The Fowlea Brook catchment in particular is a classed as a 'rapid response' catchment, which means a specific plan is available to address flash flooding in the area. Figure 3-3 shows the topography of the City.

Geology

The bedrock geology within Stoke-on-Trent is split between east and west, the western boundary is classified as Warwickshire Group, consisting of siltstone and sandstone with mudstone. The western boundary is classified as Pennine Middle Coal Measures, consisting of mudstone, siltstone, sandstone, coal, ironstone and ferricrete as seen in Figure 3-4. The superficial geology is predominantly Till- diamicton with alluvium – clay, silt and sand and River Terrace Deposits – sand and gravel adjacent to the water courses (Figure 3-5). The majority of soils in Stoke-on-Trent are classified as slowly permeable and

seasonally wet acid loamy and clayey soils, which impede drainage. In the floodplains of the River Trent and Fowlea Brook there are loamy and clayey soils with high groundwater levels. However, there are areas where more permeable ground conditions are encountered in parts of the city, including locations where there are lenses of more permeable soils between clay soils.

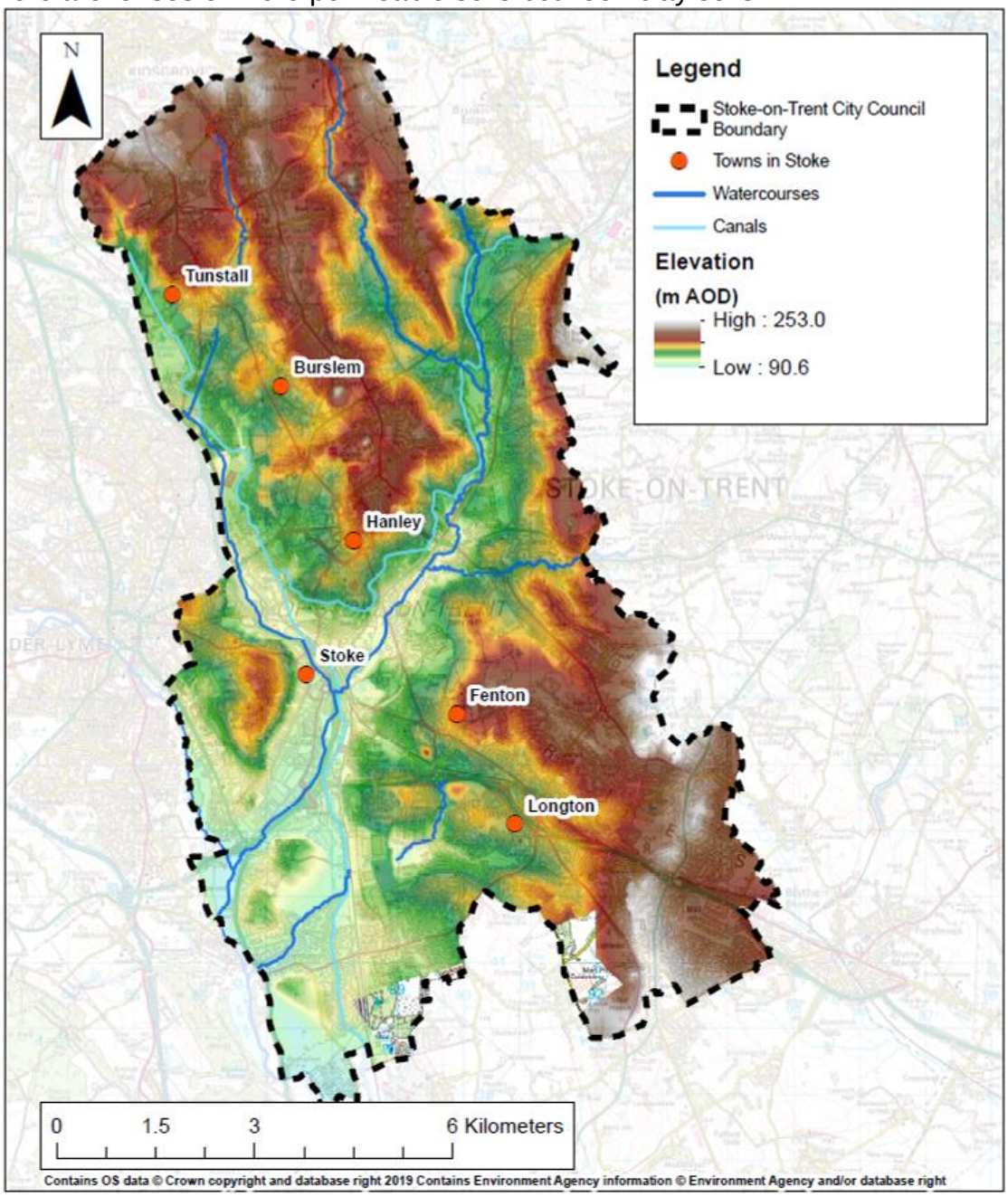


Figure 3-3: Topography of the district, with the canals and main rivers highlighted

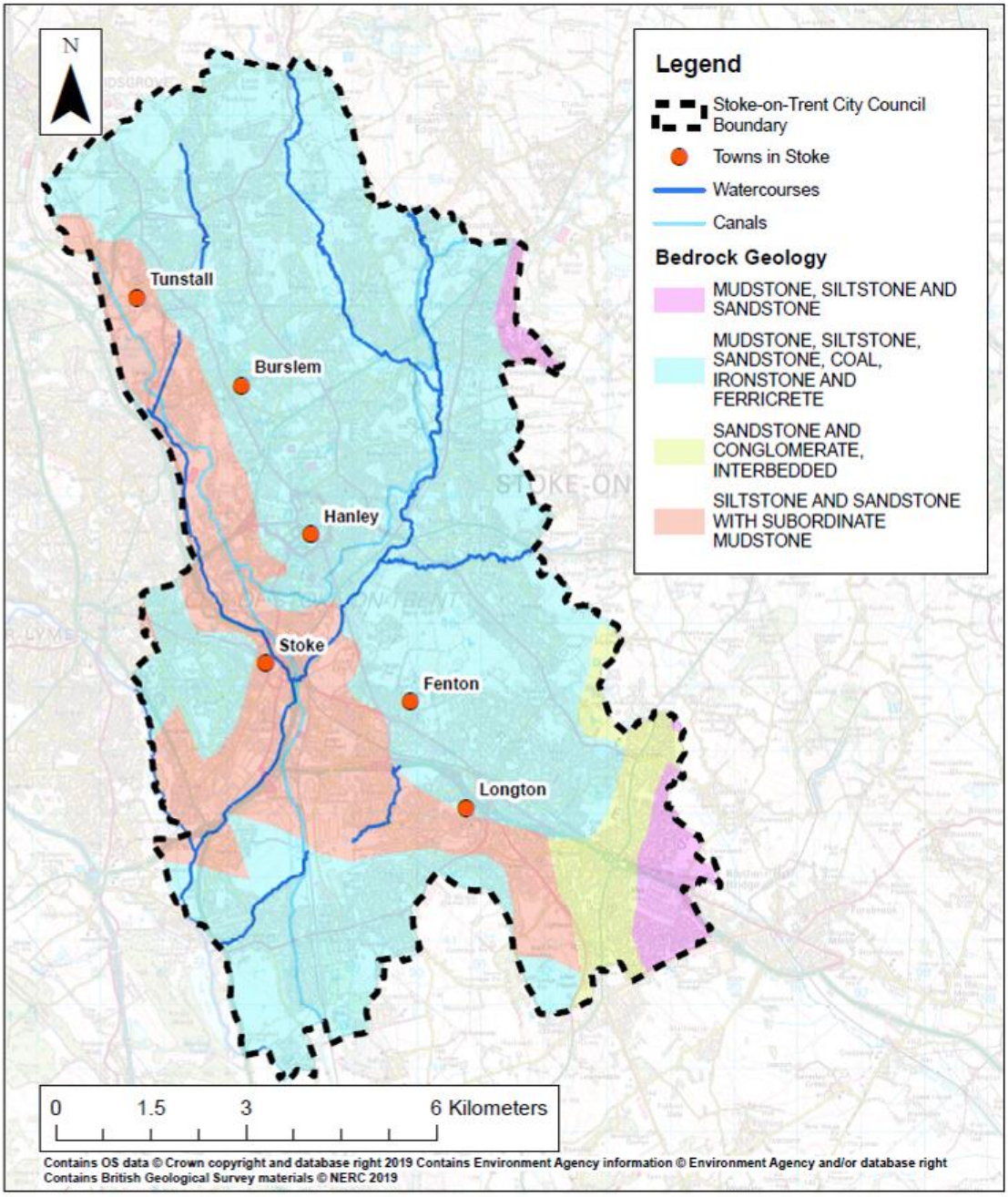


Figure 3-4: Bedrock Geology within Stoke-on-Trent

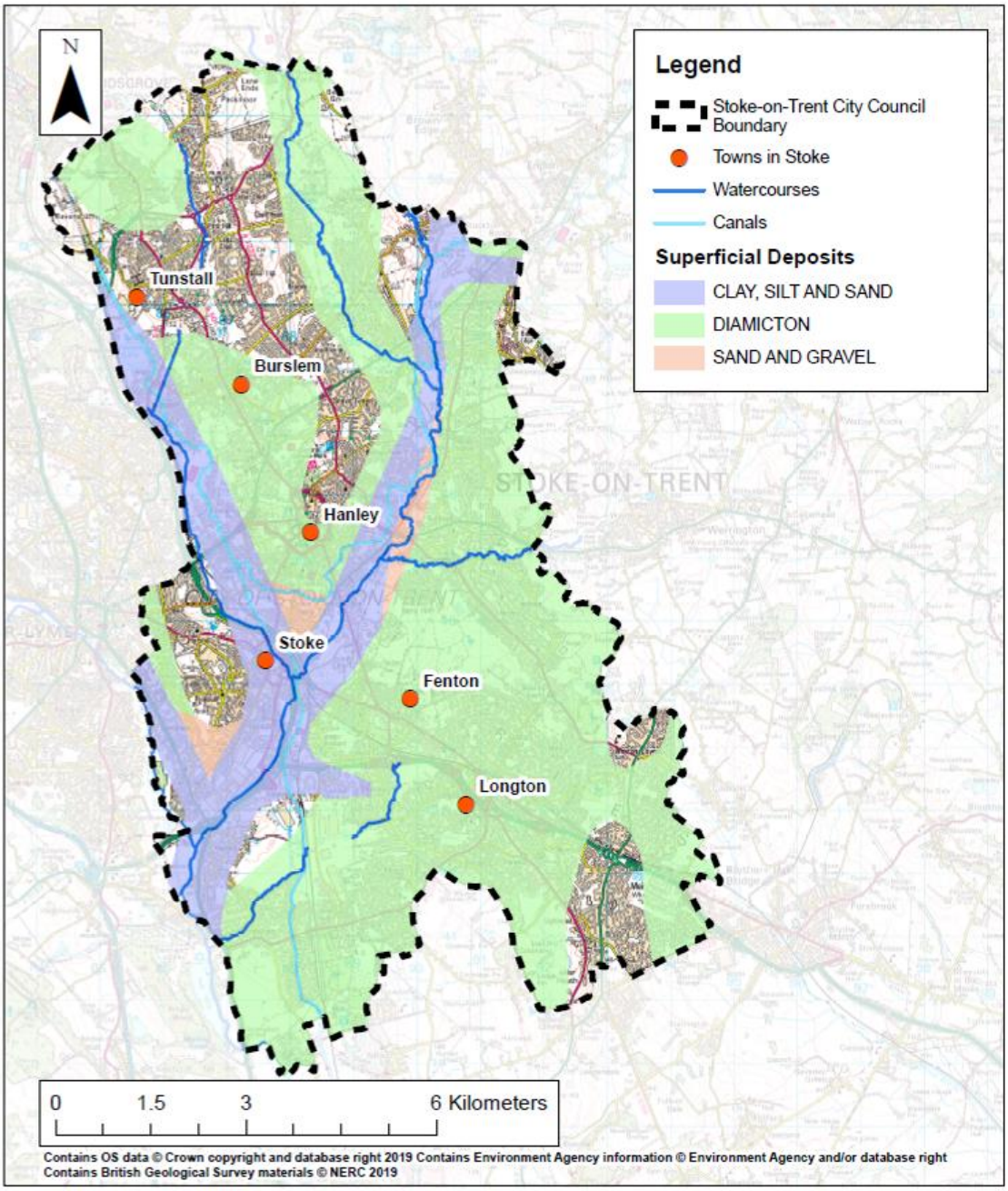


Figure 3-5: Superficial Deposits within Stoke-on-Trent

3.5.1 Fluvial Flooding

Fluvial flooding is associated with the exceedance of channel capacity during higher flows. The process of flooding from watercourses depends on a number of characteristics associated with the catchment including geographical location and variation in rainfall; steepness of the channel and surrounding floodplain; and infiltration and rate of runoff associated with urban and rural catchments. The primary fluvial flood risk across Stoke-on-Trent is along the River Trent. This presents a fluvial flood risk, urban areas in the vicinity of the Trent, including Norton Green, Bucknall, Shelton, Boothen, and Trentham. There is also a risk of flooding from the Fowlea Brook in Etruria Valley, Stoke town centre and Cliff Vale. The River Blithe also flows along a small section of the south east boundary but remains modestly confined to its floodplain with little flood risk to

properties.
The Ford Green Brook, Causley Brook, Longton Brook and Newstead Brook are tributaries of the River Trent which present a flood risk to areas in Ford Green, Bucknall and Trentham. All major watercourses in the City can be seen on Figure 1-1.

3.5.2 Environment Agency Flood Map for Planning

The Environment Agency (EA) Flood Map for Planning is the main dataset used by Planning Authorities for predicting the location and extent of fluvial flooding. This is supported by the CFMPs and FRMPs along with a number of detailed hydraulic river modelling reports which provide further detail on flooding mechanisms.
The Flood Map for Planning provides flood extents for the 1 in 100 AEP fluvial event (Flood Zone 3) and the 1 in 1000 AEP fluvial flood events (Flood Zone 2). Flood Zones were originally prepared by the EA using a methodology based on the national digital terrain model (NextMap), derived river flows from the Flood Estimation Handbook (FEH) and two-dimensional flood routing. Since their initial release, the EA has regularly updated their Flood Zones with detailed hydraulic model outputs as part of their national flood risk mapping programme. The EA Flood Map for Planning is precautionary in that it does not take account of flood defence infrastructure (which can be breached, overtopped or may not be in existence for the lifetime of the development) and, therefore, represents a worst-case scenario of flooding. The Flood Zones do not consider sources of flooding other than fluvial and tidal, and do not take account of climate change. The Flood Zone maps for Stoke-on-Trent are in Appendix A. These are interactive maps and show Flood Zones 2, 3a and 3b (including an 'indicative 3b' where FZ3a acts as FZ3b in the absence of detailed model data). The interactive SFRA Maps in Appendix A present the EA's Flood Map for Planning which shows the fluvial coverage of Flood Zones 2 and 3 across the city.
The EA also provides a 'Risk of Flooding from Rivers and the Sea Map'. This map shows the EA's assessment of the likelihood of flooding from rivers, at any location, and is based on the presence and effect of all flood defences, predicted flood levels and ground levels. This dataset is not used in the assessment of flood risk for planning applications. This dataset is further discussed in Section 4.5.4.

3.5.3 Functional Floodplain (Flood Zone 3b)

The functional floodplain forms a very important planning tool in making space for flood waters when flooding occurs. Development should be directed away from these areas.
Table 1, Paragraph 065 of the FRCC-PPG defines Flood Zone 3b as:
"…land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency."
Paragraph 015 of the FRCC-PPG explains that *the identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. However, land which would naturally flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood (such as a flood attenuation scheme) in an extreme (0.1% annual*

probability) flood, should provide a starting point to help identify the functional floodplain.

The area identified as functional floodplain should take into account the effects of all flood risk management infrastructure including defences. Areas which would naturally flood, but which are prevented from doing so by existing defences and infrastructure or solid buildings, will not normally be identified as functional floodplain. If an area is intended to flood, e.g. an upstream flood storage area designed to protect communities further downstream, then this should be safeguarded from development and identified as functional floodplain, even though it might not flood very often.

A technical note is provided in Appendix C which explains the methodology used in creating the functional floodplain outline. The outline is also displayed on the SFRA Maps in Appendix A.

As part of this SFRA, the Environment Agency provided all its most recent, readily available hydraulic river model 20-year defended scenario modelled flood outlines for the city. Where a 1 in 20 year, defended scenario outline was available, this was used to help define the functional floodplain. Where no outline has been produced, Flood Zone 3a has been used to update the indicative Flood Zone 3b floodplain.

Any site-specific FRAs should further assess areas of functional floodplain through detailed investigation and assessment of the actual risk and extent of any possible functional floodplain.

3.5.4 EA Risk of Flooding from Rivers and the Sea Map

This map shows the likelihood of flooding from rivers and the sea based on the presence and effect of all flood defences, predicted flood levels and ground levels. The map splits the likelihood of flooding into four risk categories:

- High – greater than or equal to 1 in 30 (3.3%) chance in any given year
- Medium – less than 1 in 30 (3.3%) but greater than or equal to 1 in 100 (1%) chance in any given year
- Low – less than 1 in 100 (1%) but greater than or equal to 1 in 1,000 (0.1%) chance in any given year
- Very Low – less than 1 in 1,000 (0.1%) chance in any given year

The Risk of Flooding from Rivers and the Sea Map (RFRSM) is included on the SFRA Maps to act as a supplementary piece of information to assist the LPA in the decision-making process for site allocation.

This dataset is not suitable for use with any planning application nor should it be used for the sequential testing of site allocations as is broadscale dataset taking into account defences. The EA's Flood Map for Planning should be used for all planning purposes, as per the FRCC-PPG.

3.6 Surface Water Flooding

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

The Environment Agency Risk of Flooding from Surface Water mapping (RoFfSW) provided by the Environment Agency shows that a number of

communities are at risk of surface water flooding. The mapping shows that surface water predominantly follows topographical flow paths of existing watercourses or dry valleys and can pond in low-lying areas. Whilst in the majority of cases the risk is confined to roads, there are notable prominent run-off flow routes around properties, e.g. properties situated at the foot of surrounding hills. The RoFfSW mapping for Stoke-on-Trent can be found in Appendix A. RoFfSW includes surface water flood outlines for the following events:

- 1 in 30 AEP event (high risk)
- 1 in 100 AEP event (medium risk)
- 1 in 1000 AEP event (low risk)

There are certain locations, generally within urban areas, where the probability and consequence of pluvial and sewer flooding are more prominent due to the complex hydraulic interactions that exist in the urban environment. Urban watercourse connectivity, sewer capacity, and the location and condition of highway gullies all have a major role to play in surface water flood risk.

It should be acknowledged that once an area is flooded during a large rainfall event, it is often difficult to identify the route, cause and ultimately the source of flooding without undertaking further site-specific and detailed investigations. Surface water flooding is a known and recognised risk in the City; this has been complicated by the large expanse of urbanised areas in Stoke-on-Trent, where many smaller watercourses were culverted and, in some cases, built over. This both promotes excess surface water flowing over the ground as it cannot get into a watercourse and heightens the risk of flooding from culvert blockage or failure. In recognition of this, Stoke-on-Trent City Council commissioned a Surface Water Management Plan (SWMP) in 2018. The SWMP has taken into account the outcomes of previous detailed modelling of the interactions between surface water, sewers and culverted watercourses.

In no particular order, the locations of the further modelling are:

- Fenn Park
- Baddeley Green
- Bucknall
- Harpfields
- Ubberley
- Eaves Lane
- Hilton Road
- Uffington Parade
- Weston Coyney
- Goms Mill

The mapped outputs from these local models for the same return periods as the national mapping can be found in Appendix A. Where this data it exists, it represents the best and most update to date surface water flooding data for the City at the time of publication.

Stoke-on-Trent City Council are currently exploring mitigation options for a culvert in Carmountside which involves the creation of a baseline model to identify the main flows contributing to flooding and flooding mechanisms in the area.

Critical Drainage Areas (or Council defined Areas of Critical Drainage)

The Town and Country Planning (Development Management Procedure)

(England) Order 2010 defines a Critical Drainage Area (CDA) as:
"…an area within Flood Zone 1 which has critical drainage problems and which has been notified to the local planning authority by the Environment Agency".
EA guidance on carrying out Flood Risk Assessments states that an FRA should be carried out for sites in Flood Zone 1 that are…
"…in an area with critical drainage problems as notified by the Environment Agency."
The EA has not formally designated any CDAs within the Stoke-on-Trent City Council area.

3.6.1 Surface Water Management Plan

The 2019 Surface Water Management Plan has brought together data on:

- Past flooding from SoTCC and Severn Trent Water
- The national RoFfSW mapping
- Local detailed model study outputs
- Groundwater mapping

This data has been analysed to identify those areas that are most at risk from localised flooding, applying greatest weight to those areas that have flooded in the past and where there are more detailed model outputs. A full description of the methodology can be found in Appendix G, with an accompanying map showing the outcome of the SWMP analysis.

3.6.2 Sewer Flooding

Combined sewers spread extensively across urban areas serving residential homes, business and highways, conveying waste and surface water to treatment works. Combined Sewer Overflows (CSOs), provide an EA consented overflow release from the drainage system into local watercourses or large surface water systems during times of high flows. Some areas may also be served by separate waste and surface water sewers which convey wastewater to treatment works and surface water into local watercourses.
Flooding from the sewer network mainly occurs when flow entering the system, such as an urban storm water drainage system, exceeds its available discharge capacity, the system becomes blocked or it cannot discharge due to a high-water level in the receiving watercourse. Pinch points and failures within the drainage network may also restrict flows. Water then begins to back up through the sewers and surcharge through manholes, potentially flooding highways and properties. It must be noted that sewer flooding in 'dry weather' resulting from blockage, collapse or pumping station mechanical failure (for example), is the sole concern of the drainage undertaker.
STW are the water company responsible for the management of public sewers in the study area, with historical reports of flooding from the HFRR, tabulated in Figure 4-6 below.

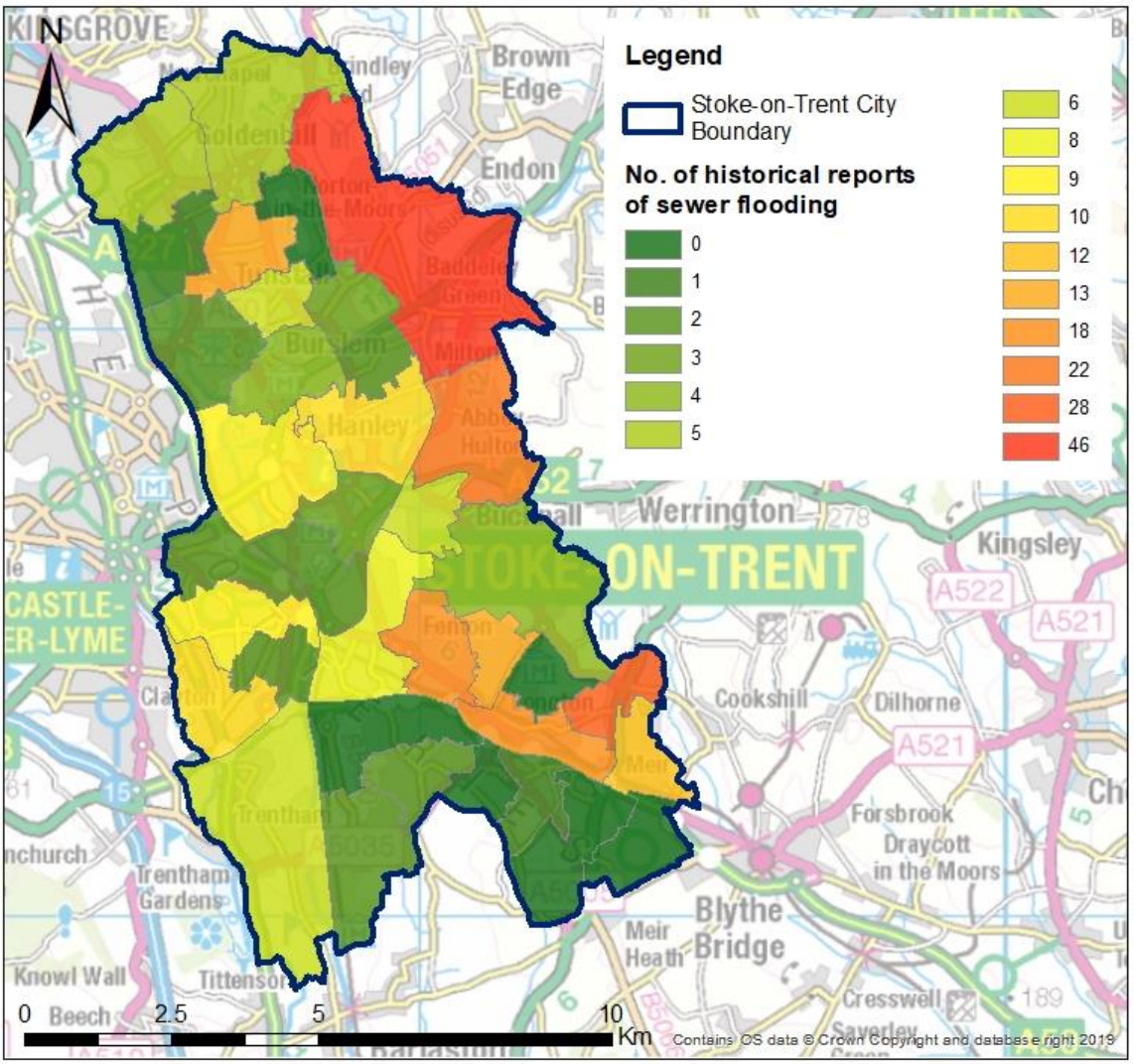


Figure 3-6 – Heatmap illustrating historical sewer incidents recorded by Severn Trent Water across Stoke on Trent.

Sewer flooding has been an issue in parts of the City as demonstrated by Figure 3-6. The map illustrates the wards within Stoke-on-Trent with the highest number of historical reports of sewer flooding. The wards with the most incidents are: Baddeley, Milton and Norton; Abbey Hulton and Townsend; Weston Coyney; Little Chell and Stanfield; Broadway and Longton East; Fenton East; and Sandford Hill.

3.7 Groundwater Flooding.

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

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

Groundwater flooding is different to other types of flooding. It can last for days,

weeks or even months and is much harder to predict and warn for. Monitoring does occur in certain areas of the country, for example where there are major aquifers or when mining stops. Further information is also available from the British Geological Survey on their website.

Following the cessation of deep coal mining, mine dewatering pumps can be are switched off, with groundwater levels then tending to rebound to historic seasonal levels. Groundwater recovery can take months to several decades and the implication is that in former mining areas, groundwater levels may still be recharging and can potentially adversely affect new or existing developments if groundwater levels near, or reach, the surface. In some areas, mine water levels are actively controlled via Coal Authority abstractions to help prevent mine water level rising to a level where it may cause pollution. Within Stoke-on-Trent, the Coal Authority monitor groundwater levels in parts of the wider area and the records show that groundwater levels have been rising over time since mining cessed, which could increase the frequency or severity of ground water flooding.

The City is also within the Coal Authorities Coal Mining Reporting area and as such, if a development site is within a Development High Risk Area (formally Development Referral Area), additional consideration to the proposed drainage and infiltration plans is needed so that sustainable development and sustainable drainage systems (SuDS) may be appropriately designed and implemented. The Development High Risk Area are locations where there are one or more recorded coal mining related features which have the potential for instability or a degree of risk to the surface from the legacy of coal mining operations.

New development in this area needs to demonstrate that the development will be safe and stable taking full account of former coal mining activities by undertaking a Coal Mining Risk Assessment. Mapping of the Development High Risk Areas can be found on the Coal Authority Interactive Mapping.

3.7.1 JBA Groundwater Flood Map (National)

The JBA Groundwater Flood Map provides a detailed assessment of the risk of groundwater emergence in a 1 in 100-year event at a 5m resolution. The risk is scaled between 0 and 4, with 0 indicating no risk and 4 identifying groundwater levels either at or very near (within 0.025m of) the ground surface. The groundwater levels are compared against ground surface levels to determine the head difference in metres; with 0m suggesting artesian discharge of groundwater at the ground surface.

The JBA Groundwater Flood Map should be used in combination with other information, such as local data or historic data. It should not be used as sole evidence for any specific flood risk management, land use planning or other decisions at any scale. The data can however help to identify areas for further assessment at a local scale, where finer resolution datasets may exist or more data could be gathered.

Table 3-3: JBA Groundwater Flood Hazard Classification

Groundwater head difference (m)*	Grid code	Class label
0.025	4	Groundwater levels are either at very near (within 0.025m of) the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
0.025 to 0.5	3	Groundwater levels are between 0.025m and 0.5m below the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
0.5 to 5	2	Groundwater levels are between 0.5m and 5m below the ground surface in the 100-year return period flood event There is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.
>5	1	Groundwater levels are at least 5m below the ground surface in the 100-year return period flood event. Flooding from groundwater is not likely.
N/A	0	No risk. This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.

*Difference is defined as ground surface in mAOD minus modelled groundwater table in mAOD.

In general, Stoke-on-Trent is at no to low risk of flooding from ground water, with scattered areas predominately in the south where groundwater levels are between 0.025m and 0.5m below the ground surface. Within this zone there is a risk to both surface and subsurface assets and the possibility of groundwater emerging at the surface locally. At the confluence of the Trent & Mersey Canal and the Longton Brook, there is a zone of high risk from ground water flooding where ground water may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots. Along the Newcastle Road, Leek Road and High lane all are at medium risk of surface water flooding, but the surface manifestation of groundwater is unlikely. The groundwater dataset does not account for the potential influence mining works may have on groundwater flood risk.
Mapping of groundwater flood risk can be found in Appendix A.

3.8 Canal and Reservoir Flood Risk

3.8.1 Canals

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

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

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

There are two canals in Stoke-on-Trent: the Trent and Mersey Canal and Caldon Canal, which can be seen in Figure 3-3.

- The Trent and Mersey Canal. There are historic records of canal breaches in Burslem (caused by culvert failure, SJ 86631 48877)
- The Caldon Canal. There is one recorded flooding incident from the reach of the Caldon Canal within the study area caused by the installation of pipes adjacent to the embankment (SJ 89824 48071).

The risk of flooding along a canal is considered residual and is dependent on a number of factors. As canals are manmade systems that are heavily controlled, it is unlikely they will respond in the same way as a natural watercourse during a storm event. Flooding is more likely to be associated with residual risks, similar to those associated with river defences, such as overtopping of canal banks, breaching of embanked reaches or asset (gate) failure as highlighted in Table 3-4. Canals can also have a significant interaction with other sources, such as watercourses that feed them and minor watercourses or drains that cross underneath.

The risks associated with these events are also dependent on their potential failure location with the consequence of flooding being higher where floodwater could cause the greatest harm due to the presence of local highways and adjacent property. The focus should be on areas adjacent to raised embankments. The pound length of the canal also increases the consequences of failure, as there is greater volume of water that could be released.

Table 3-4: Canal flooding mechanisms

Potential Mechanism	Significant Factors
Leakage causing erosion and rupture of canal lining leading to breach	Embankments Sidelong ground Culverts Aqueduct approaches

Collapse of structures carrying the canal above natural ground level	Aqueducts Large diameter culverts Structural deterioration or accidental damage
Overtopping of canal banks	Low freeboard Waste weirs
Blockage or collapse of conduits	Culverts

3.8.2 Reservoirs

A reservoir can usually be described as an artificial lake where water is stored for use. Some reservoirs supply water for household and industrial use, others serve other purposes, for example, as fishing lakes or leisure facilities. The risk of flooding associated with reservoirs is residual and is associated with failure of reservoir outfalls or breaching. This risk is reduced through regular maintenance by the operating authority. Reservoirs in the UK have an extremely good safety record with no incidents resulting in the loss of life since 1925.

The Environment Agency is the enforcement authority for the Reservoirs Act 1975 in England and Wales. All large reservoirs must be regularly inspected and supervised by reservoir panel engineers. Local Authorities are responsible for coordinating emergency plans for reservoir flooding and ensuring communities are well prepared. Local Authorities should work with other members of the Stoke-on-Trent and Staffordshire Local Resilience Forum, of which SoTCC is a member, to develop these plans.

3.8.3 Reservoir Flood Maps

Reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975 and are on a register held by the Environment Agency. The level and standard of inspection and maintenance required under the Act means that the risk of flooding from reservoirs is very low. Flooding from reservoirs occurs following partial or complete failure of the control structure designed to retain water in the artificial storage area. Reservoir flooding is very different from other forms of flooding; it may happen with little or no warning and evacuation will need to happen immediately. The likelihood of such flooding is difficult to estimate but is extremely low compared to flooding from other sources. It may not be possible to seek refuge upstairs from floodwater as buildings could be unsafe or unstable due to the force of water from the reservoir breach or failure.

The Environment Agency hold mapping showing what might happen if reservoirs fail. They are currently updating the mapping and new data should be available in late 2019. Developers and the LPA should check the Long-Term Risk of Flooding website before using the reservoir mapping shown in this SFRA to make sure they are using the most up to date mapping

Reservoir	Reservoir owner	Local Authority Area	Is the reservoir located within the study area?
Serpentine	Staffordshire County Council	Staffordshire	No
Knypersley	Canal & River Trust	Staffordshire	No

Brindley Ford Flood Storage Reservoir	The Coal Authority	Staffordshire	No
Trentham Gardens Lake	Trentham Leisure Ltd	Staffordshire	No
Black Lake, Knowle Wall Farm	Prestwood	Staffordshire	No

The current mapping shows that there are five reservoirs (shown in Table 3-5) that could cause flooding in the city. The reservoir inundation extents are shown on the EA's long-term flood risk website.

Table 3-5 Reservoirs with the potential to cause flooding in the area

Although there are no reservoirs within Stoke-on-Trent City boundary, there are five upstream reservoirs that could cause flooding:

- Brindley Ford Flood Storage Reservoir is located just outside the boundary and effects properties East of Fishers Lane in Brindley Ford and the north of Fegg Hayes.
- The Serpentine and the Knypersley are two connected reservoirs which feed the Caldon Canal and the only reservoir along the River Trent. The inundation extent of both reservoirs stretches the full length of the City following Trent watercourse and presents a significant threat to life. A number of settlements are affected, including Norton Green, Milton, Bucknall, Boothen and Hanford.
- The impact of a breach at either Trentham Gardens Lake and Black Lake is relatively minimal in Stoke-on-Trent, affecting the south western tip of the City boundary impacting Severn Trent Water at Strongford.

3.8.4 Culverted Watercourses

The term watercourse includes all open, bridged, culverted or piped rivers, streams, ditches, drains, cuts, dykes, sluices and passages through which water flows. Culverted watercourses pose a real risk to many areas throughout Stoke-on-Trent and many historic culverts are still unknown or untraced. There is a residual risk from such watercourses should they become blocked or collapse. The culverting of an 'ordinary watercourse' does not change its status to that of a sewer, and the responsibility for maintenance of the watercourse remains with the riparian owner or owners. It is assumed that the riparian owner owns up to the middle of the watercourse, unless land registry records or land ownership agreements indicate otherwise. Where riparian responsibility is shared, there may be past agreements or common law agreements historically.
Reinstatement of open watercourses provides continuity of the watercourse corridor habitat with recreational opportunities; furnishes additional capacity for flood water conveyance and storage; alleviates difficulties in identifying pollution sources; removes blockage, safety and maintenance hazards; and permits aquifer recharge or base flow support.
Any culvert should be surveyed by CCTV to inform an assessment of the condition of the existing culvert to determine it has sufficient capacity receive additional flows and to carry the loading from the development. Stoke-on-Trent City Council are generally opposed to the culverting of watercourses for numerous reasons, including, but not limited to, adverse ecological, flooding and health and safety reasons and lack of wider amenity benefits. In certain limited

circumstances it may be unavoidable to culvert a short length of watercourse e.g. access purposes or for highways purposes. However, culverting will not be fully considered until other options have been thoroughly explored, such as the use of sympathetic open span bridges, retention of open channel and / or diversion of any watercourse, undertaken in a in an environmentally sympathetic manner.

3.8.5 Historic Flooding

Stoke-on-Trent has been affected by flooding in the past, with the primary source of flooding being surface water but there are also historical records of groundwater and fluvial flooding issues. The significant flood events which have been recorded by the EA, STW and Stoke-on-Trent City Council are listed in Table 3-6.

Table 3-6: Historic flooding from all sources

Cause of flooding	Area Affected	Years of event
Above average rainfall with snow melt and heavy rain causing out of bank flooding	Fowlea Brook catchment	1947
Severe rainfall leading to rapid urban run-off, culvert blockage or blocked trash screen	Fowlea Brook catchment - Liverpool Road culvert and Bucknall Road Bridge	1996, August 1977, 1987, 1998
Cause unrecorded	Weston Coyney	July 2000
Flooding from public sewerage system by foul water, surface water or combined sewerage after heavy rainfall	Roads flooding in Bentilee, Meir Hay (between Meir and Weston Coyney), Trent Vale and Hartshill	Pre-2008 (no exact date known)
High rainfall leading to surcharging of highway drainage and sewer systems via overland flow paths	Residential and non-residential properties including a school and care home affected by overland flow path Bentilee, Bucknall, Blurton, Dresden, Fenpark, Fenton, Hanley, Harpfields Longton, Stoke, Meir Heath, Weston Coyney Milton, M6, A500	June and September 2016, 2018
Groundwater from high water table coupled with previous mining work and heavy rainfall	N\A	N\A

Heavy rainfall caused major disruptions across stoke and the midlands, with fluvial flooding from the River Trent, Lyme Brook and Fowlea Brook.	All trains through Stoke-on-Trent were cancelled and junction 16 on the M6 closed due to flooding. Some of the worst impacted areas were Brindley Ford, Tunstall, Sneyd Green, Norton Green and Stockton Brook.	25th, 26th and 27th October 2019.

3.8.6 EA Historic Flood Map

The Historic Flood Map (HFM) contains outlines of past fluvial and groundwater flooding though does not contain any information regarding flood source, return period or date of flood.
The HFM outlines show no flooding in the city. The absence of coverage by Recorded Flood Outlines for an area does not mean that the area has never flooded, only that the Environment Agency do not currently have records of flooding in this area.

3.8.7 Summary of flood risk in Stoke-on-Trent

Appendix F contains a summary of the key flood risks to different areas of Stoke-on-Trent.

4 Flood Risk Management

The aim of this section of the SFRA is to identify existing Flood Risk Management (FRM) assets and previous / proposed FRM schemes across Stoke-on-Trent. The location, condition and design standard of existing assets will have a significant impact on actual flood risk mechanisms. Whilst future schemes in high flood risk areas carry the possibility of reducing the probability of flood events and reducing the overall level of risk. Both existing assets and future schemes will have a further impact on the type, form and location of new development or regeneration.

4.1 Asset Management

Risk Management Authorities hold databases of flood risk management and drainage assets:

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

to refine the understanding of flood risk over time.

- Developers should collect the available asset information and undertake further survey as necessary to present an understanding of current flood risk and the existing drainage network in a site-specific Flood Risk Assessment.

4.1.1 EA Assets

The EA provided an ArcGIS shapefile of its flood defence dataset which shows that there is a network of flood defence infrastructure along the Lyme Brook. A series of flood embankments and flood walls provide a standard of protection (SoP) up to the 1 in 100 year. There are however some minor flood defences in the City and these are shown on Table 4-1 and Figure 4-1.

Table 4-1: Flood defences in Stoke-on-Trent

Watercourse	Location	NGR	Type	Asset maintained by	Design SOP	Condition
River Trent	Wall along A500 between Shelton and Mount Pleasant	SJ 88058 45129	Wall	Environment Agency	25	2 (Good)

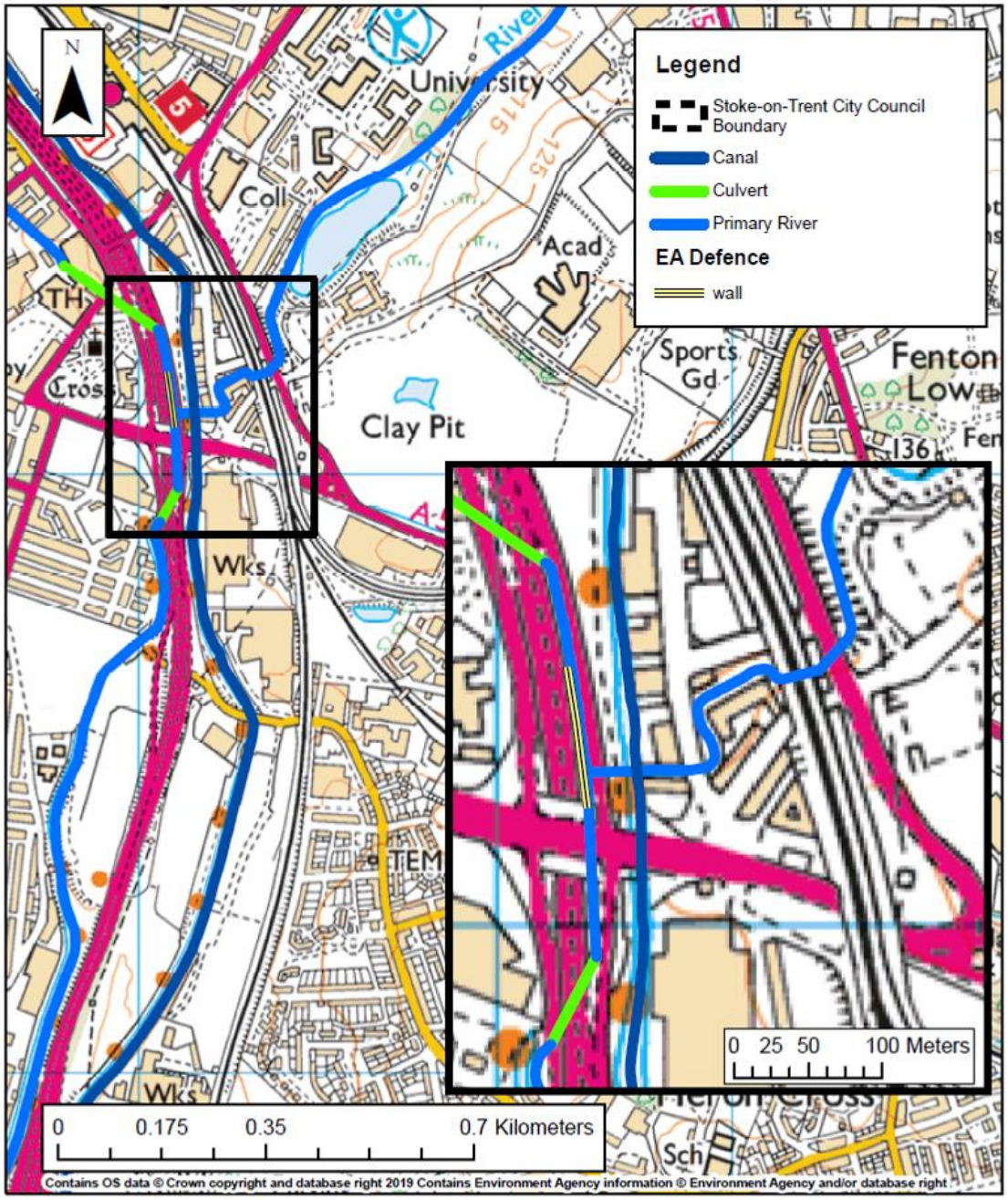


Figure 4-1: Flood Defences on Main Rivers in Stoke-on-Trent

As well as the ownership and maintenance of a network of formal defence structures, the EA carries out a number of other flood risk management activities that help to reduce the probability of flooding, whilst also addressing the consequences of flooding. These include:

- Maintaining and improving the existing flood defences, structures and watercourses.
- Enforcement and maintenance where riparian owners unknowingly carry out work that may be detrimental to flood risk.
- Identifying and promoting new flood alleviation schemes (FAS) where appropriate.
- Working with local authorities to influence the location, layout and design of new and redeveloped property and ensuring that only appropriate development is permitted relative to the scale of flood risk.

- Operation of Floodline Warnings Direct and warning services for areas within designated Flood Warning Areas (FWA) or Flood Alert Areas (FAA). EA FWAs are shown on the SFRA Maps in Appendix A and also in Appendix E.
- Promoting awareness of flooding so that organisations, communities and individuals are aware of the risk and are therefore sufficiently prepared in the event of flooding.
- Promoting resilience and resistance measures for existing properties that are currently at flood risk or may be in the future as a result of climate change.

4.1.2 Local Authority Assets

The City Council own and maintain a number of assets throughout Stoke-on-Trent which includes culverts, bridge structures, gullies, weirs and trash screens. The majority of these assets will lie along ordinary watercourses within smaller urban areas where watercourses may have been culverted or diverted, or within rural areas. All these assets can have flood risk management functions as well as an effect on flood risk if they become blocked or fail. In the majority of cases responsibility lies with the riparian/land owner.

As part of their FWMA duties as LLFA, Stoke-on-Trent City Council has a duty to maintain a register of structures or features, which are considered to have a significant effect on flood risk, including details on ownership and condition as a minimum. This information is available on request from the City Council.

The Asset Register should include those features relevant to flood risk management function including feature type, description of principal materials, location, measurements (height, length, width, diameter) and condition grade. The Act places no duty on the LLFA to maintain any third-party features, only those for which the authority has responsibility as land / asset owner.

4.1.3 Water Company Assets

The sewerage infrastructure within Stoke-on-Trent is likely to be based on Victorian sewers from which there is a risk of localised flooding associated with the existing drainage capacity and sewer system. The drainage system may have stressed capacity and / or subject to blockages resulting in localised flooding of roads and property. Severn Trent Water is responsible for the management of public sewers. This includes surface water and foul sewerage. There may however be some private surface water sewers in the city as only those connected to the public sewer network transferred to the water companies under the Private Sewer Transfer in 2011. Surface water sewers discharging to watercourses did not transfer and would therefore not be under the ownership of a water company, unless adopted under a Section 104 adoption agreement. Water company assets include Wastewater Treatment Works, Combined Sewer Overflows, pumping stations, detention tanks, sewer networks and manholes.

4.2 Standards of Protection

Flood defences are designed to give a specific Standard of Protection (SoP), reducing the risk of flooding to people and property in flood prone areas. For example, a flood defence with 100-year SoP means that the flood risk in the defended area is reduced to at least a 1% chance of flooding in any given year. Over time the actual SoP provided by the defence may decrease, for example

due to deterioration in condition or increases in flood risk due to climate change. The understanding of SoP may also change over time as RMAs undertake more detailed surveys and flood modelling studies.
It should be noted that the Environment Agency's on-going hydraulic modelling programme may revise flood risk datasets and as a consequence, the standard of protection offered by flood defences in the area, may differ from those discussed in this report.
Planning Authorities should note the areas that are protected by defences where further work to understand the actual and residual flood risk through a Level 2 SFRA may be beneficial. Developers should consider the benefit they provide over the lifetime of a development and the actual and residual risk further in a site-specific Flood Risk Assessment.

4.2.1 Maintenance

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 practise is that assets are maintained to common standards and improvements are prioritised for the parts of the network that do not meet this standard e.g. where there is frequent 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

4.3 Current and Future Flood Risk Management Work Programmes

There is understood to be two schemes on the current Flood and Coastal Erosion Risk Management (FCERM) Programme across the Stoke-on-Trent area up to 2021:

- Stoke Town Centre Flood Alleviation Scheme is an Environment Agency led scheme, with partnership contributions, and will endeavour to better protect up to 179 homes from flooding by 2020/21, and is due to be fully complete by 2021, using a combination of channel improvement works, upstream alleviation measures and independent solutions.
- The Weston Coyney, Surface Water Flood Alleviation Scheme is a programmed scheme put forward by Stoke-on-Trent City Council as the Lead Local Flood Authority. Detailed modelling work is currently being carried out to establish the nature and extent of flooding in the area. This

work will inform the need for any potential future flood mitigation schemes in the area.

Beyond 2021, further schemes to address issues with surface water and culverted watercourses may come forward, but there is limited detail available on such schemes at this time.

For new development sites across Stoke-on-Trent, major developments should seek to further address flood risk issues offsite wherever possible, by holding back water e.g. through flood storage/ oversized sustainable drainage/green infrastructure features to capture overland flows and help to reduce flows in downstream watercourses.

Impact of Climate Change

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

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

4.4 Revised Climate Change Guidance

The Environment Agency published updated climate change guidance in 2016 on how allowances for climate change should be included in both strategic and site specific FRAs. The guidance adopts a risk-based approach considering the vulnerability of the development.

In 2018, the government published new UK Climate Projections (UKCP18). The Environment Agency is currently using these to update their climate change guidance for new developments. Developers should check on the government website for the latest guidance before undertaking a detailed Flood Risk Assessment. At the time of writing this report, this was due in spring/ summer 2019.

The UKCP18 contains high resolution mapping with peak river flow allowances at 1km grid scale that will be released later in 2019. The regional peak river flow allowances in the 2016 guidance may not change but the LPA and developers may need to consider the finer resolution data where it shows a significant difference to the regional averages.

The UKCP18 high resolution (daily and sub daily) rainfall projections are due to be published in late 2019. Following this, the Environment Agency may update the recommended peak rainfall allowances in their guidance for the LPA and developers.

4.5 Applying the climate change guidance

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

The vulnerability of the development – see the NPPG.

When deciding which range of scenarios are appropriate, developers should consider the:

- The likely lifetime of the development – in general 60 years is used for commercial development and 100 for residential, but this needs to be confirmed in an FRA.

- The River Basin that the site is in Stoke-on-Trent is within the Humber RBD. Likely depth, speed and extent of flooding for each allowance of climate change over time considering the allowances for the relevant epoch (2020s, 2050s and 2080s).
- The vulnerability of the development to flooding – see the NPPG.
- '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.
- In most cases, it is expected that the EA and SoTCC would look to the Upper and Higher Central Categories.

4.6 Relevant allowances for Stoke-on-Trent

Table 0-1 show the peak river flow allowances that apply in Stoke-on-Trent.

Table 0-1: Peak river flow allowances for the Humber river basin district

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

Table 0-2 shows the peak rainfall intensity allowances that apply in Stoke-on-Trent. Both the central and upper end allowances should be considered to understand the range of impact. Stoke-on-Trent City Council use peak rainfall intensity allowance in small and urban catchments of Upper End for the 2080's (40%). The LLFA and LPA are working towards introducing updated and new policy documents, including the Local SuDS Handbook and streamlining internal procedures, to be formally launched in 2020.

Table 0-2: Peak rainfall intensity allowances for small urban catchments

Allowance Category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

4.7 Climate change modelling for the 2019 SFRA

Climate change modelling for the watercourses in the study area was undertaken based on the 2016 climate change guidance. Existing Environment Agency hydraulic models (shown on Table 6-3) were run for the 2080s period for all three allowance categories (relevant to the river basin district). Mapping of the climate change modelling outputs are provided in Appendix A. Due to this, the Climate Change outlines are using the most up to date data and in some areas may not be comparable with the broadscale mapped extents used to inform Flood Zone 3a and Flood Zone 2.

There are notable cases where the modelled extents indicate sensitivities to an

increase in flows due to climate change:

- The confluence between the Fowlea Brook, River Trent and the Trent and Mersey Canal in Stoke town centre, shows significant sensitivity to increasing flow on the Fowlea Brook and River Trent.
- The Fowlea Brook in the 100-year with climate change upper end allowance backs flow behind Shelton New Road, impacting the industrial sites in this area.
- The River Trent shows sensitivity to increased flow upstream of Bucknall Road (A52), predominately affecting the sports ground but also properties on Westacre Road, Dividy Road, Ruxley Road, Finney Green and Atlam Close.
- Water builds up behind Victoria Road in Joiner's Square from the River Trent in the extreme climate change events.

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

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

- Confirm which national guidance on climate change and new development applies by visiting GOV.uk
- Apply this guidance when deciding the allowances to be made for climate change, having considered the potential sources of flood risk to the site (using this SFRA), the vulnerability of the development to flooding and the proposed lifetime of the development. If the site is just outside the indicative climate change extents in this SFRA, the impact of climate change should still be considered because these may get affected should the more extreme climate change scenarios materialise.
- Contact the Environment Agency to confirm which is the most up to date model available for the area. Table 0-3 has a list of the current models in the Stoke-on-Trent City Council area and notes which models were rerun for the SFRA.
- Section 6 provides further details on climate change for developers, as part of the FRA Guidance.

Table 0-3: Hydraulic models used to inform the SFRA

Hydraulic model	Date	Software	Watercourse
River Trent 2019 SFRA model	2019	Estry-ISIS-TUFLOW	River Trent
2014 Newcastle Hazard Mapping Study	-	Estry-Tuflow	Lyme Brook
Fowlea Brook Hydraulic Modelling Study	2017	Estry-Tuflow	Fowlea Brook

4.7.1 Adapting to climate change

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

- Considering future climate risks when allocating development sites to ensure risks are understood over the development's lifetime.
- Considering the impact of and promoting design responses to flood risk

and coastal change for the lifetime of the development.

- Considering availability of water and water infrastructure for the lifetime of the development and design responses to promote water efficiency and protect water quality.
- Promoting adaptation approaches in design policies for developments and the public realm for example by building in flexibility to allow future adaptation if needed, such as setting new development back from watercourses.
- Identifying no or low-cost responses to climate risks that also deliver other benefits, Flood Risk Management Plans (FRMPs) (e.g. by leaving areas shown to be at risk of flooding as public open space).

5 Development and Flood Risk

5.1 Introduction

This section of the SFRA provides a strategic assessment of the suitability, relative to flood risk, of the potential development sites provided by SoTCC to be considered though the Local Plan.

The information and guidance provided in this Section (supported by the SFRA mapping in Appendix A and the Development Site Screening Spreadsheet in Appendix B) can be used by SoTCC to inform their Joint Local Plan, and provide the basis from which to apply the Sequential Approach in the development allocation and development management process.

5.2 The Sequential Approach

The Flood Risk and Coastal Change Planning Practice Guidance (FRCC-PPG) provides the basis for the Sequential Approach. It is this approach, integrated into all stages of the development planning process, which provides the opportunities to reduce flood risk to people, their property and the environment to acceptable levels.

The approach is based around the flood risk management hierarchy, in which actions to avoid, substitute, control and mitigate flood risk is central. For example, it is important to assess the level of risk to an appropriate scale during the decision-making process, (starting with this Level 1 SFRA). Once this evidence has been provided, positive planning decisions can be made, and effective flood risk management opportunities identified.

Figure 5-1 illustrates the flood risk management (FRM) hierarchy with an example of how these may translate into the council's management decisions and actions.

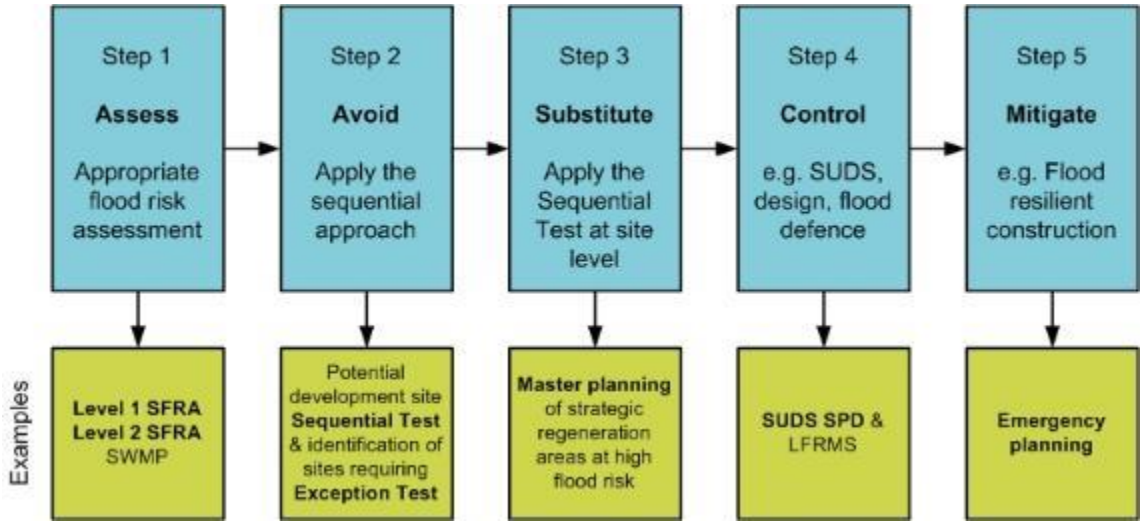


Figure 5-1: Flood Risk Management hierarchy

The overall aim of the Sequential Approach should be to steer new development to low risk Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1, the flood risk vulnerability of land uses and reasonably available sites in Flood Zone 2 should be considered, 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 higher risk Flood Zone 3, be considered. This should

take into account the flood risk vulnerability of land uses and the likelihood of meeting the requirements of the Exception Test if required.
There are two different aims in carrying out the Sequential Approach depending on what stage of the planning system is being carried out i.e. LPAs allocating land in Local Plans or determining planning applications for development. This SFRA does not remove the need for a site-specific Flood Risk Assessment at a development management stage.
The following sections provide a guided discussion on why and how the Sequential Approach should be applied, including the specific requirements for undertaking Sequential and Exception Testing.

5.3 Local Plan Sequential and Exception Test

Stoke-on-Trent City Council, as the LPA, should seek to avoid inappropriate development in areas at risk of flooding by directing development away from areas at highest risk and ensuring that all development does not increase risk and where possible can help reduce risk from flooding to existing communities and development.
Guidance on the application of the Sequential and Exception tests through the development management process is provided at Section 6.2.3 of this report.

At a strategic level, this should be carried out as part of the Local Plan. This should be done by:

1. Applying the Sequential Test and if the Sequential Test is passed, applying the Exception Test, if required;
2. Safeguarding land from development that is required for current and future flood management;
3. Using opportunities offered by new development to reduce the causes and impacts of flooding and where climate change is expected to increase flood risk so that existing development may not be sustainable in the long term; Seeking opportunities to facilitate the relocation of development including housing to more sustainable locations.

Figure 5-2 illustrates the Sequential and Exception Tests as a process flow diagram using the information contained in this SFRA to assess potential development sites against the EA's Flood Map for Planning Flood Zones and development vulnerability compatibilities.
This is a stepwise process, but a challenging one, as a number of the criteria used are qualitative and based on experienced judgement. The process must be documented, and evidence used to support decisions recorded.

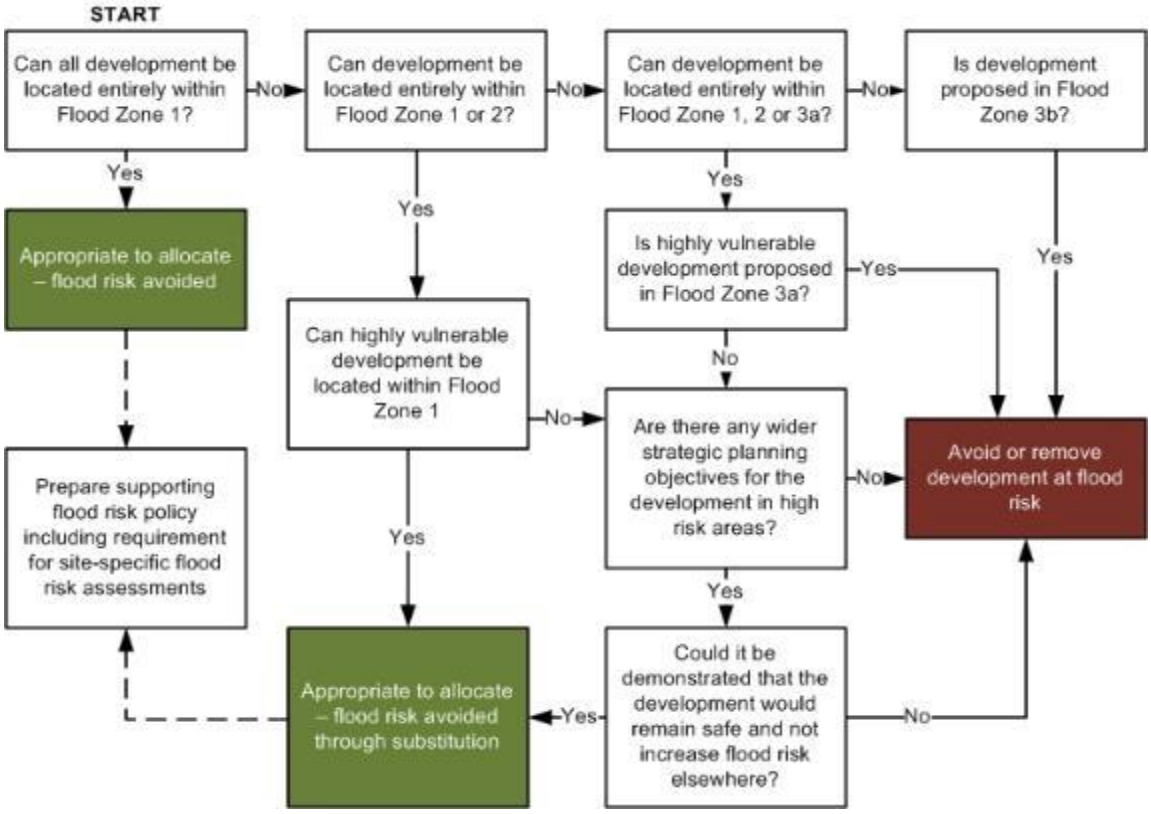


Figure 5-2: Local Plan sequential approach to site allocation

This SFRA provides the main evidence required. This process also enables those sites that have passed the Sequential Test, and may require the Exception Test, to be identified.

The NPPF Paragraph 160 states that for the Exception Test to be passed it should be demonstrated that:

A) The development would provide wider sustainability benefits to the community that outweigh the flood risk; and

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.

B) Both elements of the test will have to be passed for development to be allocated or permitted.

At a Planning Allocation stage SoTCC should be able to apply the Exception Test by using the information contained in a SFRA to answer the following questions:

a. Can development within higher risk areas be avoided or substituted?

b. Is flood risk associated with possible development sites considered too high; and will this mean that the criteria for Exception Testing are unachievable?

c. Can risk be sustainably managed through appropriate development techniques (resilience and resistance) and incorporate Sustainable Drainage Systems without compromising the viability of the development?

d. Can the site, and any residual risks to the site, be safely managed to ensure that its occupiers remain safe during times of flood if developed?

In order to fully answer questions b to d, further, more detailed assessment may be required through a Level 2 SFRA.

Where it is unlikely that the Exception Test can be passed due to few wider

sustainability benefits, the risk of flooding being too great, or the viability of the site being compromised by the level of flood risk management work required, then the LPA should consider avoiding the site all together.
Once the process has been completed the LPA should then be able to allocate appropriate development sites through the Local Plan as well as prepare flood risk policy including the requirement to prepare site-specific FRAs for all allocated sites that remain at risk of flooding.

5.3.1 Sustainability Appraisal and Flood Risk

The Sustainability Appraisal should help to ensure that flood risk is taken into account at all stages of the planning process with a view to directing development away from areas at flood risk, now and in the future, by following the sequential approach to site allocation, as shown in Figure 5-2.
By avoiding sites identified in this SFRA as being at significant risk, such as those listed in Recommendation A or by considering how changes in site layout can avoid those parts of a site at flood risk, such as any site included within Recommendation C, the Council would be demonstrating a sustainable approach to development.
In terms of surface water, the same approach should be followed whereby those sites at highest risk should be avoided or site layout should be tailored to ensure sustainable development.
Once the City Council has decided on a final list of sites following application of the Sequential Test and, where required, the Exception Test (which may require a Level 2 SFRA), a phased approach to development should be carried out to avoid any cumulative impacts that multiple developments may have on flood risk. For example, for any site where it is required to develop in Flood Zone 3, detailed modelling would be required to ascertain where water displaced by development may flow and to calculate subsequent increases in downstream flood volumes. The modelling should investigate scenarios based on compensatory storage techniques to ensure that downstream or nearby sites are not adversely affected by development on other sites.
Using a phased approach to development, based on modelling results of floodwater storage options, should ensure that any sites at risk of causing flooding to other sites are developed first in order to ensure flood storage measures are in place before other sites are developed, thus ensuring a sustainable approach to site development.
Also, it may be possible that flood mitigation measures put in place at sites upstream could alleviate flooding at downstream or nearby sites. This is especially important for large strategic sites that are likely to be brought forward as sub parcels in separate phases.

6 Local Plan Sites Assessment

As assessment of the Preferred Option sites will inform the preparation of the council's Local Plan. LPAs have a requirement under the National Planning Policy Framework (NPPF) to demonstrate a sufficient supply of potential sites suitable for residential development to meet local housing requirements as well as sites for economic development uses. The preferred options show the levels of housing and employment growth that Stoke-on-Trent City Council are planning for over a twenty-year period and the initial set of preferred housing and employment site locations to accommodate this growth.

The Preferred Option sites have been considered in this SFRA update. 111 potential sites overall have been assessed and subdivided into several proposed uses including:

- Residential - 77 sites
- Employment - 36 sites

In order to inform the first part of the Sequential Approach for allocation of development through the Local Plan (illustrated in Figure 5-2), this SFRA has carried out a high-level GIS screening exercise which involved overlaying the potential sites against Flood Zones 1, 2, 3a and 3b. Surface water risk to sites has also been assessed through the EA's updated Flood Map for Surface Water dataset and the output from the local detailed models to help identify those sites that may have critical drainage problems. An assessment of the potential future flood risk has been assessed by overlaying the potential sites against the three 100-year Climate Change allowances, Central, Higher Central and Upper End. The Development Site Screening spreadsheet, included in Appendix B, provides a breakdown of each site and the area (ha) and percentage coverage of each Flood Zone, each surface water Flood Zone and Climate Change outline. Zones 3b, 3a and 2 are considered in isolation. Any area of a site within the higher risk Flood Zones 3b that is also within Flood Zone 3a is excluded from Flood Zone 3a and any area within Flood Zone 3a is excluded from Flood Zone 2. This allows the sequential assessment of risk at each site by addressing those sites at higher risk first. Table 6-1 provides a count of the number of sites within each Flood Zone.

Table 6-1: Number of potential development sites at risk from Flood Map for Planning Flood Zones

Potential Development Site	Flood Zone 1*	Flood Zone 2	Flood Zone 3a	Flood Zone 3b
Residential	69	8	8	1
Employment	26	10	9	6
Total	95	18	17	7

*Sites with 100% area within Flood Zone 1

SoTCC should use the Development Site Screening spreadsheet in Appendix B to identify which sites should be avoided during the Sequential Test. If this is not the case, or where wider strategic objectives require regeneration in areas

already at risk of flooding, then SoTCC should consider the compatibility of vulnerability classifications and Flood Zones (refer to FRCC-PPG) and whether or not the Exception Test will be required before finalising sites. The decision-making process on site suitability should be transparent and information from this SFRA should be used to justify decisions to allocate land in areas at high risk of flooding.

6.1 Potential Development Sites Review

This section of the report assesses flood risk to potential sites. Section 8.1.1 provides high level broad-brush recommendations for those sites within the Flood Zones of the Flood Map for Planning. Section 8.1.2 reviews the surface water risk to the potential sites by way of the updated Flood Map for Surface Water. An assessment of the sites at risk from Climate Change is outlined in Section 8.1.3.

It is important to note that each individual site will require further investigation, as local circumstances may dictate the outcome of the recommendation. Such local circumstances may include the following:

- Flood depths and hazards will differ locally to each at risk site therefore modelled depth, hazard and velocity data should be assessed for the relevant flood event outlines, including climate change (using the EA's February 2016 allowances), as part of a site-specific FRA.
- Current surface water drainage infrastructure and applicability of SuDS techniques are likely to differ at each site considered to be at risk from surface water flooding. Further investigation would therefore be required for any site at surface water flood risk.
- If sites have planning permission but construction has not started, the SFRA will only be able to influence the design of the development e.g. finished floor levels. New, more extensive flood extents (from new models) cannot be used to reject development where planning permission has already been granted.
- It may be possible at some sites to develop around the flood risk. The LPA are best placed to make this judgement i.e. will the site still be deliverable if part of it needs to be retained to make space for flood water.
- Surrounding infrastructure may influence scope for layout redesign/removal of site footprints from risk.
- Current land use. A number of sites included in the assessment are likely to be brownfield, thus the existing development structure could be taken into account as further development may not lead to increased flood risk.
- Existing planning permissions may exist on some sites where the EA may have already passed comment and/or agreed to appropriate remedial works concerning flood risk. Previous flood risk investigations/FRAs may already have been carried out at some sites.

Development viability is assessed, based on the flood risk vulnerability classification in Table 2 of the Flood Risk and Coastal Change Planning Practice Guidance (FRCC-PPG), and subsequent strategic recommendations were made and are discussed in this report.

The following strategic recommendations may apply to a site, following application of the Sequential Test by the LPA:

- Strategic Recommendation A - consider withdrawing the site based on significant level of fluvial flood risk;

- Strategic Recommendation B - Exception Test required if site passes Sequential Test;
- Strategic Recommendation C - consider site layout and design around the identified flood risk, if site passes Sequential Test;
- Strategic Recommendation D - site can be permitted on flood risk grounds due to limited perceived risk, subject to consultation with the LPA / LLFA;
- Strategic Recommendation E - can be allocated on flood risk grounds subject to consultation with the LPA / LLFA.

Table 6-2 summarises the number of sites that each recommendation applies to.

Table 6-2: Number of sites per Strategic Recommendation (Following Council review of flood risk and development)

Site/Proposed use	Strategic Recommendation				
	A	B	C	D	E
Residential	1 *	7	0	43	26
Employment	6	0	3	19	8
Total	**7**	**7**	**3**	**62**	**34**

*This refers to site 351, which is impacted by FZ3b outlines from the Fowlea Brook. This model was provided by the EA and in this case the channel isn't represented, which can give a skewed look to the flood outlines. This is explained further in Appendix D.

6.1.1 Flood Map for Planning Site Assessment

The following recommendations provide only a guide, based on the flood risk information made available for this Level 1 SFRA. Information regarding local, site specific information is beyond the scope of this SFRA. It is SoTCC's responsibility to carry out sequential testing of each site using the information provided in this SFRA and more specifically using their local, site specific knowledge and advice from the EA. These sections should be read alongside the Development Site Screening spreadsheet in Appendix B.

Recommendation A – consider withdrawing the site or redefining the developable area of the site based on significant level of fluvial flood risk This recommendation DOES NOT take account of local circumstances, only that part of a site area falls within a Flood Zone.

Recommendation A applies to any site within the functional floodplain

The FRCC-PPG flood risk vulnerability classification states that only water-compatible uses and essential infrastructure should be permitted in Flood Zone 3b, though any essential infrastructure must pass the Exception Test. Land allocated for housing falls in to the more vulnerable category and sites for employment; retail; recreation and leisure; and mineral and waste are in the less vulnerable category, though waste management sites for hazardous materials fall with the more vulnerable category. Gypsy and traveller sites fall within the

highly vulnerable category. Mixed use sites should be placed into the higher of the relevant classes of flood risk sensitivity.
Development should not be permitted for sites within the more vulnerable and less vulnerable categories that fall within Flood Zone 3b. If the developer is able to avoid 3b however, then part of the site could still be delivered.
Depending on how much of the site is at risk and whether the location of highest risk would affect safe access and egress during a flood, it may be possible to develop on the parts of the site at lower risk, having firstly considered whether there are reasonable alternative sites at a lower risk of flooding. Site boundaries can be redrawn to exclude the functional floodplain. When doing so care needs to be taken to ensure there are no areas adjacent to watercourses that are left inaccessible and not maintained.
Strategic recommendation A applies to 7 of the potential development sites.

Table 6-3: Sites which apply to strategic recommendation A

Site ID	Site Name	Proposed use	Site Area (ha)	% Area within FZ3A	% Area within FZ3b
10355/9756 /New12	63-65 Birches Head Road, Hanley, Stoke on Trent, Staffs	Employment	17.70	27%	<1%
10294/10295	New House Abattoir, Werrington Road, Bucknall, Stoke on Trent, Staffs	Employment	0.85	1%	3%
02020/CFS20	Former Tunstall Sewage Works	Employment	10.75	13%	8%
New5	Former Brownhills Tileries, Harewood Street, Tunstall	Employment	14.00	1%	1%
CFS4	Former Ravensdale Sportsfield, Land off Chemical Lane, Tunstall	Employment	6.55	1%	1%
New2	Etruria Valley Phases 3a and 3b, Forge Lane, Etruria	Employment	0.63	1%	<1%
351	Land between Huntilee Road and Scotia Road, Scotia Road, Tunstall	Residential	0.21	1%	<1%

Recommendation B – Exception Test
Recommendation B applies to sites where it is likely the Exception Test would be required. This does not include any recommendation on the likelihood of a site passing the Exception Test. These sites may need to be examined as part of a more in-depth Level 2 SFRA. The developer / LPA should attempt to avoid the risk area where possible.
This recommendation DOES NOT take account of local circumstances, only that part of a site area falls within a Flood Zone.

Recommendation B applies to sites where the following criteria is true:
- Where any residential site is in Flood Zone 3a

All development proposals in Flood Zone 3a must be accompanied by a FRA.

Table 6-4 lists those sites where Recommendation B should apply. The Development Site Assessment spreadsheet in Appendix B illustrates that there are seven sites where Recommendation B would need to be applied. The larger the percentage of the site at flood risk, the more challenging it may be for a site to pass the Exception Test, if it is not already protected by flood defences.

Table 6-4: Sites which require Exception test

	Site Name	Proposed use	Site Area (ha)	% Area within FZ3A	% Area within FZ3b
	Land at, Trentham Lakes, Stanley Matthews Way, Stoke-on-Trent – Under Construction	Residential	4.23	2%	0%
	Land off, Magdalen Road, Blurton	Residential	6.17	10%	0%
	Victoria Ground, Boothen Old Road, Stoke – Under Construction	Residential	0.33	3%	3%
	Minton Hollins (land) (employment), Shelton Old Road, Stoke – Planning app approved	Residential	0.40	16%	0%
	Mitchell High School, Bucknall, Stoke on Trent, ST2 9EY.	Residential	1.98	10%	0%
	Land at, Berryhill	Residential	4.06	>1%	0%
	New Inn Lane	Residential	70.53	9%	0%

Recommendation C – Consider site layout and design

This recommends a review of site layout and / or design at the development planning stage in order for development to proceed. A site-specific FRA would be required to inform site layout and design.

This recommendation DOES NOT take account of local circumstances, only that part of a site area falls within a Flood Zone.

Recommendation C applies to sites where the following criteria is true:

- Where any commercial development is in Flood Zone 3a.

Table 8-5 lists those sites where Recommendation C should apply. The Development Site Assessment spreadsheet in Appendix B illustrates that there are three sites where Recommendation C would need to be applied.

Table 6-5: Sites to which recommendation C applies

	Site Name	Proposed use	Site Area (ha)	% Area within FZ3A	% Area within FZ3b
	Land at Whieldon Road	Employment	3.01	74%	0%
	Land Adjacent to Brownhills Road, Tunstall, Stoke on Trent	Employment	1.13	22%	0%
	Trentham Lakes South (Area 3)	Employment	13.64	65%	0%

Recommendation D – Development could be allocated subject to FRA

This recommends that development could be allocated, assuming a site-specific FRA shows the site can be safe and it is demonstrated that the site is sequentially preferable. A site within Flood Zone 2 could still be rejected if the conclusions of the FRA decide development is unsafe or inappropriate.

This recommendation DOES NOT take account of local circumstances, only that part of a site area falls within a Flood Zone.

Recommendation D applies to sites where the following criteria is true:

- Any site within Flood Zone 2 that does not have any part of its footprint within Flood Zone 3a, except for highly vulnerable developments (such as gypsy and traveller sites) which would be subject to, and have to pass, the Exception Test.
- Any site 100% within Flood Zone 1 where surface water flood risk is apparent on site and therefore recommended for investigation through a site-specific FRA.
- Any site 100% within Flood Zone 1 that is greater than or equal to 1 hectare in area.

Recommendation D applies to 62 potential sites overall and can be identified in Appendix B.

All development proposals within Flood Zone 2 must be accompanied by a site-

specific Flood Risk Assessment. Any sites 100% within Flood Zone 1 that are equal to or greater than 1 hectare in area must be accompanied by a site-specific Flood Risk Assessment to determine vulnerability to flooding from other sources as well as fluvial. The FRA should determine the potential of increased flood risk elsewhere as a result of the addition of hard surfaces on-site and the effect of new development on surface water runoff.

Recommendation E - Should be allocated on flood risk grounds subject to consultation with the LPA / LLFA

This recommends that development should be allocated on flood risk grounds, based on the evidence provided within this SFRA. Further investigation may be required by the developer and an FRA is required to assess flood risk in detail at a site-specific level.

Recommendation E applies to any site with its area 100% within Flood Zone 1 and with either no risk or minimal risk from surface water, based on the Risk of Flooding from Surface Water and local surface water modelled data.

Recommendation E applies to 34 potential sites overall and can be identified in Appendix B.

Strategic recommendation summary

Table 6-6 summaries the strategic recommendations made for the sites at fluvial flood risk. Table 6-7 lists the number of sites to which each strategic recommendation applies.

Table 6-6: Summary of strategic recommendations

Recommendation	Outcome	Reasons
A	Consider Withdrawal of Site	Any part of the site is within the Functional Floodplain Flood Zone 3b
B	Exception Test	The site is residential and in Flood Zone 3a
C	Consider site layout and design	The site is commercial and in Flood Zone 3a
D	Development could be allocated subject to FRA	Any site within Flood Zone 2 that does not have any part of its footprint within Flood Zone 3a Any site 100% within Flood Zone 1 where surface water flood risk is apparent on site and therefore recommended for investigation through a site-specific FRA. Any site 100% within Flood Zone 1 that is greater than or equal to 1 hectare in area
E	Should be allocated on flood risk grounds subject to consultation with the LLFA	Any site 100% within Flood Zone 1 that is less than or equal to 1 hectare in area and has no surface water flood risk issues.

Table 6-7: Number of sites per strategic recommendations

Site/Proposed use	Strategic Recommendation				
	A	B	C	D	E
Residential	1	7	0	43	26
Employment	6	0	3	19	8
Total	**7**	**7**	**3**	**62**	**34**

Rejection of site

A site which fails to pass the Sequential Test and / or the Exception Test should be rejected. Rejection would also apply to any residential (including gypsy and traveller) or employment site, or mixed-use schemes with an element of residential development, as this falls into the more vulnerable, less vulnerable or highly vulnerable categories within Flood Zone 3b for which development should not be permitted. The Flood Risk and Coastal Change PPG flood risk vulnerability classification states that only water-compatible uses and essential infrastructure should be permitted in Flood Zone 3b, though any essential infrastructure must pass the Exception Test and clearly demonstrate that it does not increase or exacerbate flood risk. If the developer is able to avoid 3b, part of the site could still be delivered, as part of the Exception Test.

Exception Test required

For those sites that, according to the FRCC-PPG vulnerability tables, would require the Exception Test. Only water-compatible and less vulnerable uses of land would not require the Exception Test in Flood Zone 3a. More vulnerable uses, including residential, and essential infrastructure are only permitted if the Exception Test is passed and all development proposals in Flood Zone 3a must be accompanied by a Flood Risk Assessment. To avoid having to apply the Exception Test, the developer / LPA should attempt to avoid the risk area altogether.

Consideration of site layout and design

Site layout and site design is important at the site planning stage where flood risk exists. The site area would have to be large enough to enable any alteration of the developable area of the site to remove development from the functional floodplain, or to leave space for on-site storage of flood water within Flood Zone 3a. Careful layout and design at the site planning stage may apply to such sites where it is considered viable based on the level of risk. Surface water risk and opportunities for SuDS should also be assessed during the planning stage. Developers should refer to the Stoke-on-Trent specific appendix to the Stoke SuDS handbook (Appendix H) which provides details when and where SuDS are required.

Depending on local circumstances, if it is not possible to adjust the site boundary to remove the site footprint from Flood Zone 3b to a lower risk zone then development should not be permitted. If it is not possible to adjust the developable area of a site to remove the proposed development from Flood Zone 3a to a lower risk zone, then the Exception Test would have to be passed as part of a site-specific Flood Risk Assessment.

Any site layout and design should take account of the 8-metre easement buffer

along watercourses, from the top of the bank or the landward to of a defence on main rivers, where development is not permitted. This easement buffer is recommended by the EA to allow ease of access to watercourses for maintenance works. Any site redesign, where Flood Zone 3a is included within the site footprint, should allow water to flow naturally or be stored in times of flood through application of suitable SuDS and surface water mitigation measures.

The FRCC-PPG (Paragraph 050) states:

Local authorities and developers should seek opportunities to reduce the overall level of flood risk in the area and beyond. This can be achieved, for instance, through the layout and form of development, including green infrastructure and the appropriate application of sustainable drainage systems, through safeguarding land for flood risk management, or where appropriate, through designing off-site works required to protect and support development in ways that benefit the area more generally.

Site-Specific Flood Risk Assessment

According to the FRCC-PPG (Para 030), a site-specific FRA is:

"…carried out by (or on behalf of) a developer to assess the flood risk to and from a development site". Where necessary (see footnote 50 in the National Planning Policy Framework), the assessment should accompany a planning application submitted to the local planning authority. The assessment should demonstrate to the decision-maker how flood risk will be managed now and over the development's lifetime, taking climate change into account, and with regard to the vulnerability of its users (see Table 2 – Flood Risk Vulnerability of PPG)."

The FRCC-PPG does not contain any further detail on the minimum requirements for site-specific FRAs. It is therefore important that the EA's FRA guidance is referred to and also the site-specific Flood Risk Assessment Checklist in paragraph 068 of the FRCC-PPG should be consulted. CIRIA's report 'C624 Development and Flood Risk' also provides useful guidance.

According to NPPF footnote 50, a site-specific FRA should be prepared when the application site is:

- Situated in Flood Zone 2 and 3; for all proposals for new development (including minor development and change of use)
- 1 hectare or greater in size and located in Flood Zone 1
- Located in Flood Zone 1 where there are critical drainage problems
- At risk of flooding from other sources of flooding, such as those identified in this SFRA
- Subject to a change of use to a higher vulnerability classification which may be subject to other sources of flooding
- The LPA may also like to consider further options for stipulating FRA requirements, such as:
- Situated in an area currently benefitting from defences
- Where the site is at risk of surface water flooding
- Where there is a watercourse under or adjacent to the site

These further options should be considered during the preparation and development of the Joint Local Plan.

Sites passing the Sequential and Exception Tests

Development sites can be allocated where the Sequential Test and the Exception Test (if required) are passed. This Level 1 SFRA informs the Sequential Test. If the Exception Test is required, further and more detailed work

would be needed as part of a Level 2 SFRA. A Flood Risk Assessment will still be required at the Planning Application stage.

6.1.2 Surface Water Risk to Potential Sites

This section assesses surface water risk to each site according to the RoFSW and where applicable the local detailed modelling outputs. The Development Site Screening spreadsheet in Appendix B isolates each of the surface water outlines so that any area of a site within the higher risk 1 in 30 year outline is excluded from the medium risk 1 in 100 year outline and any area within the 1 in 100 year outline is excluded from the lower risk 1 in 1000 year outline. This allows a sequential assessment of risk at each site. Table 6-8 shows the number of sites at risk for each event. A number of these sites are also at fluvial flood risk.

NOTE: Appendix B shows the percentage of a site at risk from both the national and local data on surface water flooding. It also identifies where sites fall within the extent of the locally modelled areas. If a site is within an area that can been subject to more detailed modelling, then that should be used in preference to the national data. It is the aspiration of SoTCC to submit the outputs of the locally modelled data for inclusion in the next version of the national surface water mapping.

Table 6-8 lists the sites where surface water flood risk is considered to be significant enough that it may be difficult to develop these sites and where further work as part of a Level 2 SFRA may be beneficial according to the RoFSW. Table 6-9 lists the sites where surface water flood risk is considered to be significant enough that it may be difficult to develop these sites and where further work as part of a Level 2 SFRA may be beneficial according to the Stoke-on-Trent Local Surface Water Mapping.

Table 6-8: Sites requiring further investigation based on national surface water risk

Site ID	Site Name	Proposed use	Site Area (ha)	% Area within 1 in 30 Year Outline (RoFSW)	% Area within 1 in 100 Year Outline (RoFSW)	% Area within 1 in 1000 Year Outline (RoFSW)
10355/9756/New12	63-65 Birches Head Road, Hanley, Stoke on Trent, Staffs	Employment	17.70	1%	3%	38%
10148	Land at, Brownley Road, Newford, Stoke on Trent, Staffs	Employment	0.94	5%	5%	41%

CFS5	Land at Whieldon Road	Employment	3.01	0%	6%	46%
02020/CFS 20	Former Tunstall Sewage Works	Employment	10.75	1%	4%	21%
375	Land off, Magdalen Road, Blurton	Residential	6.17	7%	33%	22%
163	Corner of, Nursery Lane, Baddeley Green	Residential	1.08	0%	10%	15%
675	Wedgwood Estate (Phase2 The Village), Wedgwood Drive, Trentham, Stoke-on-Trent, ST12 9ER	Residential	4.18	3%	5%	27%
410	Melville Street / Wooliscroft Factory, Berryhill and Hanley East, Stoke on Trent, Staffordshire, ST1 3LY	Residential	2.90	1%	2%	33%
562	Land at Umberleigh Road, Blurton, and other land, ST3 3ND and Public Open Space at Newstead	Residential	5.64	0%	3%	27%

Table 6-9- Sites requiring further investigation based on local surface water risk.

Site ID	Site Name	Proposed use	Site Area (ha)	% Area within 1 in 30 Year Outline (RoFSW)	% Area within 1 in 100 Year Outline (RoFSW)	% Area within 1 in 1000 Year Outline (RoFSW)
9877	Former Shires Bathrooms Site, Uttoxeter Road, Longton	Employment	1.56	7%	11%	21%
10546/2182B	Land at Mossfield Road, Mossfield Industrial Estate	Employment	0.59	8%	8%	17%
55907/FUL	191 Uttoxeter Road, Normacot	Employment	0.06	3%	3%	18%
58117/FUL	Land at Gower Street, Longton	Employment	0.54	5%	16%	27%
379	Land off, Wren View, Normacot	Residential	0.69	12%	21%	37%
774	Development Land at Bengry Road, Longton	Residential	2.36	2%	2%	11%
297	Land at, Central Outpatients/Central Pathology Laboratory, Thornburrow – PP granted	Residential	2.79	0%	0%	6%
320	Land at, North Staffordshire Royal Infirmary, Princes Road / Queens Road, Hartshill, Stoke-on-Trent – PP granted	Residential	1.66	0%	0%	1%
163*	Corner of, Nursery Lane, Baddeley Green	Residential	1.08	3%	4%	13%
415	Mitchell High School, Bucknall, Stoke on Trent, ST2 9EY.	Residential	1.98	3%	6%	11%
140	Bucknall Hospital, Eaves Lane, Bucknall, Stoke on Trent, ST2 8LD - UC	Residential	2.55	2%	3%	6%

651	Land adj Blackfriars School, Castle Grove, Abbey Hulton	Residential	0.33	1%	3%	21%
730	Land to the south of Lillydale Road, Townsend	Residential	6.72	11%	14%	20%
491	Royal Doulton, Leek New Road, Baddeley Green	Residential	0.85	4%	5%	6%
370	Land off Baron Street, Fenton	Residential	2.09	1%	5%	31%
766	Land at Power Grove, Hollybush, Longton	Residential	1.09	4%	5%	12%
767	Coronation Avenue Development Land, off Heathcote Road, Longton	Residential	7.88	6%	8%	15%
132	Berry Hill High School and Sports College, Bucknall, Stoke on Trent, ST2 9LR	Residential	6.80	12%	17%	28%
172	Edensor Technology School, Edensor Road, Longton	Residential	2.04	7%	10%	25%
196	Former Blythe and Sutherland Works,Sutherland Road, Longton	Residential	0.38	1%	4%	13%
468	Pottery, Sutherland Road, Longton	Residential	1.40	61%	66%	76%
433	Portland Works, Sutherland Road, Longton	Residential	1.00	1%	2%	30%
187	Foley Goods Yard, Bute Street, Fenton	Residential	1.04	7%	7%	10%
292	Land at, Berryhill	Residential	4.06	1%	2%	3%

* Sites at risk from both National Surface Water Flooding and Local Surface Water Flooding and therefore developers should use the Local Surface water percentages.

For sites at surface water flood risk the following should be considered:

- Possible withdrawal, redesign or relocation of the site, certainly for those sites at higher risk from the 1 in 30-year event and those with a large percentage area at risk. This applies to the sites listed in Table 6-8 where further investigation is recommended;
- A detailed site-specific Flood Risk Assessment incorporating surface

water flood risk management;

- A FRA may need to consider detailed surface water modelling, particularly for the larger sites which may influence sites elsewhere;
- The size of development and the possibility of increased surface water flood risk caused by development on current Greenfield land, and cumulative impacts of this within specific areas;
- Management and re-use of surface water on-site, assuming the site is large enough to facilitate this and achieve effective mitigation;
- Larger sites could leave surface water flood prone areas as open greenspace, incorporating social and environmental benefits;
- Effective surface water management should ensure risks on and off site are controlled;
- SuDS should be used where possible. Appropriate SuDS may offer opportunities to control runoff to Greenfield rates. Developers should refer to the Stoke-on-Trent specific appendix to the SoTCC SuDS handbook (Appendix H). Restrictions on surface water runoff from new development should be incorporated into the development planning stage. For brownfield sites, where current infrastructure may be staying in place, then runoff should attempt to mimic that of Greenfield rates, unless it can be demonstrated that this is unachievable or hydraulically impractical.

6.1.3 Climate change

NOTE: This assessment of Climate Change risk to sites DOES NOT take account of local circumstances, only that part of a site area falls within a outline of the Climate change outline as part of this SFRA.

This assesses the climate change risk to each site according to the climate changes outlines created as part of this SFRA. The LPA should also consider whether there is a significant increase in flood risk due to climate change, using the maps in Appendix A and Development Site Screening in Appendix B, and how much of the site is affected. They should form a judgement based on the likely lifetime of a development (e.g. 60 years for commercial and 100 years for residential) as to whether the site is likely to become at unacceptable risk of flooding over time. Table 6-10 sets out which sites are at increasing risk due to climate change from river flooding and shows how this risk might increase, depending on which emissions scenario is taken into account. A number of these sites are also at surface water flood risk.
In order to take account of the implications of climate change, “a sequential approach should be used in areas known to be at risk now or in the future from any form of flooding” (NPPF, paragraph 158). It is not uncommon that the modelled Flood Zone 3a plus climate change outline can be more extensive than present day Flood Zone 2, and may even intrude into Flood Zone 1. Sites or opportunities in these areas have the potential to not be considered in the application of the Sequential Test as future risks / uplifts are not considered in the Flood Zones.

Table 6-10: Number of sites at risk from Climate Change

Climate change event outline	Number of sites at risk	Number of sites with >10%
Within 100-year Climate Change Central	12	4
Within 100-year Climate Change Higher Central	12	4
Within 100-year Climate Change Upper End	14	6

Table 6-10 summarises the number of sites at risk from each climate change allowance. Of the 113 sites 12 sites are at risk of flooding from the three SFRA Climate Change outlines. Of the 12 sites at risk from only 4 sites have 10% or more of their site area at risk.

Existing Environment Agency hydraulic models were run for the 2080s period for all three allowance categories to create the SFRA Climate Change outputs. Where there is no existing EA model at the time of writing of this SFRA, there is no data within the Climate Change outline. This does not mean there is no risk of flooding, only that there is insufficient data to predict the effect of climate change.

Where there are climate change outputs (shown on the maps in Appendix A), the results of the climate change modelling may not be directly comparable with the Flood Map for Planning Flood Zone 3a and Flood Zone 2, because the Flood Zones do not take flood defences into account. Should a site be within any of the Climate Change outlines, a Level 2 SFRA is recommended that can explore in greater detail the impact of climate change in relation to the Flood Zones.

Table 6-11 compares the sites where Climate Change is considered to be significant (over 10% of the site at risk from the Climate Change outlines) that further investigation is required with Flood Zone 3b. The 10% threshold is not included within any policy, it is merely considered that it would likely prove difficult for developers to deliver a site where 10% or more of the site area is considered as undevelopable, based on the NPPF.

Table 6-11: Comparison of the sites with Flood Zone 3b with the three climate change allowances

Site Reference	Within Flood Zone 3b Outline	Within 100-year Climate Change Central	Within 100-year Climate Change Higher Central	Within 100-year Climate Change Upper End
10355/9756/New12	<1%	19%	24%	68%
10294/10295	3%	3%	3%	3%
02020/CFS20	8%	14%	15%	20%
New5	1%	1%	1%	1%
CFS4	1%	1%	1%	2%
New2	<1%	1%	1%	2%
539 - UC	3%	58%	62%	65%
351	<1%	<1%	<1%	1%

For sites at future flood risk, taking into account the impacts of climate change,

the following recommendations should be considered:

- Possible withdrawal, redesign or relocation of the site for those sites at upper end or higher central climate change flood risk and those with a large percentage area at risk. This applies to the sites listed in Table 6-11 where further investigation is recommended;
- Undertake an appropriately detailed flood risk assessment to help evaluate flood risk over the lifetime of the development and to ensure that the risk and proposed mitigation are sufficient for the proposed use with no increased flood risk elsewhere;
- Demonstrate that the design, fabric and structure of the building/s are sufficiently resilient to withstand a climate change flood event and appropriate for use on the site;
- If a site is affected by the climate change Higher Central or Upper End allowances, the site should give precedence to developing areas at lesser risk of flooding and site buildings should be located where the depth/velocity and hazard ratings are shown to be low;
- Raise finished floor levels to above the required design flood level, depending on the flood risk vulnerability and the lifetime of the development, with adequate freeboard and to incorporate safe access and egress routes and resilience / resistance measures, where necessary.

Cumulative impact of development and strategic solutions

This section considers the cumulative impact that development may have on flood risk and opportunities for future development to contribute towards strategic solutions to manage flood risk.

Under the revised 2019 NPPF, strategic policies and their supporting Strategic Flood Risk Assessments (SFRA), are required to '*consider cumulative impacts in, or affecting, local areas susceptible to flooding*' (para. 156), rather than just to or from individual development sites.
When allocating land for development, consideration should be given to the potential cumulative impact of the loss of floodplain storage volume. Whilst the loss of storage for individual developments may only have a minimal impact on flood risk, the cumulative effect of multiple developments may be more severe. The cumulative impact of development should be considered at the planning application and development design stages and the appropriate mitigation measures undertaken to ensure flood risk is not exacerbated, and where possible, the development should be used to improve flood risk. Conditions imposed by Stoke-on-Trent City Council should allow for mitigation measures so any increase in runoff as a result of development is properly managed and should not exacerbate flood risk issues, either within, or outside of the Council's administrative area.

6.1.4 Cross-boundary issues

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

increase in flood risk within Stoke-on-Trent.
Development Control should ensure that the impact on receiving watercourses from development in Stoke-on-Trent has been sufficiently considered during the planning stage and appropriate development management decisions put in place to ensure there is no adverse impact on flood risk or water quality by following the recommendations in Section 13 and by applying suitable SuDS.
The topography of the City means that a number of major watercourses such as the River Trent, Lyme Brook and River Blithe flow through the study area and into neighbouring authorities. Figure 6-1 shows the catchments covering the City mapped against the topography. As such, future development, both within and outside Stoke-on-Trent City can have the potential to affect flood risk to existing development and surrounding areas, depending on the effectiveness of SuDS and drainage implementation. The Stoke area has boundaries with the following Local Authorities, which can be seen on Figure 6-2.
The City of Stoke-on-Trent has boundaries with the following Local Authorities, which can be seen on Figure 6-2:

- Newcastle-under-Lyme District
- Staffordshire Moorlands District
- Stafford

Stoke-on-Trent sits in the headwaters of the River Trent and close to the watershed. Parts of Newcastle-under-Lyme and Staffordshire Moorlands drain towards the City. Stafford lies downstream of the City on the River Trent.
Policy recommendations with regards to managing the cumulative impact of development have been made in Section 13. This will help to ensure there is no incremental increase in flood risk both within and downstream of Stoke-on-Trent.

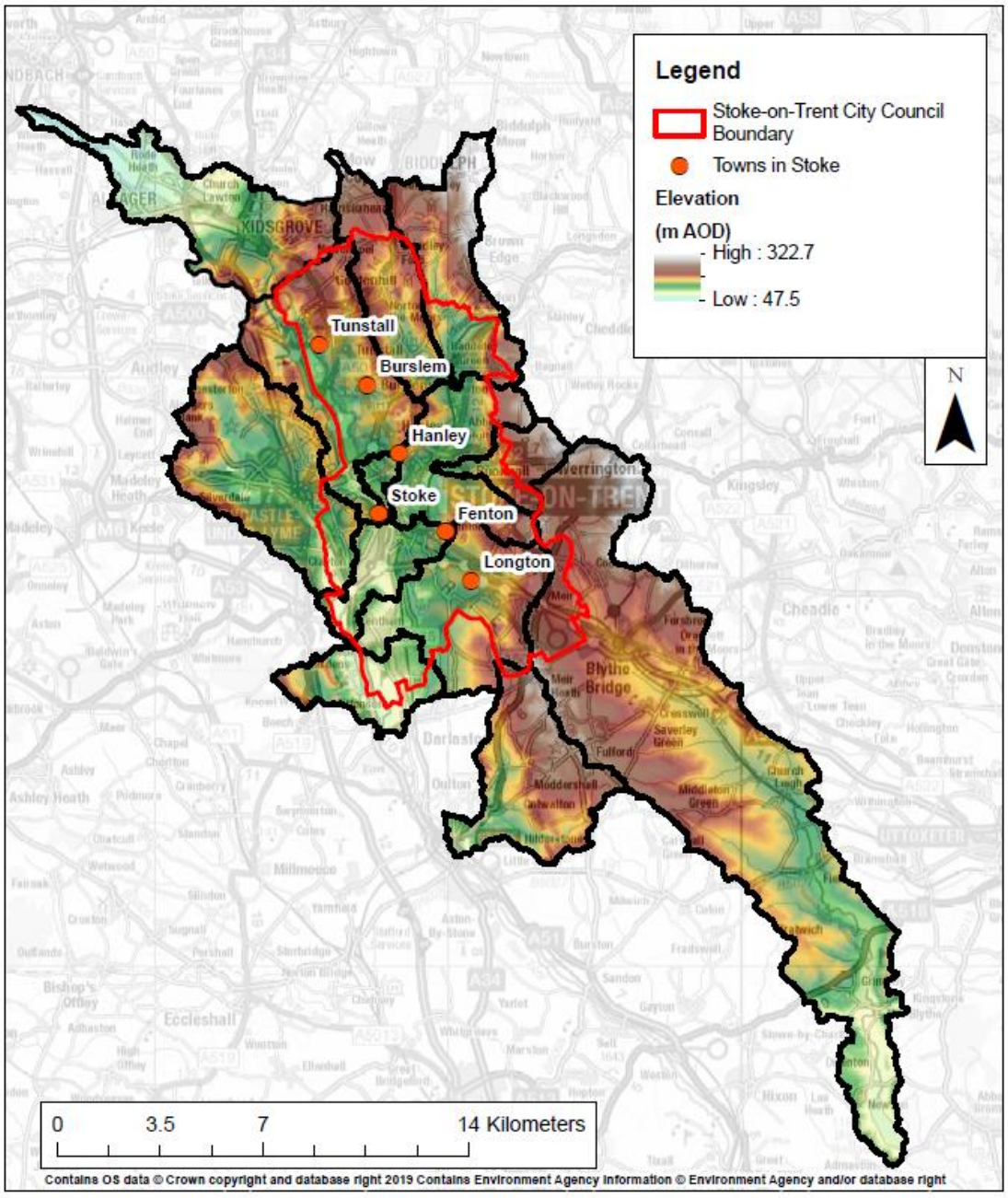


Figure 6-1: Elevation and surrounding river catchments

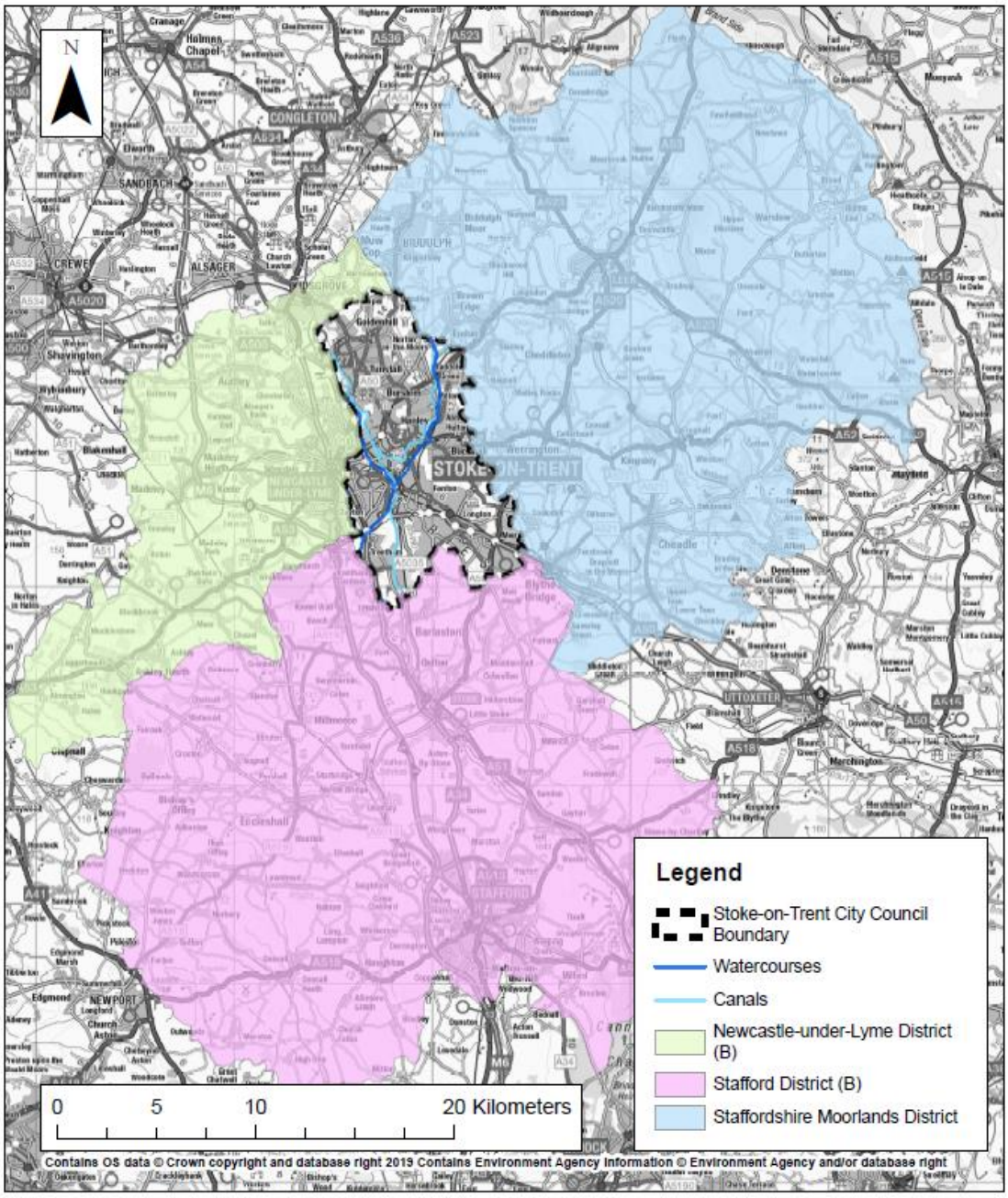


Figure 6-2: Surrounding Authorities

6.2 Strategic solutions

The Risk Management Authorities have a collective vision for the future management of flood risk and drainage in the study area. This concerns flood risk management, alongside wider environmental and water quality enhancements. Strategic solutions may include upstream flood storage, integrated major infrastructure/ FRM schemes, new defences and watercourse improvements as part of regeneration and enhancing green infrastructure, with opportunities for natural flood management and retrofitting sustainable drainage systems.

Section 3.2 sets out the strategic plans that exist for the City. The list below summarises the key outcomes theses are seeking to achieve that are relevant to new development and the planning system.

- Risk Management Authorities working in partnership to manage all sources of flooding;
- Managing flood risk to existing communities, infrastructure and the environment in a sustainable manner;
- De-culverting and restoring watercourses, including taking opportunities presented by new development to do so;
- Recognising that new development is one of the best ways to manage flood risk, by avoiding inappropriate development in flood risk areas and ensuring that new development does not increase flood risk elsewhere;
- Encouraging the take up of multi-functional Sustainable Drainage Systems and retrofitting and enhancing green infrastructure;
- Ensuring communities are prepared for flood events (and that the residual risk to new developments has been considered and planned for);
- Recognising the role of strategic solutions in reducing flood risk to enable regeneration as well as the protection of existing communities, infrastructure and the environment; and
- Recognising the potential for developers to contribute towards such flood risk management measures that reduce risk to their development sites, facilitate regeneration and the wider community.

6.2.1 Natural flood management

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

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

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

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

management tool kit.

Evidence base for NFM to reduce flood risk

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

Mapping showing the potential for NFM can be found at the following website. 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.

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

6.2.2 Cumulative Impact Assessment

A cumulative impact assessment was undertaken for the SFRA to identity those catchments at highest risk of flooding, where development might have the potential to increase flood risk and where, with appropriate planning policies in place, there is the opportunity for development to contribute towards a reduction in flood risk across the wider area. This work was undertaken in parallel with the Surface Water Management Plan work, which has identified hotspot areas for localised flooding.

The following areas have been identified as those for which targeted Local Plan policies are recommended in Section 13 and shown on **Figure 6-3**:

- Fowlea Brook: the catchment is vulnerable to flash flooding and designated by the Environment Agency as a ‘rapid response’ catchment. It is a high flood risk urban catchment with complex localised flooding issues. There is the potential for development in this catchment to contribute towards works to reduce flood risk and enable regeneration e.g. at Elenora Street/ Liverpool Road, as well as contributing to the wider provision of green infrastructure. The catchment extent is based on the catchment boundary defined in detailed flood modelling studies for the Fowlea Brook.
- Surface Water Management Plan flood hotspot areas: the SFRA has highlighted local areas at high risk of surface water flooding, draining towards flood hotspots. The catchment extents are based on the extents of the integrated flood models created for areas of the city that have previously experienced localised flooding. These extents capture the catchments that feed overland flows towards the areas that flooded:
  - Fenn Park
  - Eaves Lane
  - Hilton Road
  - Uffington Parade
  - Weston Coyney

- The model extents were merged in GIS software as they overlapped in places and small areas sandwiched between the model areas were integrated into the overall flood hotspot areas to create a continuous area where suitable.

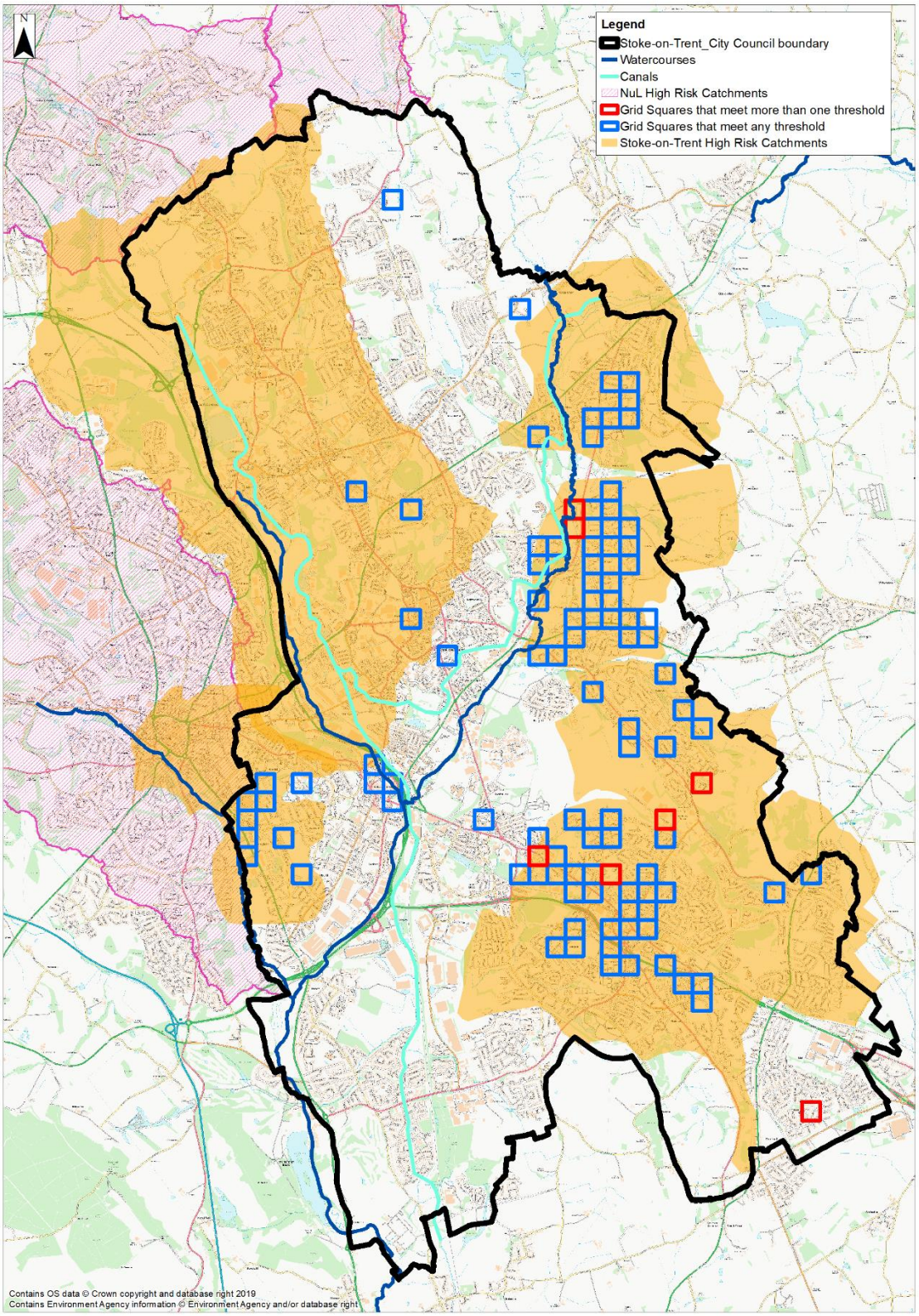


Figure 6-3 Catchments for which specific Local Plan policies are recommended

Guidance for Developers

This section provides guidance on site specific Flood Risk Assessments (FRAs). These are carried out by (or on behalf of) developers to assess flood risk to and from a site. They are submitted with Planning Applications and should demonstrate how flood risk will be managed over the development's lifetime, considering climate change and vulnerability of users.

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

A detailed FRA may show that a site is not appropriate for development of a particular vulnerability or even at all. The Sequential and Exception Tests in the NPPF apply to all developments and an FRA should not been seen as an alternative to proving these tests have been met.

This SFRA provides the evidence base for developers to assess flood risk at a strategic level and to determine the requirements of an appropriate site-specific FRA.

The aim of this section is to provide guidance for developers on using this SFRA. When initially considering the development options for a site, developers should use this SFRA, the NPPF and the Planning Practice Guidance to:

- Identify whether the site is
- A windfall development, allocated development, within a regeneration area, single property or subject to a change of use to identify if the Sequential and Exception Tests are required.
- Check whether the Sequential Test and / or the Exception Test have already been applied
- Request information from the LPA on whether the Sequential Test and whether applicable the Exception Test, have been assessed;
- If not, provide evidence to the LPA that the site passes the Sequential Test;
- Where the Exception Test applies, all developers will need to prove that the site passes the Test at planning application stage, even if it has already been applied at allocation stage.
- Consult with the LPA Development Control, the LLFA and the EA and the wider group of flood risk consultees, where appropriate, to scope an appropriate FRA if required
- Guidance on FRAs provided this SFRA;
- Also refer to the EA Standing Advice, CIRIA Report C624, Stoke-on-Trent SUDS Handbook local appendix, the NPPF and the Planning Practice Guidance;
- Consult LLFA (Stoke-on-Trent City Council).
- Submit FRA to Development Control and the EA for approval, where necessary.

Table 0-1 identifies, for developers, when the Sequential and Exception Tests are required for certain types of development and who is responsible for providing the evidence and those who should apply the tests if required.

Table 0-1: Development types and application of Sequential and Exception Tests for developers

Development	Sequential Test Required	Who Applies the Sequential Test?	Exception Test Required?	Who Applies the Exception Test?
Allocated Sites	No (assuming the development type is the same as that submitted via the allocations process)	LPA should have already carried out the test during the allocation of development sites	Dependent on land use vulnerability	The developer must provide evidence that the test can be passed by providing planning justification and producing a detailed FRA
Windfall Sites	Yes	Developer provides evidence, to the LPA that the test can be passed. An area of search will be defined by local circumstances relating to the catchment and for the type of development being proposed	Dependent on land use vulnerability	The developer must provide evidence that the test can be passed by providing planning justification and producing a detailed FRA
Regeneration Sites Identified Within Local Plan	No	-	Dependent on land use vulnerability	The developer must provide evidence that the test can be passed by providing planning justification and producing a detailed FRA

Redevelopment of Existing Single Properties	No	-	Dependent on land use vulnerability	The developer must provide evidence that the test can be passed by providing planning justification and producing a detailed FRA
Changes of Use	No (except for any proposal involving changes of use to land involving a caravan, camping or chalet site	Developer provides evidence, to the LPA that the test can be passed	Dependent on land use vulnerability	The developer must provide evidence that the test can be passed by providing planning justification and producing a detailed FRA

6.2.3 Principles for new developments

Apply the Sequential and Exception Tests

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

Having first applied the Sequential Test, developers should also apply the sequential approach to locating development within the site. The following questions should be considered:

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

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

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

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

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

adaptation measures.

Ensure that the development does not increase flood risk elsewhere.

Section 10.3.8 sets out these requirements for taking a sustainable approach to surface water management. Developers should also ensure mitigation measures do not increase flood risk elsewhere and that floodplain compensation is provided when necessary.

Ensure the development is safe for future users

Consideration should first be given to minimising risk by planning sequentially across a site. Once risk has been minimised as far as possible, only then should mitigation measures be considered. Developers should consider both the actual and residual risk of flooding to the site (Section 4.3.1).
Further flood mitigation measures may be needed for any developments in an area protected by flood defences, where the condition of those defences is 'fair' or 'poor', and where the standard of protection is not of the required standard.

Enhance the natural river corridor and floodplain environment through new development

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

Consider and contribute to wider flood mitigation strategy and measures across the City

Wherever possible, developments should seek to help reduce flood risk in the wider area e.g. by contributing to a wider community scheme or strategy for strategic measures, such as defences or natural flood management or by contributing in kind by mitigating wider flood risk on a development site. More information on the contribution developers are expected to make towards achieving the wider vision for FRM and sustainable drainage can be found in Section 9.2. Developers must demonstrate in an FRA how they are contributing towards this vision.

6.2.4 Requirements for site-specific Flood Risk Assessments

When undertaking a site-specific FRA, developers should:

- Confirm which national guidance on climate change and new development applies by visiting GOV.UK.
- Apply this guidance when deciding the allowances to be made for climate change, having considered the potential sources of flood risk to the site (using this SFRA), the vulnerability of the development to flooding and the proposed lifetime of the development. If the site is just outside the indicative climate change extents in this SFRA, the impact of climate change should still be considered because these may get affected should the more extreme climate change scenarios materialise.
- Chapter 6 provides further details on climate change for developers, as

part of the FRA Guidance.

6.2.5 When is an FRA required?

Site-specific FRAs are required in the following circumstances:

- Proposals of 1 hectare or greater in Flood Zone 1.
- Proposals for new development (including minor development such as non-residential extensions, alterations which do not increase the size of the building or householder developments and change of use) in Flood Zones 2 and 3.
- Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.
- An FRA may also be required for some specific situations:
- If the site may be at risk from the breach of a local defence (even if the site is actually in Flood Zone 1).
- Where evidence of historical or recent flood events have been passed to the LPA.
- In an area of significant surface water flood risk.

6.2.6 Objectives of a site-specific FRA

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

- whether a proposed development is likely to be affected by current or future flooding from any source including 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 SoTCC. Guidance and advice for developers on the preparation of site-specific FRAs include:

- Standing Advice on Flood Risk (Environment Agency);
- Flood Risk Assessment for Planning Applications (Environment Agency);and
- Site-specific Flood Risk Assessment: CHECKLIST (NPPF PPG, Defra)
- Guidance for local planning authorities for reviewing flood risk assessments submitted as part of planning applications has been published by Defra in 2015 – Flood Risk Assessment: Local Planning Authorities.

The FRCC-PPG doesn't contain any further detail on the minimum requirements for site-specific FRAs. It is therefore important that the EA's FRA guidance is referred to and also the site-specific Flood Risk Assessment Checklist in paragraph 068 of the FRCC-PPG should be consulted. CIRIA's report 'C624 Development and Flood Risk' also provides useful guidance.

6.3 Site layout and design

Flood risk should be considered at an early stage in deciding the layout and

design of a site to provide an opportunity to reduce flood risk within the development.

The NPPF states that a sequential, risk-based approach should be applied to try to locate more vulnerable land use away from Flood Zones, to higher ground, while more flood-compatible development (e.g. vehicular parking, recreational space) can be located in higher risk areas. Whether parking in floodplains is appropriate will be based on the likely flood depths and hazard, evacuation procedures and availability of flood warning.

Waterside areas, or areas along known flow routes, can act as Green Infrastructure, being used for recreation, amenity and environmental purposes, allowing the preservation of flow routes and flood storage, and at the same time providing valuable social and environmental benefits contributing to other sustainability objectives. Landscaping should ensure safe access to higher ground from these areas and avoid the creation of isolated islands as water levels rise.

6.3.1 Modification of ground levels

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

Modifying ground levels to raise the land above the required flood level is an effective way of reducing flood risk to a particular site in circumstances where the land does not act as conveyance for flood waters. However, care must be taken as raising land above the floodplain could reduce conveyance or flood storage in the floodplain and could adversely impact flood risk downstream or on neighbouring land. Raising ground levels can also deflect flood flows, so analyses should be performed to demonstrate that there are no adverse effects on third party land or property.

Compensatory flood storage should be provided, and would normally be on a level for level, volume for volume basis on land that does not currently flood but is adjacent to the floodplain (in order for it to fill and drain). It should be in the vicinity of the site and within the red line of the planning application boundary (unless the site is strategically allocated). Guidance on how to address floodplain compensation is provided in Appendix A3 of the CIRIA Publication C62430.

Where proposed development results in a change in building footprint, the developer should ensure that it does not impact upon the ability of the floodplain to store or convey water and seek opportunities to provide floodplain betterment. Raising levels can also create areas where surface water might pond during significant rainfall events. Any proposals to raise ground levels should be tested to ensure that it would not cause increased ponding or build-up of surface runoff on third party land.

6.3.2 Raised floor levels

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

The Environment Agency advises that minimum finished floor levels should be set 600mm above the 100-year plus climate change peak flood level, where the

new climate change allowances have been used (see Section 6 for the climate change allowances). An additional allowance may be required because of risks relating to blockages to the channel, culvert or bridge and should be considered as part of an FRA.

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. Other measures that be taken include:

- Services such as electrical fittings, kitchen appliances and sanitary ware should be fitted at least 300mm above the FFL
- The electrical sockets, switches and wiring should meet the wiring regulations listed under Part M of the Building Regulation and BS7671
- Kitchen units and appliances should be raised

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

6.3.3 Development and raised defences

Construction of localised raised floodwalls or embankments to protect new development is not a preferred option, as a residual risk of flooding will remain. Compensatory storage must be provided where raised defences remove storage from the floodplain.

Where development is located behind, or in an area benefitting from defences, the residual risk of flooding must be considered, as set out in Section 5.

6.3.4 Developer contributions

In some cases and following the application of the Sequential Test, it may be appropriate for the developer to contribute to the improvement of flood defence provision that would benefit both proposed new development and the existing local community. Developer contributions can also be made to maintenance and provision of flood risk management assets, flood warning and the reduction of surface water flooding (i.e. SuDS). Further information can be found about where strategic flood risk solutions are being planned in Section 9.2.

6.3.5 Resistance and resilience measures

The above design considerations should be implemented before resistance and resilience measures are considered. The consideration of resistance and resilience measures should not be used to justify development in inappropriate locations. It should be noted that only ‘water compatible’ and ‘essential infrastructure’ are permitted in Flood Zone 3b, and that ‘more vulnerable’ development is only allowable in Flood Zone 3a - subject to passing the exception test - in line with the NPPF and associated PPG. However, having applied planning policy, there will still be instances where developments are permitted in high flood risk areas.

Resistance measures such as flood doors and flood guards are aimed at preventing water from entering properties whilst resilience measures, such as

the use of waterproof plaster, tiled floors and raised electrics, aim to limit the damage caused once water has entered the building itself. The effectiveness of resistance and resilience measures are often dependant on the availability of a reliable forecasting and warning system and the use of back up pumps to remove water from a property as quickly as possible. The proposals must include details of how any temporary measures will be erected and decommissioned, the responsibility for maintenance and the cost of replacement when they deteriorate. The following measures are available:

- 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.

6.4 Reducing flood risk from other sources

6.4.1 Groundwater

Groundwater flooding has a very different flood mechanism to any other and so many conventional flood mitigation methods are not suitable. The only way to fully reduce flood risk would be through building design (development form), ensuring floor levels are raised above the water levels caused by a 1 in 100-year plus climate change event. Site design would also need to preserve any flow routes followed by the groundwater overland to ensure flood risk is not increased downstream. The Coal Authority are to be consulted for proposals in Development High Risk Areas and any development proposal may require the support of a groundwater risk assessment or coal mining risk assessment to assess the likely impacts and risks.

Infiltration SuDS can cause increased groundwater levels and subsequently may increase flood risk on or off a site. An adequate site investigation should allow for groundwater monitoring to establish the risk associated with groundwater. Developers should provide evidence and ensure that this will not be a significant risk.

6.4.2 Surface water and sewer flooding

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

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

When redeveloping existing buildings, the installation of some permanent or temporary floodproofing and resilience measures could protect against both surface water and sewer flooding. Non-return valves prevent water entering the property from drains and sewers. Non-return valves can be installed within

gravity sewers or drains within a property's private sewer upstream of the public sewerage system. These need to be carefully installed and must be regularly maintained.
Consideration must also be given to attenuation and flow ensuring that flows during the 100-year plus climate change storm event are retained within the site if any flap valves shut. This should be demonstrated with suitable modelling techniques.
The Stoke-on-Trent Surface Water Management Plan (SWMP) is to be published in 2020 and Developers should pay due regard to areas shown at risk and not increase pluvial risk elsewhere, with a view to provide betterment in terms of discharge rates and volumes to offer improvement.

6.4.3 Canals

Developers should consult with the Canal and Rivers Trust who have produced a checklist for developments close to canals.

6.4.4 Reservoirs

The risk of reservoir flooding is extremely low. However, there remains a residual risk to development from reservoirs which developers should consider during the planning stage:
Developers should contact the reservoir owner for information on:

- The Reservoir Risk Designation;
- Reservoir characteristics: type, dam height at outlet, area/volume, overflow location;
- Operation: discharge rates / maximum discharge;
- Discharge during emergency drawdown; and
- Inspection / maintenance regime.

The EA 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). Consideration should be given to the extent, depths and velocities shown in these online maps.
Developers should consult the Stoke-on-Trent and Staffordshire Local Resilience Forum about emergency plans for reservoir breach.
Developers should use the above information to:

- Apply the sequential approach to locating development within the site.
- Consider the impact of a breach and overtopping, particularly for sites proposed to be located immediately downstream of a reservoir. This should consider whether there is sufficient time to respond.
- Assess the potential hydraulic forces imposed by sudden reservoir failure event and check that that the proposed infrastructure fabric could withstand the structural loads.
- Develop site specific emergency plans if necessary and ensure the future users of the development are aware of these plans.

6.5 Permits and consents for undertaking work to watercourses

Under the Environmental Permitting Regulations certain works within 8m of a main river, or within 8m of any flood defence structure on a main river, require a Flood Risk Activity Permit from the Environment Agency. You can find more information on permit requirements using the EA Website. If a permit is required, it

must be obtained prior to beginning the works.
Under the Land Drainage Act 1991 certain types of work within an ordinary watercourse may not be permitted due to the potential increase in flood risk. SoTCC can provide guidance on request setting out where consents will be required for works that could affect flows in watercourses.

6.6 Flood warning and emergency planning

Emergency planning covers three phases: before, during and after a flood. Measures involve developing and maintaining arrangements to reduce, control or mitigate the impact and consequences of flooding and to improve the ability of people and property to absorb, respond to and recover from flooding. National Planning Policy takes this into account by seeking to avoid inappropriate development in areas of flood risk and considering the vulnerability of new developments to flooding.
The 2019 NPPF requires site level Flood Risk Assessments to demonstrate that
a) any residual risk can be safely managed; and
b) safe access and escape routes are included where appropriate, as part of an agreed emergency plan."
Certain sites will need emergency plans:

- Sites with vulnerable users, such as hospitals and care homes
- Camping and caravan sites
- Sites with transient occupants e.g. hostels and hotels
- Developments at a high residual risk of flooding from any source e.g. immediately downstream of a reservoir or behind raised flood defences
- Situations where occupants cannot be evacuated (e.g. prisons) or where it is safer to remain "in-situ" and / or move to a higher floor or safe refuge area (e.g. at risk of a breach).

Emergency Plans will need to consider:

- The characteristics of the flooding e.g. onset, depth, velocity, hazard, flood borne debris
- The vulnerability of site occupants.
- Structural safety.
- The impact of the flooding on essential services e.g. electricity, drinking water.
- Flood warning systems and how users will be encouraged to sign up for them.
- Safe access and egress for users and emergency services.
- How to manage the consequences of events that are un-foreseen or for which no warnings can be provided e.g. managing the residual risk of a breach.
- A safe place of refuge where safe access and egress and advance warning may not be possible, having discussed and agreed this first with emergency planners. Proposed new development that places an additional burden on the existing response capacity of the Councils will not normally be appropriate.

The Stoke-on-Trent and Staffordshire LRF provides Emergency Planning relevant information that is both general and flood specific. This includes practical advice before, during and after flooding has occurred including, preparation, understanding warnings, actions to limit exposure to risk and recovery.

- Further information is also available from:
- The National Planning Policy Guidance
- The Environment Agency and DEFRA's standing advice for FRAs
- Environment Agency's "How to plan ahead for flooding"
- Sign up for Flood Warnings with the Environment Agency
- National Flood Forum
- GOV.UK - Make a Flood Plan guidance and templates

When is a Site-Specific FRA Required?

According to NPPF footnote 20, a site-specific FRA should be prepared when the application site is:

- Situated in Flood Zone 2 and 3; for all proposals for new development (including minor development and change of use)
- 1 hectare or greater in size and located in Flood Zone 1
- Located in Flood Zone 1 where there are critical drainage problems
- At risk of flooding from other sources of flooding, such as those identified in this SFRA
- Subject to a change of use to a higher vulnerability classification which may be subject to other sources of flooding

The LPA may also like to consider further options for stipulating FRA requirements, such as:

- Situated in an area currently benefitting from defences
- Situated within 20 metres of the bank top of a Main River
- Situated over a culverted watercourse or where development will require controlling the flow of any river or stream or the development could potentially change structures known to influence flood flow
- These further options should be considered during the preparation and development of the Local Plan.

7 Surface water management and SuDS

Development has the potential to cause an increase in impermeable area, an associated increase in surface water runoff rates and volumes, and consequently a potential increase in downstream flood risk due to overloading of sewers, watercourses, culverts and other drainage infrastructure. Managing surface water discharges from new development is therefore crucial in managing and reducing flood risk to new and existing development downstream. Carefully planned development can also play a role in reducing the amount of properties that are directly at risk from surface water flooding.

As previously noted, Stoke-on-Trent City Council has a Local SuDS Handbook and specific appendix which should be referred to alongside this SFRA (Appendix H).

The FWMA, 2010, originally transferred the adoption and maintenance of SuDS to Sustainable Drainage Systems Approval Bodies (SABs) that were supposed to be established by local authorities, or LLFA's, under Schedule 3 of the Act (if it were to have been enacted via secondary legislation). However, the designation of a SAB has since been removed following lengthy consultation, with the announcement from the Department for Communities and Local Government (DCLG) in December 2014 that the LPA will be responsible for delivering SuDS. Changes to planning legislation give provisions for major applications of ten or more residential units or equivalent commercial development to require sustainable drainage within the development proposals in accordance with the non-statutory technical standards for sustainable drainage systems, published in March 2015. This builds on the existing planning system, the NPPF, which developers and local authorities are already using. Policy changes to the planning system can also be introduced relatively quickly ensuring that flood risk benefits from sustainable drainage systems can be brought forward as part of planning application proposals.

The NPPF continues to reinforce how planning applications that fail to deliver SuDS above conventional drainage techniques could be rejected and sustainable drainage should form part of integrated design secured by detailed planning conditions so that the SuDS to be constructed must be maintained to a minimum level of effectiveness.

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

In April 2015 Stoke-on-Trent City Council was made a statutory planning consultee on the management of surface water. They provide technical advice on surface water drainage strategies and designs put forward for major development proposals.

When considering planning applications, Stoke-on-Trent Council will provide advice to the Planning Department on the management of surface water. As LPA and LLFA, Stoke-on-Trent City Council should 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.

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.

7.2 Sustainable Drainage Systems (SuDS)

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

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

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

The runoff destination should always be the first consideration when considering design criteria for SuDS including the following possible destinations in order of preference:

To ground (infiltration);

- To surface water body;
- To surface water sewer;
- To combined sewer.

Effects on water quality should also be investigated when considering runoff destination in terms of the potential hazards arising from development and the sensitivity of the runoff destination. Developers should also establish that proposed outfalls are hydraulically capable of accepting the runoff from SuDS through consultation with the LLFA, EA, and STW.

The non-statutory technical standards for sustainable drainage systems (March 2015) set out appropriate design criteria based on the following:

- Flood risk outside the development;
- Peak flow control;
- Volume control;
- Flood risk within the development;
- Structural integrity;
- Designing for maintenance considerations;
- Construction.

In addition, the Local Planning Authority may set local requirements for planning permission that include more rigorous obligations than these non-statutory technical standards. More stringent requirements should be considered where current Greenfield sites lie upstream of high-risk areas. This could include improvements on Greenfield runoff rates. CIRIA has also produced a number of guidance documents relating to SuDS that should be consulted by the LPA and developers.

Many different SuDS techniques can be implemented. As a result, there is no one standard correct drainage solution for a site. In most cases, a combination of techniques, using the Management Train principle (see Figure 7-1), will be

required, where source control is the primary aim.

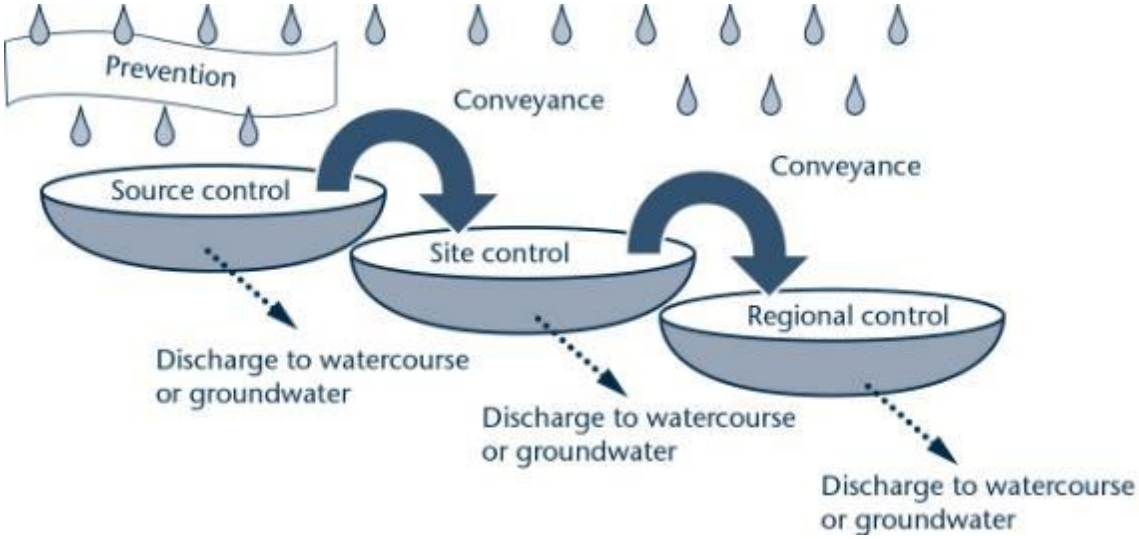


Figure 7-1: SuDS Management Train Principles

The effectiveness of a flow management scheme within a single site is heavily limited by land use and site characteristics including (but not limited to) topography; geology and soil (permeability); and available area. Potential ground contamination associated with urban and former industrial sites should be investigated with concern being placed on the depth of the local water table and potential contamination risks that will affect water quality. The design, construction and ongoing maintenance regime of any SuDS scheme must be carefully defined as part of a site-specific FRA. A clear and comprehensive understanding of the catchment hydrological processes (i.e. nature and capacity of the existing drainage system) is essential for successful SuDS implementation.

Maintenance options must clearly identify who will be responsible for SuDS maintenance and funding for maintenance should be fair for householders and premises occupiers; and, set out a minimum standard to which the sustainable drainage systems must be maintained.

7.3 Sources of SuDS guidance

7.3.1 C753 CIRIA SuDS Manual (2015)

The C753 CIRIA SuDS Manual (2015) provides guidance on planning, design, construction and maintenance of SuDS. The manual is divided into five sections ranging from a high-level overview of SuDS, progressing to more detailed guidance with progression through the document.

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

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

7.3.3 Stoke-on-Trent City Council Local SuDS Handbook

Stoke-on-Trent City Council has worked in partnership with seven other West Midlands LLFA's to produce the Local SuDS Handbook. The front end of the document is identical across LLFAs and each LLFA has a specific appendix in their version setting out local design considerations, constraints, case studies and arrangements for SuDS maintenance. Stoke-on-Trent City Council has widely consulted with other RMAs when preparing the document to ensure their views have been taken into account.

The Local SuDS Handbook was adopted through the Local Flood Risk Management Strategy in 2016 and presents design guidance alongside Local SuDS Standards that developers should meet when proposing SuDS systems on new developments. It also contains a proforma that a developer should submit with a Flood Risk Assessment/ Surface Water Drainage Strategy. The Local Standards are that:

Design Principles

Local Standard A – Phased Development and Drainage Strategies

For phased developments, the LLFA will expect planning applications to be accompanied by a Drainage Strategy which takes a strategic approach to drainage provision across the entire site and incorporates adequate provision for SuDS within each phase.

Local Standard B – Pollution Prevention and Control

The LLFA will expect the SuDS to demonstrate how pollutants are prevented or controlled as part of the SuDS scheme. This should include consideration of the sensitivity of receiving waterbodies and particular attention should be given to the first 5mm of rainfall ('first flush' that mobilises the most pollutants).

Local Standard C – Conformity with the SuDS Management Train Principles

The LLFA will expect the SuDS design to demonstrate how the principles of the SuDS Management Train have been taken into account.

Local Standard D – Multiple Benefits

The LLFA will expect the SuDS design to demonstrate, where appropriate, how environmental site constraints have been considered and how the features design will provide multiple benefits e.g. landscape enhancement, biodiversity, recreation, amenity, leisure and the enhancement of historical features.

Volume Control

Local Standard E – Climate Change

The LLFA will expect SuDS design to include an allowance for a 30%* increase in rainfall for a 1% Annual Exceedance Probability rainfall event in order to accommodate climate change. (*note that guidance may be subject to change and therefore the most up to date information should be referenced).

Local Standard F – Urban Creep

The LLFA will expect the SuDS design to include an allowance for an increase in impermeable area to accommodate urban creep.

Local Standard G – Emergency Overflows

The LLFA will expect an emergency overflow to be provided for piped and storage features above the predicted water level in a 1% Annual Exceedance Probability rainfall event, with an allowance for climate change.

Local Standard H – Freeboard Levels

The LLFA will expect all surface water storage ponds to provide a 300mm freeboard above the predicted water level arising from a 1% Annual Exceedance Probability rainfall event inclusive of an allowance for climate change. Care must

be taken to ensure that excavations do not take place below the ground water level.

Flood Risk within the Development

Local Standard I – Exceedance Flows

The LLFA will expect exceedance flows, originating from both within and outside of the development site, must be directed through areas where the risks to both people and property are minimised.

When considering exceedance routes, particular attention should be paid to:

- The position of walls, bunds and other obstructions that may direct water but must not cause ponding
- The location and form of buildings (e.g. terraces and linked detached properties) that must not impede flows or cause ponding

Submitted drawings and calculations must identify sources of water entering a site pre-development, how flows will be routed through a site, where flows leave the site pre-development and where they leave the site post development.

Local Standard J – Watercourse Floodplains

The LLFA will expect the floodplains of ordinary watercourses to be mapped to an appropriate level of detail considering the nature of the application (i.e. detailed flood modelling should be undertaken to support full planning applications). The layout of the development will then take a sequential approach, siting the least vulnerable parts of that development in the highest flood risk areas.

Local Standard K – Retention of Natural Drainage Features

The LLFA will expect natural drainage features on a site should be maintained and enhanced. Culverting of open watercourses will not normally be permitted except where essential to allow highways and / or other infrastructure to cross. In such cases culverts should be designed in accordance with CIRIA's Culvert design and operation guide, (C689).

Where a culverted watercourse crosses a development site, it should be reverted back to open channel. In such a case the natural conditions deemed to have existed prior to the culverting taking place should be re-instated.

Local Standard L – Impact of Downstream Water Levels

If high water levels within a receiving watercourse into which a SuDS scheme discharges are anticipated, the LLFA will expect that they will not adversely affect the function of that SuDS system.

Designing for Maintenance Considerations

Local Standard M – Maintenance Requirements

The LLFA will expect SuDS to be designed so that they are easy to maintain. Proper use of the SuDS management train, including surface features, is one way to achieve this.

The developer must set out who will maintain the system, how the maintenance will be funded and provide a maintenance and operation manual.

Local Standard N – Minimising the Risk of Blockages

The LLFA will expect the SuDS design to minimise the risk of blockage as far as is reasonably possible e.g. by using suitable pipe sizes and making underground assets as visible and accessible as possible.

Local Standard O – Use of Pumped Systems

If it can be demonstrated that a partial or completely pumped drainage system is the only viable option, the LLFA will expect the residual risk of flooding due to the failure of the pumps to be assessed. The design flood level must be

determined under the following conditions:

- If the pumps were to fail;
- If the attenuation storage was full; and
- If a design storm occurred.

The finished floor levels of the affected properties should be raised above this level and all flooding should be safely stored onsite.
An emergency overflow must be provided for piped and storage features above the predicted water level arising from a 1% Annual Exceedance Probability rainfall event inclusive of allowances for climate change and urban creep.

7.4 Other surface water considerations

7.4.1 Groundwater Vulnerability Zones

The Environment Agency has published new groundwater vulnerability maps in 2015. These maps provide a separate assessment of the vulnerability of groundwater in overlying superficial rocks and those that comprise of the underlying bedrock. The map shows the vulnerability of groundwater at a location based on the hydrological, hydro-ecological and soil propertied within a one-kilometre grid square.
The groundwater vulnerability maps should be considered when designing SuDS. Depending on the height of the water table at the location of the proposed development site, restrictions may be placed on the types of SuDS appropriate to certain areas. Groundwater vulnerability maps can be found on Defra's interactive mapping.

7.4.2 Groundwater Source Protection Zones (GSPZ)

The Environment Agency also defines Groundwater Source Protection Zones near groundwater abstraction points. These protect areas of groundwater used for drinking water. The Groundwater SPZ requires attenuated storage of runoff to prevent infiltration and contamination. Groundwater Source Protection Zones can be seen in Figure 7-2.
The majority of Stoke-on-Trent is outside of a source protection zone. The area to the very south west is predominately within Zone 3 (total catchment) with a small area around the Uttoxetter Road (A50) between Weston Coyney and Meir within SP Zone 1 and 2.
Depending on the nature of the proposed development and the location of the development site with regards to SPZ's, restrictions may be in place on the types of SuDS used within appropriate areas. For example, infiltration SuDS are generally accepted within Zone 3, whereas in Zones 1 (Inner Protection Zone) or 2 (Outer Protection Zone), the Environment Agency will need to be consulted and infiltration SuDS may only be accepted if the correct treatments and permits are put in place. Any restrictions imposed on the discharge of the site generated runoff by the Environment Agency will be determined on a site by basis using the risk-based approach.

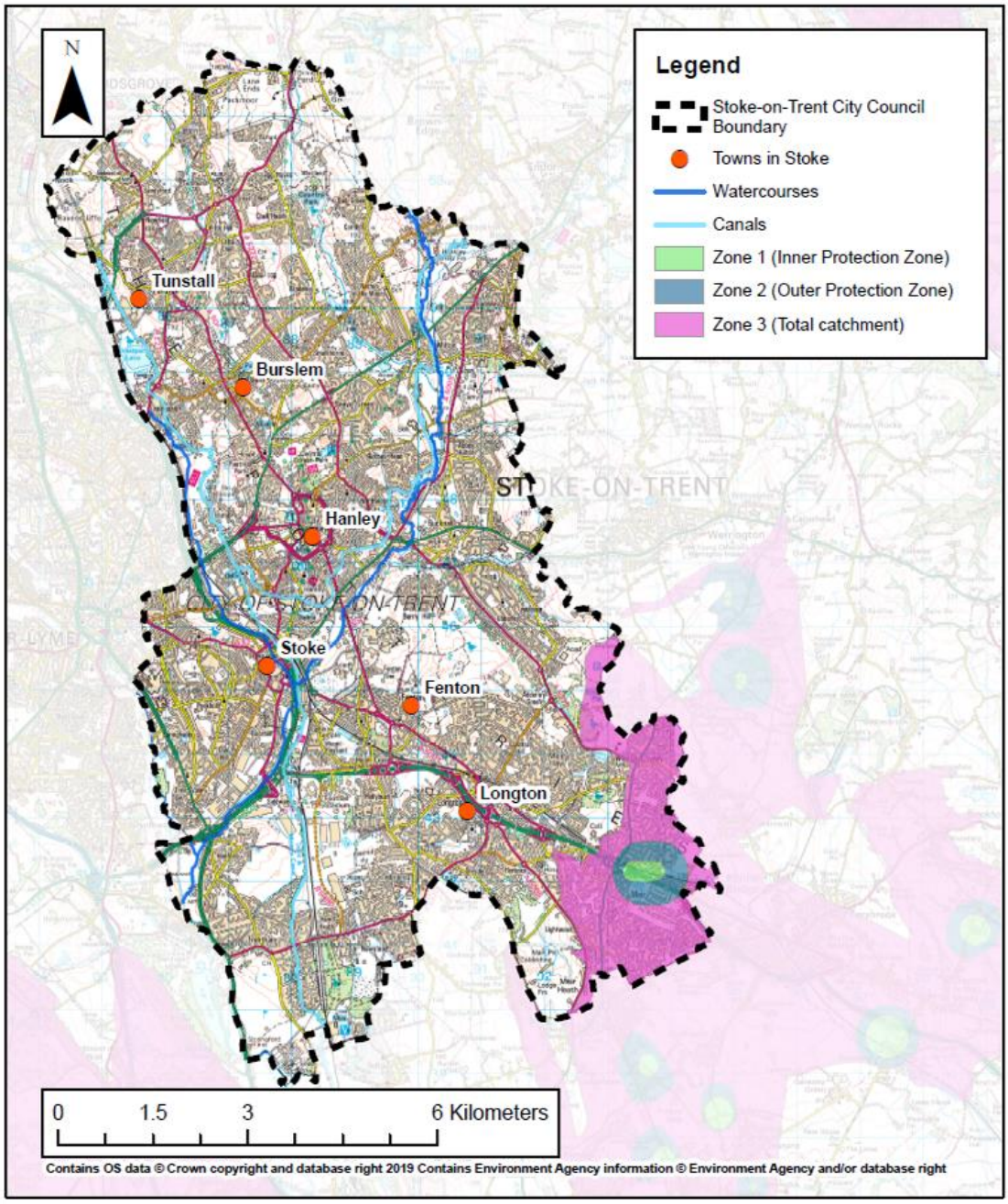


Figure 7-2: Groundwater Source Protection Zones

7.4.3 Nitrate Vulnerable Zones

Nitrate Vulnerable Zones (NVZs) are areas designated as being at risk from agricultural nitrate pollution. Nitrate levels in waterbodies are affected by surface water runoff from surrounding agricultural land entering receiving waterbodies. The level of nitrate contamination will potentially influence the choice of SuDS and should be assessed as part of the design process. Stoke-on-Trent is entirely within a Surface Water NVZ. Weston Coyney and Meir are within a Eutrophic Water Zone and a Drinking Water Safeguards zone. Nitrate Vulnerability Zones can be viewed on the Environment Agency's website.

8 Emergency Planning

The provisions for emergency planning for local authorities as Category 1 responders are set out by the Civil Contingencies Act, 2004 and the National Flood Emergency Framework for England, December 2014. This framework is a resource for all involved in emergency planning and response to flooding from the sea, rivers, surface water, groundwater and reservoirs. The Framework sets out the Government's strategic approach to:

- Ensuring all delivery bodies understand their respective roles and responsibilities when planning for and responding to flood related emergencies;
- Give all players in an emergency flooding situation a common point of reference which includes key information, guidance and key policies;
- Establish clear thresholds for emergency response arrangements;
- Place proper emphasis on the multi-agency approach to managing flooding events;
- Provide clarity on the means of improving resilience and minimising the impact of flooding events;
- Provide a basis for individual responders to develop and review their own plans; and
- Being a long-term asset that will provide the basis for continuous improvement in flood emergency management.

Along with the EA flood warning systems, there are a range of flood plans at a sub-regional and local level, outlining the major risk of flooding and the strategic and tactical response framework for key responders.

This SFRA contains useful data to allow emergency planning processes to be tailored to the needs of the area and be specific to the flood risks faced. The SFRA Maps in Appendix A, Appendix E and accompanying GIS layers should be made available for consultation by emergency planners during an event and throughout the planning process.

8.1 Civil Contingencies Act

Under the Civil Contingencies Act (CCA, 2004), Stoke-on-Trent City Council is classified as a Category 1 responder and has duties to assess the risk of emergencies occurring, and uses this to:

- Inform contingency planning;
- Put in place emergency plans;
- Put in place Business continuity management arrangements;
- Put in place arrangements to make information available to the public about civil protection matters;
- Maintain arrangements to warn, inform and advise the public in the event of an emergency;
- Share information with other local responders to enhance coordination;
- Cooperate with other local responders to enhance coordination and efficiency and to provide advice and assistance to businesses and voluntary organisations about business continuity management.

During an emergency such as a flood event, the local authority must also co-operate with other Category 1 responders (such as the emergency services and the EA) to provide the core response.

8.1.1 Local Flood Plans

This SFRA provides a number of flood risk data sources that should be used when producing or updating flood plans. Stoke-on-Trent City Council will be unable to write specific flood plans for new developments at flood risk. Developers should write their own. Guidance can be found on the government web site. Generally, owners with individual properties at risk should write their own individual flood plans, however larger developments or regeneration areas, such as retail parks, hotels and leisure complexes, should consider writing one collective plan for the assets within an area.

The information in this SFRA can be used to:

- Update these flood plans if appropriate;
- Inform emergency planners in understanding the possibility, likelihood and spatial distribution of all sources of flooding (emergency planners may however have access to more detailed information, such as for Reservoir Inundation Maps, which have not been made available for this SFRA);
- Identify safe evacuation routes and access routes for emergency services;
- Identify key strategic locations to be protected in flooding emergencies, and the locations of refuge areas which are capable of remaining operational during flood events;
- Provide information on risks in relation to key infrastructure, and any risk management activities, plans or business continuity arrangements;
- Raise awareness and engage local communities;
- Support emergency responders in planning for and delivering a proportionate, scalable and flexible response to the level of risk;
- Provide flood risk evidence for further studies.

8.2 Flood Warning and Evacuation Plans

Developments that include areas that are designed to flood (e.g. ground floor car parking and amenity areas) or have a residual risk associated with them, will need to provide appropriate flood warning and instructions so users and residents are safe in a flood. This will include both physical warning signs and written flood warning and evacuation plans. Those using the new development should be made aware of any evacuation plans.

Whilst there is no statutory requirement on the EA or the emergency services to approve evacuation plans, Stoke-on-Trent City Council is accountable under its Civil Contingencies duties, via planning condition or agreement, to ensure that plans are suitable. This should be done in consultation with Development Management Officers. Given the cross-cutting nature of flooding, it is recommended that further discussions are held internally to Stoke-on-Trent City Council between emergency planning and policy planning teams / development management officers, the LLFA, drainage engineers and also to external stakeholders such as the emergency services, the EA, STW, and Canal & River Trust.

Once the development goes ahead, it will be the requirement of the plan owner (developer) to make sure the plan is put in place, and to liaise with SoTCC regarding maintenance and updating of the plan.

8.2.1 What should the Plan Include?

Flood warning and evacuation plans should include the information stated in

Table 8-1. Advice and guidance on plans is accessible from the government website and there are templates available for businesses and local communities.

Table 8-1: Flood warning and evacuation plans

Consideration	Purpose
Availability of existing flood warning system	The EA offers a flood warning service that currently covers designated Flood Warning Areas in England and Wales. In these areas they are able to provide a full Flood Warning Service.
Rate of onset of flooding	The rate of onset is how quickly the water arrives and the speed at which it rises which, in turn, will govern the opportunity for people to effectively prepare for and respond to a flood. This is an important factor within Emergency Planning in assessing the response time available to the emergency services.
How flood warning is given and occupants awareness of the likely frequency and duration of flood events	Everyone eligible to receive flood warnings should be signed up to the EA flood warning service. Where applicable, the display of flood warning signs should be considered. In particular sites that will be visited by members of the public on a daily basis such as sports complexes, car parks, retail stores. It is envisaged that the responsibility should fall upon the developers and should be a condition of the planning permission. Information should be provided to new occupants of houses concerning the level of risk and subsequent procedures if a flood occurs.
The availability of staff / occupants / users to respond to a flood warning and the time taken to respond to a flood warning	The plan should identify roles and responsibilities of all responders. The use of community flood wardens should also be considered.
Designing and locating safe access routes, preparing evacuation routes and the identification of safe locations for evacuees	Dry routes will be critical for people to evacuate as well as emergency services entering the site. The extent, depth and flood hazard rating, including allowance for climate change, should be considered when identifying these routes.
Vulnerability of occupants	Vulnerability classifications associated with development as outlined in the FRCC-PPG. This is closely linked to its occupiers.
How easily damaged items will be relocated, and the expected time taken to re-establish normal use following an event	The impact of flooding can be long lasting well after the event has taken place affecting both the property which has been flooded and the lives that have been disrupted. The resilience of the community to get back to normal will be important including time taken to repair / replace damages.

8.3 Flood Awareness

Emergency planners may also use the outputs from this SFRA to raise awareness within local communities. This should include raising awareness of flood risks, roles and responsibilities and measures that people can take to make their homes more resilient to flooding from all sources whilst also encouraging all those at fluvial flood risk to sign up to the EA's Flood Warning System service.

It is also recommended that Category 1 responders are provided with appropriate flood response training to help prepare them for the possibility of a major flood with an increased number of people living within flood risk areas, to ensure that adequate pre-planning, response and recovery arrangements are in place.

Summary and Recommendations

This Level 1 SFRA delivers a strategic assessment of risk from all sources of flooding in Stoke-on-Trent. It also provides an overview of policy and provides guidance for the LPA and developers. The flood risk information, assessment, guidance and recommendations of the SFRA will provide the City Council with the evidence base required to apply the Sequential, as required under the NPPF, and demonstrate that a risk based, sequential approach has been applied in the preparation of its new Local Plan.
Key flood risk stakeholders, namely the EA, Severn Trent Water and the Canal and River Trust were consulted to collate all available and relevant flood risk information on all sources into one comprehensive assessment. Together with this report, this SFRA also provides a suite of interactive GeoPDF flood risk maps (Appendix A) and a Development Site Assessment spreadsheet (Appendix B) illustrating the level of risk to sites identified in the Preferred Options, with subsequent recommendations.

8.4 Recommendations for development and flood risk in the City

1. 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, giving highest priority to Flood Zone 1. 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.
- Following this a sequential approach to site design will be used to reduce risk, by placing the least vulnerable parts of the site in the highest flood risk areas.
- Sites should be designed so that the safety of future users is accounted for and that they do not increase flood risk offsite.
- Ensure development is 'safe'. Safe pedestrian egress from the floodplain and emergency vehicular access should be possible for all residential development for a design flood (the 1 in 100 year fluvial flood event). If at risk, then an assessment should be made to detail the flood duration, depth, velocity and flood hazard rating in the 1 in 100 year plus climate change flood event, in line with FD2320.
- Raise residential and commercial finished floor levels 600mm above the 1 in 100 year plus climate change flood level.

2. Assess condition of existing assets and upgrade, if required, to ensure that the infrastructure can accommodate pressures / flows for the lifetime of the development

- Identify and confirm maintenance arrangements for any asset e.g. culverts, flood walls, trash screens, pumping stations etc.
- Assess condition of existing 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 flood risk to the site have been accounted for.

3. Site design should mitigate against residual risk, consider Emergency Planning implications and improve flood awareness

- Parts of Stoke-on-Trent are vulnerable to rapid inundation in the event of a breach / failure. The assessment of the residual risk for a development site at Flood Risk Assessment stage should take into account and consider as part of a Flood Evacuation and Warning Plan:
    - The flood hazard, depth and velocity that would result from overtopping or breach of defences. Flood gate or pumping station failure and/ or culvert blockage (as appropriate). The Environment Agency can provide advice at site-specific development level for advice on breach/ overtopping parameters for flood models.
    - Design development to take account of the highest risk parts of the site e.g. allowing for flood storage on parts of the site and considering the design of the development to keep people safe e.g. sleeping accommodation above the flood level.
    - Implement a system of warning and a safe means of access and egress from the site in the event of a flood for users of the site and emergency services.
    - Ensure robust emergency (evacuation) plans are produced and implemented for major developments.
    - Exceedance flows, both within and outside of the site, should be appropriately designed to minimise risks to both people and property.
    - Consideration and incorporation of flood resilience measures up to the 1 in 1,000-year event.
    - Emergency Plans will be needed as part of a Flood Risk Assessment for sites within Flood Zones 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. Future users within a Flood Warning and/ or Alert area should be encouraging to sign up to receive Flood Warnings.
- The information within the SFRA can also be useful to Emergency Planners for identifying areas of the City at the highest risk from all sources of flooding.

4. Protect and Promote Areas for Future Flood Alleviation Schemes

- Aim to protect 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.
- 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.

5. Implement Sustainable Drainage Systems as standard on all developments

- SuDS must be designed following the guidance in the Stoke-on-Trent Local SuDS Handbook and in accordance with both the National and Local SUDS Standards.
- SuDS must 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.

6. Enhance and Restore River Corridors and Habitat

- Natural drainage features should be maintained and enhanced and there are opportunities for river restoration / enhancement to make space for water in the City.
- Culverted watercourses should be opened up and new culverting resisted. This is covered in the SoTCC culvert policy in Appendix A2 of the Local Flood Risk Management Strategy.
- There should be no built development within 8m from the top of a watercourse or Main River for the preservation of the watercourse corridor, wildlife habitat, flood flow conveyance and future watercourse maintenance or improvement.
- This would help to achieve the outcomes of the:
    - Staffordshire Trent Valley Catchment Partnership Trent Headwaters project which aims to identify locations and opportunities where the rivers and brooks which encompass the Trent Headwaters can be improved to create better environments for people and wildlife.
    - Trent SUNRISE project which has identified a programme of works to link, buffer, restore and recreate habitats across Stoke and the urban area of Newcastle, with a special focus on improving riverside areas and grassland restoration.
- SoTCC should work closely with the Environment Agency, Staffordshire County Council, NULBC, Staffordshire Moorlands District Council and the Staffordshire Wildlife Trust to identify areas of land upstream of the Newcastle and Stoke urban areas that should be safeguarded for the future use of natural flood management features.

7. Cumulative Impact

- Conditions imposed by Stoke-on-Trent City Council should allow for mitigation measures so any increase in runoff as a result of development is properly managed and should not exacerbate flood risk issues, either

within, or outside of the Council's administrative area.

- When allocating land for development, consideration should be given to the potential cumulative impact of the loss of floodplain storage volume. Whilst the loss of storage for individual developments may only have a minimal impact on flood risk, the cumulative effect of multiple developments may be more severe.
- Phasing of development should be carried out by the LPA to avoid any cumulative impacts of flood risk.
    - Using a phased approach to development, should ensure that any sites at risk of causing flooding to other sites are developed first in order to ensure flood storage measures are in place before other sites are developed, thus contributing to a sustainable approach to site development.
    - It may be possible that flood mitigation measures put in place at sites upstream could alleviate flooding at downstream or nearby sites.
- Specific policies are recommended for the Surface Water Management Plan hotspot catchments and the Fowlea Brook catchment (outlined in section 13.2). Subject to the findings of the SWMP and Flood Risk Management Plans, SoTCC and the Environment Agency may enter into discussions into whether any areas across the City should be formally designated as areas as a Critical Drainage Areas (CDA). If any areas are designated as a CDA, this would mean that a detailed Flood Risk Assessment would be required for all developments that are proposed, regardless of their size.
- Complementary planning policy for Newcastle Borough for the high-risk catchments draining towards Stoke-on-Trent including the Ford Green Brook catchment, Park Brook catchment and Lyme Brook (including Silverdale) catchments, should ensure that there is no adverse effect on flood risk downstream. The Environment Agency, in consultation with NULBC and Staffordshire County Council, should consider whether to formally designate these areas as a 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.

8.5 Local Plan policy recommendations

Stoke-on-Trent is a densely populated and in places, steeply sloping urban area. This makes it prone to rapid surface water flooding following heavy rainfall and flooding from smaller watercourses that are tributaries of the River Trent. The industrial legacy leaves complex urban drainage challenges, with many watercourses that heavily modified and culverted in places, providing little if any biodiversity benefit and making them prone to blockage.

The City experienced severe localised flooding in 2016, 2018 and it is estimated that over 6,000 residential properties are at risk from localised surface water and fluvial flooding in the City in the 1 in 30-year event. Hence an approach is needed to new development that recognises local flood risk constraints and the following Local Plan policies are recommended:

Policy S1: A risk-based approach to Flood Risk Management

The Sequential Test should be firstly applied to all developments to ensure that development takes place in the lowest flood risk areas. The Sequential Test

should take account of the information on river (fluvial) flooding and all other sources of flooding, using the information provided in the 2019 Strategic Flood Risk Assessment. It should also take into account the impact of climate change over the lifetime of that development.
The area of search for the consideration of reasonable alternatives should be discussed with the Local Planning Authority and will be proportionate to the scale and type of the development being proposed. Ownership of land is not a reason in itself for a site to pass the Sequential Test.
The vulnerability of the development type to flooding should then be considered with regards to the Flood Zone information in the 2019 SFRA:

- Where the site is in the Functional Floodplain (Flood Zone 3b) development should be resisted (including extensions and intensification of use and changes of use) and opportunities to relocate development on brownfield sites out of the floodplain should be sought. The only development that can be permitted in Flood Zone 3b is essential infrastructure, subject to the Exception Test.
- Where the site is High Probability (Flood Zone 3a):
  - Residential dwellings can be permitted, subject to the Exception Test.
  - A site-specific Flood Risk Assessment must be submitted with a Planning Application for all sites in Flood Zone 3.

- To pass the **Exception Test**, developments will need to:
  - Provide a demonstrable benefit to the wider sustainability of the area. Matters such as biodiversity, green infrastructure, historic environment, climate change adaptation, flood risk, green energy, pollution, health, transport should be considered. Applicants should detail the suitability issues the development will address and how doing so will outweigh the flood risk concerns for the site e.g. by facilitating wider regeneration of an area, providing community facilities, infrastructure that benefits the wider area etc.
  - Prove that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.
- Where the site is Medium Probability (Flood Zone 2): most development can be permitted, subject to a site-specific Flood Risk Assessment. Highly vulnerable developments, such as caravans, mobile homes and park homes with permanent residential use can be permitted, subject to the Exception Test.
- Where the site is Low Probability (Flood Zone 1), the information in the 2019 SFRA should be used to assess if a development is at risk from other sources of flooding and/ or if there is an increased risk of flooding in the future due to climate change. If this site is shown to be at risk, a site-specific Flood Risk Assessment should accompany a planning application.

Policy S2: Sustainable Drainage

All major developments must:

- Incorporate SuDS and provide details of adoption, ongoing maintenance and management on all development sites. SUDS must be designed in line with the Stoke-on-Trent Local Standards for SUDS. Preference will

be given to systems that contribute to the conservation and enhancement of biodiversity and green infrastructure in the wider area where practicable.

- Greenfield runoff rates will be used to determine the pre-developed runoff rates from the site and then compared to the post-development runoff rates to determine the storage requirements for a site. If greenfield runoff rates are not considered to be feasible then the developer must submit evidence demonstrating what the constraints are to achieve this and how their development will accommodate runoff rates that are as close as reasonable possible to greenfield rates. Under no circumstances will post runoff rates that are greater than predevelopment runoff rates be permitted.
- Stoke-n-Trent City 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. Surface Water Drainage Strategies are required for all major developments, regardless of their size and the Flood Zone and catchment they are in to meet the requirements of the LLFA.

Policy S3: For developments that fall within the surface water flood map, 1 in 1,000-year extent:

A Flood Risk Assessment will be required for all developments that should:

- Consider in more detail the local features that may influence the pattern and extent of surface water flooding for a 1 in 30 year, 1 in 100 year and 1 in 1,000-year storm event.
- Consider the impact of climate change on increasing storm intensity for a 1 in 100-year storm event, over the lifetime of the development.
- Set out methods employed to design a development to accommodate overland flow paths and mitigate against surface water flooding to properties on site.
- Set out how the mitigation designs will ensure that there is no net increase to surface water flood risk downstream and where practicable how the development could help mitigate against downstream surface water flood risk.
- The surface water flood extents may highlight the presence of the floodplain of an Ordinary (and potentially culverted) Watercourse. If investigations on site highlight this to be the case then policy S4 will also apply.

Policy S4: Developments with a watercourse

Developers should:

- Confirm the location and presence of a watercourse (or otherwise) through ground truthing strategic datasets in the SFRA e.g. by site visits, reference to historical mapping etc.
- For culverts, a detailed CCTV assessment of the extent and condition of the culvert is required.
- Developments should naturalise urban watercourses and open up underground culverts, to provide biodiversity net gain as well as amenity

improvements. Culverts are only acceptable for essential infrastructure crossings e.g. where a culvert passes under a gas main and the length of culvert should be limited to that which is essential.

- There should be no built development within 8m from the top of any watercourse for the preservation of the watercourse corridor, wildlife habitat, flood flow conveyance and future watercourse maintenance or improvement.
- Confirm by survey, modelling and mapping, the flood extends of the watercourse, as many of the flood outlines associated with such watercourses have been carried out at a broadscale level and may not take into specific local features, such as culverts, bridges and detailed topographical survey.
- Design the development to accommodate the floodplain of the watercourse and mitigate against flooding to properties on site. This includes a consideration of residual flood risk e.g. if a downstream culvert was to block.
- Set out how the mitigation designs will ensure that there is no net increase to fluvial flood risk downstream and where practicable how the development could help mitigate against downstream fluvial flood risk.

Policy S5: Surface water flood hotspot areas

The SFRA has highlighted local areas at high risk of surface water flooding, draining towards flood hotspots.
In no particular order, these are:

- Fenn Park (Clarice Cliff)
- Eaves Lane
- Hilton Road
- Uffington Parade
- Norton Green
- Milton Road
- Weston Coyney

Developments should 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 wider community schemes. Consultation on the site-specific requirements should be undertaken with the Councils and the Environment Agency at the earliest opportunity.

Policy S6: the Fowlea Brook

The Fowlea Brook catchment is vulnerable to flash flooding and is a high flood risk urban catchment with complex localised flooding issues. Developments in this catchment should:

- Take into account the rapid response nature of the catchment when designing safe access and escape routes, the availability of flood alerts and flood warnings and time people would have to respond and ensure

no additional burden is placed on emergency services as part of an agreed emergency flood plan.

- 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 (and in particular by slowing the flow of water 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 wider community and regeneration schemes, such as that proposed at Elenora Street/ Liverpool Road. Consultation on the site-specific requirements should be undertaken with SoTCC and the Environment Agency at the earliest opportunity.

8.6 Recommendations for further work in a Level 2 SFRA

To further inform the site allocations and development of local planning policies, a Level 2 SFRA could be used to:

- Assist the application of the Exception Test, where necessary. If residential development is to be allocated in Flood Zone 3 then the Exception Test will be required (unless the site boundary is amended to remove the area at risk);
- Provide further information on sites that are at significant risk from surface water flooding and the possibilities for surface water mitigation measures on sites at high risk of surface water flooding, linked to work on the Surface Water Management Plan and other ongoing flood studies; and
- Provide further information on sites that are vulnerable to a significant increase in flood risk in future due to climate change on flood hazard.

Table 13-1 highlights which Preferred Option sites would benefit from a Level 2 assessment:

Table 0-1 sites recommended for Level 2 Strategic Flood Risk Assessment

Site code	Site name	In Flood Zone 3	Significant surface water risk (National)	Significantly affected by climate change
10355/9756/New12	Former Slimma Works/ Twyfords Excelsior Works, Cliffe Vale	YES	YES	YES
10294/10295	Riverside Park off Campbell Road	YES		
02020/CFS20	Former Tunstall Sewage Works	YES	YES	YES
New5	Former Brownhills Tileries, Harewood Street, Tunstall	YES		
CFS4	Former Ravensdale Sportsfield, Land off Chemical Lane, Tunstall	YES		

New2	Etruria Valley Phases 3a and 3b, Forge Lane, Etruria	YES		
351	Land between Huntilee Road and Scotia Road, Scotia Road, Tunstall	YES		
331	Land at, Trentham Lakes, Stanley Matthews Way, Stoke-on-Trent	YES		
375	Land off, Magdalen Road, Blurton	YES	YES	
539	Victoria Ground, Boothen Old Road, Stoke	YES		YES
426	Minton Hollins (land) (employment), Shelton Old Road, Stoke	YES		YES
415	Mitchell High School, Bucknall, Stoke on Trent, ST2 9EY.	YES		
292	Land at, Berryhill	YES		
0	New Inn Lane	YES	YES	YES
CFS5	Land at Whieldon Road	YES		
N/A	Land adjacent to Brownhills Road, Tunstall, Stoke-on-Trent	YES		
N/A	Trentham Lakes South (Area 3)	YES		
10148	Gas Holder Site, Etruscan Street		YES	YES
675	Wedgwood Estate (Phase2 The Village), Wedgwood Drive, Trentham, Stoke-on-Trent, ST12 9ER		YES	

Site code	Site name	In Flood Zone 3	Significant surface water risk (National)	Significantly affected by climate change

562	Land at Umberleigh Road, Blurton, and other land, ST3 3ND and Public Open Space at Newstead		YES	
163	Corner of, Nursery Lane, Baddeley Green		YES	

For high risk catchments in Stoke-on-Trent (Fowlea Brook and SWMP hotspot catchments) and Newcastle where they drain towards Stoke-on-Trent (Lyme Brook, Park Brook and Ford Green Brook catchments) it is recommended that more detailed drainage strategy work is undertaken as part of a Level 2 SFRA 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/ enforce 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, integrate SUDS features into wider green infrastructure provision and where land should be safeguarded within proposed site allocations to fulfil this purpose.

Appendices

A Interactive Flood Risk Mapping

Interactive GeoPDF Maps - This SFRA appendices are published separately to the main SFRA report.
To access these, firstly open the Overview Map in Adobe Acrobat. The Overview Map contains a set of four index squares covering the city. Clicking on one of the four index squares will open up an Index Map for that area, by way of a hyperlink.
Each of the Index Maps contain a further set of index squares covering different areas of the city at a scale of 1:10,000. Clicking on one of these index squares will open up a more detailed map of that area (scale = 1:10,000) by way of a hyperlink.
Within the detailed maps, use the zoom tools and the hand tool to zoom in/out and pan around the open detailed map. In the legend on the right-hand side of the detailed maps, layers can be switched on and off when required by way of a dropdown arrow. The potential development site reference labels can also be switched on and off if, for example, smaller sites are obscured by the labels.
This SFRA appendix is published separately to the main SFRA report.

B Development Site Assessment Spreadsheet

Excel spreadsheet containing an assessment of flood risk to the potential development sites based on:

- Flood Zones 2, 3a, indicative 3b and 3b as delineated through this SFRA
- The Risk of Flooding from Surface Water (RoFfSW)
- Local detailed flood model outputs for localised flooding and whether the site is an area covered by the local modelling. If it is then these data should be used in preference to the RoFfSW.
- Results of modelling the impact of different climate change allowances on fluvial flood risk (Central, Higher Central and Upper End as delineated in this SFRA)
- Distance to an ordinary watercourse
- Strategic recommendation with regards to allocation

This SFRA appendix is published separately to the main SFRA report.
Some sites may show as being within Local Surface Water Mapping, however, show 0% at risk from Surface Water Flooding. These sites were located within the areas used to model the local surface water flooding. Data sources used in the SFRA

Fluvial flooding

Flood Zones 2 and 3a

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

Flood Zone 3b (the Functional Floodplain)

Flood Zone 3b, as shown in Appendix A, has been compiled for the study area as part of this SFRA and is based on the 5% AEP (1 in 20-year chance of flooding in any given year) extents produced from Environment Agency detailed hydraulic models, where outputs were available. This information is only available in the SFRA and not shown on the online map.
For areas not covered by detailed models, a precautionary approach should be adopted for Flood Zone 3b with the assumption that the extent of Flood Zone 3b would be equal to Flood Zone 3a. If development is shown to be in Flood Zone 3a, further work should be undertaken as part of a detailed site-specific Flood Risk Assessment to define the extent of Flood Zone 3b.
If the area of interest is in an area that has seen some major changes to the extent of the Flood Zones, having checked the online mapping, Developers will also need to remap Flood Zone 3b as part of a detailed site-specific Flood Risk Assessment

Climate change

Please refer to Section 6 for information on the approach to climate change in this SFRA.

Surface water

Mapping of surface water flood risk in study area has been taken from the Risk of Flooding from Surface Water (RoFfSW) maps published online by the Environment Agency and from local detailed flood modelling studies where

these were available. The RoFfSW map is intended to provide a consistent standard of assessment for surface water flood risk across England and Wales in order to help LLFAs, the Environment Agency and any potential developers to focus their management of surface water flood risk.
The RoFfSW is derived primarily from identifying topographical flow paths of existing watercourses or dry valleys that contain some isolated ponding locations in low lying areas. They provide a map which displays different levels of surface water flood risk depending on the annual probability of the land in question being inundated by surface water (Table C-1).
Table C-0-2: RoFfSW risk categories

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

Although the RoFfSW offers improvement on previously available datasets, the results should not be used to understand flood risk for individual properties. The results should be used for high level assessments such as SFRAs for local authorities. If a site is indicated in the Environment Agency mapping to be at risk from surface water flooding, a more detailed assessment should be considered to more accurately illustrate the flood risk at a site-specific scale.
The locally modelled data takes into account the interactions between surface water, sewers and culverted watercourses and is available for the same return periods for:

- Fenn Park
- Baddeley Green
- Eaves Lane
- Hilton Road
- Uffington Parade
- Weston Coyney

Sewers

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

Reservoirs

The risk of inundation because of reservoir breach or failure of reservoirs within the area has been mapped using the outlines produced as part of the National Inundation Reservoir Mapping (NIRIM) study. These outlines were the same as those on the Long-Term Risk of Flooding website at the time of publication. The Environment Agency are currently updating their national reservoir flood maps

and SFRA users should check there are no major changes to the reservoir maps before relying on the mapping in the SFRA.

Groundwater

The JBA Groundwater Flood Map provides a detailed assessment of the risk of groundwater emergence in a 1 in 100-year event at a 5m resolution. The risk is scaled between 0 and 4, with 0 indicating no risk and 4 identifying groundwater levels either at or very near (within 0.025m of) the ground surface. The groundwater levels are compared against ground surface levels to determine the head difference in metres; with 0m suggesting artesian discharge of groundwater at the ground surface.

The JBA Groundwater Flood Map should be used in combination with other information, such as local data or historic data. It should not be used as sole evidence for any specific flood risk management, land use planning or other decisions at any scale. The data can however help to identify areas for further assessment at a local scale, where finer resolution datasets may exist or more data could be gathered.

Table 0-3: JBA Groundwater Flood Hazard Classification

Groundwater head difference (m)*	Grid code	Class label
0.025	4	Groundwater levels are either at very near (within 0.025m of) the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
0.025 to 0.5	3	Groundwater levels are between 0.025m and 0.5m below the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
0.5 to 5	2	Groundwater levels are between 0.5m and 5m below the ground surface in the 100-year return period flood event There is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.
>5	1	Groundwater levels are at least 5m below the ground surface in the 100-year return period flood event. Flooding from groundwater is not likely.
N/A	0	No risk. This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.

C Relevant Flood Risk Studies

Name of Study	Area Affected/ Scope	Recommendations
Burslem Canal Arm 2011 (AECOM)	Sizeable brownfield site at Burslem Port in Stoke-on-Trent, in the centre of the site lies the old Burslem Branch Canal corridor.	The incorporation of SUDS features into the design of the surface water drainage system within the development parcels and surface water discharge from redevelopment should be limited to existing brownfield rates minus 20%. Housing should be located outside the extent of the Flood Zone 3 on the southern boundary of the site, being replaced with Less Vulnerable or Water Compatible land uses instead. If it is considered that housing is required in this area to achieve the target number of units, a Sequential Test and Exception Test would be required.
Fowlea Brook Flood Risk & Hazard Mapping Study (2013)	1D-2D hydraulic model from a mix of new and existing survey for an improved understanding of flood risk within the Fowlea Brook catchment. Outputs have been used to update the EA flood map and allowed the LPA to defend planning decisions.	Working in partnership with the Environment Agency to provide additional attenuation.
Etruria Valley scheme 2015-2016 (SoTCC, JBA Consulting)	Provision of flood mitigation measures for Etruria Valley development scheme and an option scoping study to test 3 different flood flow / flood storage configurations.	A tilting weir using automated parameters and to carry out an Economic Analysis in order to understand the present value benefits generated by preferred option.

Weston Coyney Study Area 2016	STW's asset data was used to develop 1D-2D hydraulic models to improve the understanding of surface water flood risk within the Goms Mill and Weston Coyney areas of Stoke-on-Trent, including the areas around Horton Drive, Park Hall Road, Englesea Avenue.	Investigate options for flood mitigation, including sewer upsizing, introduction of surface water storage areas and river restoration.
Fowlea Brook Flood Mitigation Study, 2016	Following the 2013 flood hazard mapping study, study to investigate flood mitigation measures in Fowlea Brook catchment to identify locations for flood storage and WFD improvement.	Possible works at Etruria Valley to furnish improved flood storage.
Goms Mill Study Area 2016	Used STW's asset data to develop 1D-2D hydraulic models to improve the understanding of surface water flood risk within the Goms Mill and Weston Coyney areas of Stoke.	Models used as a tool to investigate options for flood mitigation, including sewer upsizing, surface water storage areas and river restoration.
Staffordshire University Flood Mitigation Options 2016 (Peter Brett Associates)	The flood mitigation options intend to provide increased standard of protection against fluvial flooding to the existing buildings on site, provide an increased standard of protection to the site in order to enable the redevelopment of new facilities, including new student accommodation.	Long list and short list of options to allow regeneration and offer flood storage areas.
City Centre Public Realm 2016	A number of City Centre streets are prone to surface water flooding exacerbated by hardstanding, inadequate drainage and the extent of culverted sections through the city.	Further exploratory works required to ascertain the extent of culverted watercourse and design standard of drainage networks throughout the City centre area.
Fenpark Study Area 2017	Study to explore possible improvements to reduce surface water flooding.	Interception of flows from upstream and possible SuDS features and exploration of ways to lessen flood risk.

Braithwell Drive Study Area 2017	Study to explore possible improvements to reduce surface water flooding	Sewer assets and culverted watercourses to be maintained to reduce the risk of flooding.
Hilton Road Study Area 2017	Surface water converges from a number of directions causing flooding.	Interception of flows from upstream and possible SuDS features and exploration of flood risk alleviation designs. Works programmed for 2020.
Eaves Lane Study Area 2017	Surface water converges on Eaves Lane amongst other surface water and highway drainage routes outfalling into area.	Interception of flows from upstream and possible SuDS features and exploration of flood risk alleviation designs
Culvert Blockages Scenarios 2017	Upgrades to culverted watercourses and trash screen blockages caused by trapped debris	Intercept surface water by retrofitting of bioretention, swale and an attenuation pond.
Fowlea Brook Hydraulic Model update 2018, (incorporating the Scotia Brook and Barnfield Brook)	Production of hydraulic models and identification of possible improvements to reduce surface water flooding in the Little Chell and Stanfield area	Interception of flows from upstream and possible SuDS features and exploration of flood risk alleviation designs.
Clarice Cliff School 2017	Internal flooding caused on at least five occasions caused by a combination of surface water runoff and sewer capacity being exceeded within the school grounds	Works undertaken by STW to help alleviate the risk and above ground SuDS retrofit to endeavour to provide a 1 in 100 year protection to the site.
Uffington Parade Study Area 2017	Surface water congregates on the dip at the entrance of the road flooding nearby properties.	Interception of flows from east and west of Uffington Parade and possible SuDS features and exploration of flood risk alleviation designs. Works programmed for 2020.

Fowlea Brook Catchment Study 2017	Following the 2013 hazard mapping study, this study investigated flood mitigation measures to reduce flood risk associated with the Fowlea Brook catchment.	Areas highlighted for potential flood storage and WFD improvements to help reduce flood risk downstream
Victoria Link Road	Surface water inundation and required improvements to pumping station to limit risk of flooding to residential properties in area	Intercept surface water by use of compensation areas, attenuating rain gardens, bioretention and swales
Etruria Valley (SUNRISE)	To restore and naturalise Fowlea Brook as it flows through part of the Etruria Valley site.	Watercourse enhancements consisting of restoring the river to its original with a naturalised river channel and infilling in of the existing concrete river structure
Former Victoria Ground (SUNRISE)	To restore and naturalise the River Trent corridor in conjunction with redevelopment of the former Stoke City Football Cub stadium	Watercourse enhancements consisting of restoring the river to its original with a naturalised river channel and infilling in of the existing concrete river structure

D Flood Alert and Flood Warnings

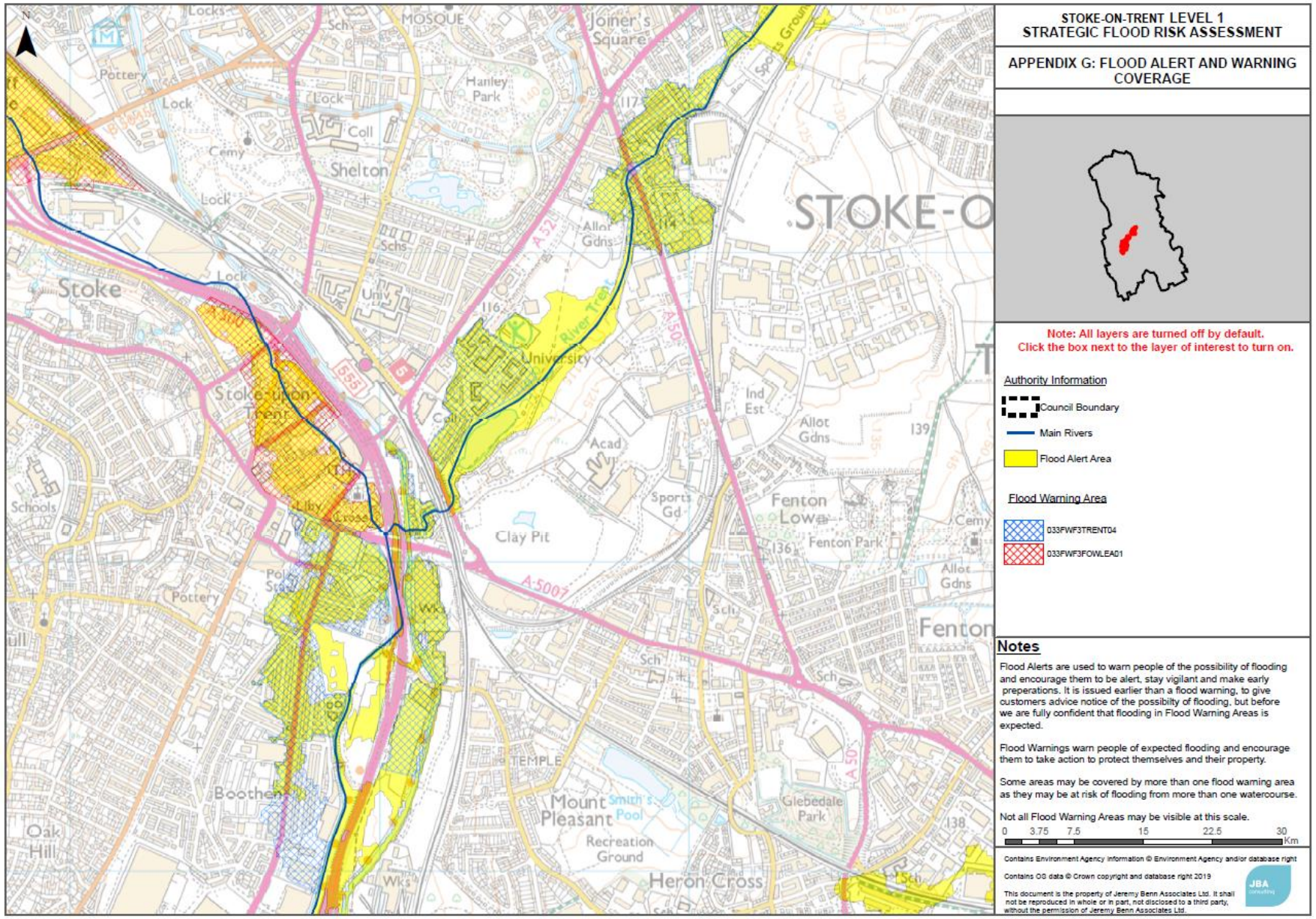
D.1 Flood Alerts

Flood Alert Code	Flood Alert Name	Watercourse/s	Coverage
033WAF309	Stoke Trent	Ford Green Brook, Lyme Brook, River Trent	Low-lying land and roads between Norton Green and Barlaston on the River Trent and on the Lyme Brook and Ford Green Brook
033WAF313	River Blithe and River Swarbourn	River Blithe, River Swarbourne	Low-lying land and roads between Blythe Bridge and Nethertown on the River Blithe and between Hoar Cross and Yoxall on the River Swarbourne

D.2 Flood Warning

Flood Alert Code	Flood Alert Name	Watercourse/s	Coverage
033FWF3FGREEN01	Ford Green Brook at Fegg Hayes, Bradeley and Sneyd Green	Ford Green Brook	Ford Green Brook at Fegg Hayes, Bradeley and Sneyd Green, Stoke on Trent including Catherine Road in Fegg Hayes, Tudor Rose Way and Station Crescent in Bradeley and Milton Road in Sneyd Green.
033FWF3TRENT03	River Trent at Abbey Hulton and Bucknall	River Trent	River Trent at Abbey Hulton and Bucknall area of Stoke including Fishpond Way, Mill Farm, Leek Road, Atlam Close, Westacre, Broughton Road and Dividy Road

033FWF3TRENT04	River Trent at Stoke on Trent	River Trent	River Trent at Stoke on Trent including Joiners Square, the University and Boothen
033FWF3TRENT05	River Trent at Hanford and Trentham	River Trent	River Trent at Hanford and Trentham including Church Lane area of Hanford, Park Drive in Trentham and Trentham Gardens
033FWF3LYME01	Lyme Brook at Newcastle under Lyme and Trent Vale	Lyme Brook	Lyme Brook at Newcastle under Lyme and Trent Vale including Hatrell Street, Brook Lane, Lyme Valley Road and Sports Grounds
033FWF3TRENT01	River Trent at Norton Green	River Trent	River Trent at Norton Green including Trent Terrace, Endon Road, Foundry Square, Probisher Street and Little Heakley Farm
033FWF3FOWLEA01	Fowlea Brook at Stoke on Trent	Fowlea Brook	Fowlea Brook from Cliff Vale Industrial Park to Stoke Town Hall


STOKE-ON-TRENT LEVEL 1
STRATEGIC FLOOD RISK ASSESSMENT
APPENDIX G: FLOOD ALERT AND WARNING COVERAGE
Note: All layers are turned off by default.
Click the box next to the layer of interest to turn on.
Authority Information
Council Boundary
Main Rivers
Flood Alert Area
Flood Warning Area
033FWF3TRENT04
033FWF3FOWLEA01
Notes
Flood Alerts are used to warn people of the possibility of flooding and encourage them to be alert, stay vigilant and make early preperations. It is issued earlier than a flood warning, to give customers advice notice of the possibilty of flooding, but before we are fully confident that flooding in Flood Warning Areas is expected.
Flood Warnings warn people of expected flooding and encourage them to take action to protect themselves and their property.
Some areas may be covered by more than one flood warning area as they may be at risk of flooding from more than one watercourse.
Not all Flood Warning Areas may be visible at this scale.
0 3.75 7.5 15 22.5 30 Km
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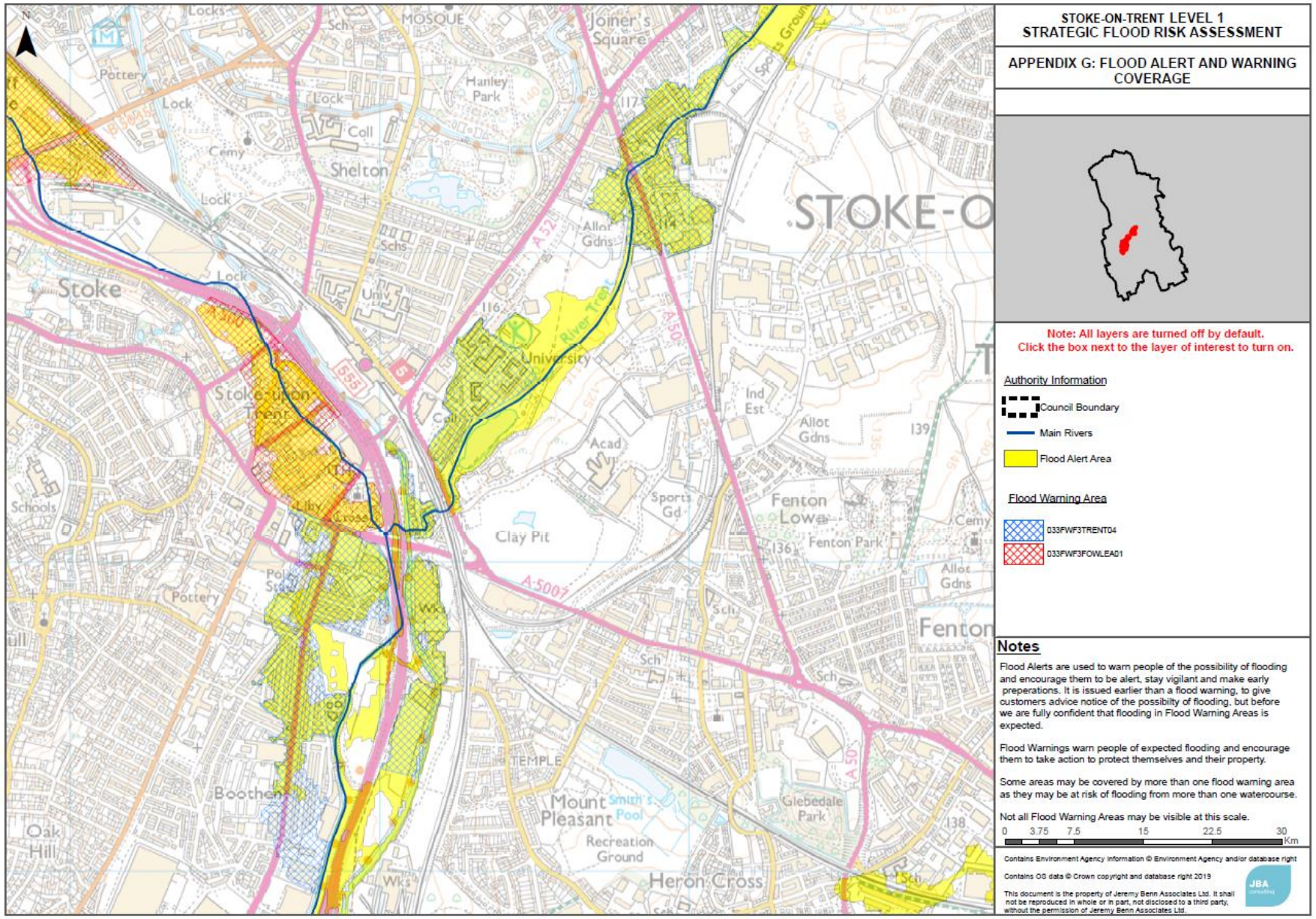
Stoke
Stoke-upon-Trent
Shelton
Hanley Park
Joiner's Square
University
Fenton Lowes
Fenton Park
Clay Pit
Mount Pleasant
Glebedale Park
Boothen
Oak Hill
Heron Cross
Recreation Ground
A52
A50
A5007


STOKE-ON-TRENT LEVEL 1
STRATEGIC FLOOD RISK ASSESSMENT
APPENDIX G: FLOOD ALERT AND WARNING COVERAGE
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033FWF3FOWLEA01
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Shelton
Hanley Park
Joiner's Square
Stoke-upon-Trent
University
River Trent
Fenton Lowes
Fenton Park
Clay Pit
Boothen
Oak Hill
Mount Pleasant
Smith's Pool
Recreation Ground
Glebedale Park
Heron Cross
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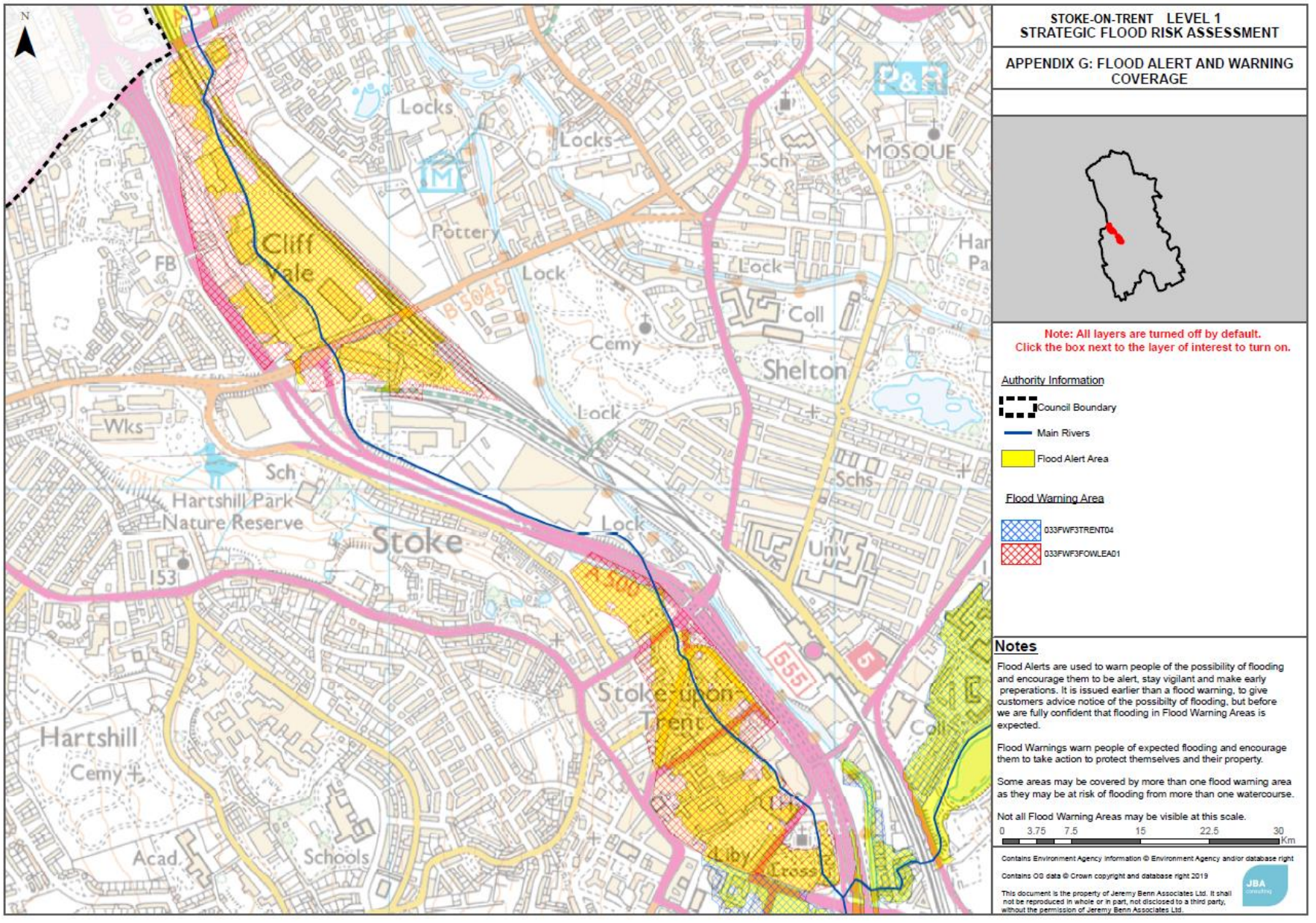
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STOKE-ON-TRENT LEVEL 1
STRATEGIC FLOOD RISK ASSESSMENT
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033FWF3FOWLEA01
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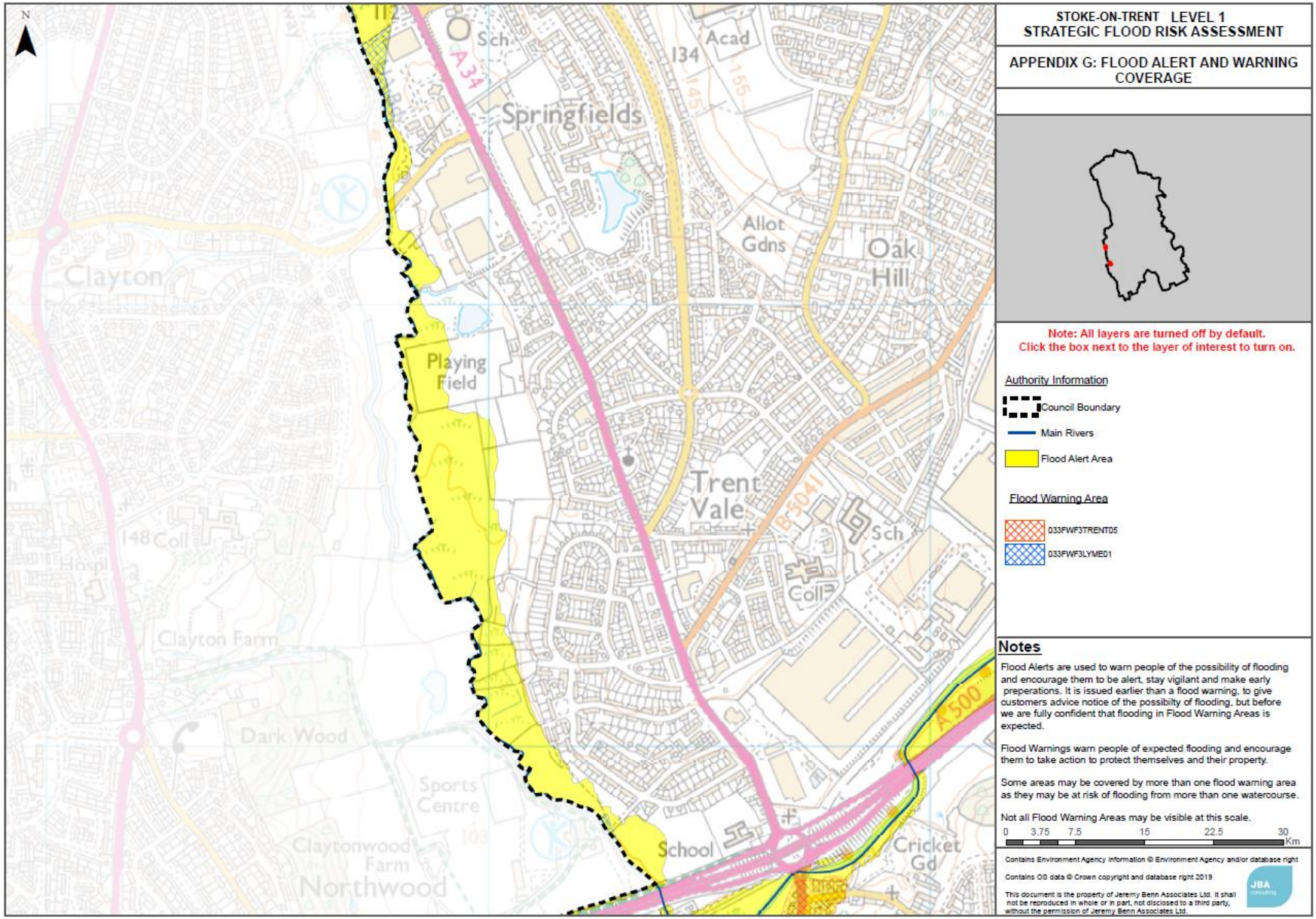
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Allot Gdns
Oak Hill
Clayton
Playing Field
Trent Vale
Clayton Farm
Dark Wood
Sports Centre
Claytonwood Farm
Northwood
School
Cricket Gd
A34
A500
B5041
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134
155
145
103
STOKE-ON-TRENT LEVEL 1
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033FWF3TRENT05
033FWF3LYME01
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Km
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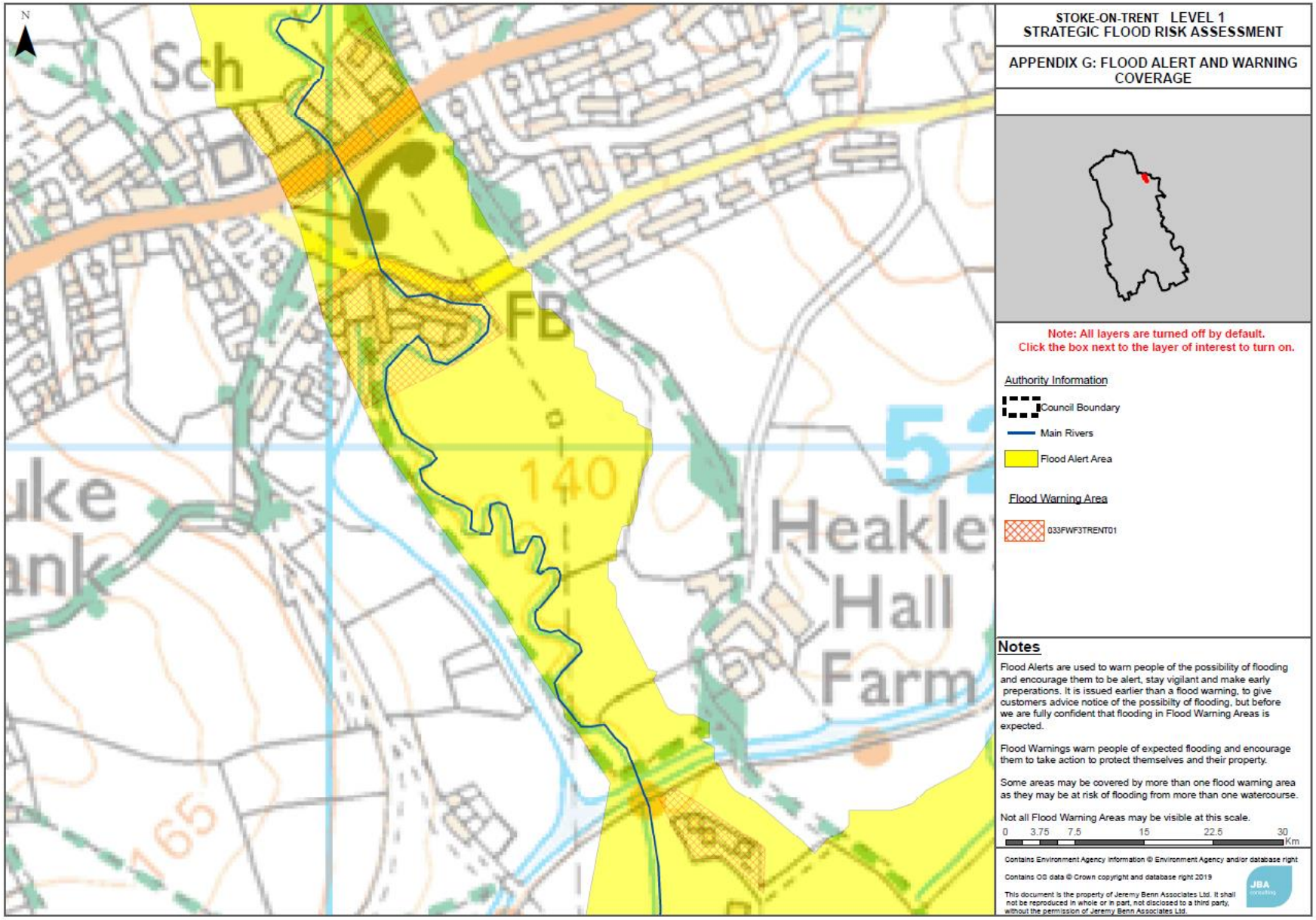
JBA consulting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Farm
STOKE-ON-TRENT LEVEL 1
STRATEGIC FLOOD RISK ASSESSMENT
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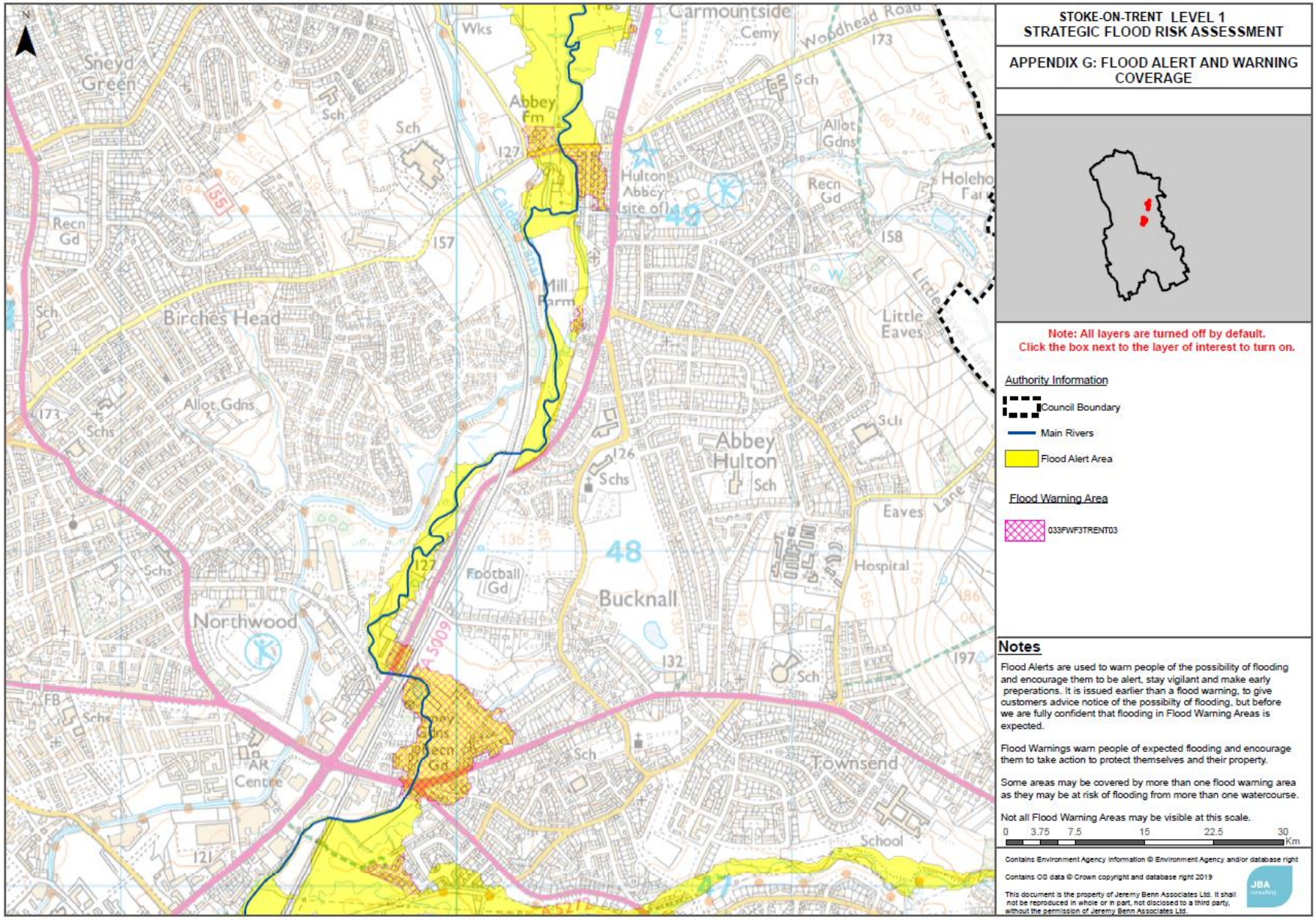
STOKE-ON-TRENT LEVEL 1
STRATEGIC FLOOD RISK ASSESSMENT
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Authority Information
Council Boundary
Main Rivers
Flood Alert Area
Flood Warning Area
033FWF3TRENT03
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0 3.75 7.5 15 22.5 30 Km
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Sneyd Green
Abbey Fm
Hulton Abbey (site of)
Carmountside
Cemy
Woodhead Road
Birches Head
Allot Gdns
Mill Farm
Little Eaves
Abbey Hulton
Eaves Lane
Hospital
Bucknall
Northwood
Football Gd
Townsend
School
AR Centre
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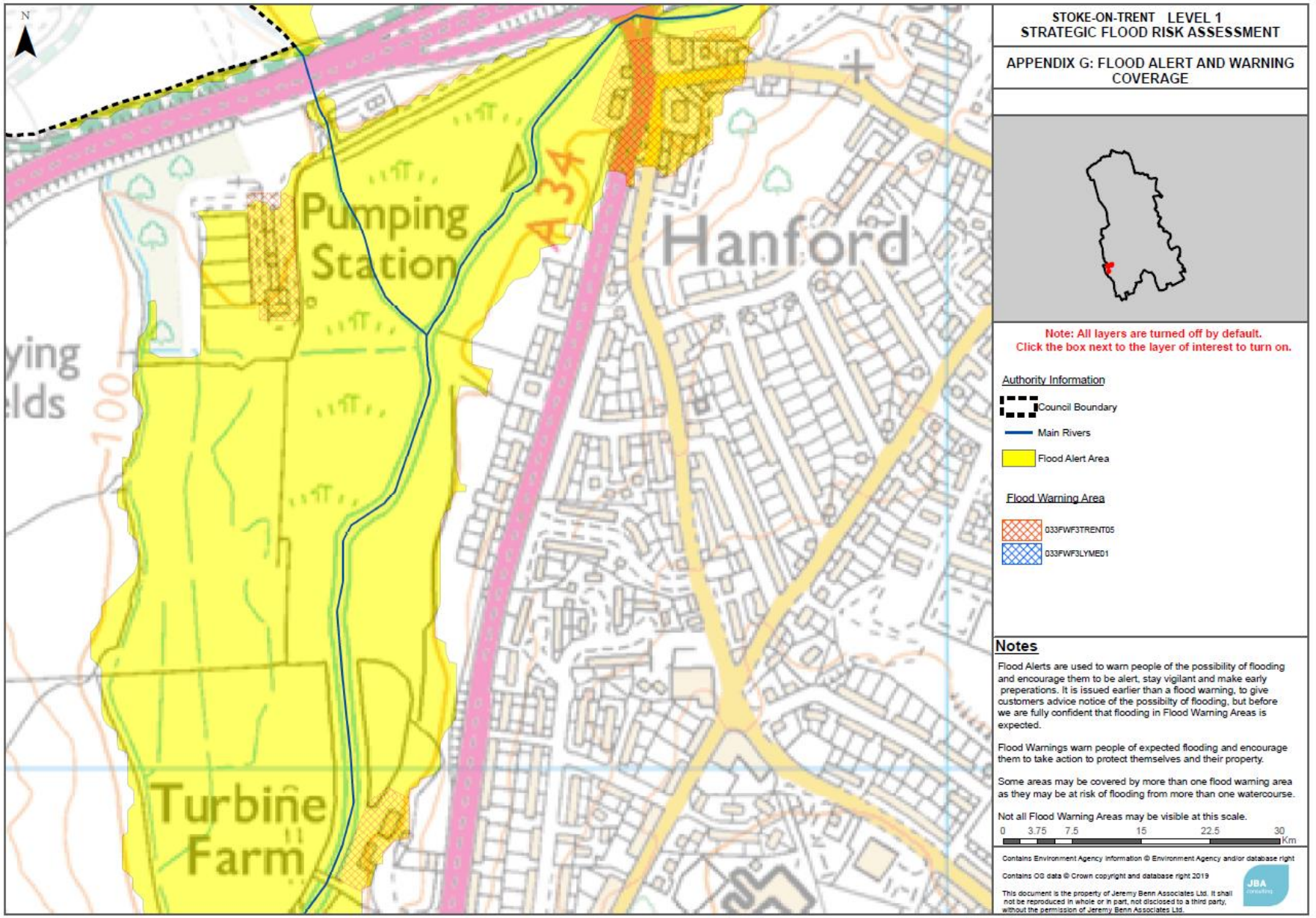
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Pumping Station
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STOKE-ON-TRENT LEVEL 1
STRATEGIC FLOOD RISK ASSESSMENT
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033FWF3LYME01
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E Summary of flood risk across the City

Settlement	Fluvial flood risk	Existing or proposed defences	Surface water flood risk	Susceptibility to Groundwater flood risk	Historic, recorded flood events
Burslem / Tunstall	There are areas of Flood Zones 2 and 3 within this area. Primarily, these Flood Zones follow the main watercourses of Fowlea Brook and the River Trent and their associated tributaries. Key areas at risk are Scotia Road between Burslem and Tunstall, Pitts Hill and along the A5271, Crowndale place (a large section of properties are within Flood Zone 3 here) and especially Ford Green/Chell Heath where a number of properties are within Flood Zone 3, including a museum.	No formal flood defences	Surface water flooding seems to be an issue affecting properties across this area. Burslem and Tunstall centres and the key routes out of these urban areas are heavily affected by surface water flooding. Surface water flooding follows the topographical drainage paths within the area. There is a noticeable flow path that follows the Scotia Brook into Tunstall. Again, in Burslem a flow path drains from the A53 to Burslem centre. Towards the northern section of the city boundary Oxford is affected by a large flow path draining into the river valley to the east of the area.	The majority of the area has NO RISK of GW flooding. Areas between 0.25 and 0.5m below the surface: Middleport, parallel to the A50 and again to the west of Tunstall. There are 4 areas where GW is 0.25m below the surface, the largest of these being north of the A53 and South of the River Trent, particularly affecting Alicia Way.	There are 28 sewer flood incidents within this area since 1991. Norton/Norton Green have had 10 separate additional incidents between 2012-2016 and Tunnel Terrace has also had 5 separate incidents between 2014-2016.
Fenton	The majority of Fenton is within Flood Zone 1. However, there are still properties at risk within Flood Zones 2 and 3	No formal flood defences	Fenton and the area around Fenton are heavily impacted by surface water flooding. Areas of higher elevation to the E and SE,	The majority of the area has NO RISK. 0.25-0.5: more areas	There have been 81 Sewer flood incidents since 1998. Goddard

	along the key watercourses in the area. Key areas at risk within Flood Zone 3 are: along the tributary of the Trent (flows from Washerwall) especially between Berry Hill and Ubberley, especially Zennor Grove and Yately Close. Again, where this tributary meets the Trent there are some properties at risk along Bucknall Street. Additionally, where the Trent and Fowlea brook meet there is a large area of Staffs University which is within Flood Zone 3. Joiners Square has some areas that are within Flood Zone 2, especially, Victoria road (A50), Cotesheath St and Berry hill Rd which both have properties at risk.		there is a large area of lower elevation where flow paths merge and pool. The flow paths drain towards the river Trent and the areas most at risk are those closest in the Trent valley. Some key areas can be highlighted include Fenton Low (large areas of buildings affected by 1 in 30 year events) and Adderley Green (source of a major flow path that flows all the way down A5272.	where the GW is at these depths, including: Weston Coyney, along the A520, between Sandford Hill and Berry Hill. <0.25: Bucknall and Townsend and in-between have both 0.25-0.5 and <0.25. West of Fenton Low and East of the River Trent, both 0.25-0.5 and <0.25. Sandford Hill and Meir Hay, 0.25-0.5 and <0.25.	Street has had 8 separate incidents between 2008 and 2016. Golden Hill rd. in Fenton has also had 8 separate incidents between 2013 and 2016
Hanley (City Centre)	The majority of Hanley is within Flood Zone 1. Flood Zones 2 and 3 can be found along the Trent and Fowlea brook. Most of the properties at risk fall into Flood Zone 2, but some are still located within Flood Zone 3. Birches Head	Some brick lined and concrete lined channels. One flood wall along the A500.	There is an area of high elevation to the NE of Hanley, and the surface water flooding in the area is dominated by this feature. There are some smaller flow paths draining into the SW that affect the centre. The main flow path affects the area from Eldon St to the A53, with many	The majority of the area has NO RISK. <0.25m: Milton Rd/ Redhill Rd. West of A5009 West of Abbey Hulton, below R. Trent.	There have been 25 sewer flood incidents since 1994. Rectory Road has had 5 separate incidents between 1997-2006. The most

	Road/Fish Pond Way is located in Flood Zones 2/3. As is a large portion of Cliff Vale.		buildings being affected in 1in30 year events. A large part of the A5010 is a flow path for surface water flooding.	East of A500, Garner St, West of Fowlea Brook. Lakeside Close. 0.25-0.5m: City Centre has bands of GW at this depth. Continuing north from the city centre, the depth of GW increases.	recent incident was in 2017 off Bedford Street. 1987 Bucknall Rd - Severe rainfall and blocked culvert.
Longton	This area has the largest areas affected by Flood Zones 2 and 3 within Stoke on Trent. The largest area affected is Trentham with Flood Zone 3 stretching across more than 1700m of properties from New Inn Lane to the B45490. Flood Zone 3 is predominately along Longton Brook but also stretches across from the A34 across to Sideway and up towards the River Trent and the A500. Cockster Brook also has an area of Flood Zones 2 and 3 associated with it, affecting some properties in Longton especially around	No formal flood defences	The majority of Longton and the southern area of the city is at a lower elevation and consequently the majority of the area is impacted by surface water flooding. There are 2 major flow paths that impact buildings in the 1 in 30 year events. One flows from Florence to Blurton rd. near Holly Bush, the other impacts a lot of buildings in Newstead, the train line and a large majority of Trentham. Similar to Fenton there is a lot of other areas that are impacted by surface water flooding and should be explored further	The majority of the area has NO RISK but has the largest areas of shallower GW. <0.25m: N. Trentham, West of the Trent and Mersey canal. Newstead. Hollybush, Longton Hall Road / Perton Wood Longton, Longton Hall Road, Coleridge Rd, South of the Trainline and east of the station.	There have been 16 sewer flood incidents since 1994, 5 of these were within Longton.

	Langland Drive. There is a larger area of properties that are affected by Flood Zone 3, from Trentham Rd., the properties off Belgrave road and up to almost the A50. Hanford is also located within Flood Zones 2 and 3 where the Lyme Brook meets the River Trent. This mostly affects the flood plain but there is also a small area of the A34 (Stone Road) affected. In the southern tip of the area there is an area of Flood Zone 3 associated with the River Trent. Again this mostly impacts a rural area around Strongford farm.			Nomacot, along the A50. 0.25-0.5: The majority of Meir and Lightwood. West Hanford and Trentham. Blurton West Holly Bush and Heron Cross.	
Stoke town centre	This has the largest area of Flood Zone 1 within Stoke. The largest section of Flood Zone 3 is within Stoke, along the River Trent. Key roads at risk are Liverpool Rd, Elenora St, the A52 and Woodhouse St. This continues as Flood Zone 2 down towards Boothen. There is also an area of Flood Zone 3 along the Lyme Brook, this mostly	64 Flood Defences. Most High ground, brick lined, concrete lined and natural channels. 1 Flood wall along	To the West of Stoke there is an area of higher elevation which enables to SW to drain to both the east, affecting stoke and the A500, towards Fowlea Brook. It also drains to the East into the Lyme Brook Valley. Hilton Road and the Hospital are affected by a flow path to the east where 4 flow paths merge. Many buildings in Hartshill are affected in the 1 in 30 year events.	The majority of the area has NO RISK and >0.5m below Ground level. <0.25m: small areas of North Street (South of the A500) and along the Northern edge of the Lyme brook along the SW boundary.	There have been 37 sewer flood incidents since 1999. Stoke upon Trent has had 5 separate incidents between 2012 and 2014.

	affects open space but there is a small area of Lyme Drive in Springfields that is within Flood Zone 3.	the A500.		0.25-0.5m: Hartshill 0.5-5m: A34/ Harpfield Road, Oakhill and Boothen, Stoke (especially London road). >5m: Penkull.	

F Surface Water Management hotspot analysis

The SWMP appendices are published separately to the main SFRA report.

G Local SuDS Handbook - developer proforma

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