South Gloucestershire Council – Level 1 Strategic Flood Risk Assessment

Final Report

November 2021

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Revision History

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July 2021	Draft Report	Patrick Conroy (South Gloucestershire Council)
October 2021	Draft report with amendments made following feedback	Patrick Conroy (South Gloucestershire Council)
November 2021	Final report	Patrick Conroy (South Gloucestershire Council)

Contract

This report describes work commissioned by Dawn Morgan on behalf of South Gloucestershire Council, by an email dated 26 February 2021. South Gloucestershire Council's representatives for the contract were Dawn Morgan, Patrick Conroy and Carl McClure. Peter Rook, Gwyn Jones and Alastair Dale of JBA Consulting carried out this work.

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Purpose

This document has been prepared as a Final Report for South Gloucestershire Council. JBA Consulting accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

JBA Consulting has no liability regarding the use of this report except to South Gloucestershire Council.

Acknowledgements

We would like to acknowledge the assistance of South Gloucestershire Council, the Environment Agency, Wessex Water, the Lower Severn Internal Drainage Board and the neighbouring authorities of Bristol City Council, Bath and North East Somerset Council, Stroud District Council, Cotswold District Council and Wiltshire Council.

Carbon Footprint

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Executive summary

Introduction

The study area for this Strategic Flood Risk Assessment (SFRA) is the South Gloucestershire Council area. South Gloucestershire is located in the far south of Gloucestershire and to the north of Bristol, stretching from the Severn estuary on its western boundary to the Cotswolds on its eastern, covering 50,000 hectares. The unitary authority area was created in 1996 and accommodated the northern section of the abolished county of Avon. The area derives its name from the ceremonial county of Gloucestershire, although it is not administered as such. As a unitary authority area, it is the Lead Local Flood Authority (LLFA) for the area.

The SFRA update was required to be compliant with the latest guidance described in the revised National Planning Policy Framework (NPPF) (February 2019, last updated July 2021) and accompanying Planning Practice Guidance (PPG, updated August 2019). The 2021 SFRA provides flood risk evidence and long-term strategy to support the management and planning of development, protect the environment and deliver infrastructure. The SFRA supports the selection of site allocations in the Local Plan 2020 and provides information and guidance to be used in the preparation of Flood Risk Assessments in support of site-specific planning applications.

SFRA objectives

The key objectives of this SFRA are:

- To provide a robust evidence base to inform the application of the Sequential, and if necessary, Exception Tests for developers and planners.
- To assess the flood risk to and from the study area from all sources, now and in the future (accounting for climate change).
- To assess the impact that cumulative land use changes and development in the area will have on flood risk.
- To identify and provide recommendations on opportunities to reduce the causes and impacts of flooding to existing communities and developments.
- To identify land usage for flood risk management.

Levels of SFRA

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

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

This report fulfils the Level 1 SFRA requirements. The report has identified potential development sites across South Gloucestershire and has provided an assessment of cumulative impacts. The information included in this report is appropriate to enable South Gloucestershire Council to apply the sequential test when considering potential strategic allocations in the Local Plan 2020.

How to use this document

SFRAs are high level strategic documents and, as such, do not go into specific detail on an individual site-specific basis. This SFRA has been developed using the best available information, supplied at the time of preparation. This relates both to the current risk of flooding from rivers and surface water and where available the potential effects of future climate change. Recommendations and details on how to access the information and apply the Sequential and Exception tests using the data set out in this report are provided Appendix D.

This SFRA has incorporated the latest modelling provided by the Environment Agency. It should be noted that the Environment Agency's Flood Zones, on their Flood Map for Planning website, may differ to the maps in the SFRA for a short period of time whilst the Environment Agency incorporate the latest modelling. Other datasets used to inform this SFRA may also be periodically updated and following the publication of this SFRA, new information on flood risk may be provided by Risk Management Authorities.

Flood risk policy and strategy

Relevant regional policies have also been reviewed as part of the SFRA, such as the Severn Estuary Shoreline Management Plan (SMP2), Severn River Basin Management Plan and the Bristol and Avon and the Severn Tidal Tributaries Catchment Flood Management Plans. Local Policies have also been assessed, for example the South Gloucestershire Local Flood Risk Management Strategy and Preliminary Flood Risk Assessment. Other policy considerations have also been incorporated, such as sustainable development principles, climate change and flood risk management.

Planning policy for flood risk management

The **National Planning Policy Framework** (NPPF) and associated **National Planning Practice Guidance** (NPPG) have been reviewed in terms of their requirements as to how flood risk and surface water drainage should be managed through the planning system, and how these policies should be implemented. Proposed development sites at locations at risk of flooding will be required to satisfy the Sequential and, where necessary, Exception Tests in accordance with the NPPF. . Links are provided to various guidance documents and policies published by other Risk Management Authorities such as the Lead Local Flood Authority and the Environment Agency.

Climate change

The interpretations of flood risk in the SFRA have considered the impacts of climate change on the Plan area in the future. It should be noted that the UK Climate Change Projections 2018 (**UKCP18**) were published on 26 November 2018. The UKCP18 projections replace the UKCP09 projections as the official source of information on how the climate of the UK may change over the next 100 years.

The Environment Agency updated the climate change allowances for sea level rise in December 2019 to take account of the UKCP18 projections. Updated climate change allowances for peak river flows and peak rainfall intensity were published by the Environment Agency towards the end of July 2021. When undertaking an FRA, reference should be made to the most up to date climate change allowances provided by the Environment Agency.

Sources of information used in preparing the SFRA

The SFRA has collated flood risk information from a number of key sources to understand flood risk within the Plan area. This includes the definition of Flood Zones that has been made as part of the SFRA. Other datasets such as the Risk of Flooding from Surface Water (RoFSW) mapping have also been analysed as well as records of

historic flood incidents, reservoir inundation, groundwater flooding and sewer flooding incidents.

The Environment Agency regularly reviews its flood risk mapping, with the Little Avon and Severn House Farm models having recently been updated. It is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a site-specific FRA.

Understanding flood risk in South Gloucestershire

The key sources of flooding in the district have been explored in terms of their potential effects on plan preparation. This includes the factors that affect flooding such as topography, soils and geology.

- The data shows the most frequent cause of flooding within South Gloucestershire to be fluvial along main rivers, surface water in inland and urban areas; tidal along the coastline; and a combination of tidal and fluvial flooding in the Severn Estuary-draining tidal plain, particularly in the area of the Lower Severn IDB.
- The Main River watercourses of the River Frome, River Avon, Little Avon, Henbury Trym, Stoke Brook, Folly Brook and Ladden Brook have long been associated with fluvial flooding and are relatively well understood in that capacity. The settlements identified as most at risk of fluvial flooding are Hanham, Swineford, Chipping Sodbury and Yate.
- The Severn Estuary is located along the north-west boundary of the study area and is the source of tidal flood risk within South Gloucestershire. Major tidal flooding occurred in 1977 which led to the construction of tidal defences along the Severn Estuary. The areas identified most at risk of tidal flooding are Severnside, Severn Beach, New Passage and Oldbury/ Sheppardine.
- In some places along the coastline, such as within the Lower Severn IDB, tidal flood risk can occur in combination with fluvial and surface water sources which can exacerbate flood risk, particularly by reducing the capacity of rhines (drainage channels) discharging to the Severn Estuary which can be tide locked. This can also impact surface water flooding, if surface water drainage systems are unable to discharge runoff to the rhines.
- Surface water flooding is a major concern within South Gloucestershire. Urban areas within north and north east Bristol, and include sections of communities within Filton and Kingswood, as well as Thornbury, Emerson's Green, Longwell Green, Yate, Pilning, Hanham, Aust and North Common, are at the greatest risk of surface water flooding. The study area is characterised by extensive locations where the proportion of paved areas is relatively high (urban and commercial areas) that can potentially generate substantive surface runoff volumes and flows.
- An influential characteristic of South Gloucestershire study area is that the catchment runoff contributions to the River Frome potentially increase the magnitude and volume of flows that discharge through the middle of Bristol City and to the Floating Harbour. The Frome watercourse is unusual in that it comprises relatively flat areas in its upper reaches but has steep gradients along the lower reaches that contribute to the Floating Harbour. Historically this system has caused extensive flooding to the centre of Bristol and resulted in the implementation of substantive flood alleviation schemes.
- The JBA Groundwater Flood Map shows that the vast majority of South Gloucestershire is considered at low risk of groundwater flooding. Cromhall and Bitton are identified in the Local Flood Risk Management Strategy as

having reported historic incidents, and other settlements may be at localised risk.

- Wessex Water SIRF data indicates that there have been 32 historic incidents of sewer flooding in the Local Plan area from 2004 – 2020. All but four of the incidents are located in the suburbs of Bristol, with the remaining four located in Tytherington.
- Environment Agency reservoir flood risk mapping show that the settlements most at risk of reservoir flooding including parts of Bitton, Pucklechurch, Filton, and parts of Mangotsfield along the Folly brook.

Fluvial, tidal and coastal flood defences

All main rivers in South Gloucestershire have flood defences in some locations along their lengths and there are Environment Agency maintained tidal defence schemes along virtually the entire coast of South Gloucestershire. When considering defences along the coastline, it is important to differentiate between those which are constructed to provide some protection to the coastal frontage from erosion and those which are designed to provide a measure of protection from flood risk from the tide, waveand surge levels in the Severn Estuary.

There are a number of potential flood future defence schemes being brought forward in South Gloucestershire. Most notably the Avonmouth and Severnside Enterprise Area (ASEA) Ecology Mitigation and Flood Defence Project is currently under construction and is intended to support the growth of the Avonmouth Severnside Enterprise Area. The ASEA scheme will upgrade existing defences along a 17 km stretch of coastline, including the defences from Severn Beach to Aust in the Local Plan area. It should be noted that the scheme is understood not to be intended to provide appropriate standards of protection for potential further residential development in the area[1].

FRA requirements and flood risk management guidance

Site specific FRAs are required by developers to provide a greater level of detail on flood risk and any protection provided by defences and, where necessary, demonstrate the development satisfies part 'b' of the Exception Test. Where appropriate this should include consideration of the cumulative effects of development on existing communities that might be relatively remote from proposed plan allocations.

Information which should be used to support the Sequential and Exception Tests for both Local Plans and Flood Risk Assessments has been documented, along with guidance for planners and developers. Links are provided to various guidance documents and policies published by other Risk Management Authorities such as the Lead Local Flood Authority and the Environment Agency.

Developers should consult with South Gloucestershire Council (as both LPA and LLFA), the Environment Agency, Wessex Water and (where relevant) the Lower Severn Internal Drainage Board at an early stage to discuss flood risk including requirements for site-specific FRAs, detailed hydraulic modelling, and drainage assessment and design.

1 ASEA Scheme Flood Risk Assessment: https://developments.southglos.gov.uk/online-applications/applicationDetails.do?activeTab=documents&keyVal=P9HBM7OKJNR00

Surface water management and SuDS

Advice and guidance on managing surface water runoff and flooding throughout South Gloucestershire has been provided. This includes specific advice relating to the use of Sustainable Drainage Systems (SuDS), these are management practices which enable surface water to be drained in a more sustainable manner and mimic the local natural drainage. The inclusion of SuDS within developments is an opportunity to enhance ecological and amenity value, and promote Green Infrastructure, incorporating above ground facilities into the development landscape strategy. Proposals should have close regard to the appropriate guidance and requirements as set out in the South Gloucestershire Local Flood Risk Management Strategy (being updated at the time of the preparation of this SFRA).

South Gloucestershire Council has produced **a guide for designers and developers** which includes guidance for using SuDS. In October 2020, South Gloucestershire Council published a **Supplementary Planning Document** (SPD) on SuDS, including detailed guidance on the policy, standards and implementation of SuDS within the council area.

Flood warning and emergency planning

Emergency planning has been considered as part of the SFRA, this includes guidance and advice on managing flood related incidents before, during and after flooding occurs. The NPPF requirements have also been reviewed with regard to emergency plans and making new development safe. There are currently 7 Flood Alert Areas and 23 Flood Warning Areas in the Local Plan area, a full description of the areas and waterbodies affected by these has been provided.

Strategic flood risk solutions

Consideration has been made to the potential for strategic flood risk solutions within South Gloucestershire and how these could potentially be implemented. Potential solutions include flood storage, natural flood management, promotion of SuDS and floodplain restoration. Where appropriate such solutions should have regard to potential effects on flood risk to Bristol City.

For South Gloucestershire Council

The following additional policy recommendations for inclusion in the Local Plan 2020 based on the findings of this SFRA:

- Requirements for Level 2 SFRA;
- Coastal flood risk policy; and
- Sustainable drainage policy.

Recommendations for development and flood risk in the district

A review of national and local policies has been conducted against the information collected on flood risk in this SFRA. Following this, several recommendations have been made for South Gloucestershire Council to consider as part of Flood Risk Management in the study area.

- Reduction of flood risk through site allocations and appropriate site design;
- Promote SuDS to mimic natural drainage routes to improve water quality;
- Reduce surface water runoff from new developments and agricultural land;
- Enhance and restore river corridors and habitat; and
- Mitigate against risk, improved emergency planning and flood awareness.
- Appropriate consideration of cumulative effects on land remote from proposed plan allocations.

Technical recommendations

It is recommended that further recommendations are considered by South Gloucestershire Council and the Environment Agency:

- Potential modelling improvements;
- Climate change modelling; and
- Updates to the SFRA.

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Abbreviations

	Definition
AEP	Annual Exceedance Probability - the chance of an event with a particular magnitude occurring in each and every year
AOD	Above Ordnance Datum
AONB	Area of Natural Beauty
ASEA	Avonmouth and Severnside Enterprise Area
BCC	Bristol City Council
CFMP	Catchment Flood Management Plan
CIL	Community Infrastructure Levy
CIRIA	Construction Industry Research and Information Association
Defra	Department of the Environment, Food and Rural Affairs
SGC	South Gloucestershire Council
FAA	Flood Alert Area
FCERM GiA	Flood and Coastal Erosion Risk Management Grant in Aid
FRA	Flood Risk Assessment
FRMP	Flood Risk Management Plan
FSA	Flood Storage Area
FWMA	Flood and Water Management Act
FWA	Flood Warning Area
FWS	Flood Warning Service
GI	Green Infrastructure
GIS	Geographical Information System
GSPZ	Groundwater Source Protection Zone
HELAA	Housing and Economic Land Availability Assessment - The Housing and Economic Land Availability Assessment (HELAA) is a technical piece of evidence to support local plans and Sites & Policies Development Plan Documents (DPDs). Its purpose is to demonstrate that there is a supply of housing land in the district which is suitable and deliverable.
JBA	Jeremy Benn Associates
LFRMS	Local Flood Risk Management Strategy
LLFA	Lead Local Flood Authority - Local Authority responsible for taking the lead on local flood risk management
LPA	Local Planning Authority
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers
NFF	National Flood Forum
NFM	Natural Flood Management
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
NRD	National Receptor Database
NRIM	National Reservoir Inundation Mapping
NVZ	Nitrate Vulnerable Zones

	Definition
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
RBMP	River Basin Management Plan
Resilience measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Resistance measures	Measures designed to keep flood water out of properties and businesses; could include flood guards for example.
RoFSW	Risk of Flooding from Surface Water
SFRA	Strategic Flood Risk Assessment
SIRF	Sewer Incident Report Form – Wessex Water's database of sewer flooding incidents
SGC	South Gloucestershire Council
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
TUFLOW	Two-dimensional Unsteady FLOW (a hydraulic model)
UKCP18	United Kingdom Climate Projections 2018
WFD	Water Framework Directive

1 Introduction

1.1 Study area

This Strategic Flood Risk Assessment (SFRA) covers the study area of South Gloucestershire. The SFRA study area is shown in Figure 1-1. South Gloucestershire is located in the far south of Gloucestershire and to the north of Bristol, stretching from the Severn estuary on its western boundary to the Cotswolds on its eastern, covering 50,000 hectares. The unitary authority area was created in 1996, replacing the northern section of the abolished county of Avon. The area derives its name from the ceremonial county of Gloucestershire, although it is not administered as such. As a unitary authority area, it is the Lead Local Flood Authority (LLFA) for the area.

The water and sewerage provision of the area is administered by Bristol and Wessex, respectively, as shown in Figure 1-2 and Figure 1-3. Figure 1-4 shows the Internal Drainage Board (IDB) boundaries within the study area.

1.2 Purpose of the Strategic Flood Risk Assessment

> "Strategic policies should be informed by a strategic flood risk assessment and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards."
>
> (National Planning Policy Framework (February 2019, updated June 2019), Section 14 paragraph 156)

This SFRA 2021 document supersedes the **previous South Gloucestershire Level 1 SFRA** (2008)[2].

The main purpose of this SFRA update is to prepare a document that provides up to date, comprehensive supporting evidence for the emerging Local Plan. South Gloucestershire Council adopted its **Local Plan Core Strategy**[3] in 2013. South Gloucestershire Council is currently in the process of carrying out a five-year update as required by the plan making regulations. As part of ensuring that a robust evidence base is in place, the Council commissioned a new SFRA. The SFRA will influence the location of development. The SFRA update was also required to be compliant with the latest guidance described in the 2019 update to the National Planning Policy Framework (NPPF), support the selection of site allocations in the Local Plan Review and to provide information and guidance to be used in the preparation of Flood Risk Assessments (FRAs) in support of site specific planning applications.

An **updated NPPF**[4] was published in July 2021 and sets out Government's planning policies for England and how these are expected to be applied. This updated Framework replaces the previous versions of the NPPF published in July 2018 and March 2012.

The key objectives of the 2021 SFRA are:

- To provide a robust evidence base to inform the application of the Sequential, and if necessary, Exception Tests for developers and planners.

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2 South Gloucestershire Level 1 SFRA. (2008) https://www.gloucestershire.gov.uk/media/6830/gloucestershire_level_1_sfra_exec_summary_final-28389.pdf

3South Gloucestershire Local Plan Core Strategy. (2013). https://beta.southglos.gov.uk/core-strategy-2006-2027/

4 Revised National Planning Policy Framework. Ministry of Housing, Communities, and Local Government. (2021). https://www.gov.uk/government/collections/revised-national-planning-policy-framework

- To assess the flood risk to and from the study area from all sources, now and in the future (accounting for climate change).
- To assess the potential effects of cumulative land use changes and development in the area on flood risk.
- To identify and provide recommendations on opportunities to reduce the causes and impacts of flooding to existing communities and developments.
- To identify land usage for flood risk management.

The SFRA has been completed in line with the guidance from DEFRA and the Environment Agency titled **'How to prepare a strategic flood risk assessment'**[5] (last updated September 2020)

1.3 Levels of SFRA

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

1 Level One: where flooding is not a major issue and where development pressures are low. The assessment should be sufficiently detailed to allow application of the Sequential Test.

2 Level Two: where land outside Flood Zones 2 and 3 cannot appropriately accommodate all the necessary development creating the need to apply the NPPF's Exception Test. In these circumstances the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

This report fulfils the Level One SFRA requirements.

1.4 SFRA outputs

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

- Inform the development of the Sustainability Appraisal through the Local Plan process.
- Inform the preparation of flood risk policy and guidance.
- Identify the requirements for site-specific Flood Risk Assessments.
- Assess the cumulative impact that development or changing land use would have on the risk of flooding.
- Identify opportunities to reduce the causes and impacts of flooding to existing communities and developments.
- Identify any land likely to be needed for flood risk management features.
- Determine the acceptability of flood risk in relation to the study areas emergency planning capabilities.

5 How to prepare a strategic flood risk assessment. DEFRA. (2020) https://www.gov.uk/guidance/local-planning-authorities-strategic-flood-risk-assessment

1.5 Structure of this report

Table 1-1: SFRA report contents

Section	Contents
1. Introduction	Provides a background to the study, defines objectives, outlines the approach adopted and the consultation performed.
2. Flood Risk Policy and Strategy	Includes information on the implications of recent changes to planning and flood risk policies and legislation, as well as documents relevant to the study.
3. Roles and Responsibilities for Flood Risk Management	The roles and responsibilities of Risk Management Authorities (RMAs) in South Gloucestershire
4. Planning Policy for Flood Risk Management	Describes the Sequential Approach and application of Sequential and Exception Tests. Outlines cross-boundary issues and considerations.
5. Climate change	Outlines climate change guidance and the implications for the study area.
6. Sources of information used in preparing the SFRA	Outlines what information has been used in the preparation of the SFRA.
7. Understanding Flood Risk in South Gloucestershire	Introduces the assessment of flood risk and provides an overview of the characteristics of flooding affecting South Gloucestershire. Provides a summary of responses that can be made to flood risk, together with policy and institutional issues that should be considered.
8. Fluvial, tidal, and coastal flood defences	Assessment of existing flood defences and flood risk management measures
9. FRA requirements and flood risk management guidance	Identifies the scope of the assessments that must be submitted in FRAs supporting applications for new development. Provides guidance for developers and outlines conditions set by the LLFA that should be followed
10. Surface water management and SuDS	Advice on managing surface water run-off and flooding and the application of SuDS.
11. Flood Warning and Emergency Planning	Outlines the flood warning service in the Local Plan area and provides advice for emergency planning, evacuation plans and safe access and egress.
12. Strategic Flood Risk Solutions	Overview of possible strategies to reduce flood risk.
13. Level 1 summary assessment of potential development locations	Overview of the allocation proposals
14. Summary	Review of the Level 1 SFRA.
15. Recommendations	Identifies recommendations for the council to consider as part of Flood Risk Management policy based on finding of the study to date.

1.6 Consultation

The following stakeholders have been consulted during the preparation of this Level 1 SFRA:

- South Gloucestershire Council (LLFA)
- South Gloucestershire Council (LPA)
- Environment Agency
- Wessex Water
- Severn Trent Water
- Lower Severn Internal Drainage Board (IDB)
- Neighbouring Authorities (Bath and North-East Somerset Council, Bristol City Council, Cotswold District Council, Gloucester County Council, Wiltshire Council, Stroud District Council).

1.7 Use of SFRA data

Level 1 SFRAs are high-level strategic documents and do not go into detail on an individual site-specific basis. The primary purpose is to provide an evidence base to inform the 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.

Appendix D contains a guide to using the technical data presented within this SFRA, further explaining how SFRA data should be used, including reference to relevant sections of the SFRA, how to consider different sources of flood risk and recommendations and advice for Sequential and Exception Tests.

Hyperlinks to external documents/guidance have been provided in **Green** throughout the SFRA.

Advice to users have been highlighted in **Amber** boxes throughout the SFRA.

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.

Figure 1-1 - SFRA study area with surrounding unitary authorities and districts

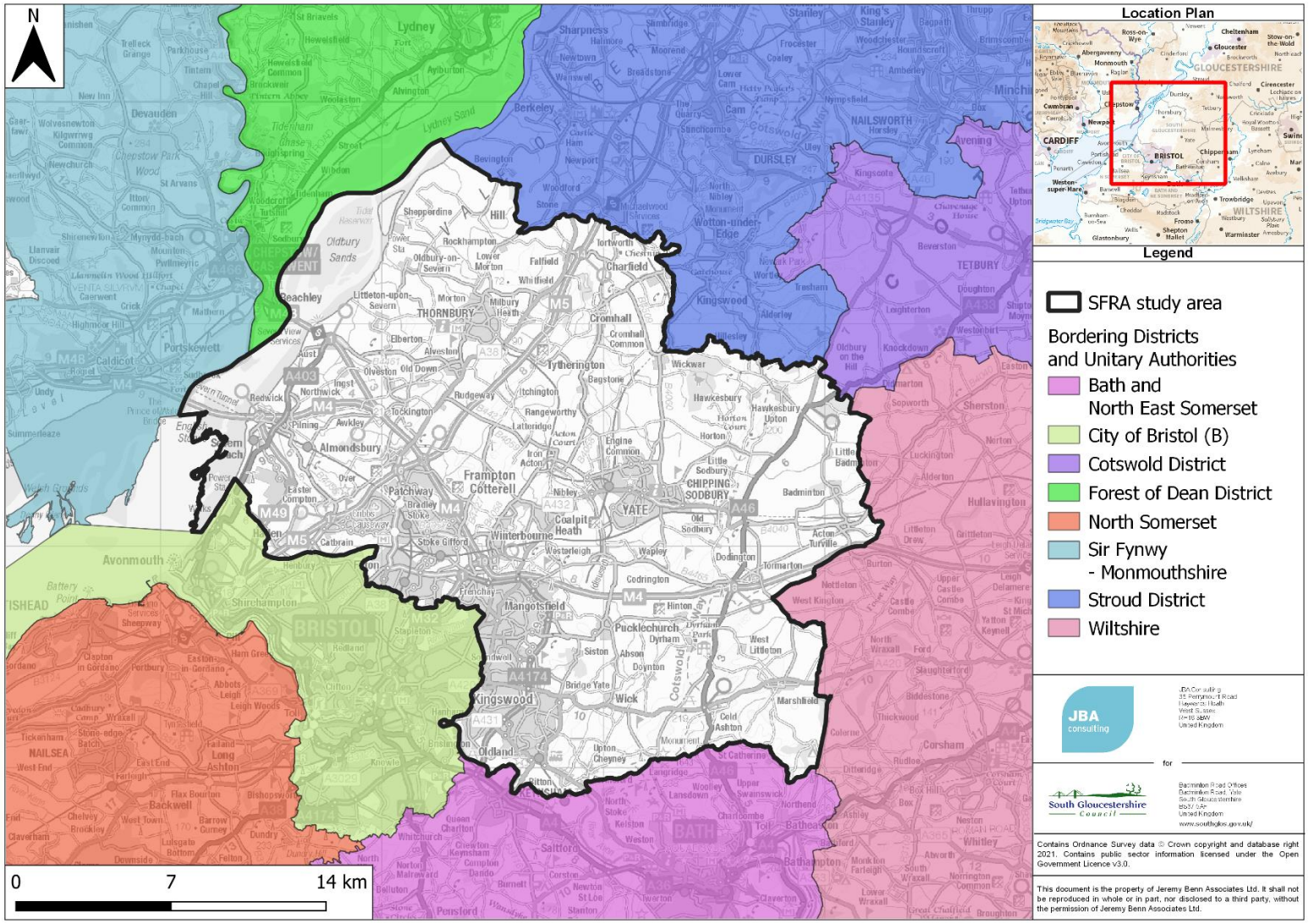


Figure 1-2 - Water providers to the SFRA area

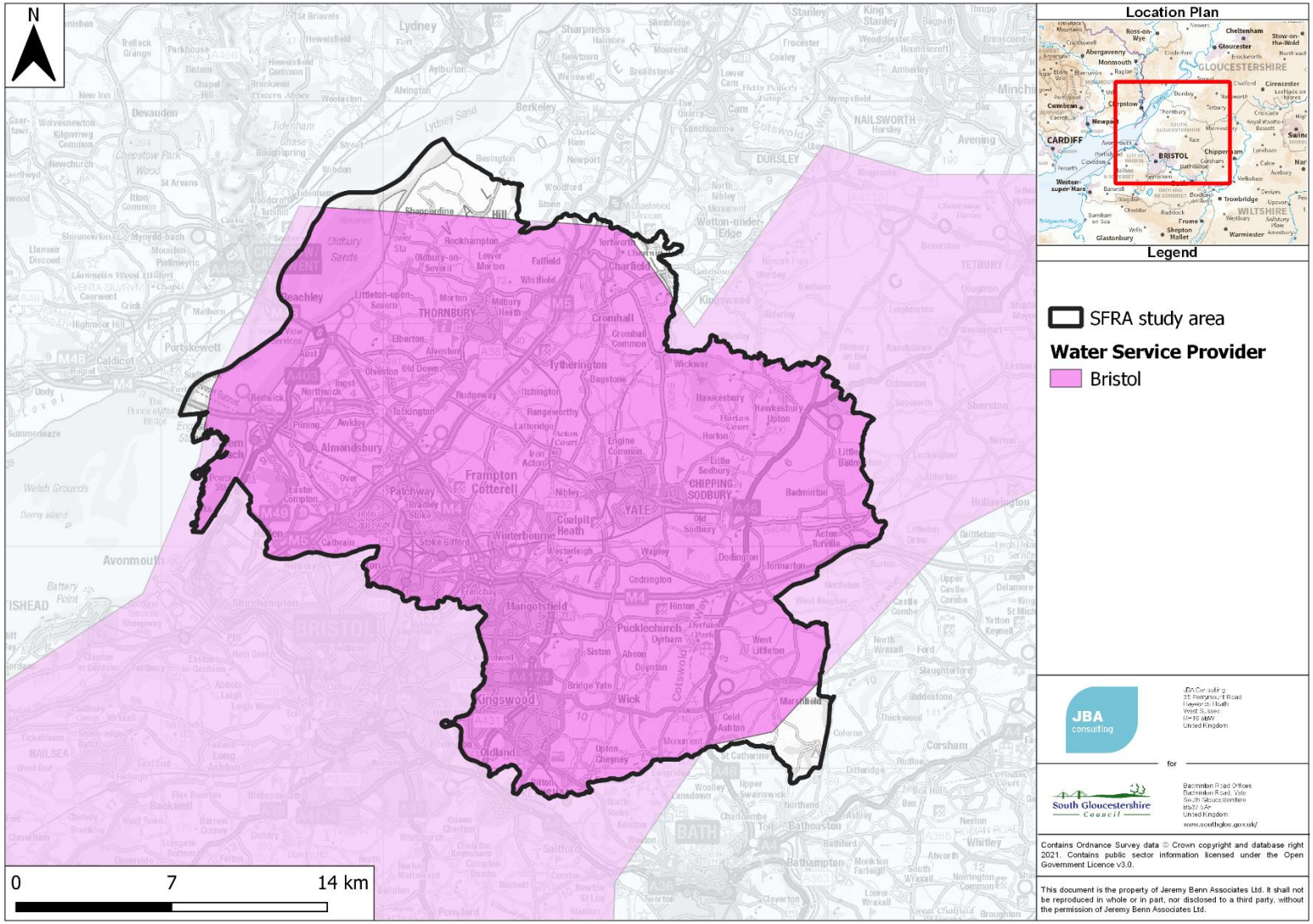


Figure 1-3 - sewerage providers to the SFRA area

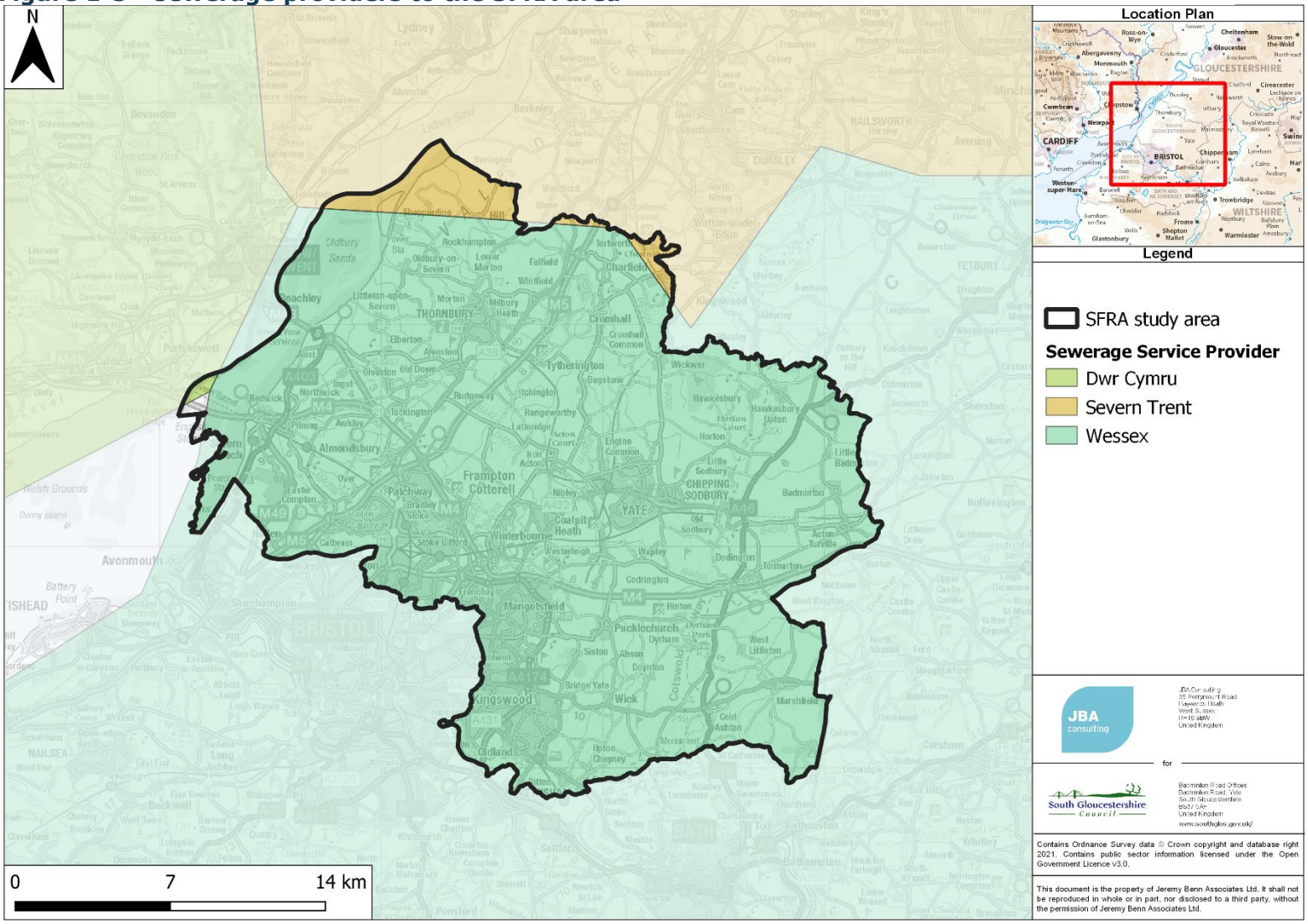
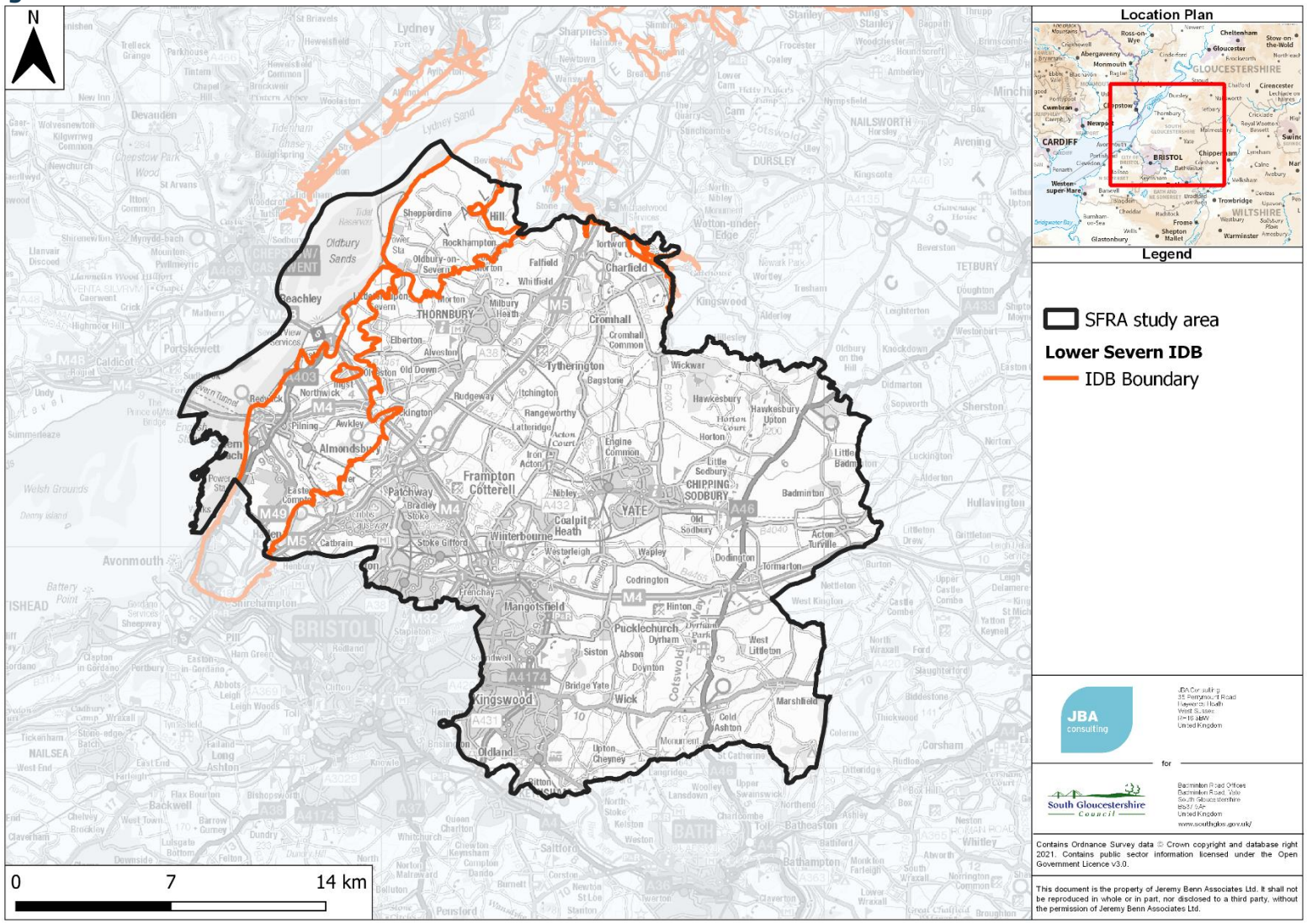


Figure 1-4 - IDB boundaries within the SFRA area



2 Flood Risk Policy and Strategy

This section sets out the relevant legislation, policy, and strategy for Flood Risk management in South Gloucestershire.

2.1 Key legislation for flood and water management

2.1.1 Floods Directive (2007) and Flood Risk Regulations (2009)

The **Flood Risk Regulations**[6] translated the **EU Floods Directive**[7] into UK law. The EU required 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. The threshold for designating significant Flood Risk Areas is defined by DEFRA. For these Flood Risk Areas, States must then undertake Flood Risk and Hazard Mapping and produce Flood Risk Management Plans.

The Flood Risk Regulations as pertain to English and Welsh legislation direct the Environment Agency to do this work for river, sea and reservoir flooding. LLFAs must do this work for surface water, Ordinary Watercourses and groundwater flooding. This is a six-year cycle of work and the second cycle started in 2017. In the instance of this SFRA, the LLFA is South Gloucestershire Council (SGC).

The **South Gloucestershire PFRA**[8]**(2011)** provided information on significant past and future flood risk from localised flooding in South Gloucestershire.

In 2011 indicative Flood Risk Areas were identified nationally by LLFA's. The exercise was repeated in 2018 and a further national study prepared to identify potential areas of significant flood risk ("Flood Risk Areas") – **'Review of preliminary flood risk assessments (Flood Risk Regulations 2009): guidance for lead local flood authorities in England – 25th Jan 2017'**. However, there were no indicative Flood Risk Areas identified within South Gloucestershire.

2.1.2 Flood and Water Management Act (2010)

The **Flood and Water Management Act**[9] (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.

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6 Flood Risk Regulations. UK Government. (2009). https://www.legislation.gov.uk/uksi/2009/3042/contents/made

7 EU Floods Directive. European Commission. (2007) https://ec.europa.eu/environment/water/flood_risk/

8 South Gloucestershire PFRA. South Gloucestershire Council. (2007) https://www.southglos.gov.uk/documents/cos110168.pdf

9 Flood and Water Management Act. UK Government. (2010) https://www.legislation.gov.uk/ukpga/2010/29/pdfs/ukpga_20100029_en.pdf

2.1.3 Water Framework Directive (2000) & Water Environmental Regulations (2017)

The purpose of the **Water Framework Directive**[10] (WFD), which was transposed into English Law by the **Water Environment Regulations**[11] (first published in 2003 and updated in 2017), is to deliver improvements across Europe in the management of water quality and water resources. This is enforced through a series of plans called River Basin Management Plans (RBMP) (see section 2.3.3), which were last published in 2015 and are currently being updated.

2.1.4 Environmental permitting

The **Environmental Permitting Regulations**[12] (2016, amended 2018) set out where developers will need to apply for additional permission (as well as Planning Permission) to undertake works to an Ordinary Watercourse (pollution related works only) or Main River. This includes flood risk activities, for example:

- on or within 8 metres of a main river (16 metres if tidal);
- on or within 8 metres of a flood defence structure or culvert (16 metres if tidal);
- on or within 16 metres of a sea defence;
- involving quarrying or excavation within 16 metres of any main river, flood defence (including a remote defence) or culvert; and
- in a floodplain more than 8 metres from the riverbank, culvert or flood defence structure (16 metres if it is a tidal main river) and you do not already have planning permission.

Environmental permits may also be required from the Environment Agency to discharge runoff, trade effluent or sewage into a main river. They may also be required in relation to groundwater activities, where there may be a risk of groundwater contamination.

An Ordinary Watercourse consent may be required where work is carried out which could affect the flow of water within a watercourse which is not main river. These should be acquired from **South Gloucestershire Council**[13] or the Lower Severn Internal Drainage Board (Section 2.1.6).

2.1.5 Land Drainage Act (1991)

Under the **Land Drainage Act (1991)**[14] Internal Drainage Boards were also given the power to implement their own Byelaws. The act also outlines riparian responsibilities to maintain the flow of water and sets out Local Authority powers to regulate works that may alter the flow of water in a watercourse.

2.1.6 Byelaws

Land Drainage Byelaws outline legal obligations and responsibilities when undertaking works on or close to a watercourse, for the purpose of preventing flooding, or mitigating any damage caused by flooding.

Under the Land Drainage Act, Internal Drainage Boards were also given the power to implement their own Byelaws. The **Lower Severn Internal Drainage Board Byelaws**[15]

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10 Water Framework Directive. European Commission. (2000) https://ec.europa.eu/environment/water/water-framework/index_en.html

11 Water Environment Regulations. UK Government. (2003) https://www.legislation.gov.uk/uksi/2003/3242/contents/made

12 Environmental Permitting Regulations. UK Government. (2016) https://www.legislation.gov.uk/uksi/2018/110/contents/made

13Land drainage (land and homeowners). South Gloucestershire Council https://www.southglos.gov.uk/environment/drainage-and-flood-risk-management/land-drainage-land-homeowners/

14 Land Drainage Act. UK Government. (1991). https://www.legislation.gov.uk/ukpga/1991/59/contents

15 Lower Severn Internal Drainage Board Byelaws. https://lowersevernidb.org.uk/development/land-drainage-byelaws/

have effect within South Gloucester. These Byelaws have effect on any activity within the Internal Drainage Board District that affect the flow of water and flood risk. The Byelaws are stated to be considered necessary for the following purposes:

- Securing the effectiveness of flood risk management work within the meaning of section 14A of the Land Drainage Act.
- Regulating the effects on the environment of a drainage system
- Securing the efficient working of the drainage system

Compliance with the relevant Byelaws and standards must be demonstrated by any developer planning works within the two IDB's drainage district and watershed (or catchment) within the Local Plan area. The byelaws that are most relevant to flood risk management are Byelaws 3 and 10:

- Byelaw 3 - Control of Introduction of Water and Increase of in Flow or Volume or Water: *No person shall, without the previous consent of the Board, for any purpose, by means of any channel, siphon, pipeline or sluice or by any other means whatsoever, introduce any water into the District or, whether directly or indirectly, increase the flow or volume of water in any watercourse in the District.*
- Byelaw 10 - No Obstructions within 8 Metres of the Edge of the Watercourse: *No person without the previous consent of the Board shall erect any building or structure, whether temporary or permanent, or plant any tree, shrub, willow or other similar growth within 8 metres of the landward toe of the bank where there is an embankment or wall or within 8 metres of the top of the batter where there is no embankment or wall, or where the watercourse is enclosed within 8 metres of the enclosing structure.*

2.1.7 Additional legislation

Additional legislation relevant to development and flood risk in South Gloucestershire include:

- The **Town and Country Planning Act**[16] (1990) and the **Water Industry Act**[17] (1991). These set out the roles and responsibilities for organisations that have a role in Flood Risk Management (FRM).
- Other environmental legislation such as the **Habitats Directive**[18] (1992), **Environmental Impact Assessment Directive**[19] (2014) and **Strategic Environmental Assessment Directive**[20] (2001) also apply as appropriate to strategic and site-specific developments to guard against environmental damage.

It should be noted that the some of the environmental directives listed are from European Union (EU) legislation, due to the UK leaving the EU these may be subject to change in the future.

16 Town and Country Planning Act. UK Government. (1990) https://www.legislation.gov.uk/ukpga/1990/8/contents

17 Water Industry Act. UK Government. (1991) https://www.legislation.gov.uk/ukpga/1991/56/contents

18 Habitats Directive. European Commission. (1992) https://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm

19 Environmental Impact Assessment Directive. European Commission. (2014) https://ec.europa.eu/environment/eia/eia-legalcontext.htm

20Strategic Environmental Assessment Directive. European Commission. (2001) https://ec.europa.eu/environment/eia/sea-legalcontext.htm

2.2 Relevant national, regional and local policy documents and strategies

Table 2-1 - summary of legislation summarises key national, regional and local flood risk policy and strategy documents and how these apply to development and flood risk. Hyperlinks are provided to external documents.

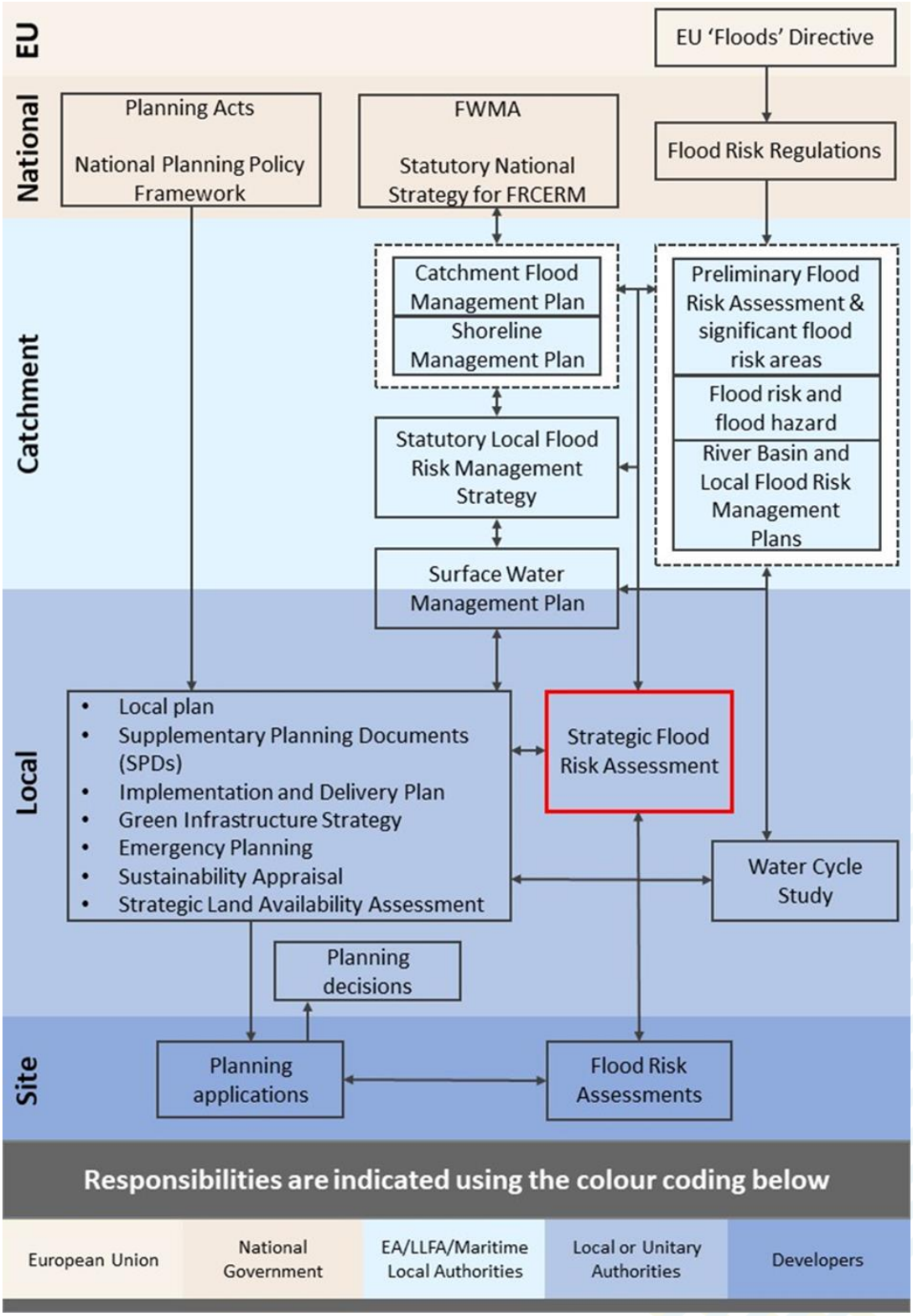
These documents may:

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

Table 2-1 - summary of legislation

Document, lead author, and date		Relevant direct legislation	Information	Policy and measures	Development design requirements	Next update due
National	**National Flood and Coastal Erosion Risk Management Strategy** (Environment Agency) 2020	FWMA(Section 0)	No	Yes	No	2026
	Natural Flood Management Plans (Environment Agency)	N/A	Yes	No	No	-
	National Planning Policy Framework (MHCLG) 2019	Planning and Compulsory Purchase Act 2004 as amended & The Town and Country Planning (Local Planning) (England) Regulations 2012 as amended	No	Yes	Yes	-
	National Planning Practice Guidance (MHCLG) 2019		Yes	No	Yes	-
Regional	**Severn River Basin District Management Plan** (Environment Agency) 2015	WFD (Section 2.2.3)	No	Yes	No	2021
	Severn River Basin District Flood Risk Management Plan (Environment Agency) 2016	Flood Risk Regulations (section 2.2.1)	No	Yes	No	2021
	Bristol and Avon, Severn Tidal Tributaries Catchment Flood Risk Management Plans (Environment Agency) 2012, 2009	N/A	Yes	Yes	No	-
	Climate change guidance for development and flood risk (Environment Agency) 2020	N/A	No	No	Yes	
Local	**South Gloucestershire Local Flood Risk Management Strategy 2015 – 2020** (South Gloucestershire Council) 2015	FWMA	Yes	No	Yes	2021
	Designers and Developers (South Gloucestershire Council)	N/A	Yes	No	Yes	

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



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

The **National Flood and Coastal Erosion Risk Management Strategy**[21] (FCERM) for England provides the overarching framework for future action by all risk management authorities to tackle flooding and coastal erosion in England. The new Strategy has been in preparation since 2018. The Environment Agency brought together a wide range of stakeholders to develop the strategy collaboratively. The Strategy is much more ambitious than the previous one from 2011 and looks ahead to 2100 and the action needed to address the challenge of climate change.

The Strategy has been split into 3 high level ambitions: climate resilient places; today's growth and infrastructure resilient in tomorrow's climate; and a nation ready to respond and adapt to flooding and coastal change. The strategy outlines strategic objectives relating to these ambitions, with specific measures to achieve these.

The Strategy was laid before parliament in July 2020 for formal adoption and published alongside a **New National Policy Statement for Flood and Coastal Erosion Risk Management**[22]. The statement sets out five key commitments which will accelerate progress to better protect and better prepare the country for the coming years:

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

2.2.2 River Basin Management Plans

River Basin Management Plans (RBMPs) are prepared under the Water Framework Directive (WFD) and assess the pressure facing the water environment in River Basin Districts. The South Gloucestershire area falls within the **Severn River Basin District RBMP**[23] (2015).

The plan provides a summary of programmes of measures that help prevent deterioration to protect and improve the beneficial use of the water environment in the river basin district. An assessment of whether deterioration has occurred from the 2015 classification baseline will be carried out in 2021.

Measures are presented for each significant water management issue in the river basin district which are:

- Physical modifications
- Managing pollution from wastewater
- Managing pollution from towns, cities and transport
- Changes to natural flow and levels of water
- Managing invasive non-native species

21 National Flood and Coastal Erosion Risk Management Strategy. Environment Agency. (2020). https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/920944/023_15482_Environment_agency_digitalAW_Strategy.pdf

22 New National Policy Statement for Flood and Coastal Erosion Risk Management https://www.gov.uk/government/publications/flood-and-coastal-erosion-risk-management-policy-statement

23 Severn River Basin District RBMP. Environment Agency. (2015) https://www.gov.uk/government/collections/river-basin-management-plans-2015#severn-river-basin-district-rbmp:-2015

- Managing pollution from rural areas

2.2.3 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. Under the Regulations, it is a requirement for the Environment Agency to prepare and publish a Flood Risk Management Plan (FRMP) for risk from rivers, reservoirs and the sea. The FRMP process adopts the same catchments as used in the preparation of River Basin Management Plans, in accordance with the Water Framework Directive.

Accordingly, more detailed strategic information on proposed strategic measures and approaches can be found in the **Severn River Basin District Flood Risk Management Plan**[24] (FRMP) (2016) – Parts A,B and C. The FRMP draws on previous policies and actions identified in the Catchment Flood Management Plans (see section 2.2.6) and also incorporates information from Local Flood Risk Management Strategies (see section 2.2.8).

Flood Risk Management Plans are now being updated for the second cycle of implementation of the Flood Risk Regulations. They will be published by December 2021.

2.2.4 West of England Sustainable Drainage Developer guide

The **West of England Sustainable Drainage Developer**[25] guide sets out guidance for developers in the West of England Region to include sustainable drainage in their designs. The guide is a collaboration between the local authorities of South Gloucestershire Council, Bristol City Council, North Somerset Council, and Bath and North East Somerset Council, and is supported by the Environment Agency, the Lower Severn Internal Drainage Board (IDB), Somerset County Council, North Somerset IDB and Wessex Water were involved in its preparation.

2.2.5 Natural Flood Management (NFM) Plans

The Environment Agency has developed **Natural Flood Management (NFM) mapping**[26] which displays opportunities for NFM. These maps are to be used as a guide and supplemented with local knowledge to provide a starting point for discussions about NFM. NFM aims to protect, restore and emulate the natural functions of catchments, floodplains, rivers and the coast. NFM should be used on a catchment wide scale and is the linking of blue and green infrastructure.

The maps identify NFM opportunities on different catchment scales:

- National River Basin Districts
- River Basin Districts showing Management Catchments
- Management Catchments showing Water Body Catchments
- Water Body Catchments.

These catchments cross boundaries between the South Gloucestershire area and other neighbouring authorities. Discussions about NFM should be had with catchment stakeholders in combination with local knowledge.

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24 Severn River Basin District Flood Risk Management Plan. Environment Agency. (2016). https://www.gov.uk/government/publications/severn-river-basin-district-flood-risk-management-plan

25 West of England Sustainable Drainage Developer guide. Bristol City Council. (2015) https://www.bristol.gov.uk/documents/20182/34524/West+of+England+sustainable+drainage+developer+guide+section+1/864fe0d2-45bf-4240-95e2-a9d1962a0df9

26 Working with Natural Processes. Environment Agency. wwnp.jbahosting.com

2.2.6 Catchment Flood Management Plans

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

There are six pre-defined national policies provided in the CFMP guidance and these are applied to specific locations through the identification of 'Policy Units'. These policies are intended to cover the full range of long-term flood risk management options that can be applied to different locations in the catchment.

The six national policies are:

- No active intervention (including flood warning and maintenance). Continue to monitor and advise
- Reducing existing flood risk management actions (accepting that flood risk will increase over time)
- Continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from this baseline)
- Take further action to sustain the current level of flood risk (responding to the potential increases in risk from urban development, land use change and climate change)
- Take action to reduce flood risk (now and/or in the future)
- Take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits, locally or elsewhere in the catchment.

South Gloucestershire sits within the **Bristol and Avon CFMP**[27] and the **Severn Tidal Tributaries CFMP**[28].

2.2.7 Shoreline Management Plans

Shoreline Management Plans (SMP) form part of Defra's strategy for flood and coastal defence. They provide a large-scale assessment of risks associated with coastal evolution and present the policy framework to address these risks in a sustainable manner. The SMP policies defined by DEFRA are:

- **Hold the line** – maintain or upgrade the level of protection provided by defences.
- **Advance the line** – build new defences seaward of the existing defence line.
- **Managed realignment** – allowing retreat of the shoreline, with management to control or limit the movement.
- **No active intervention** – a decision not to invest in providing or maintaining defences.

Not all policies are guaranteed funding and over time the Environment Agency along with other partners will identify the cost. The SMPs are currently undergoing a refresh.

27 Bristol and Avon Catchment Flood Risk Management Plan. Environment Agency. (2012) https://www.gov.uk/government/publications/bristol-avon-catchment-flood-management-plan

28Severn Tidal Tributaries Catchment Flood Risk Management Plan. Environment Agency. (2009) https://www.gov.uk/government/publications/severn-tidal-tributaries-catchment-flood-management-plan

The **Severn Estuary Shoreline Management Plan**[29] (SMP2) covers the length of the coastline in the South Gloucestershire area. The plan was approved in 2017, replacing the earlier SMP1 (2000). The coastline in the study area is being actively managed under the 'hold the line' policy, except for a small section around Aust which is designated as 'no active intervention'.

2.2.8 South Gloucestershire Local Flood Risk Management Strategy

Local Flood Risk Management Strategies set out how Lead Local Flood Authorities such as South Gloucestershire Council will manage local flood risk i.e. from surface water runoff, groundwater and ordinary watercourses, for which they have a responsibility as LLFA and the work that other Risk Management Authorities are doing to manage flood risk in South Gloucestershire.

The Local Flood Risk Management Strategy 2015 – 2020[30] sets out the LLFA's plan for managing local flood risk. It is understood at the time this SFRA was written, that SGC is currently in the process of updating its LFRMS which will become available in due course.

2.2.9 SuDS guide

South Gloucestershire Council encourages all developments to use Sustainable Drainage Systems (SuDS) to manage flood risk and improve water quality, the local environment and wildlife habitats. South Gloucestershire Council have produced **a guide for designers and developers**[31] which includes guidance for using SuDS. The guide sets out the framework for integrating SuDS into development layouts, and explains in more detail what SuDS are, their benefits and the process of designing and implementing them within the South Gloucestershire environment. More information on this is provided in Section 0.

In October 2020, South Gloucestershire Council published a **Supplementary Planning Document**[32] (SPD) on SuDS, including detailed guidance on the policy, standards and implementation of SuDS within the council area.

2.2.10 Surface Water Management Plans

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

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29 Severn Estuary Shoreline Management Plan. Severn Estuary Coastal Group. (2017) https://severnestuarycoastalgroup.org.uk/shoreline-management-plan/smp2-action-plan/

30South Gloucestershire Local Flood Risk Management Plan 2015-2020. https://www.southglos.gov.uk/documents/SGC-LFRMS-FINAL-summary-MAY-2015.pdf

31Designers and Developers. South Gloucestershire Council. https://www.southglos.gov.uk/documents/Developers-designers-030117.pdf

32 Sustainable Drainage Systems: Guidance for new developments. South Gloucestershire Council. (2020). https://consultations.southglos.gov.uk/gf2.ti/f/1202562/82245541.1/PDF/-/SuDS_SPD_-_October_2020.pdf

3 Roles and Responsibilities for Flood Risk Management

This section sets out the Flood Risk Management roles and responsibilities for different organisations in South Gloucestershire.

3.1 Environment Agency

The Environment Agency is responsible for protecting and enhancing the environment and contributing to the government's aim of achieving sustainable development in England and Wales. In terms of flood risk, the Environment Agency has a strategic overview of all sources of flooding and coastal erosion. Examples of this strategic overview role include:

- Setting the direction for managing the risks through strategic plans;
- Providing evidence and advice to inform Government policy and support others;
- Working collaboratively to support the development of risk management skills and capacity; and
- Providing a framework to support local delivery.

The Agency also has operational responsibility for managing the risk of flooding from main rivers, reservoirs, estuaries and the sea.

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

The Environment Agency also has powers to regulate and consent works. You must follow the environmental permitting rules if you want to do work:

- on or near a main river
- on or near a flood defence structure
- in a flood plain
- on or near a sea defence

Further details on Environment Agency permits can be found on the **Environment Agency's Flood risk activities: environmental permits**[33] website.

3.2 South Gloucestershire Council

South Gloucestershire Council, as an unitary authority, are the Lead Local Flood Authority (LLFA) and the Local Planning Authority (LPA) for the SFRA study area. These roles are discussed separately below.

3.2.1 Lead Local Flood Authority

As the Lead Local Flood Authority (LLFA) for the area, South Gloucestershire Council's duties and powers include:

- Developing a Local Flood Risk Management Strategy (LFRMS): LLFAs must develop, maintain, apply and monitor a LFRMS to outline how they will manage flood risk, identify areas vulnerable to flooding and target resources where they are needed most.
- Investigating flooding: When appropriate and necessary LLFAs must investigate and report on flooding incidents (Section 19 investigations).

33 Flood risk activities environmental permits. Environment Agency. https://www.gov.uk/guidance/flood-risk-activities-environmental-permits

- Register of Flood Risk Features: LLFAs must establish and maintain a register of structures or features which, in their opinion, are likely to have a significant effect on flood risk in the LLFA area.
- Designation of Features: LLFAs may exercise powers, as all RMAs can, to designate structures and features that affect flood risk, requiring the owner to seek consent from the authority to alter, remove or replace it.
- Consenting: When appropriate, LLFAs will perform consenting of works on ordinary watercourses. Further details can be found on the KCC land drainage website38.
- Regulation: The LLFA has enforcement powers under the Land Drainage Act 1991 and FWMA 2010.

SGC is also the Local Highway Authority and manages highway drainage, carrying out maintenance and improvement works on an on-going basis, as necessary. It also has the responsibility to ensure road projects cause no increased flood risk. SGC as LLFA is a statutory consultee to the planning system with respect to surface water management for major development. SGC's **sustainable drainage in planning website**[34] provides further information and advice.

3.2.2 Local Planning Authority

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

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

3.3 Water and wastewater providers

Wessex Water is the sewerage undertaker for the SFRA study area. They have the responsibility to maintain surface, foul and combined public sewers to ensure the area is effectually drained. When flows (foul or surface water) are proposed to enter public sewers, Wessex Water will assess whether the public system has the capacity to accept these flows as part of their pre-application service. If there is not available capacity, they will provide a solution that identifies the necessary mitigation. Wessex Water can also comment on the available capacity of foul and surface water sewers as part of the planning application process although this is not a statutory role.

Bristol Water provide potable water to the SFRA study area.

For further details about developer services and relevant application forms please see **Wessex Water's Developer Services website**[35] and **Bristol Water's Development Services website**[36].

3.4 Lower Severn Internal Drainage Board (LSIDB)

Under the Land Drainage Act 1991 the LSIDB exercises general powers of supervision over all matters relating to water level management within their district. Key watercourses are adopted by the Board for maintenance purposes and the Board also has responsibility for the operation and maintenance of assets used to manage water levels.

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34 Sustainable Drainage in Planning. South Gloucestershire Council. https://www.southglos.gov.uk/environment/drainage-and-flood-risk-management/planning-development-related-drainage/

35 Developer Services. Wessex Water. https://www.wessexwater.co.uk/services/building-and-developing

36Development Services. Bristol Water. https://www.bristolwater.co.uk/business-developers/

4 Planning Policy for Flood Risk Management

4.1 National Planning Policy Framework

The **revised National Planning Policy Framework**[37] (NPPF) was published in July 2021 (, replacing the previous versions published in July 2018 and March 2012. 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*"

National Planning Practice Guidance[38] (NPPG) on flood risk was published in March 2014 (and has since been revised / updated) and sets out how the policy should be implemented. **Diagram 1 in the NPPG**[39] sets out how flood risk should be considered in the preparation of Local Plans.

4.2 Local Plan policies

Local planning authorities must prepare a local plan which sets planning policies in a local authority area. These are important when deciding planning applications. The local plan is subject to examination by an independent planning inspector. This includes local development documents such as the Strategic Flood Risk Assessment.

4.2.1 Localism Act

The Localism Act outlines plans to shift and re-distribute the balance of decision making from central government back to councils, communities and individuals. Two provisions in the Act should be considered in relation to flood risk management and this SFRA:

- The duty to cooperate on Local Authorities. This duty requires Local Authorities to *"engage constructively, actively and on an ongoing basis in any process by means of which development plan documents are prepared so far as relating to a strategic matter"*.
- New rights to allow local communities to come together and shape new developments by preparing Neighbourhood Plans. As neighbourhoods draw up their proposals, Local Planning Authorities are required to provide technical advice and support.

37 National Planning Policy Framework. UK Government. (2021) https://www.gov.uk/government/collections/revised-national-planning-policy-framework

38 National Planning Practice Guidance. UK Government. (2021) (https://www.gov.uk/government/collections/planning-practice-guidance

39Flood Risk and coastal change. UK Government. (2014). https://www.gov.uk/guidance/flood-risk-and-coastal-change#flood-risk-in-local-plans

4.3 The risk-based approach

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

4.3.1 The Flood Zones

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. Flood Zone 3b is primarily based on the defended 5% AEP flood extent.

Excluding Flood Zone 3b, 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.

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

4.3.2 The Sequential Test

Firstly, land at the lowest risk of flooding and from all sources should be considered for development. A test is applied called the 'Sequential Test' to do this. Figure 4-1 summarises the Sequential Test. The LPA will apply the Sequential Test to strategic allocations. For all other developments in Flood Zones 2 and 3 (or in Flood Zone 1 on land with other flooding/drainage issues), developers must supply evidence to the LPA, with a Planning Application, that the development has passed the test.

The LPA should work with the Environment Agency to define a suitable area of search for the consideration of alternative sites in the Sequential Test. A local planning authority should demonstrate through evidence that it has considered a range of options in the site allocation process, using the Strategic Flood Risk Assessment to apply the Sequential Test and the Exception Test where necessary. This can be undertaken directly or, ideally, as part of the sustainability appraisal. Where other sustainability criteria outweigh flood risk issues, the decision-making process should be transparent with reasoned justifications for any decision to allocate land in areas at high flood risk in the sustainability appraisal report. The Sequential Test can also be demonstrated in a free-standing document, or as part of the Housing and Economic Land Availability Assessment (HELAA).

Whether any further work is needed to decide if the land is suitable for development will depend on both the vulnerability of the development and the Flood Zone it is proposed for. **Table 2 of the NPPG**[40] defines the vulnerability of different development types to flooding.

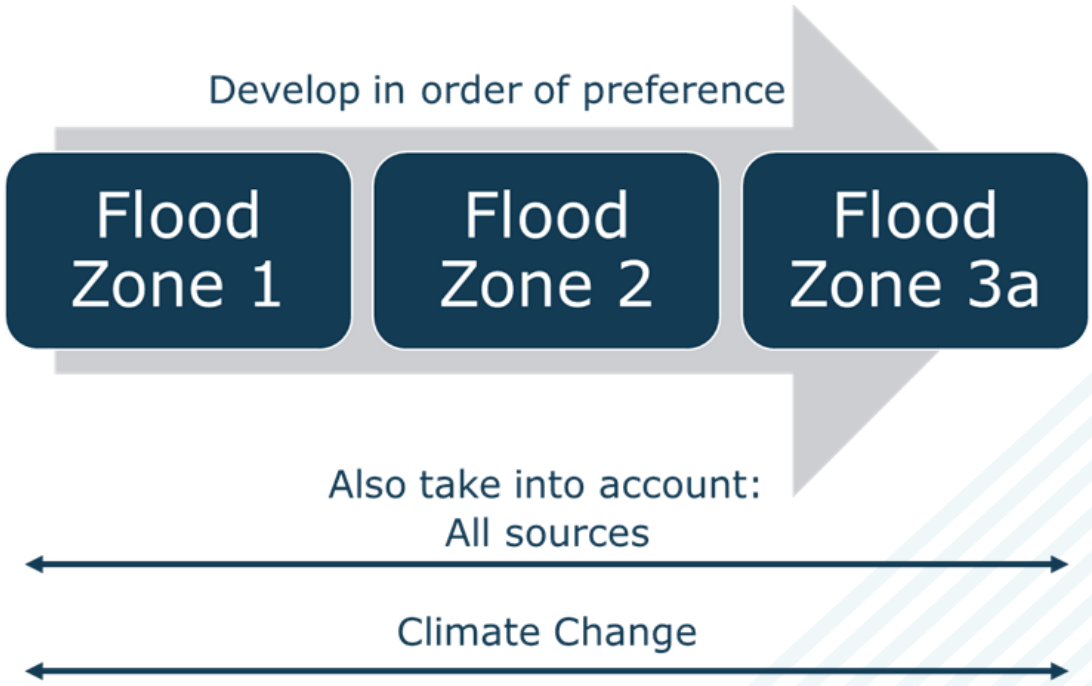
40 Flood Risk and coastal change. UK Government. (2014). https://www.gov.uk/guidance/flood-risk-and-coastal-change#Table-2-Flood-Risk-Vulnerability-Classification

Table 3 of the NPPG[41] shows whether, having applied the Sequential Test first, the vulnerability of development is suitable for that Flood Zone and where further work is needed.

Figure 4-2 illustrates the Sequential and Exception Tests as a process flow diagram using the information contained in this SFRA to assess potential development sites against flood zones and development vulnerability compatibilities.

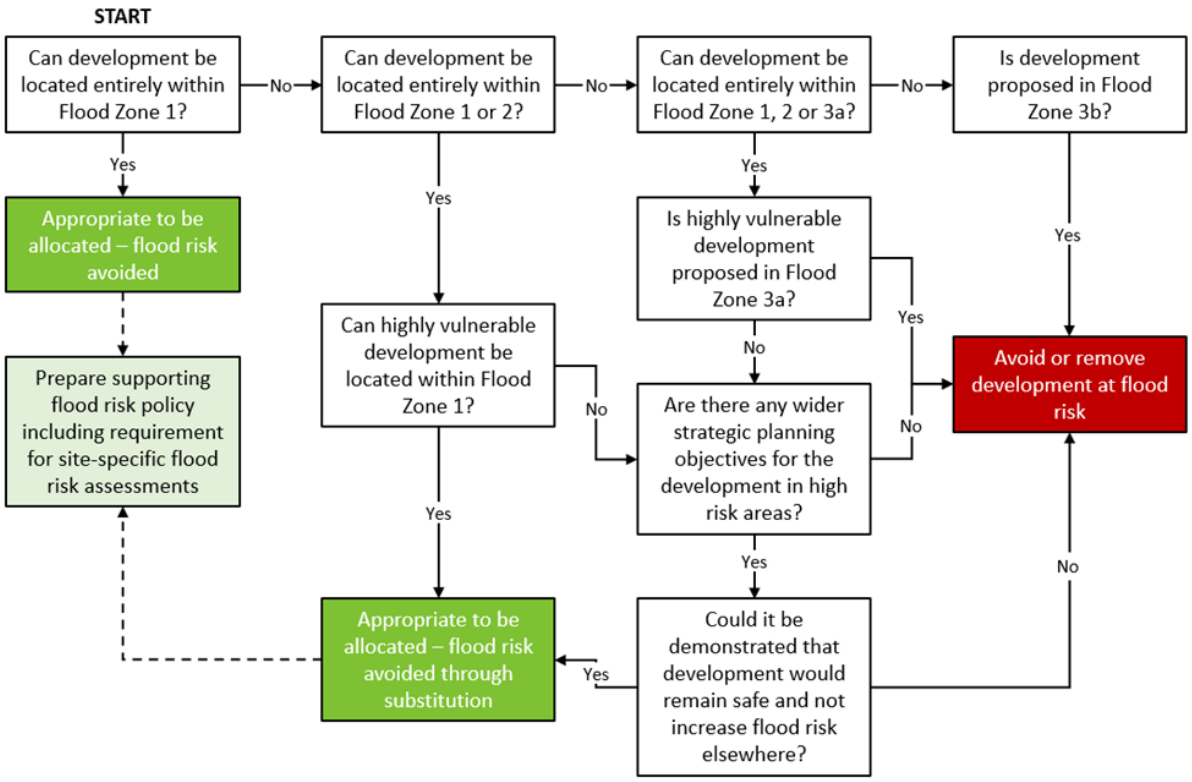
This is a stepwise process, but a challenging one, as a number of the criteria used are qualitative and based on experienced judgement. The process must be documented, and evidence used to support decisions recorded. In addition, the risk of flooding from other sources and the impact of climate change must be considered when assessing which sites are suitable to allocate. The SFRA guide to using technical data in Appendix D shows where the Sequential and Exception Tests may be of concern with the datasets, recommending what development might be appropriate in what situations.

Figure 4-1 - the Sequential Test



41 Flood Risk and coastal change. UK Government. (2014). https://www.gov.uk/guidance/flood-risk-and-coastal-change#Table-3-Flood-risk-vulnerability

Figure 4-2 - Local Plan sequential approach for site allocation



4.3.3 The Exception Test

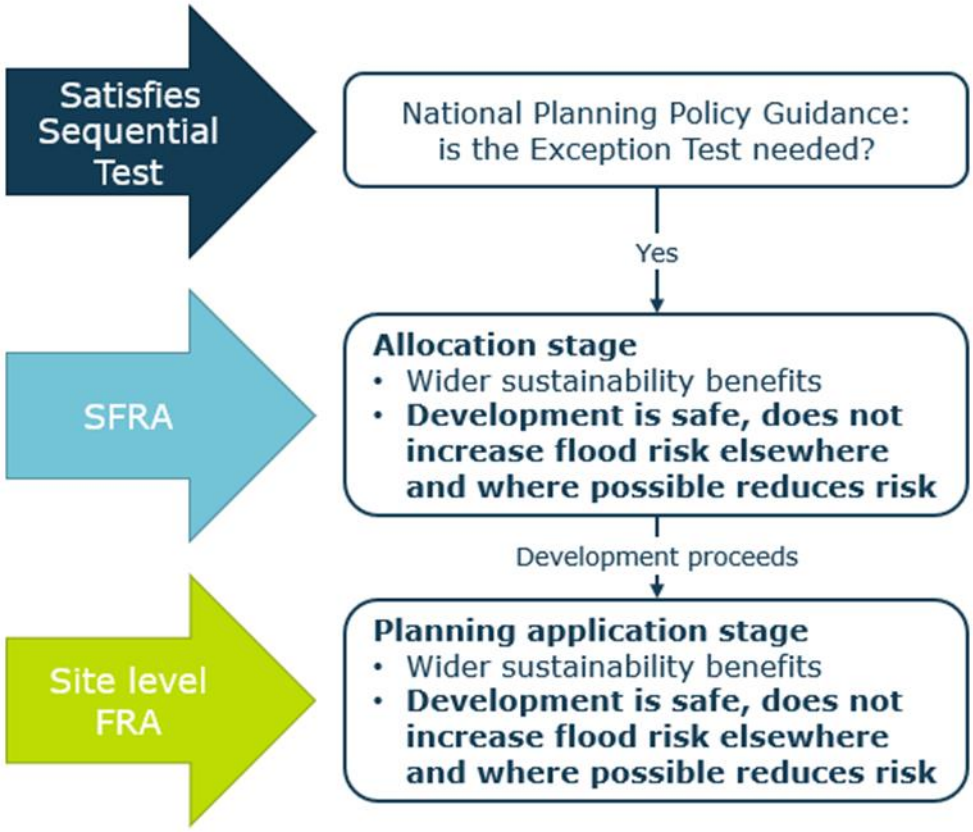
It will not always be possible for all new development to be allocated on land that is not at risk from flooding. To further inform whether land should be allocated, or Planning Permission granted, a greater understanding of the scale and nature of the flood risks is required. In these instances, the 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 4-3 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 4-3 - The Exception Test



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

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

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

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

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

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

4.4.1 The Sequential Test

South Gloucestershire Council are responsible for considering the extent to which Sequential Test considerations have been satisfied. The Environment Agency may be invited by South Gloucestershire Council to provide comment in respect of the accuracy of the data the test is based on.

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

- a strategic allocation and the test has already been carried out by the LPA
- a change of use (except to a more vulnerable use)
- a minor development (householder development, small non-residential extensions with a footprint of less than 250m2); or
- a development in flood zone 1 unless there are other flooding issues in the area of the development (i.e. surface water, ground water, sewer flooding).

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

The following appendices should be referred to when undertaking the Sequential Test:

Appendix A – GeoPDF mapping

Appendix B – Reservoir inundation mapping

Appendix C – Site summary tables

Appendix D – Guide to using SFRA data

Please note that Appendix A includes the SFRA flood zones showing fluvial and tidal flood risk, groundwater flood risk, surface water flood risk, climate change datasets, watercourses, and historic flooding.

Local circumstances must be used to define the area of application of the Sequential Test (within which it is appropriate to identify reasonably available alternatives). The criteria used to determine the appropriate search area relate to the catchment area for the type of development being proposed. For some sites this may be clear e.g. school catchments, in other cases it may be identified by other Local Plan policies. For some sites e.g. regional distribution sites, it may be suitable to widen the search area beyond LPA administrative boundaries.

The sources of information on reasonably available sites may include:

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

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

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

The SFRA guide to using technical data in Appendix D shows where the Sequential and Exception Test may be required for the datasets assessed in the SFRA, and how to interpret

different levels of concern with the datasets, recommending what development might be appropriate in what situations.

It should also be noted that for "small catchments" (typically less than 3 square kilometres) or the upper extremity of larger catchments the nationally available flood mapping might not have been prepared. This potentially gives the incorrect impression that a site is in Zone 1, when in fact it might be affected by flood risk from an adjacent watercourse. In such circumstances an initial assessment should be performed to identify the extent of the flood zones to understand the implications with respect to applying the Sequential Test.

4.4.2 The Exception Test

If, following application of the Sequential Test, it is not possible for the development to be located in areas with a lower probability of flooding the Exception Test must then be applied if required (as set out in Table 3 of the NPPG). Developers are required to apply the Exception Test to all applicable sites (including strategic allocations).

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

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

  Applicants should refer to wider sustainability objectives in Local Plan Sustainability Appraisals. These generally consider matters such as biodiversity, green infrastructure, historic environment, climate change adaptation, flood risk, green energy, pollution, health, transport etc.

  Applicants should detail the sustainability issues the development will address and how these will outweigh the flood risk concerns for the site e.g. by facilitating wider regeneration of an area, providing community facilities, infrastructure that benefits the wider area etc.

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

  The site-specific Flood Risk Assessment should demonstrate that the site will be safe, and the people will not be exposed to hazardous flooding from any source. The FRA should consider actual and residual risk and how this will be managed over the lifetime of the development, including:

  - the design of any flood defence infrastructure;
  - access and egress;
  - operation and maintenance;
  - design of the development to manage and reduce flood risk wherever possible;
  - resident awareness;
  - flood warning and evacuation procedures, including whether the developer would increase the pressure on emergency services to rescue people during a flood event; and
  - any funding arrangements required for implementing measures

4.5 Cumulative impacts

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

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

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

For windfall sites which have not yet been allocated, the NPPF requires that the cumulative impact of development should be considered at the application stage and the appropriate mitigation measures undertaken to ensure flood risk is not exacerbated, and in many cases the development should be used to improve the flood risk.

4.6 Cross boundary considerations

Situations may occur where a development site is situated across Local Authority boundaries, or where the development in one district or borough may impact flood risk elsewhere. South Gloucestershire Council should consider the impacts of development on flood risk elsewhere even if the impact of this is not within their area. In situations where cross-boundary developments are proposed, South Gloucestershire should work closely with other Local Planning Authorities to satisfy the requirements of policies in their respective Local Plans, in consultation with statutory consultees such as the Environment Agency and Lead Local Flood Authority.

The study area is characterised by extensive locations where the proportion of paved areas is relatively high (urban and commercial areas) that can potentially generate substantive surface runoff volumes and flows. An influential characteristic of South Gloucestershire study area is that the catchment runoff contributions to the River Frome potentially increase the magnitude and volume of flows that discharge through the middle of Bristol City and to the Floating Harbour. The Frome watercourse is unusual in that it comprises relatively flat areas in its upper reaches but has steep gradients along the lower reaches that contribute to the Floating Harbour. Historically this system has caused extensive flooding to the centre of Bristol and resulted in the implementation of substantive flood alleviation schemes.

5 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 considered. Refer to the SFRA guide to using technical data in Appendix D for recommendations and details on how to apply the Sequential and Exception tests using the data set out in this section.

5.1 Climate change, the NPPF and PPG

The updated NPPF (published July 2021) sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. NPPF and NPPG describe how FRAs should demonstrate how flood risk will be managed over the lifetime of the development, taking climate change into account.

The updated 2021 NPPF also states that the 'sequential approach should be used in areas known to be at risk now or in the future from any form of flooding' (para 158).

The Environment Agency published **updated climate change guidance**[42] on 19 February 2016 (further updated in February 2019, December 2019, and July 2021), which supports the NPPF and must now be considered in all new developments and planning applications. The document contains guidance on how climate change should be accounted for when considering development, specifically how allowances for climate change should be included with FRAs. The Environment Agency can give a free preliminary opinion to applicants on their proposals at pre-application stage. There is a charge for more detailed pre-application planning advice.

5.2 Climate change guidance and allowances

Making an allowance for climate change helps reduce the vulnerability of the development and provides resilience to flooding in the future.

The 2016 climate change guidance includes climate change predictions of anticipated change for peak river flow and peak rainfall intensity. These allowances are based on climate change projections and different scenarios of carbon dioxide emissions to the atmosphere.

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

The **UK Climate Predictions 2018**[43] (UKCP18) were published on 26 November 2018. The UKCP18 projections replace the UKCP09 projections and are the official source of information on how the climate of the UK may change over the rest of this century. The Environment Agency have already updated the climate change allowances for sea level rise to take account of the UKCP18 projections and further updates for peak river levels rainfall intensity were issued on 20th July 2021.

For the purposes of the 2021 Level 1 SFRA the 2019 updated tidal allowances have been considered along with the 2016 fluvial climate change allowances. Section 6.3 details the climate change modelling used for the study and where applicable the model where climate change allowances were updated for the study. Any further changes which impact on this

42 Flood Risk Assessments: climate change allowances. Environment Agency (2016, last updated 2020) https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

43 UK Climate Predictions: Headline Findings. Met Office. (2019) https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp-headline-findings-v2.pdf

SFRA will be addressed after the release of the updated peak river level predictions, which are expected by the middle of 2021. If a Level 2 SFRA is required, any further changes to the climate change allowances will be considered at that stage.

5.3 Peak river flows

Climate change is expected to increase the frequency, extent and impact of flooding, reflected in peak river flows. Wetter winters and more intense rainfall may increase fluvial flooding and surface water runoff and there may be increased storm intensity in summer. Rising river levels may also increase flood risk.

The peak river flow allowances provided in the guidance show the anticipated changes to peak flow for the river basin district within which a watercourse is located. Once the river basin district has been identified, guidance on uplift in peak flows are provided for three allowance categories, Central, Higher Central and Upper End which are based on the 50th, 70th and 95th percentiles respectively. The allowance category to be used is based on the vulnerability classification of the development and the Flood Zones within which it is located.

These allowances (increases) are provided, in the form of figures for the total potential change anticipated, for three climate change epochs:

- The '2020s' (2015 to 2039)
- The '2050s' (2040 to 2069)
- The '2080s' (2070 to 2125)

The time period used in the assessment depends upon the expected lifetime of the proposed development. Residential development should be considered for a minimum of 100 years, whilst the lifetime of a non-residential development depends upon the characteristics of that development. Further information on what is considered to be the lifetime of development is provided in the **NPPG**.

The July 2021 update to peak river flow allowances, as Land within the South Gloucestershire area is located entirely within the Avon Bristol and North Somerset Management Catchment which is part of the Severn River Basin District. Maps showing the extent of Management Catchments **are published by the Environment Agency**[44]. The allowances for the Avon Bristol and North Somerset Management Catchment are provided in Table 5-1.

Updated peak river flow allowances (taking account of UKCP18 projections) are expected from the Environment Agency by the middle of 2021. Developers should consult the **climate change allowances guidance website**[37] for details of the most up-to-date allowances.

Table 5-1 - Climate change allowances for the Avon Bristol and North Somerset Streams Management Catchment

Allowance Category	Total potential change anticipated for '2020s' (2015 to 2039)	Total potential change anticipated for '2050s' (2040 to 2069)	Total potential change anticipated for '2080s' (2070 to 2125)
Upper end	27%	38%	71%
Higher central	15%	19%	39%
Central	10%	12%	26%

44 Climate Change allowances – Hydrology Data Explorer: https://environment.data.gov.uk/hydrology/climate-change-allowances

5.3.1 SFRA allowances

Current guidance published in July 2021, is that Strategic Flood Risk Assessments should use the Central and Higher Central allowances to assess the impacts of climate change on flood risk. The updates for peak river flows place increased emphasis on the Central and Higher Central scenarios, using the Upper End in a similar way to the former H++ allowances. The new guidance states that the Upper End allowances for peak river flows should be used to assess the following:

- Nationally Significant Infrastructure Projects;
- New settlements;
- Significant urban extensions.

5.4 Peak rainfall intensity allowance

Climate change is predicted to result in wetter winters and increased summer storm intensity in the future. This increased rainfall intensity will affect land and urban drainage systems, resulting in surface water flooding, due to the increased volume of water entering the systems. Table 5-2 shows anticipated changes in extreme rainfall intensity in small catchments (FEH hydrological catchments with an area of less than 5km^2) and urbanised drainage catchments (where underground sewer networks are likely to have a significant impact on hydrological flows in the catchment).

These allowances should be used for small catchments and urbanised drainage sites. For Flood Risk Assessments, both the central and upper end allowances should be assessed to understand the range of impact.

For catchments, larger than 5km^2, the guidance suggests the peak river flow allowances should be used.

Table 5-2 - Peak rainfall intensity allowance in small and urban catchments

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

Updated peak rainfall intensity allowances (taking account of UKCP18 projections) are expected from the Environment Agency, by the middle of 2021. Developers should consult the climate change allowances guidance website for details of the most up-to-date allowances.

5.5 Tidal change

Climate change is predicted to result in higher sea levels caused by melting ice sheets and more extreme storm events which will create higher storm surges

The **Environment Agency's 2020 sea level allowances**[45] have been used in the preparation of this report as confirmed by the Environment Agency (Table 4-6). These are based on coastal regions and South Gloucestershire district is within the South West region. In situations where it is appropriate to apply the credible maximum scenario, the H++ allowance for sea level rise beyond 2100 should be used, this represents an increase of 1.9m.

45 Flood risk assessments: climate change allowances – sea level allowances. Environment Agency. (2016, updated 2020) https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#sea-level-allowances

Table 5-3 - Peak sea level allowances for South West

Allowance category	Annual sea level rise allowance 2000 to 2035	Annual sea level rise allowance 2036 to 2065	Annual sea level rise allowance 2066 to 2095	Annual sea level rise allowance 2096 to 2125	Cumulative rise 2000 to 2125
Upper end	245mm	342mm	480mm	552mm	1.62m
Higher central	203mm	264mm	351mm	393mm	1.21m

5.6 Groundwater

The effect of climate change on groundwater flooding problems, and those watercourses where groundwater has a large influence on winter flood flows, is much more uncertain. Milder wetter winters may increase the frequency of groundwater flooding incidents in areas that are already susceptible, but warmer drier summers may counteract this effect by drawing down groundwater levels to a greater extent during the summer months. The effect of climate change on groundwater levels for sites in areas where groundwater is known to be an issue should be considered at the planning application stage.

5.7 The impact of climate change in the Local Plan Review area

5.7.1 Previous studies

The **UKCP18**[46] provides a number of future projections for different variables across the UK.

South West England

With an increase in global temperature between 2 – 4 degrees, the UKCP18 allowances estimate that:

- Increased mean summer temperature of up to 5°C by 2099.
- Increased mean winter temperatures of up to 3ºC or a decrease of up to -1ºC by 2099.
- Summer rainfall could decrease by over 60% or it could increase up to 20% by 2099.
- Winter rainfall could decrease by up to 10% or it could increase over 30% by 2099.

Whilst changes in trends and mean values is important, the more influential effect of climate change with respect to flood risk and drought is to increase the chance of occurrence and severity of more extreme wet and dry events.

46 UKCP18 Climate Projections. Met office (2018). https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/index

5.7.2 Adapting to climate change

The **NPPG Climate Change guidance**[47] contains information for how to identify suitable mitigation and adaptation measures in the planning process to address the impacts of climate change. Examples of adapting to climate change include:

- Considering future climate risks when allocating development sites to ensure risks are understood over the development's lifetime
- Considering the impact of and promoting design responses to flood risk and coastal change for the lifetime of the development
- Considering availability of water and water infrastructure for the lifetime of the development and design responses to promote water efficiency and protect water quality
- Promoting adaptation approaches in design policies for developments and the public realm for example by building in flexibility to allow future adaptation if needed, such as setting new development back from watercourses

On 17th July 2019, South Gloucestershire Council declared a climate emergency, meaning that the council believes "that the global climate is in a state of breakdown and that this is an emergency situation". Accordingly, SGC adopted its **Climate Emergency Strategy**[48] in 2019. The strategy aims to make the area carbon neutral by 2030, maximise the generation of renewable energy; preparing for the local impacts of climate change; protecting the natural area and increasing biodiversity; and doubling tree cover by 2030. It also aims to reduce flood risk "through managing landscapes, for example by slowing the rate at which rainfall runs from higher ground into streams and rivers", which is a form of natural flood management.

47 Climate change guidance. Ministry of Housing, Communities, and Local Government. (2014, updated 2019) https://www.gov.uk/guidance/climate-change

48 Climate Emergency Strategy. South Gloucestershire Council. (2019) https://www.southglos.gov.uk/documents/2213-Climate-Emergency-Strategy-Document-Digital-v4.pdf

6 Sources of information used in preparing the SFRA

This chapter describes the key sources of flood risk information used within this SFRA. Refer to the SFRA guide to using technical data in Appendix D for recommendations and details on how to apply the Sequential and Exception tests using the data set out in this section.

6.1 Historic flooding

The historic flood risk in the Local Plan areas has been assessed using point information of recorded incidents provided by South Gloucestershire Council, the Environment Agency's recorded flood outline dataset and Wessex Water's Sewer Incident Report Form (SIRF) dataset.

This has been supplemented with other information from the South Gloucestershire SFRA (2008), South Gloucestershire Council's PFRA and LFRMS, Environment Agency Flood Investigation reports and news reports. The key considerations from these sources are outlined in Section 7.3. Historic flood mapping for South Gloucestershire can be found in Appendix A. Guidance on how this information should be used to inform the Sequential and Exception Tests can be found in Appendix D.

6.2 Flood Zones

Flood Zones 2, 3a and 3b have been compiled for South Gloucestershire as part of this SFRA. Flood Zones are based on the undefended scenario with the exception of Flood Zone 3b, which includes the presence of defences on the basis that land behind existing defences is not functional floodplain. The Flood Zones presented in this SFRA should be used for the basis for decision making in the South Gloucestershire Council Local Plan review. This will in some circumstances update the existing Environment Agency Flood Zones.

Flood zone mapping is only available where hydraulic modelling has been undertaken and therefore there are some areas (typically watercourses with a catchment area of less than 3km^2) where the fluvial flood risk has not been mapped and so are shown to be in Flood Zone 1. In these areas detailed modelling may be required to accurately determine the flood zones (refer also to para 4.4.1).

The following categories have been used to define each Flood Zone:

- Flood Zone 1: Comprised of land having a less than 1 in 1,000 annual probability of river or sea flooding in any year (<0.1% AEP)
- Flood Zone 2: Comprised of land having between a 1 in 100 (1% AEP) and 1 in 1,000 annual probability of river flooding or 1 in 200 (0.5% AEP) and 1 in 1,000 (0.1% AEP) annual probability of sea flooding.
- Flood Zone 3a: This zone comprises land assessed as having a greater than 1 in 100 (>1% AEP) annual probability of river flooding or Land having a 1 in 200 or greater annual probability of sea flooding.
- Flood Zone 3b: This zone comprises land where water has to flow or be stored in times of flood (the functional floodplain).

Flood Zone 3b, unlike other Zones, does show flood risk that takes account of the presence of existing flood risk management features and flood defences, as land afforded this standard of protection is not appropriately included as functional flood plain. The mapping in the SFRA identifies this Flood Zone as land which would flood from a 5% Annual Exceedance Probability fluvial event, with defences in place.

Please note that a tidal a Flood Zone 3b has not been defined in accordance with best practice, and PPG notes that 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.

Where the 5% Annual Exceedance Probability (AEP) outputs are not available, a precautionary approach has been taken using the 1% AEP undefended scenario (Flood Zone 3a). If a proposed development is shown to be within this area, further investigation should be undertaken as part of a detailed site-specific FRA to define and confirm the extent of Flood Zone 3b.

If existing development or infrastructure is shown in Flood Zone 3b, additional consideration should be given to whether the specific location is appropriate for designation as 'Functional' with respect to the storage or flow of water in time of flood.

Care should be taken when interpreting how Flood Zone 3b is predicted to change as a consequence of climate change. At such locations there may be a possible need to account for potential changes in the standard of protection provided by flood risk management features. In areas where no detailed modelling is available, a precautionary approach has been taken to the identification of Flood Zone 3b, where an 'Indicative Flood Zone 3b' has been designated based on the best available data.

Flood Zone mapping for South Gloucestershire can be found in Appendix A. Guidance on how this information should be used to inform the Sequential and Exception Tests can be found in Appendix D displays the datasets used within the creation of Flood Zones for the study area.

6.2.1 Fluvial models used in this SFRA

Table 6-1 lists the flood risk modelling used to inform the SFRA.

Table 6-1 – Fluvial flood risk models used for the Level 1 SFRA

Model name	Year	Software
Bath to Bristol	2017	Flood Modeller / TUFLOW
Bristol Frome	2014	Flood Modeller/ TUFLOW
Little Avon	2016	Flood Modeller / TUFLOW
Yate and Chipping Sodbury	2016	Flood Modeller / TUFLOW

6.2.2 Tidal models used in this SFRA

Table 6-2 lists the tidal flood risk modelling used to inform this SFRA.

Table 6-2 - Tidal flood risk models used for the Level 1 SFRA

Model name	Year	Software
North Coast Tidal	2012	TUFLOW
Severn House Farm	2020	SWAN 1D / TUFLOW

6.3 Climate change for fluvial, tidal and coastal flood risk

The Environment Agency 2021 climate change guidance shows that for watercourses in the Avon Bristol and North Somerset Streams Management Catchment the fluvial allowances set out in Table 5-1 should be considered, although the SFRA should consider the next 100 years up until 2121.

No climate change modelling was undertaken for this SFRA, and climate change mapping from previous modelling studies was used to inform the impacts of climate change on the study area. This mapping can be found in Appendix A.

Where there are no available climate change outputs, for fluvial and tidal sources of flooding, present day Flood Zone 2 has been used as a proxy to represent increases to present day Flood Zone 3 resulting from climate change, in the absence of detailed modelling. This level of assessment can be used to inform an SFRA. However, detailed hydraulic modelling using topographic survey would be required at a site-specific level to confirm the flood risk to these sites.

For tidal climate change. If a level 2 SFRA is undertaken then updated data will be prepared for the Level 2 sites and used to retrospectively update the Level 1 SFRA. the Environment Agency guidance provides sea level rise allowances for four epochs up to 2125.

For further information on climate change allowances please refer to Section 5.2. Table 5-3 summarises what datasets have been used to determine future flood risk within South Gloucester.

Table 6-3: Model outputs used to understand the impacts of climate change

Model name	Annual Exceedance Probability (%AEP)	Allowance type	Allowances used in the SFRA
Severn House Farm	0.5%	Tidal	Upper End 2118
Bristol Frome	1%	Fluvial	20%
Little Avon	1%	Fluvial	30%, 40%, 85%
Yate and Chipping Sodbury	1%	Fluvial	30%, 40%

6.4 Surface water

Flooding from surface water runoff (or 'pluvial' flooding) is caused by intense short periods of rainfall. It often occurs where the natural (or artificial) drainage system is unable to cope with the volume of water. Surface water flooding problems are inextricably linked to issues of poor drainage (or drainage blockage by debris) and sewer flooding.

Mapping of surface water flood risk in the Local Plan area has been taken from **the Risk of Flooding from Surface Water**[49] (RoFSW) published online by the Environment Agency. These maps are 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 different surface water risk categories used in the RoFSW mapping are defined in Table 6-4.

The RoFSW 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. The RoFSW mapping is generally based on national modelling and therefore should be used as an indication of flood risk only. As a result, more detailed site-specific surface water modelling may be required. It is recommended that developers consult South Gloucestershire Council as the LLFA at the earliest opportunity.

49 Risk of flooding from surface water. Environment Agency. (2013) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/297429/LIT_8986_eff63d.pdf

Table 6-4 - Surface water risk categories used in the RoFSW mapping

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

Although the RoFSW offers improvement on previously available datasets, the results should not be used to understand flood risk for individual properties. The results should be used for high level assessments such as SFRAs for local authorities. If a particular site is indicated in the Environment Agency mapping to be at risk from surface water flooding, a more detailed assessment should be considered to more accurately illustrate the flood risk at a site-specific scale. Such an assessment will use the RoFSW in partnership with other sources of local flooding information, to confirm the presence of a surface water risk at that particular location.

The RoFSW map for South Gloucestershire can be found in Appendix A. Guidance on how this information should be used to inform the Sequential and Exception Tests can be found in Appendix D.

6.4.1 Critical Drainage Areas

Critical drainage areas are defined by the Town and Country Planning (General Development Procedure Amendment No. 2, England) Order 2006 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*". These can cover wide areas within both rural and urban environments and are typically where man made drainage infrastructure has been identified as at critical risk of failure, resulting in flooding. An absence of critical drainage areas does not mean there are no areas with potential drainage problems.

No formal critical drainage areas have been identified within South Gloucestershire by the Environment Agency

6.5 Groundwater

JBA has developed a range of Groundwater Flood Map products at the national scale. The 5m resolution JBA Groundwater map has been used within the SFRA. The modelling involves simulating groundwater levels for a range of return periods (including 75, 100 and 200-years). Groundwater levels are then compared to ground surface levels to determine the head difference in metres. The JBA Groundwater Map categorises the head difference (m) into five feature classes based on the 100-year model outputs which are outlined in Table 6-5.

Table 6-5 - JBA Groundwater flood risk map categories

Flood depth range during a 1% AEP flood event	Groundwater flood risk
Groundwater levels are either at or very near (within 0.025m of) the ground surface.	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.
Groundwater levels are between 0.025m and 0.5m below the ground surface.	Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
Groundwater levels are between 0.5m and 5m below the ground surface.	There is a risk of flooding to subsurface assets but surface manifestation of groundwater is unlikely.
Groundwater levels are at least 5m below the ground surface.	Flooding from groundwater is not likely.
No Risk	This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.

It is important to note that the modelled groundwater levels are not predictions of typical groundwater levels. Rather they are flood levels i.e. groundwater levels that might be expected after a winter recharge season with 1% AEP, so would represent an extreme scenario.

It should be noted that as the JBA Groundwater Flood Map is based on national modelling it should only be used for general broad-scale assessment of the groundwater flood hazard in an area and it is not explicitly designed for the assessment of flood hazard at the scale of a single property. In high-risk areas a site-specific risk assessment for groundwater flooding is recommended to fully inform the likelihood of flooding. South Gloucestershire County Council should be consulted at the earliest opportunity to understand local groundwater issues around development sites and developers should prioritise groundwater monitoring to further understand local impacts.

The JBA Groundwater Map for the Local Plan areas can be found in Appendix H. Guidance on how this information should be used to inform the Sequential and Exception Tests can be found in Appendix A.

6.6 Sewers

Historical incidents of flooding are detailed by Wessex Water through their Sewer Incident Report Form (SIRF). This database records incidents of flooding relating to public foul, combined or surface water sewers and displays properties that both internal and external flooding. For confidentiality reasons, this data has been supplied on a postcode basis from the SIRF for incidents recorded in the study area. The database covers reported incidents of sewer flooding in the last 17 years. The SIRF for the Local Plan area can be found in Table 7-3 Mapping of this data, indicating quantities of recorded flood incidents per postcode, is shown in Figure 6-7.

Sewer flood risk has also been assessed using Wessex Water information regarding postcodes at risk from 20%,10% and 5% AEP sewer flood events. No drainage issues were identified by Wessex Water as part of this study, however they may undertake site specific sewer capacity assessments when an application is made to connect to a sewer.

6.7 Reservoirs

The risk of inundation due to reservoir breach or failure of reservoirs within the area has been assessed using the **Environment Agency's Risk of Flooding from Reservoirs dataset**[50].

The Risk of Flooding from Reservoirs mapping for the Local Plan area can be found in Appendix B. Guidance on how this information should be used to inform the Sequential and Exception Tests can be found in Appendix D. An Environment Agency programme for updating and improving this modelling and mapping was completed in October 2020 and updated and improved data is due to be published in Late 2021.

6.8 Other relevant information

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

- **Bristol and Avon Catchment Flood Management Plan** and **Severn Tidal Tributaries Catchment Flood Management Plan**

These provide information on the catchment-wide strategy for flood risk management. This information should be used to informing flood risk management measures.

- **The South Gloucestershire Local Flood Risk Management Strategy 2015 – 2020**

This provides information on local flooding issues and the plan for managing risk. This information should be used to inform any development and any flood risk management measures are consistent with the strategy. The LFRMS is currently being updated by SGC.

- **Severn River Basin District Flood Risk Management Plan (2016)**

This provides information on the catchment-wide strategy for flood risk management. This information should be used to inform any flood risk management measures.

- **Severn Estuary Shoreline Management Plan (2017)**

This provides a large-scale assessment of the risks associated with coastal evolution and presents the policy framework to address these risks in a sustainable manner. This information should be used to inform any coastline development and flood risk management measures.

- Section 19 Investigations – **Oldbury-on-Severn (2017)**[51] and **NHS Blood & Transplant Centre, Filton (2012)**[52].

These provide detailed assessments of flood events that met certain criteria, looking at the cause of flooding, responsibilities, and future recommendations.

50 Risk of Flooding from Reservoirs. Environment Agency. (2020) https://data.gov.uk/dataset/44b9df6e-c1d4-40e9-98eb-bb3698ecb076/risk-of-flooding-from-reservoirs-maximum-flood-extent-web-mapping-service

51 Oldbury-on-Severn Flood Report. South Gloucestershire Council. (2017). https://www.southglos.gov.uk/documents/Oldbury-on-Severn-Flood-Report-May-2017.pdf

52 NHS Blood & Transplant Centre, Filton Section 19 Flood Report. South Gloucestershire Council. (2012) https://www.southglos.gov.uk/documents/Section-19-Flood-report-Filton-v7.pdf

7 Understanding Flood Risk in South Gloucestershire

7.1 Topography and Geology

7.1.1 Topography

As shown in Figure 7-1, the study area slopes north-west towards the coast, with the highest ground being found along the Cotswolds along the south-eastern boundary of the site. The high point is Hanging Hill (237m) on the southern border. A band of higher ground runs parallel to the Cotswolds approximately 13km to the north-west, reaching elevations of approximately 100m, meaning the main watercourses in the study area drain to the south-west within this valley. A substantial proportion of the mid catchment range of study area is located at an elevations ranging between 40 and 70m AOD. The consequence of this is that the Frome watercourse is unusual in that it comprises relatively flat areas in its upper reaches but has steep gradients along the lower reaches that contribute to the Floating Harbour. Historically this system has caused extensive flooding to the centre of Bristol and resulted in the implementation of substantive flood alleviation schemes. Similarly flows from smaller watercourses that contribute in a westerly direction to the low land adjacent to the Severn Estuary have the potential to influence local conditions in the drainage and rhine systems.

7.1.2 Geology and soils

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

The bedrock geology of South Gloucestershire is almost completely dominated by sedimentary deposits, with various formations of limestones, sandstones, siltstones, and mudstones covering the vast majority of the area, as shown in Figure 7-2. There is a small band of extrusive mafic tuff and lava in the far north of the area near Tortworth.

The superficial deposits of the majority of the study area has not been mapped, as shown in Figure 7-3. There is a band of alluvium (sand, silt, and mud) running north-east south-west on the coastal plain in the north-west and in various smaller deposits inland; small isolated deposits of river terrace (undifferentiated sand and gravel) at various locations inland; and landslip deposits of unknown lithology in the far south.

7.2 Watercourses

The largest river whose source lies within the study area is the River Frome, which originates in the Cotswolds near Chipping Sodbury, and flows generally south-west, exiting the study area near Frenchay. Other major rivers within the study area include the Avon, which forms part of the southern boundary, and the Little Avon, which forms part of the northern. Other Main River tributaries of the above include the Ladden, Bradley, Hortham, Patchway, and Stoke Brooks.

A summary of key information about the main watercourses in the study area is included below in Table 7-1. Mapping indicating the location of the Main Rivers and Ordinary Watercourses can be found in Appendix A.

Table 7-1 - Watercourses in South Gloucestershire

Watercourse	Description
River Frome	The Frome rises in the grounds of Dodington Park in the Cotwolds in the eastern part of South Gloucester, and initially flows north-west and west through Chipping Sodbury and Yate. It joins the Ladden Brook near Frampton Cotterall, where it then flows south-west until exiting the study area near Frenchay.
River Avon	The Avon forms approximately 10km of the southern boundary of the study area between Swineford and Kingwood, where it flows generally north-west-west. Within this area its is joined by two tributaries from within the study area – the River Boyd and the Siston Brook.
Ladden Brook	The Ladden Brook is the major right bank tributary of the Frome. It rises on the outskirts of Yate and flows initially north-east, before turning to flow south-west near Stidcot. It joins the Frome near Frampton Cotterall.
Bradley Brook	The Bradley Brook is a right bank tributary of the Frome that drains are area of Bradley Stoke. It joins the Frome near Hambrook
Folly Brook	The Folly Brook is a small left-bank tributary of the Frome which joins the main river near Winterbourne.
Hortham Brook	The Hortham Brook is a tributary of the Bradley Brook, which joins the channel near the M4 west of Bradley Stoke.
Patchway Brook	The Patchway Brook is a small tributary of the Hortham Brook that flows through Bradley Stoke.
Stoke Brook	The Stoke Brook is a right-bank tributary of the Frome that joins the river near Bromley Heath.
Little Avon	The Little Avon rises within South Gloucestershire to the east of Wickwar, and forms approximately 10km of the northern boundary of the study area, between Wickwar and Avening Green, where it exits the study area. There is an intervening area of approximately 2km where both banks of the river are within the study area, between Charfield and Avening Green.
Henbury Trym	The Henbury Trym, or River Trym, is a tributary of the Avon that rises in Filton in the west of the study area.
River Boyd	The River Boyd is a tributary of the Avon that rises north of Pucklechurch and flows generally south-south-west through Wick and Bitton, before discharging into the Avon atteh study area boudnary.
Siston Brook	Siston Brook is another tributary of the Avon that rises south of Pucklechurch and flows south through the suburbs of east Bristol, joining the Avon near Willsbridge. It has another Main River tributary, the Warmley Brook, that flows south-east from Mangotsfield and joins the Siston Brook near Warmley.

7.3 Historic flooding

The Local Plan area has a long history of recorded flood events caused by multiple sources of flooding. Information collated from the Environment Agency's recorded flood outlines, SGC's recorded flood incidents, SGC's **Local Flood Risk Management Strategy** and Wessex Water's Sewer Incident Report Form (SIRF) datasets were assessed to understand historic flooding in the Local Plan area. This information was supplemented by local flood risk documents and news reports.

The data shows the most frequent cause of flooding within South Gloucestershire to be fluvial along main rivers, surface water in inland and urban areas; tidal along the coastline; and a combination of tidal and fluvial flooding in the Severn Estuary-draining tidal plain, particularly in the area of the Lower Severn IDB.

The key historical incidents of flooding identified are summarised as follows (note these exclude events on watercourses, such as the Frome, that have caused flooding in Neighbouring authorities):

- **1977** – tidal flooding at Severn Beach resulted in tidal defences being built.
- **2000** – flood defences overtopped in Oldbury-on-Severn.
- **2001** – surface water and river flooding in Emersons Green on the Folly Brook as a result of heavy rainfall
- **2009** – high surface water runoff combined with reduced rhine capacity and sewer flooding caused internal flooding of properties in Aust.
- **2011** – significant flooding of an ordinary watercourse tributary of the Stoke Brook in Little Stoke due to poor maintenance.
- **Winter 2013/14** -extensive rainfall caused a number of localised flood incidents, the majority associated with main rivers, including the Avon, Frome, and Ladden Brook.

7.3.1 South Gloucestershire flood incidents

Reported flood incidents within the study area are recorded by South Gloucestershire Council as the LLFA. Flood incidents recorded between November 2000 and February 2021 are recorded below by community in Table 7-2.

Table 7-2 - Recorded flood incidents by community within South Gloucestershire between 2000-2021

Community	Number of flood incidents
Almondsbury	31
Alveston	2
Bitton	15
Cadbury Heath	1
Charfield	5
Chipping Sodbury	3
Coalpit Heath	4
Cold Ashton	1
Cromhall	1
Downend	15
Doynton	1
Dyrham	2

Community	Number of flood incidents
Easter Compton	1
Emersons Green	1
Falfield	1
Filton	15
Frampton Cotterell	8
Frenchay	5
Hambrook	4
Hanham	13
Iron Acton	5
Keynsham	1
Kingswood	6
Littleton-upon-Severn	1
Longwell Green	8
Mangotsfield	1
Marshfield	1
Oldbury-on-Severn	7
Oldland Common	4
Patchway	5
Pilning	2
Pucklechurch	9
Rangeworthy	2
Rockhampton	1
Severn Beach	2
Siston	3
Soundwell	2
Staple Hill	2
Swineford	11
Thornbury	7
Tomarton	1
Tytherington	1
Warmely	7
Wick	2
Wickwar	1
Willsbridge	2
Winterbourne	19
Yate	2

7.3.2 Section 19 Investigations

Two Section 19 flood investigations have been completed within South Gloucestershire - **Oldbury-on-Severn (2017)** and **NHS Blood & Transplant Centre, Filton (2012)**. Section 19 investigations are formal flood investigations that the LLFA are required to complete when made aware of a flood that meets certain predetermined criteria, as required by Section 19 of the Flood and Water Management Act 2010 (FWMA). The investigation should determine the relevant flood risk management authorities (RMA's) that should have been involved in the event and how they exercised their functions during and after the event, and which flood risk management actions have been (or should be) taken to mitigate future flood risk. The findings are to be compiled into a final report and shared with all relevant authorities.

The **NHS Blood & Transplant Centre, Filton (2012)** event occurred on the 24th of September, 2012, and saw internal flooding of the NHS Blood and Transplant Centre in Filton, following heavy rainfall of around 7% AEP (15 year event). It was concluded that the flooding occurred due to catastrophic failure of culverts carrying the Stoke Brook watercourse through Network Rail land, most likely due to blockage, undersizing, and inadequate pumping. Following the investigation, far larger box culverts were constructed, significantly reducing the flood risk.

The **Oldbury-on-Severn (2017)** events occurred during March and November 2016, which triggered the investigation into the flood risk around Oldbury-on-Severn. The events were determined to have primarily been caused by overland flow due to saturated ground, low points in the drainage network, and the impact of tidal locking in the area. It was concluded that the flood risk to the area was affected by the tidal conditions reducing the capacity of the rhines, and that further investigation was warranted to assess the conveyance of the drainage network and capacity of the tidal flaps.

7.4 Fluvial flood risk

One of the main sources of flooding in the Local Plan area is fluvial flooding. Fluvial flooding often occurs concurrently with surface water and sewer flooding as a response to extreme rainfall events and constrictions within the drainage systems.

The Main River watercourses of the River Frome, River Avon, Little Avon, Henbury Trym, Stoke Brook, Folly Brook and Ladden Brook have long been associated with fluvial flooding and are relatively well understood in that capacity. These watercourses are managed by the Environment Agency and the known risks inform planning decisions. Other, smaller ('Ordinary') watercourses may also pose localised fluvial flood risks but are more difficult to predict. The settlements identified as most at risk of fluvial flooding are Hanham, Swineford, Chipping Sodbury and Yate.

It should be noted that flood risk management measures (defences) are present within the Local Plan area which act to reduce the risk of flooding. Certain types of defences potentially inhibit the function of the river floodplain as during flood events they can prevent water being stored on the land adjacent to the river channel. This may be particularly important when considering the functional floodplain (Flood Zone 3b) for development, but the presence of such defences could also evidence that measures must be in place to make existing development and infrastructure safe. Other measures, such as the Tubb's Bottom flood storage facility mitigate flood risk by enhancing the storage capacity of the flood plain above natural levels. Further details on the flood risk management measures in South Gloucestershire are presented in Section 0 and the Flood Zones are described in Section 4.3.1.

In addition to flood risk shown by the flood risk mapping, there are a number of ordinary watercourse, small watercourse and field drains which may pose a risk to development. Generalised Flood Zone mapping (where more detailed modelling investigations are not available) has only been prepared for watercourses with a catchment greater than 3km^2. Therefore, whilst these smaller watercourses may not be shown as having flood risk on the flood risk mapping, it does not necessarily mean that there is no flood risk. Sites in proximity to these watercourses may be shown to be inaccurately located in Flood Zone 1. As part of a site-specific flood risk assessment the potential flood risk and extent of flood zones should be determined for these smaller watercourses and this information used as appropriate to perform the Sequential and Exception tests. The Risk of Flooding from Surface Water (RoFSW) mapping can be used to indicate where this is likely to be an issue

7.5 Tidal flood risk

Tidal flooding is caused by extreme tide levels exceeding ground and / or defence level. The Severn Estuary is located along the north-west boundary of the study area and is the source of tidal flood risk within South Gloucestershire. Major tidal flooding occurred in 1977 which led to the construction of tidal defences along the Severn Estuary.

The areas identified most at risk of tidal flooding are Severnside, Severn Beach, New Passage and Oldbury/Sheppardine. In some places along the coastline, such as within the Lower Severn IDB, tidal flood risk can occur in combination with fluvial and surface water sources which can exacerbate flood risk, particularly by reducing the capacity of rhines (drainage channels) discharging to the Severn Estuary which can be tide locked.

7.6 Surface water flood risk

Flooding from surface water runoff (or 'pluvial' flooding) is caused by intense short periods of rainfall and usually affects lower lying areas, often where the natural (or artificial) drainage system is unable to cope with the volume of water. Surface water flooding problems are inextricably linked to issues of poor drainage or drainage blockage by debris, and sewer flooding.

Surface water flooding is a major concern within South Gloucestershire. The current **Local Flood Risk Management Strategy** identifies that urban areas within north and north east Bristol, including parts of Filton and Kingswood, as well as Thornbury, Emerson's Green, Longwell Green, Yate, Pilning, Hanham, Aust and North Common, are at the greatest risk of surface water flooding.

Tide locking is also an issue around Oldbury-on-Severn where high tides prevent surface water from draining from gravity outfalls along the defended coastal plain.

The Risk of Flooding from Surface Water (RoFSW) map shows predicted flood extents that predominantly follow topographical flow paths of existing watercourses or dry valleys. Some isolated ponding occurs upslope of topographic features including railway lines and roads. Mapping of the RoFSW throughout the Local Plan area is provided in Appendix A and high-risk areas within each ward are identified in Table 7-5.

7.7 Groundwater flood risk

Groundwater flooding is the term used to describe flooding caused by unusually high groundwater levels. It occurs as excess water emerges at the ground surface or within manmade underground structures such as basements. Groundwater flooding tends to be more persistent than surface water flooding, in some cases lasting for weeks or months, and it can result in significant damage to property.

Cromhall and Bitton are identified in the **Local Flood Risk Management Strategy** as having reported historic incidents, and other settlements may be at localised risk, although the vast majority of South Gloucestershire is considered at low risk of groundwater flooding.

7.8 Flooding from sewers

Sewer flooding occurs when intense rainfall overloads the sewer system capacity (surface water, foul or combined), and / or when sewers cannot discharge properly to watercourses due to high water levels. Sewer flooding can also be caused when problems such as blockages, collapses or equipment (such as pumps) failure occur in the sewerage system. Surface water inundation of manhole openings and entry of groundwater may cause high flows for prolonged periods of time. Since 1980, the Sewers for Adoption guidelines (now replaced by the Design Construction Guidance) have meant that most new surface water sewers have been designed to have capacity for a rainfall event with a 1 in 30 chance of occurring in any given year (3.33% AEP), although until recently this did not apply to smaller private systems.

Consequently, even where sewers are built to current specifications, they can still be overwhelmed by larger events of the magnitude often considered when looking at river or surface water flooding (e.g. a 1 in 100 chance of occurring in any given year (1% AEP)). Existing sewers can also become overloaded as new development adds to their catchment, even with restrictions in place on permitted discharge, or due to incremental increases in roofed and paved surfaces at the individual property scale (urban creep). Sewer flooding is therefore a problem that could occur in many locations across the study area.

Wessex Water provides records of incidents of flooding relating to public foul, combined or surface water sewers and identifies which properties suffered flooding. For confidentiality reasons, this data has been supplied on a postcode basis from the Sewer Incident Report Form (SIRF) hydraulic overload database. Data covers all reported incidents within the borough between April 2004 and August 2020. The information from the SIRF database is shown in Table 7-3. All but four of the incidents are located in the suburbs of Bristol, with the remaining four located in Tytherington.

Table 7-3 - Sewer flooding incidents in South Gloucestershire from 2004-2020

Postcode	2004	2005	2007	2009	2011	2012	2013	2014	2016	2019	2020	Total
BS10 7	0	0	1	0	0	0	0	0	0	1	0	2
BS11 9	0	0	0	0	0	0	0	0	0	0	1	1
BS15 4	1	0	0	0	0	0	0	0	0	0	0	1
BS15 8	0	0	0	0	1	2	0	0	0	0	0	3
BS15 9	0	0	0	0	0	0	0	0	0	0	2	2
BS16 1	0	0	0	0	0	0	1	0	0	0	0	1
BS16 6	1	0	0	0	0	0	0	0	0	0	0	1
BS34 5	0	0	0	0	0	0	0	1	0	0	0	1
BS34 7	0	0	0	0	0	0	0	0	0	1	0	1
BS34 8	2	0	0	0	0	0	0	0	0	0	0	2
BS36 2	1	0	0	0	0	0	0	0	0	0	0	1
BS37 5	1	0	0	0	0	3	0	1	0	0	0	5
BS37 7	0	0	0	0	0	0	0	0	0	2	0	2
BS7 0	0	1	0	0	0	1	2	0	0	1	0	5
GL12 8	0	0	0	1	1	1	1	0	0	0	0	4

7.9 Flooding from reservoirs

Reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975 and are listed on a register held by the Environment Agency. The level and standard of inspection and maintenance required under the Act means that the risk of flooding from reservoirs is relatively low and is considered a 'residual risk'. Legislation under the Flood and Water Management Act requires the Environment Agency to designate the risk of flooding from these reservoirs. The Environment Agency is currently progressing a 'Risk Designation' process so that the risk is formally determined.

Appendix B shows the Risk of Flooding from Reservoirs dataset which provides an overview on how an impounding reservoir will modify flood risk in the event of a flood in the catchment, and includes indicative depths and velocities associated with this flooding. This generally results in an increase to existing fluvial flood extents as significant volumes of water would be released into existing watercourses.

The risks posed by reservoir flooding constitute a residual risk, and in most cases are unlikely to be prohibitive to development. South Gloucestershire Council should use the mapping in Appendix B to understand the potential damage to buildings and loss of life in the unlikely event of reservoir failure when considering developments downstream of reservoirs. As indicated in Appendix D, development may not be appropriate where indicative depths and velocities are especially high. It is advised that the owners/ operators of raised reservoirs are contacted with regard to development that may be at risk of flooding from reservoirs.

The settlements most at risk of reservoir flooding are Bitton, due to multiple reservoirs impacting the Avon; Pucklechurch; Filton; and parts of Mangotsfield along the Folly brook.

A list of reservoirs posing a flood risk to South Gloucestershire is shown below in Table 7-4.

Table 7-4 - Reservoirs affecting the Local Plan area

Reservoir	Location (grid reference)	Reservoir Owner	Ward	Local Authority
Unknown (Catbrain FSA)	3578 1805	Unknown	Patchway	South Gloucestershire Council
Tubb's Bottom Flood Storage Area	3681 1827	Environment Agency	Frampton Cotterell/ Westerleigh	South Gloucestershire Council
Unknown (Siston Brook FSA)	3673 1738	Environment Agency	Siston	South Gloucestershire Council
Unknown (site near Pucklechurch)	3690 1762	Unknown	Boyd Valley	South Gloucestershire Council
The Lake	3690 1921	Unknown	Siston	South Gloucestershire Council
Monkswood Reservoir	3757 1711	Wessex Water	Boyd Valley	South Gloucestershire Council/ Bath and North East Somerset

7.10 Summary of flood risk to key settlements

Flood risk to key settlements in South Gloucestershire has been summarised in Table 7-5.

Table 7-5: Summary of present-day flood risk to key settlements in South Gloucestershire

Settlement	Fluvial/tidal/coastal flood risk	Surface water flood risk	Predicted groundwater levels across the settlement during the 1% AEP event according to JBA Groundwater Flood Map (note that predicted groundwater levels may vary across the settlement so more than one level category could be ticked)					Reservoir inundation
			No risk	5m below surface	0.5 to 5m below surface	0.025m to 0.5m below surface	Within 0.025m of surface	
Chipping Sodbury	Chipping Sodbury is located on the northern banks of the River Frome. Consequently, parts of the town are located in Flood Zones 2 and 3, and the Environment agency's historic flood outline dataset show a history of fluvial flooding in the town.	Mapping indicated that several areas of the town are at risk of surface water flooding, particularly around Station road in the town centre and generally along the banks of the Frome.	✓		✓	✓	✓	No risk of reservoir flooding
Yate	The town of Yate is contiguous with Chipping Sodbury and is also located on the Frome, primarily on the southern bank. As a consequence of this, parts of the town are located in Flood Zones 2 and 3, although to a lesser extent than Chipping Sodbury. Historic flood data shows a history of fluvial flooding from the Frome within the town.	Mapping indicated that several areas of the town are at risk of surface water flooding, particularly around Rodford Way and Westerleigh Road in the south-west of the town.	✓		✓		✓	No risk of reservoir flooding
Thornbury	Thornbury is not located on any Main Rivers, but several smaller streams do run through the town, and small areas of the town are consequently in flood zones 2 and 3. The town is not included in any historic flood outlines.	Mapping indicated that several areas of the town are at risk of surface water flooding, particularly around the Gillingstool and Crossways areas of the town.	✓		✓	✓	✓	No risk of reservoir flooding
Oldbury-on-Severn	Oldbury-on-Severn is located on the Severn Estuary, approximately 1km away from the coast and is surrounded by tidally affected rhines. Consequently, considerable sections are in flood zones 2 and 3, with the majority being in the latter, as a result of tidal flood risk. Sections are also included in the historical flood outline dataset, indicating a history of tidal flooding from the Severn.	Mapping indicates several sections are at risk of surface water flooding, mostly centred around the rhines.	✓					No risk of reservoir flooding
Alveston	Alveston is not on any Main Rivers and is not contained within flood zone 2 or 3.	Parts of the settlement are considered at risk of surface water flooding, particularly Stoney Stile Road and Wolfridge Ride.	✓	✓		✓		No risk of reservoir flooding
Almondsbury	Almondsbury is not on any Main Rivers and is not contained within flood zone 2 or 3.	Significant parts of the village are considered at least at low risk of surface water flooding, including on Church Road, Lower Court Road, and Townsend Lane.	✓	✓	✓	✓	✓	No risk of reservoir flooding
Patchway	Patchway is not on any Main Rivers and is not contained within flood zone 2 or 3.	Significant parts of the area are considered at risk of surface water flooding, including a band crossing Stroud, Worthing, Durban, Pretoria, and Coniston Roads; and an area between Highwood and Gloucester Roads.	✓					No risk of reservoir flooding
Bradley Stoke	Bradley Stoke contains several Main Rivers, including the Patchway, Horthsham, Stoke and Bradley Brooks, and consequently parts of the area along these watercourses are considered in flood zones 2 and 3. The area long the Stoke Brook is contained within the Environment Agency's historic flood extent dataset, indicating a history of fluvial flood risk.	Mapping indicates that multiple sections of the area is considered at risk of surface water flooding, mostly contained along main roads and watercourses. There is risk of pooling primarily on and around Braydon Avenue.	✓					Areas along the Stoke Brook, lower Patchway Brook, and Horthham Brook
Winterbourne	Winterbourne is located near the confluence of the River Frome and the Bradley Brook, although the flood zones associated with each watercourse do not reach the settlement itself	Mapping indicated that numerous small areas of the settlement are of risk of surface water flooding, most notably along Friary Grange Park and Parkside Avenue; and between Flaxpits Lane and Huckford Road.	✓	✓	✓	✓	✓	Areas along the River Frome to the far south of the settlement
Mangotsfield and surrounding suburbs	The area includes the sources of the Folly and Warmley Brooks and areas along these watercourses are included in flood zones 2 and 3. The Warmely Brook is contained within the historic flood extent outline of the Environment Agency and indicates a history of fluvial flood risk.	Mapping indicated that several areas of the suburb are at risk of surface water flooding, particularly around Stockwell Hill, the Folly Brook, and New Cheltenham.	✓	✓	✓	✓	✓	Areas along the Folly Brook

Hanham and surrounding suburbs	This area includes the Warmley and Siston Brooks, and consequently areas along their watercourses are included in flood zones 2 and 3. The Environment Agency's historic flood extent dataset indicate a history of fluvial flooding from these sources.	Mapping indicated that several areas of the suburb are at risk of surface water flooding, particularly around the watercourses, such as the Siston brook at Warmley, and areas in Longwell Green and Cadbury Heath	✓	✓	✓	✓	✓	Areas of the Siston Brook near Warmley, and along the Avon
Bitton	Bitton is located on the River Boyd, and near to the Avon and so as a consequence significant areas of the village are within flood zones 2 and 3. The Environment Agency's historic flood extent dataset indicate a history of fluvial flooding	Mapping indicated that a significant area of the village centre is at risk of surface water flooding.	✓					The majority of the village
Wick	Wick is located on the River Boyd, and small areas along its banks in the centre are within Flood Zones 2 and 3. However, no areas are within the historic flooding extents.	Mapping indicated that several areas within Wick are at danger of surface water flooding, particularly around the banks of the Boyd, other smaller watercourses, and on Milford Avenue.	✓	✓	✓	✓	✓	No risk of reservoir flooding.
Pucklechurch	Pucklechurch is located near the Felsham Brook, a tributary of the River Boys, but the associated flood zones 2 and 3 do not extend to the village. There are no recorded historic flood outlines in the village.	Mapping indicated that areas of Pucklechurch are at risk of surface water flooding, particularly around the B4465, Feltham Road, and Homefield Road.	✓					Areas along the eastern outskirts
Marshfield	Marshfield is not located near Main Rivers and is not within flood zones 2 and 3, nor any historic flood extent.	Mapping indicated that small areas of the village are at risk of surface water flooding, such as along High Street and Back Lane.	✓	✓				No risk of reservoir flooding.
Badminton	Badminton is not located near any Main Rivers but has numerous ordinary watercourses flowing through or near it. Consequently, a significant part of the village centre is within flood zones 2 and 3. However, it is not within the Environment Agency's historic flood extent dataset.	Mapping indicates that areas of the village are at risk of surface water flooding, particularly around High street.	✓		✓		✓	No risk of reservoir flooding.
Hawkesbury Upton	Hawkesbury Upton is not located near Main Rivers and is not within flood zones 2 and 3, nor any historic flood extent.	Mapping indicated that small areas of the village are at risk of surface water flooding, such as around France Lane and east of Sandpits Lane	✓	✓				No risk of reservoir flooding.
Wickwar	Wickwar is located near the Little Avon. Most of the village is not at fluvial flood risk, but small areas on the lower end, at the study area border, are within flood zones 2 and 3 associated with the Little Avon. It is not included in within the Environment Agency's historic flood extent dataset.	Mapping indicated that small areas of the village are at risk of surface water flooding, with the greatest risk of pooling between the B4509 and Church Lane.	✓	✓	✓	✓		No risk of reservoir flooding.
Charfield/ Charfield Green	Charfield and Charfiled Green are located to the west of the Little Avon on the borer of the study area. Small parts of the far eastern area of Charfield Green are within the associated flood zones 2 and 3, and historical flood outlines from the Environment Agency show a history of fluvial flooding from the Little Avon.	Mapping indicated that parts of both settlements are at risk of surface water flooding, with the most significant risk of pooling around Woodlands Road and Little Bristol Lane; Underhill Road; and along the banks of the Little Avon.	✓			✓		No risk of reservoir flooding.
Falfield	Falfield is not located near a Main River but is bordered by two ordinary watercourses. Consequently, small parts of the village are within flood zones 2 and 3, most notably Mill Lane in the east. It is not included in within the Environment Agency's historic flood extent dataset.	Mapping indicated that small areas of the village are at risk of surface water flooding, most notably Mill Lane in the east and Sundayshill Lane in the west.	✓		✓		✓	No risk of reservoir flooding.
Tytherington	Tytherington is located near the headwaters of a tributary of the Ladden Brook, although the associated flood zones 2 and 3 extents to not extend into the village. There is a small recorded flood outline in the south-east of the village, on the corner of Duck Street and Stidcot lane, due to a fluvial flood from an ordinary watercourse.	Mapping indicated that small areas of the village are at risk of surface water flooding, most notably along Stowell Hill Road and Duck Street.	✓	✓	✓	✓	✓	No risk of reservoir flooding.
Rangeworthy	Rangeworthy is located near the Ladden Brook and several tributaries, although it is not within flood zones 2 or 3, nor within the Environment Agency's historic flood extent dataset.	Mapping indicated that small areas of the village are at risk of surface water flooding, most notably north of New Road.			✓			No risk of reservoir flooding.
Severn Beach	Severn Beach is located on the Severn Estuary, and is located almost wholly within Flood Zone 3 due to a tidal flood risk, with small areas in Flood Zone 2. The Environment Agency's historic flood extent dataset indicate a history of tidal flooding from the Severn.	Mapping indicated that very small areas are at risk of surface water flooding, most notably around Gorse Cover Road.	✓					No risk of reservoir flooding.
Aust	Aust is located on the Severn Estuary and is partly located in flood zones 2 and 3 on account of the tidal flood risk. Historic flood extents do not include the village.	Mapping indicated that the village centre is at risk of surface water flooding.	✓					No risk of reservoir flooding.

Figure 7-1 - topography of the study area

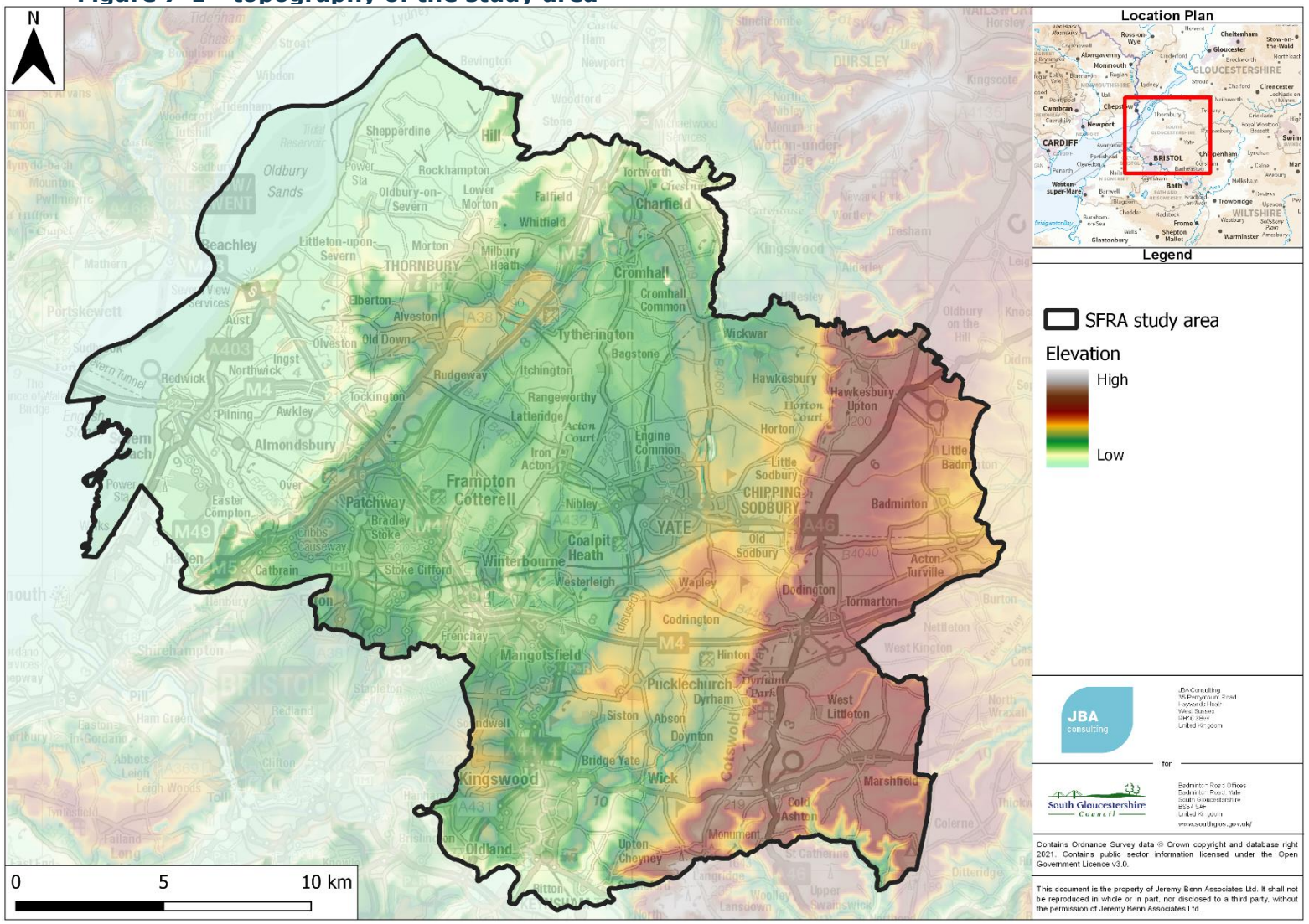


Figure 7-2 - bedrock geology of the study area

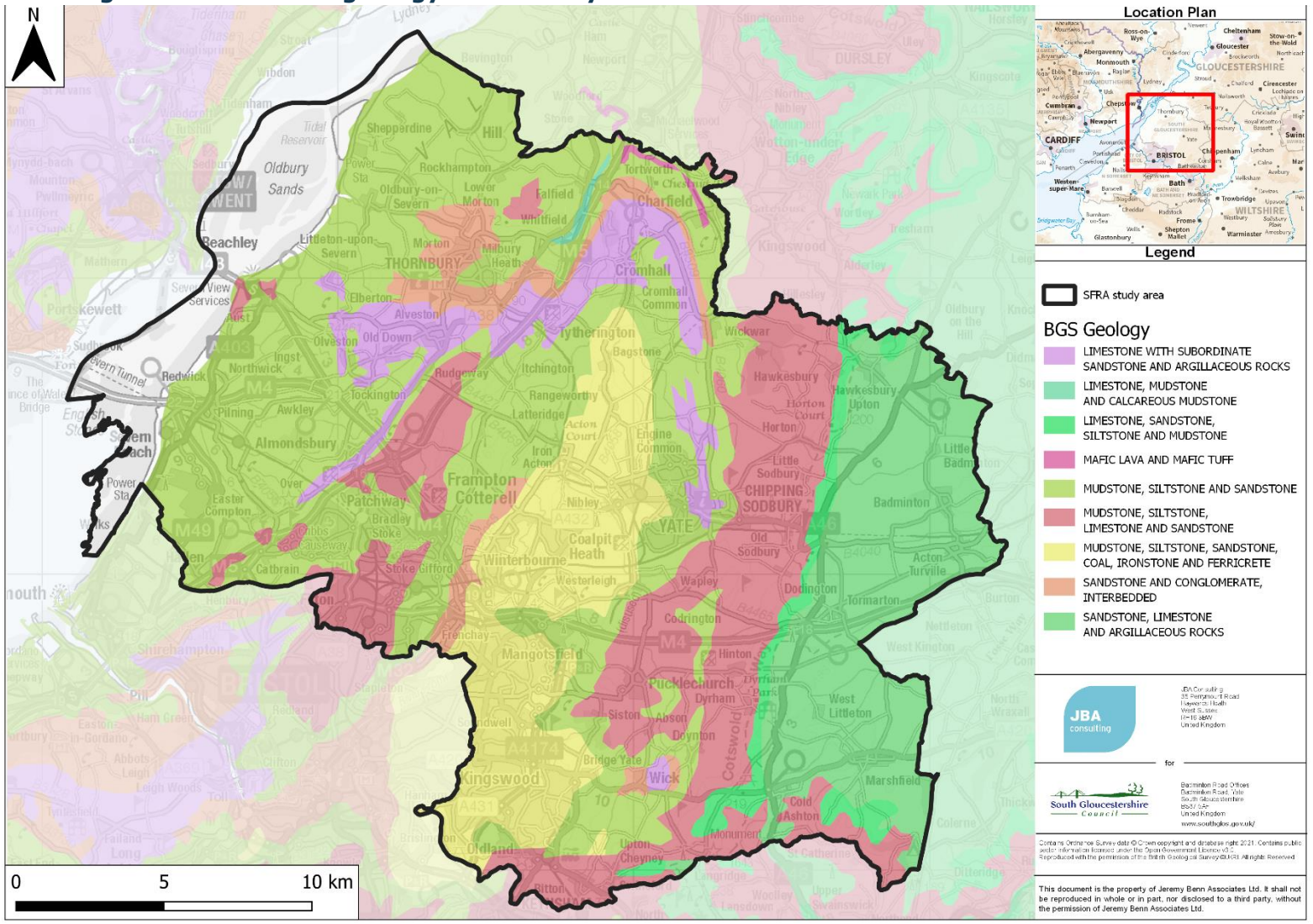
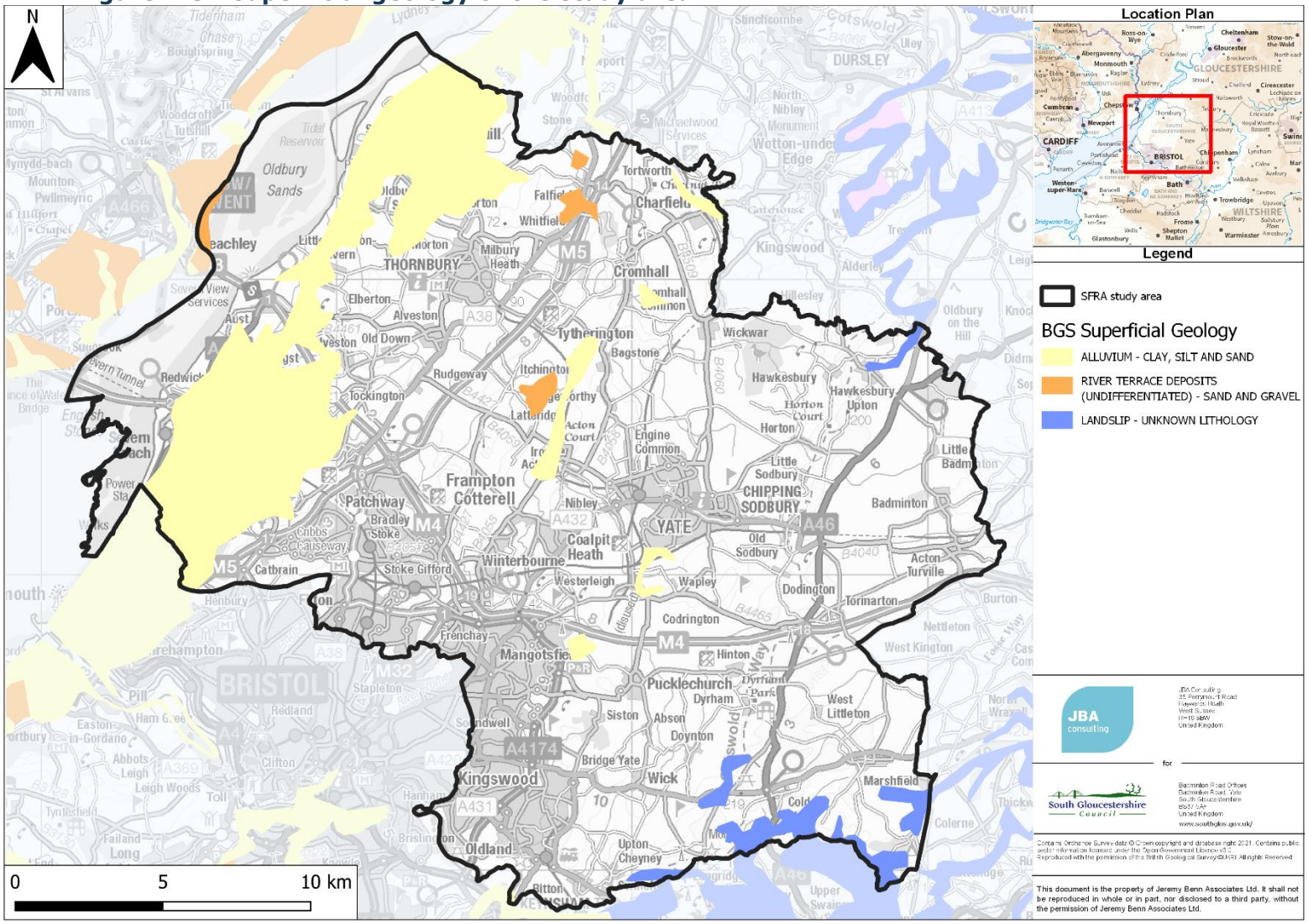


Figure 7-3 - superficial geology of the study area



8 Fluvial, tidal and coastal flood defences

A high-level review of flood defences was carried out for this SFRA, involving an interrogation of existing information on asset condition and standard of protection.

Defences are any assets that provide flood defences or coastal protection functions. An assessment of the Environment Agency Spatial Flood Defence dataset has been carried out. Flood defences which potentially provide a standard of protection from a 50% AEP event or more have been considered. The datasets include manmade and natural defences which may arise for instance due to the presence of naturally high ground adjacent to a settlement have been considered. The defences and their locations are summarised in the following sections.

8.1 Defence standard of protection and residual risk

One of the principal aims of this SFRA is to outline the present risk of flooding across the South Gloucestershire Local Plan area including consideration of the effect of flood risk management measures (including flood banks and defences). The modelling that informs the understanding of flood risk within the Local Plan area is typically of a catchment wide nature, suitable for preparing evidence on possible site options for development. In cases where a specific site risk assessment is required, detailed studies should seek to refine the results used to provide a strategic understanding of flood risk from all sources. Developers should consider the standard of protection provided by defences when preparing detailed Flood Risk Assessments.

Standard of Protection

Flood defences are designed to give a specific standard of protection, reducing the risk of flooding to people and property in flood prone areas. For example, a flood defence with a 1% AEP standard of protection means that the flood risk in the defended area is reduced to a 1% chance of flooding in any given year. Although flood defences are designed to a standard of protection it should be noted that, over time, the actual standard of protection provided by the defence may decrease, for example due to deterioration in condition or increases in flood risk due to the increased magnitude of the flood hazard caused by climate change effects (e.g. rise in frequency and intensity of extreme weather over time). For raised flood defences (bunds or banks), a standard of protection can be straight forward to define. However, sometimes it is not possible to define the standard of protection for Flood Storage Areas as there are a number of factors that determine the protection that they can provide e.g. outflow rates, number of watercourses that flow into the Flood Storage Area.

For the purpose of this study, the standard of protection has been derived from the Environment Agency Spatial Flood Defence Dataset.

8.2 Defence condition

Formal structural defences are given a rating by the Environment Agency based on a grading system for their condition[53]. A summary of the grading system used by the Environment Agency for condition is provided in

53 Condition Assessment Manual, Environment Agency (2012)

Table 8-1.

Table 8-1 - Defence asset condition rating

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

The condition of existing flood defences and whether they are planned to be maintained and/or improved in the future must be considered with respect to the safety and sustainability of development over its intended life and also with respect to the financial and economic commitment to the long-term provision of appropriate standards of protection. In some cases, the relevant strategy may suggest that it is not appropriate to maintain the condition of the assets, which may prove influential for the development over its intended life. In addition, detailed FRAs undertaken by developers (if a defence is influential to the proposed development) will need to thoroughly explore the condition of defences, especially where these defences are informal and demonstrate a wide variation of condition grades. It is important that all of these assets are maintained to a good condition and their function remains unimpaired in accordance with the policy and strategy for Flood Risk Management.

8.3 Fluvial, tidal and coastal flood defences in South Gloucestershire

8.3.1 Fluvial defences

Many main rivers in South Gloucestershire have flood defences along some of their lengths, the location of these defences are shown in Appendix A. These defences typically consist of high ground, with some sections of walls, embankments, demountable defences, and flood gates.

According to data from the Environment Agency, the vast majority of fluvial defences within South Gloucestershire are classified 1-3, signalling very good to fair conditions. However, there are 63 instances of a section of defences being classed 4 or 5, signalling poor to very poor conditions, and where a significant reduction in performance may occur. These sections are spread throughout the study area. Notable examples include a section along the River Frome at Yate/Chipping Sodbury; a section on the River Frome south of Winterbourne; a section of the Little Avon east of Charfield; and sections along tributaries of the Ladden Brook near Tytherington. Fluvial flood defences in South Gloucestershire offer a standard of protection varying from 50% AEP (2-year flood) to 0.5% AEP (20-year flood).

8.3.2 Tidal and coastal defences

There are Environment Agency maintained tidal defence schemes along virtually the entire coast of South Gloucestershire, with the exception of a section around Aust, and a small section north of Oldbury-on-Severn, due to the presence of natural high ground. These defences consist of a mix of high ground, embankments, walls, demountable defences, and flood gates.

A section of the coastal defences near Nupdown is classified as fluvial-tidal as it also protects against a network of reens that drain into the Severn estuary. These defences consist of high ground, embankments, walls, and demountable defences.

When considering defences along the coastline, it is important to differentiate between those which are constructed to protect the coastal frontage from erosion and those which are designed to protect the coast from flood risk from the tide levels in the sea e.g. still water levels exceeding the defence crest, or waves overtopping the defence. Each of these types of defence are present in the South Gloucestershire area but are not designed to necessarily fulfil the dual purpose of managing flood risk and coastal protection. However, with climate change, it is likely that many of locations with coastal defences will need to include provision for tidal defence in the future if standards of protection are to be maintained.

According to the Environment Agency, the vast majority of defences' condition are classified 1-3, signalling very good to fair conditions. Two sections are classified as 4, or in poor condition – a section of embankment near Northwick and a section of embankment north of Aust. This signifies these sections have defects that could significantly decrease their performance and increase flood risk and warrants further investigation. Tidal defences in South Gloucestershire offer a standard protection varying from 0.5% AEP (200-year flood) to 1% AEP (100-year flood).

8.4 Flood Alleviation Schemes

There are a number of alleviation schemes within the South Gloucestershire area. These include flood alleviation schemes that were completed recently as part of the Challenge Fund flood resilience works (Tranche 2A), funded by the department for Transport. These primarily consisted of highway drainage improvements, including repairs and replacement to increase capacity and reduce maintenance liability of drainage schemes. These were implemented in:

- Abson Road, Pucklechurch
- Beckspool Road, Frenchay
- Cherry Gardens, Bitton
- Bath Road, Swineford
- High Street, Wick
- High Street, Winterbourne
- Wotton Road, Bagstone and Rangeworthy
- Oldbury on Severn - included reinstatement of an historic rhine to direct storm flows away from the village and increase storage capacity.

There are three flood storage areas within the study area, including on the Frome west of Yate; on the Siston Brook north of Warmley, and on the Henbury Trym at Catbrain.

8.4.1 Frome Catchment Innovation Programme

Bristol City Council was recently awarded funding by DEFRA in 2021 as part of the Flood and Coastal Resilience Innovation Programme for the **Frome Catchment Innovation Programme**[54]. This will use a mix of flood resilience measures that mirror the rural to city nature of the Frome catchment. The project will deliver restoration of the River Frome through the Yate Masterplan and Frome Gateway regeneration initiative.

8.4.2 Proposed NFM schemes

There is a proposed Natural Flood Management (NFM) scheme recommended by the Farming and Wildlife Advisory Group (FWAG) Southwest intended to alleviate flood risk in known repeat road flooding hotspots. Proposals include the construction of in-field bunds,

54 Innovative projects to protect against flooding selected: https://www.gov.uk/government/news/innovative-projects-to-protect-against-flooding-selected

ponded storage, woody bundles, leaky dams, and flow deflectors in strategic locations in private lands to alleviate flood risk. Locations considered include:

- Kington Lane, Kington
- Itchington Road/Earthcott Road junction, Itchington
- Shellards Lane, Itchington
- Stidcot Lane, Stidcot
- Perrinpit Lane/Old Gloucester Road, Frogland Cross (near Frampton Cotterell)

8.5 Proposed flood defences in South Gloucestershire

Proposed flood defences and alleviation schemes include tranche 2B of the Challenge Fund, which will see similar works to tranche 2A being implemented to improve highway drainage schemes. Locations include:

- Gipsy Patch Lane, Stoke Gifford
- Perrinpit Road/Old Gloucester Road, Frampton Cotterell/Gaunt's Earthcott
- Coldharbour Lane, Filton
- Bristol Road, Frenchay
- B4509 The Downs, Wickwar
- B4058/B4059 Yate Road, Iron Acton
- Stover Road at Frome bridge, Yate
- New Avon Bridge, Keynsham Road, Willsbridge

8.5.1 ASEA Flood Defence Scheme

The **Avonmouth and Severnside Enterprise Area**[55] (ASEA) Ecology Mitigation and Flood Defence Project is currently under construction and is intended to support the growth of the Avonmouth Severnside Enterprise Area.

The ASEA scheme will upgrade existing defences along a 17 km stretch of coastline, including the defences from Severn Beach to Aust in the Local Plan area. The flood defences to be constructed by the consented ASEA scheme are designed to offer a 1 in 200-year (0.5% AEP) standard of protection over a 60-year design life, this considers the following factors[56]:

- For existing development: applies a 2076 design life (i.e. 60-year design life relative to a "present day" 2016 base year);
- For anticipated new development in the ASEA area: applies a 2098 design life (i.e. 60-year design life relative to a 2038 base year, assuming associated future development within the ASEA area is completed by 2038); and
- The proposed flood defences include a lower standard of protection at Old Passage, where a local 1:75-AEP (to 2076) standard of protection is proposed (as requested by and agreed with affected property/land owners) with a 1:200 AEP (to 2076) standard of protection second line of defence proposed further inland.

8.6 Residual flood risk

Residual risks are those remaining after applying the sequential approach and taking mitigating actions. The residual risk can be:

55 Avonmouth Severnside Enterprise Area (ASEA) Ecology Mitigation and Flood Defence Project: https://www.insouthglos.co.uk/enterprise/avonmouth/flood-ecology/

56 ASEA Scheme Flood Risk Assessment: https://developments.southglos.gov.uk/online-applications/applicationDetails.do?activeTab=documents&keyVal=P9HBM7OKJNR00

- the effects of a flood with a magnitude greater than that for which the defences or management measures have been designed to alleviate (the 'design flood'). This can result in overtopping of flood banks, failure of flood gates to cope with the level of flow or failure of pumping systems to cope with the incoming discharges; and/or
- failure of defences or flood risk management measures to perform their intended duty. This could be breach or failure of flood embankments, failure of flood gates to operate in the intended manner, or failure of pumping stations.

In circumstances where measures are put in place to manage flood risk, there remains a possibility of flooding being experienced, either as a consequence of the event exceeding the design capacity or the failure of the asset providing the appropriate standard of protection. Significant changes to sea level rise projections over the lifetime of a development will also result in residual risk. It is the responsibility of the developer to fully assess flood risk, propose measures to mitigate it and demonstrate that any residual risks can be safely managed.

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

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

8.6.1 Overtopping

In exposed locations along the coast, landward flooding is more likely to occur as a consequence of wave overtopping than inundation.

The risk from overtopping of defences is based on the relative heights of property or defence, the distance from the defence level and the height of water above the crest level of the defence. The Defra and Environment Agency **Flood Risks to People**[57] guidance document provides standard flood hazard ratings based on the distance from the defence and the level of overtopping.

57 Flood Risks to People. Defra/Environment Agency. (2006). https://assets.publishing.service.gov.uk/media/602bbc3de90e07055f646148/Flood_risks_to_people_-_Phase_2_Guidance_Document_Technical_report.pdf#:~:text=Flood%20risk%20is%20defined%20as%20probability%20multiplied%20by,and%20the%20failure%20of%20a%20flood%20defence%20system.

8.6.2 Defence breach

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

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

9 FRA requirements and flood risk management guidance

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.

9.1 Over-arching principles

This SFRA focuses on delivering a strategic assessment of flood risk within the study area. Prior to any construction or development, site-specific FRAs will need to be undertaken as set out in the NPPF (see 4.1) to assess all sources of flood risk.

Some sites may additionally require the application of the Exception Test following the Sequential Test if there are safety and sustainability issues to be addressed. If the Exception Test is applied, it must be informed by a detailed FRA to ensure it is safe and will not increase flooding elsewhere. Any site that does not pass the Exception Test should not normally be allocated or permitted for development. It is the responsibility of the developer to provide an FRA with an application.

It should be acknowledged that a detailed FRA may show that a site is not appropriate for development of a particular vulnerability or even at all. Where the FRA shows that a site is not appropriate for a particular use, a lower vulnerability classification may be appropriate.

9.2 Requirements for site-specific flood risk assessments

9.2.1 What are site specific FRAs?

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

Paragraph 068[58] of the NPPF Flood Risk and Coastal Change Planning Practice Guidance sets out a checklist for developers to assist with site specific flood risk assessments.

9.2.2 When are site specific FRAs required?

Site specific FRAs are required in the following circumstances:

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

58 Site specific flood risk assessment: checklist. Ministry of Housing, Communities & Local Government. (2014) https://www.gov.uk/guidance/flood-risk-and-coastal-change#Site-Specific-Flood-Risk-Assessment-checklist-section

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 the site is intended to discharge to the catchment or assets of a water management authority which requires a site-specific FRA
- Where evidence of historical or recent flood events have been passed to the LPA
- On land in the vicinity of small watercourses or drainage features that might not have been demarcated as being in a flood zone on the national mapping
- At locations where proposals could affect or be affected by substantial overland surface water flow routes

A Surface Water Drainage Strategy is required when submitting any planning application for 'major development', as defined under the **Town and Country Planning Act (1990)**[59] .

9.3 Objectives of site specific FRAs

The aim of an FRA is to demonstrate that the development is protected to the 1% AEP fluvial and 0.5% AEP tidal flood scenario and is safe for its intended life span during the 'design' flood event, including an allowance for climate change. This includes assessment of mitigation measures required to safely manage flood risk. Development proposals requiring FRAs should establish:

- Whether a proposed development is likely to be affected by current or future flooding from any source over the lifetime of the development;
- Whether a proposed development will increase flood risk elsewhere;
- Whether the measures proposed to deal with the effects and risks are appropriate;
- Were appropriate, assess the potential cumulative impact of development on flood risk (as described in Section 4.5);
- 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, if applicable.

FRAs for sites located in the Local Plan area should follow the approach recommended by the 2019 NPPF (and associated guidance) and guidance provided by the Environment Agency and South Gloucestershire Council. This includes:

- **Site-specific Flood Risk Assessment: Checklist**[60] (NPPF NPPG, Defra)
- **Standing Advice on Flood Risk**[61] (Environment Agency)
- **Flood Risk Assessment for Planning Applications**[62] (Environment Agency)
- **Designers and Developers**[63] (Guide for SuDS) (South Gloucestershire Council)

59 Town and Country Planning Act (1990): https://www.legislation.gov.uk/ukpga/1990/8/contents

60 Site specific flood risk assessment: checklist. Ministry of Housing, Communities & Local Government. (2014) https://www.gov.uk/guidance/flood-risk-and-coastal-change#Site-Specific-Flood-Risk-Assessment-checklist-section

61 Standing advice on Flood Risk. Environment Agency. (2012, updated 2021). https://www.gov.uk/guidance/flood-risk-assessment-standing-advice

62 Flood Risk Assessments for Planning Applications. Environment Agency. (2014, updated 2017). https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications

63 Designers and Developers. South Gloucestershire County Council. https://www.southglos.gov.uk/documents/Developers-designers-030117.pdf

9.4 Guidance for the Local Planning Authority

One of the key objectives of the SFRA is to provide an evidence base, which will inform the preparation of the Local Development Framework with respect to local flood risk issues and the location of future development.

The local planning authority can play an important role in strategic flood risk management. The overall aim should be to direct development to areas of lower flood risk wherever possible and resist development in areas of flood risk unless the type of development is commensurate with the type of flood risk.

The Council should also seek flood risk reduction in every new development and redevelopment through design, changes in land use and drainage requirements.

9.4.1 Reviewing of FRAs

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**[64].

9.5 Guidance for developers

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

In general, all future developments should demonstrate:

- That the probability and consequences of flooding will be reduced.
- How actual and residual flood risk to the development and flood risk to others from all sources will be managed over the lifetime of the development, taking into account climate change.
- That development will be safe through the layout, form and floor levels of the development and mitigation measures.
- That surface water runoff is being managed.
- A development will have certain requirements to fulfil, dependent upon which Flood Zone it is located within.

The following subsections contain information to assist developers where flood risk to and from a development is identified which should be read alongside the guidance documents listed in Section 9.3.

9.5.1 Climate change projections

When undertaking an FRA, developers should refer to the most up to date climate change allowances as provided by the Environment Agency. More information on the updated climate change allowances, based on the UKCP18 projections, is available in Section 5.2.

By making an allowance for climate change it will help reduce the vulnerability of the development and provide resilience to flooding in the future.

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

9.5.2 Smaller watercourses

As described in Section 7.4, the Environment Agency's Flood Maps may suggest that there is not a flood risk along small watercourses (watercourses with a catchment less than

64 Flood Risk Assessment: Local Planning authorities. Defra. (2015, updated 2021) https://www.gov.uk/guidance/flood-risk-assessment-local-planning-authorities

3km^2). As part of a site-specific flood risk assessment the potential flood risk and extent of Flood Zones should be determined for these smaller watercourses and this information used as appropriate to perform the Sequential and Exception tests.

9.6 Reducing flood risk

9.6.1 Site layout and design

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

The NPPF states that a sequential, risk-based approach should be applied to try to locate more vulnerable land use away from flood zones, to higher ground, while more flood-compatible development (e.g. vehicular parking, recreational space) can be located in higher risk areas. However, vehicular parking in floodplains should consider the nature of parking, flood depths and hazard including evacuation procedures and flood warning. The nature of risk to water quality also needs to be considered and mitigated to ensure that accumulated hydrocarbons and other vehicle related pollutants are not released to the aquatic environment.

Waterside areas, or areas along known flow routes, can be incorporated into the masterplan as multi-functional 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.

9.6.2 Raised floor levels

When designing the layout for a development, consideration should be given to the potential effects of flood risk and great care should be taken so that development is safe and there are no adverse effects on existing land, property or people. In areas potentially at risk from surface water flooding particular attention should be given to proposed ground levels, drainage design and provisions for exceedance flows. Where there is a residual risk of flooding (from any source) to properties within a development the measures to address the effects would normally include raising internal floor levels above the minimum level specified by the building regulations so that potential risks are addressed. The raising of internal floor levels and threshold levels within a development reduces the risk of damage occurring to the interior, furnishings and electrics in times of flood.

It is understood from advice given by the Environment Agency that normally ground floor sleeping accommodation is not considered to be appropriate in areas where there is a known risk of flooding. In addition, it is advised that threshold and ground floor levels should normally be set to whichever is higher of the following:

- a minimum of 300mm above the design flood level for the 1% AEP fluvial event including an allowance for climate change
- a minimum of 300mm above the design flood level for the 0.5% AEP tidal event including an allowance for climate change
- 300mm above the general ground level of the site.

Where possible, sleeping accommodation should be on the first flood or above. Where this is not possible, finished floor levels for sleeping accommodation should normally be set to whichever is higher of the following:

- a minimum of 600mm above the design flood level for the 1% AEP fluvial event including an allowance for climate change and an appropriate allowance for freeboard

- a minimum of 600mm above the design flood level for the 0.5% AEP tidal event including an allowance for climate change and an appropriate allowance for freeboard
- 300mm above the general ground level of the site.

The design flood level should be the level taking account of residual risks (i.e. the risk that remains should flood defences be breached or fail as well as any undefended risk).

If it is not practical to raise floor levels to those specified above, consultation with the Environment Agency will be required to determine alternative approaches.

The additional height that the floor level is raised above the maximum water level is referred to as the "freeboard". Additional freeboard may be required because of risks relating to blockages to the channel, culverts or bridges. These should be considered as part of a site specific Flood Risk Assessment.

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

Single storey buildings such as ground floor flats or bungalows are especially vulnerable to rapid rise of water (such as that experienced during a breach). This risk can be reduced by use of multiple storey construction and raised areas that provide an escape route. However, access and egress can still be an issue, particularly when flood duration covers many days.

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

9.6.3 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 if they are overtopped or breached. Compensatory storage must be provided where raised defences remove storage from the floodplain. It would be preferable for schemes to involve an integrated flood risk management solution.

Temporary or demountable defences are not acceptable forms of flood protection for a new development but might be appropriate to address circumstances where the consequences of residual risk are severe. In addition to the technical measures the proposals must include details of how the temporary measures will be erected and decommissioned, responsibility for maintenance and the cost of replacement when they deteriorate.

9.6.4 Modification of ground levels

Modifying ground levels to raise the land above the required flood level is an effective way of reducing flood risk to a particular site in circumstances where the land does not act as conveyance for flood waters. However, care must be taken at locations where raising ground levels could adversely affect existing communities and property as this can result in significant changes to how surface water moves around the site, introducing flood risk to areas that were not at flood risk previously. Where ground levels are modified, mitigation measures should be considered to stop the introduction of new flood risk.

In most areas of fluvial flood risk, raising land above the floodplain would reduce conveyance or flood storage in the floodplain and could adversely impact flood risk downstream or on neighbouring land.

Compensatory flood storage should be provided, and would normally be on a level for level, volume for volume basis on land that does not currently flood but is adjacent to the floodplain (in order for it to fill and drain). It should be in the vicinity of the site and within the red line of the planning application boundary.

Raising levels can also create areas where surface water might pond during significant rainfall events. Any proposals to raise ground levels should be tested to ensure that it would not cause increased ponding or build-up of surface runoff on third party land.

Any proposal for modification of ground levels will need to be discussed at an early stage with the Environment Agency and its impacts assessed as part of a detailed FRA.

9.6.5 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).

For strategic flood defence schemes, contributions towards them could be raised through the Community Infrastructure Levy (CIL). CIL was introduced in South Gloucestershire in 2010 and allows the local authority to raise funds from developers undertaking new building projects. The money raised is used to fund a wide range of infrastructure projects needed to support development in the locality.

Alternatively, for more localised schemes a Section 106 agreement could be sought. These are a mechanism which makes a development proposal acceptable in planning terms, that would otherwise not be acceptable.

South Gloucestershire Council as the LLFA may work in conjunction with the Environment Agency and to identify locations where strategic or local schemes may be appropriate. Developers are encouraged to seek pre-application advice from South Gloucestershire Council and other relevant authorities (the EA and IDBs) in order to assess the likely extent of any requirements.

DEFRA's **Flood and Coastal Erosion Risk Management Grant in Aid**[65] (FCERM GiA) can be obtained by operating authorities to contribute towards the cost of a range of activities including flood risk management schemes that help reduce the risk of flooding and coastal erosion. Some schemes are only partly funded by FCERM GiA and therefore any shortfall in funds will need to be found from elsewhere when using Resilience Partnership Funding, for example local levy funding, local businesses or other parties benefitting from the scheme.

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

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

The appropriate route for the consideration of strategic measures to address flood risk issues is discussed in more detail in Section 12. Developers must be able to demonstrate that any strategic provisions can be afforded and have an appropriate priority. The Environment Agency is also committed to working in partnership with developers to reduce flood risk. Where assets are in need of improvement or a scheme can be implemented to reduce flood risk, the Environment Agency request that developers contact them to discuss potential solutions.

65 Calculate grant-in-aid funding for flood and coastal erosion risk management projects. Defra. (2020) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/881099/Calculate_GiA_funding_for_FCERM_projects_2020.pdf

9.7 Buffer strips

The provision of a buffer strip to 'make space for water', allows additional capacity to accommodate climate change and ensure access to the watercourse, structures and defences is maintained for future maintenance purposes. It also enables the avoidance of disturbing riverbanks, adversely impacting ecology and having to construct engineered riverbank protection. Building adjacent to riverbanks can also cause problems to the structural integrity of the riverbanks and the building itself, making future maintenance of the river much more difficult.

Various buffer strip Byelaws are in place within South Gloucester. Under the **Environmental Permitting (England and Wales) Regulations 2016**[66], the Environment Agency specifies that no development is permitted within 8m either side of a Main River or within 15m of the foot of the landward side of any sea defences or between the low water mark of medium tides and the seaward side of any sea defence. No byelaws are in in place for ordinary watercourses outside of IDB areas, however the provision for a buffer zone is expected by the LLFA, it is recommended that this is the same as those of Main Rivers.

Under the **Lower Severn Internal Drainage Board Byelaws**, no development is permitted within 8m of any Ordinary Watercourse, within the Boards District and maintained by the Board.

Appendix A shows the buffer areas for different watercourses within South Gloucestershire. This map should be consulted when allocating new development.

9.8 Resistance and resilience measures

There may be instances where flood risk to a development remains despite implementation of such planning measures as those outlined above. For example, where the use is water compatible, where an existing building is being changed, where residual risk remains behind defences, or where floor levels have been raised but there is still a risk at the 0.1% AEP scenario. In these cases, (and for existing development in the floodplain), additional measures can be put in place to reduce damage in a flood and increase the speed of recovery. These measures should not normally be relied on for new development as an appropriate mitigation method.

Resistance measures aim to reduce the amount of floodwater entering the building and resilience measures aim to reduce the damage caused by flood water which has entered the property. The NPPF[67] states that development should be appropriately flood resilient *'such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment'*.

Resistance and Resilience measures will be specific to the nature of flood risk, and as such will be informed and determined by the FRA. Further guidance relating to appropriate resistance and resilience measures can be found at:

- Environment Agency's **Flood risk assessment in flood zones 2 and 3**[68] webpage.
- Gloucestershire Resilience Forum provides information and advice for individuals on **preparing for flooding**[69].

The Environmental Permitting (England and Wales) Regulations 2016. UK Government. (2016) https://www.legislation.gov.uk/uksi/2016/1154/contents/made

67 National Planning Policy Framework (July 2021) Paragraph 166

68 Flood risk assessment in flood zones 2 and 3. Environment Agency. (2012, updated 2017) https://www.gov.uk/guidance/flood-risk-assessment-in-flood-zones-2-and-3#extra-flood-resistance-and-resilience-measures

69 Be prepared: Flooding. Gloucestershire Prepared. https://glosprepared.co.uk/be-prepared-flooding/

9.8.1 Resistance measures

Resistance measures are suitable for existing development in the floodplain. Most of these measures should be regarded as reducing the rate at which flood water can enter a property during an event and considered an improvement on what could be achieved with sandbags. They are often deployed with small scale pumping equipment to control the flood water that does seep through these systems. The effectiveness of these forms of measures is often dependant on the availability of a reliable forecasting and warning system, so the measures are deployed in advance of an event. The following resistance measures are often deployed:

- **Permanent barriers**: Permanent barriers can include built up doorsteps, rendered brick walls and toughened glass barriers.
- **Temporary barriers**: Temporary barriers consist of moveable flood defences which can be fitted into doorways and/or windows. The permanent fixings required to install these temporary defences should be discrete and keep architectural impact to a minimum. On a smaller scale temporary snap on covers for airbricks and air vents can also be fitted to prevent the entrance of flood water.

9.8.2 Resilience measures

Resilience measures are suitable for new developments where there is a residual flood risk. These measures should be regarded as reducing the impact the flood water has once it has entered a property. These typically include:

- **Water resistant materials**: Floors, walls and fixtures can be finished with water resistant materials to help reduce the damage and greatly shorten the recovery time after a flood. Materials can include waterproof plaster, solid concrete floors and tiled floor coverings.
- **Electrical installation**: Electrical circuitry can be installed at a higher level with power cables being carried down from the ceiling rather than up from the floor level to reduce the likelihood of the circuitry being affected by flood water.

9.9 Emergency planning

Safe access and egress from the site should be provided to reduce the residual risks to a development. The developer should seek to incorporate an emergency plan and a safe refuge point if the development site has been identified to be at risk of flooding. The local authority and Emergency Services should be consulted when designing an emergency plan. For further details on emergency planning, see Section 11

9.10 Reducing flood risk from other sources

9.10.1 Groundwater

Groundwater flooding has a very different flood mechanism to any other and for this reason many conventional flood defence and mitigation methods are not suitable. The only way to fully reduce flood risk would be through building design (development form), ensuring floor levels are raised above the water levels caused by a 1% AEP plus climate change event. Site design would also need to preserve any flow routes followed by the groundwater overland to ensure flood risk is not increased downstream.

Infiltration SuDS can cause increased groundwater levels and subsequently may increase flood risk on or off the site. Developers should provide evidence and ensure that this will not be a significant risk.

When redeveloping existing buildings, it may be acceptable to install pumps in basements as a resilience measure. However, for new development this is not considered an appropriate solution

9.10.2 Surface water and sewer flooding

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

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

When redeveloping existing buildings, the installation of some permanent or temporary flood-proofing and resilience measures could protect against both surface water and sewer flooding. Non-return valves prevent water entering the property from drains and sewers. These can be installed within gravity sewers or drains in a property's private sewer upstream of the public sewerage system. They need to be carefully installed and must be regularly maintained. Consideration must also be given to attenuation and flow ensuring that flows during the 1% AEP plus climate change storm event are retained within the site if any flap valves shut. This must be demonstrated with suitable modelling techniques.

9.10.3 Cumulative impacts of development

At some locations it will be necessary to include consideration in an FRA of not only the flood risk at a particular site, but also the cumulative effects of all proposed plan allocations within a defined catchment. Reference should be made to Section 13 with respect to the consideration that should be given in these circumstances.

10 Surface water management and SuDS

10.1 Introduction

Sustainable Drainage Systems (SuDS) are management practices which enable surface water to be drained in a more sustainable manner and mimic the local natural drainage. The inclusion of SuDS within developments is an opportunity to enhance ecological and amenity value, and promote Green Infrastructure, incorporating above ground facilities into the development landscape strategy.

South Gloucestershire Council, as the LLFA, should be consulted on matters relating to surface water management. Guidance on the design and construction of SuDS can be found in SGC's **Supplementary Planning Document on SuDS** and in section 0 of this report.

10.2 Role of the LLFA and LPA in surface water management

From April 2015, changes to the planning system require that major development should make provision for sustainable drainage systems to manage surface water run-off, where major developments are defined as:

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

The Local Planning Authority must satisfy themselves that clear arrangements are in place for future management of the maintenance arrangements and the LLFA (South Gloucestershire Council), as statutory consultee is required to review the drainage and Sustainable Urban Drainage (SuDS) proposals to confirm they are appropriate.

When considering planning applications, Local Planning Authorities should seek advice from the relevant flood risk management bodies, principally the LLFA on the management of surface water (including what sort of SuDS they would consider to be reasonably practicable), satisfy themselves that the proposed minimum standards of operation are appropriate and ensure, through the use of planning conditions or planning obligations, that there are clear arrangements for on-going maintenance over the development's lifetime. Judgement on what SuDS system would be reasonably practicable should be through reference to Defra's **Non-statutory technical standards for SuDS**[70] document.

In its respective roles as LLFA and LPA South Gloucestershire Council:

- promotes the use of SuDS for the management of run-off;
- ensures their policies and decisions on applications support and compliment the building regulations on sustainable rainwater drainage, giving priority to infiltration over watercourses and then sewer conveyance;
- incorporates favourable policies within development plans;
- adopts policies for incorporating SuDS requirements into Local Plans; and

70 Non-statutory technical standards for sustainable drainage systems. Defra. (2015)
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf

- encourages developers to utilise SuDS whenever practical, if necessary, through the use of appropriate planning conditions.

10.3 Sustainable Drainage Systems (SuDS)

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

- **Quantity**: should be able to cope with the quantity of water generated by the development at the agreed greenfield rate and volume with due consideration for climate change via a micro-catchment based approach. Where frequency of flood risk, steepness of topography or permeability of geology has a significant impact on the volume or rate of surface water being discharged from a site, the LLFA should be contacted, as a review of the greenfield runoff rate to be achieved may be needed.
- **Quality**: should utilise SuDS features in a "treatment train" that will have the effect of treating the water before infiltration or passing it on to a subsequent water body
- **Amenity**: should integrate greenery or water features to improve the visual characteristics of the area. These can be incorporated within "open space" or "green corridors" within the site and designed with a view to performing a multifunctional purpose.
- **Biodiversity**: should include a range of natural features such as plants, trees and other vegetation which will provide additional filtration of surface water runoff. These can be designed to complement and improve the ecology of the area.

There are a number of ways in which SuDS can be designed to meet surface water quantity, climate change resilience, water quality, biodiversity and amenity goals. Given this flexibility, SuDS are generally capable of overcoming or working alongside various constraints affecting a site, such as restrictions on infiltration, without detriment to achieving these goals.

SuDS must be considered at the outset and during preparation of the initial conceptual site layout to ensure that enough land is given to design spaces that will be an asset to the development as opposed to an ineffective afterthought. For SuDS to work effectively appropriate techniques should be selected based on the objectives for drainage and the site-specific constraints. I t is recommended, that on all developments, source control is implemented as the first stage of a management train allowing for improvements in water quality and reducing or eliminating runoff from smaller, more frequent, rainfall events.

All new major development proposals should ensure that sustainable drainage systems for management of run-off are put in place. The developer is responsible for ensuring the design, construction and future/ongoing maintenance of such a scheme are carefully and clearly defined, and a clear and comprehensive understanding of the existing catchment hydrological processes and existing drainage arrangements is essential.

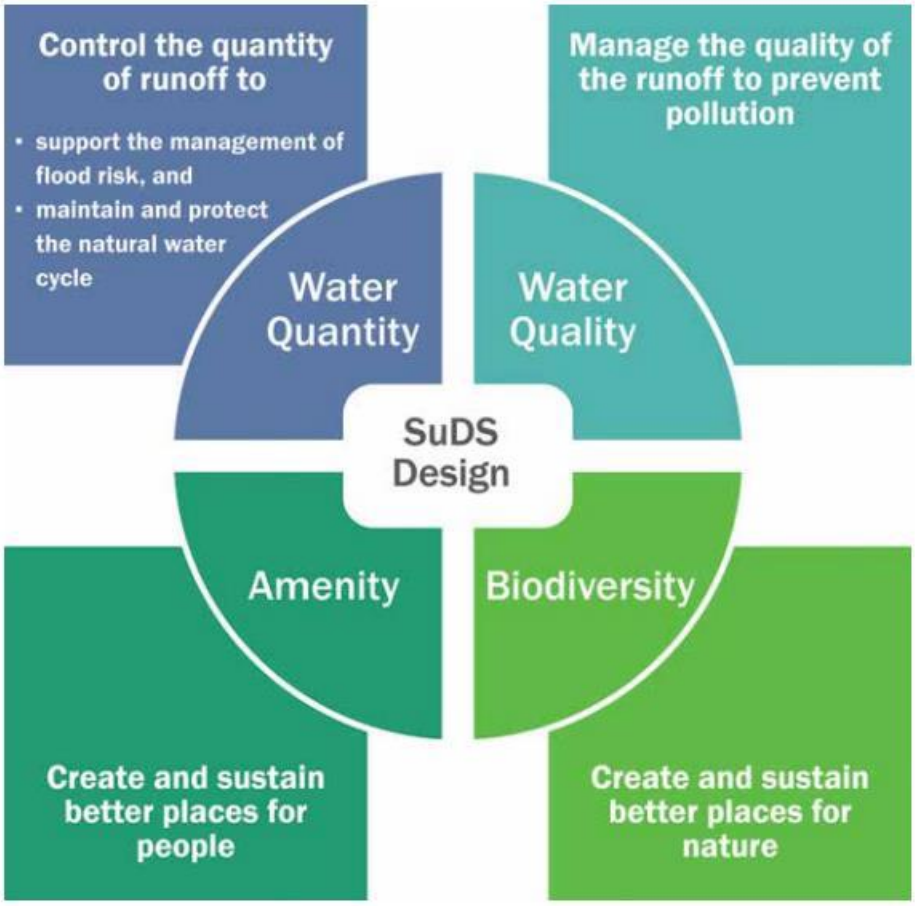


Figure 10-1 - The four pillars of SuDS design, from the The SuDS Manual C753 (2015)

10.4 SuDS techniques

There are many different SuDS techniques that can be implemented in attempts to mimic pre-development drainage (Table 10-1). Techniques can include soakaways, infiltration trenches, permeable pavements, grassed swales, green roofs, ponds and wetlands and these do not necessarily need to take up a lot of space. The suitability of the techniques will be dictated in part by the development proposal and site conditions. Advice on best practice is available from the Environment Agency and the Construction Industry Research and Information Association (CIRIA) e.g. **the CIRIA SuDS Manual C753 (2015)**[71].

71 CIRIA SuDS Manual C753. The Construction Industry Research and Information Association. (2015) https://www.ciria.org//Memberships/The_SuDs_Manual_C753_Chapters.aspx

Table 10-1 - Examples of SuDS techniques and potential benefits

SuDS Technique	Flood Reduction	Water Quality Treatment & Enhancement	Landscape and Wildlife Benefit
Living roofs	✓	✓	✓
Basins and ponds	✓	✓	✓
Constructed wetlands	✓	✓	✓
Balancing ponds	✓	✓	✓
Detention basins	✓	✓	✓
Retention ponds	✓	✓	✓
Filter strips and swales	✓	✓	✓
Infiltration devices	✓	✓	✓
Soakaways	✓	✓	✓
Infiltration trenches and basins	✓	✓	✓
Permeable surfaces and filter drains	✓	✓	
Gravelled areas	✓	✓	
Solid paving blocks	✓	✓	
Porous pavements	✓	✓	
Tanked systems	✓		
Over-sized pipes/tanks	✓		
Storm cells	✓		

10.4.1 SuDS management train

SuDS should not be used individually but as a series of features in an interconnected system designed to capture water at the source and convey it to a discharge location. Collectively this concept is described as a SuDS Management Train (see Figure 10-2). The number of treatment stages required within the Management Train depends primarily on the source of the runoff and the sensitivity of the groundwater or receiving waterbody. A drainage strategy will need to demonstrate that an appropriate number of treatment stages are delivered.

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

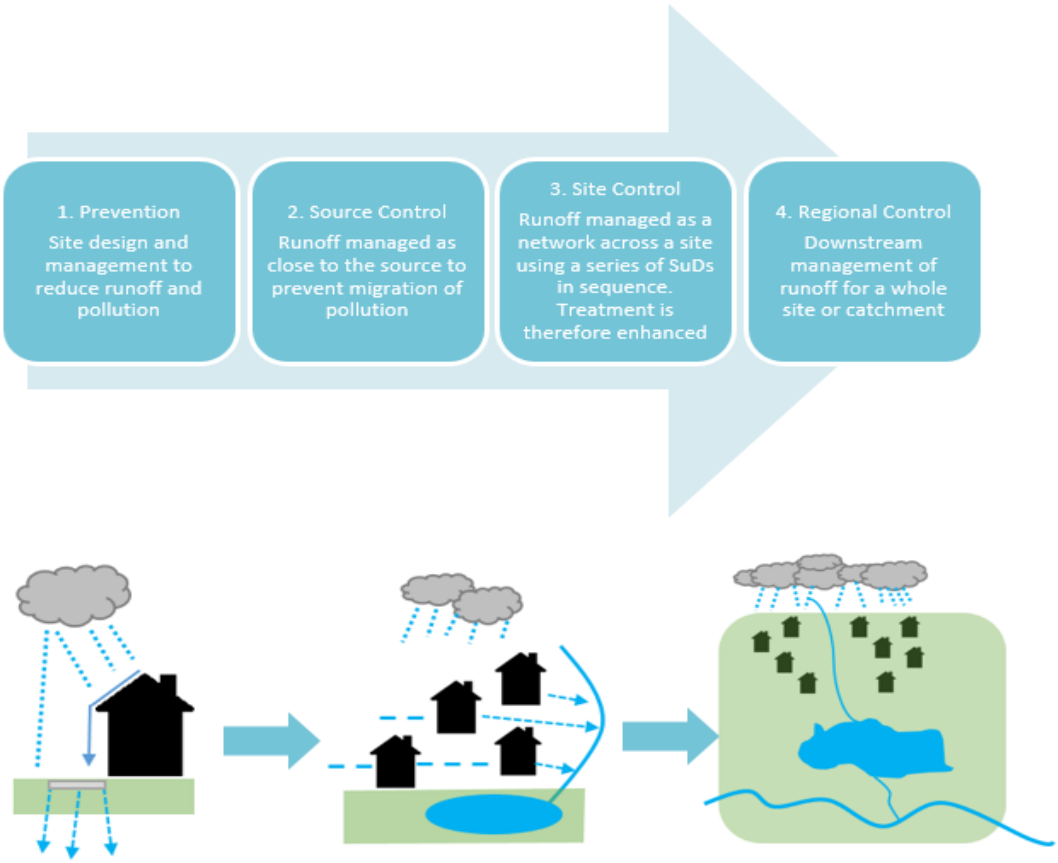


Figure 10-2 - SuDS Management Train

10.4.2 Treatment of runoff

A key part of the four pillars of SuDS is to provide the maximum improvement to water quality through the use of the "SuDS Management Train". To maximise the treatment within SuDS, CIRIA recommends the following good practice is implemented in the treatment process:

1. **Manage surface water runoff close to source:** This makes treatment easier due to the slower velocities and also helps isolate incidents rather than transport pollutants over a large area.
2. **Treat surface water runoff on the surface:** This allows treatment performance to be more easily inspected and managed. Sources of pollution and potential flood risk is also more easily identified. It also helps with future maintenance work and identifying damaged or failed components.
3. **Treat a range of contaminants:** SuDS should be chosen and designed to deal with the likely contaminants from a development and be able to reduce them to acceptably low levels.
4. **Minimise the risk of sediment remobilisation:** SuDS should be designed to prevent sediments being washed into receiving water bodies or systems during events greater than what the component may have been designed.

5. **Minimise the impact of spill:** Designing SuDS to be able to trap spills close to the source or provide robust treatment along several components in series.

The number of treatment stages required depends primarily on the source of the runoff. A drainage strategy will need to demonstrate that an appropriate number of treatment stages are delivered. This involves determining a pollutant hazard score for each pollutant type. An index is then used to determine the treatment potential of different SuDS features for different pollutant types. This is known as the mitigation index. The Total SuDS mitigation index should be equal or greater than the pollution hazard score to deliver adequate treatment.

10.4.3 Overcoming SuDS constraints

The design of a SuDS system will be influenced by a number of physical and policy constraints. These should be taken into account and reflected upon during the conceptual, outline and detailed stages of SuDS design. Table 10-2 details some possible constraints and how they may be overcome.

Table 10-2 - Example SuDS design constraints and possible solutions

Considerations	Solution
Land availability	SuDS can be designed to fit into small areas by utilising different systems. For example, features such as permeable paving and green roofs can be used in urban areas where space may be limited.
Contaminated soil or groundwater below site	SuDS can be placed and designed to overcome issues with contaminated groundwater or soil. Shallow surface SuDS can be used to minimise disturbance to the underlying soil. The use of infiltration should also be investigated as it may be possible in some locations within the site. If infiltration is not possible linings can be used with features to prevent infiltration.
High groundwater levels	Non-infiltrating features can be used. Features can be lined with an impermeable liner or clay to prevent the egress of water into the feature. Additional, shallow features can be utilised which are above the groundwater table.
Steep slopes	Check dams can be used to slow flows. Additionally, features can form a terraced system with additional SuDS components such as ponds used to slow flows.
Shallow slopes	Use of shallow surface features to allow a sufficient gradient. If the gradient is still too shallow pumped systems can be considered as a last resort.
Ground instability	Geotechnical site investigation should be done to determine the extent of unstable soil and dictate whether infiltration would be suitable or not.
Sites with deep backfill	Infiltration should be avoided unless the soil can be demonstrated to be sufficiently compacted. Some features such as swales are more adaptable to potential surface settlement.
Open space in floodplain zones	Design decisions should be done to take into consideration the likely high groundwater table and possible high flows and water levels. Features should also seek to not reduce the capacity of the floodplain and take into consideration the influence that a watercourse may have on a system. Facts such as siltation after a flood event should also be taken into account during the design phase.
Future adoption and maintenance	Local Planning Authority should ensure development proposals, through the use of planning conditions or planning obligations, have clear arrangements for on-going maintenance over the development's lifetime.

10.5 Sources of SuDS guidance

10.5.1 C753 CIRIA SuDS Manual (2015)

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

10.5.2 Non-Statutory Technical Standards for Sustainable Drainage (2015)[72]

These have been developed by Defra to sit alongside NPPG to provide non-statutory standards as to the expected design, maintenance and performance for SuDS. The LPA will make reference to these standards when determining whether proposed SuDS are considered reasonably practicable and appropriate.

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

Further **guidance**[73] has been provided by a Steering Group established by Defra, consisting of industry-wide stakeholders to provide an interpretation of the non-statutory technical standards.

10.5.3 Design and Construction Guidance for foul and surface water sewers (2019)[74]

This guidance, which replaces the Sewers for Adoption 7th edition, is for use by developers when planning, designing and construction foul and surface water drainage systems. The documents sets out guidance for SuDS that are intended for adoption by water companies. It provides a mechanism by which water companies can secure the adoption of a wide range of SuDS components that are complaint with the legal definition of a sewer, therefore allowing for better managed and integrated surface water systems.

10.5.4 Supplementary Planning Document on SuDS[75]

The South Gloucestershire Council document sets out the drainage design, approval and implementation process for its requirement in relation to SuDS within the South Gloucestershire environment.

More information on SuDS can be found on the **Susdrain**[76] website.

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72 Non-Statutory Technical Standards for Sustainable Drainage Systems: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf

73 Non-Statutory Technical Guidance for SuDS. Local Authority SuDS Officer Organisation. (2014) https://www.suds-authority.org.uk/wp-content/uploads/2018/12/non-statutory-technical-standards-guidance.pdf

74 Design and Construction Guidance for foul and surface water sewers. Water UK. (2019). https://www.water.org.uk/wp-content/uploads/2019/03/Appendix-C-to-draft-sewerage-Sector-Guidance-Design-and-Construction-Guidance.pdf

75 South Gloucestershire Council draft SuDS SPD: https://consultations.southglos.gov.uk/gf2.ti/f/1202562/82245541.1/PDF/-/SuDS_SPD_-_October_2020.pdf

76 Susdrain. https://www.susdrain.org/

10.6 Other surface water considerations

10.6.1 Sites of Special Scientific Interest

Natural England have designated areas as Sites of Special Scientific Interest (SSSIs) where a site has features of special interest such as its wildlife, geology and landform. There are 27 SSSIs situated either partially or entirely within South Gloucestershire. A number of these sites contain important species that are reliant on the hydrological properties of the area.

Mapping of these sites is available via Defra's **Magic Map**[77] and should be considered when designing SuDS. Planners and developers should consult Natural England when designing sustainable drainage systems for developments within or draining to any SSSI, to learn more about any local issues that should be taken into consideration.

10.6.2 Groundwater Vulnerability Zones

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

Two maps are available:

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

The groundwater vulnerability classifications across South Gloucestershire are particularly complex with the majority of the area located within High and Medium–High groundwater vulnerability zones. There are also large tracts of the Medium groundwater vulnerability zone along the centre of the area. The groundwater vulnerability maps which can be viewed on Defra's **MAGIC map** ,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.

10.6.3 Groundwater Source Protection Zones

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

- **Zone 1 (Inner Protection Zone)** – Most sensitive zone: defined as the 50-day travel time from any point below the water table to the source. This zone has a minimum radius of 50 metres.
- **Zone 1c (Inner Protection Zone – subsurface activity only)** – Extends Zone 1 where the aquifer is confined and may be impacted by deep drilling activities.

77 Magic Map. Defra. https://magic.defra.gov.uk/MagicMap.aspx

- **Zone 2 (Outer Protection Zone)** – Also sensitive to contamination: defined by a 400-day travel time from a point below the water table. This zone has a minimum radius around the source, depending on the size of the abstraction.
- **Zone 2c (Outer Protection Zone – subsurface activity only)** – Extends Zone 2 where the aquifer is confined and may be impacted by deep drilling activities.
- **Zone 3 (Total Catchment)** - Defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source. For heavily exploited aquifers, the final Source Catchment Protection Zone can be defined as the whole aquifer recharge area where the ratio of groundwater abstraction to aquifer recharge (average recharge multiplied by outcrop area) is >0.75. Individual source protection areas will still be assigned to assist operators in catchment management.
- **Zone 4 (Zone of special interest)** – A fourth zone SPZ4 or 'Zone of Special Interest' usually represents a surface water catchment which drains into the aquifer feeding the groundwater supply (i.e. catchment draining to a disappearing stream). In the future this zone will be incorporated into one of the other zones, SPZ 1, 2 or 3, whichever is appropriate in the particular case, or become a safeguard zone.

The locations of Groundwater SPZs in the Local Plan areas are shown in Figure 10-3, covering areas east of Yate and south of Marshfield, in the far north-east and south-east of South Gloucestershire.

10.6.4 Nitrate Vulnerable Zones

Nitrate Vulnerable Zones (NVZs) are areas designated as being at risk from agricultural nitrate pollution. Nitrate levels in waterbodies are affected by surface water runoff from surrounding agricultural land entering receiving waterbodies.

The level of nitrate contamination will potentially influence the choice of SuDS and should be assessed as part of the design process. The definition of each NVZ is as follows:

- **Groundwater NVZ** – an area of land where groundwater supplies are at risk from containing nitrate concentrations exceeding the 50mg/l level dictated by the EU's Surface Water Abstraction Directive (1975) and Nitrates Directive (1991).
- **Surface Water NVZ** – an area of land where surface waters (in particular those used or intended for the abstraction of drinking water) are at risk from containing nitrate concentrations exceeding the 50 mg/l dictated by the EU's Surface Water Abstraction Directive (1975) and Nitrate Directive (1991).
- **Eutrophic NVZ** – an area of land where nitrate concentrations are such that they could/will trigger the eutrophication of freshwater bodies, estuaries, coastal waters and marine waters.

The locations of the Nitrate Vulnerable Zones in the South Gloucestershire area are shown in Figure 10-4. There are several NVZs in the study area, again concentrated in the east and south-east of the study area. All are Surface Water NVZs with the exception of the Cotswold Jurassic NVZ, which is Groundwater.

Figure 10-3 - Groundwater Source Protection Zones in South Gloucestershire

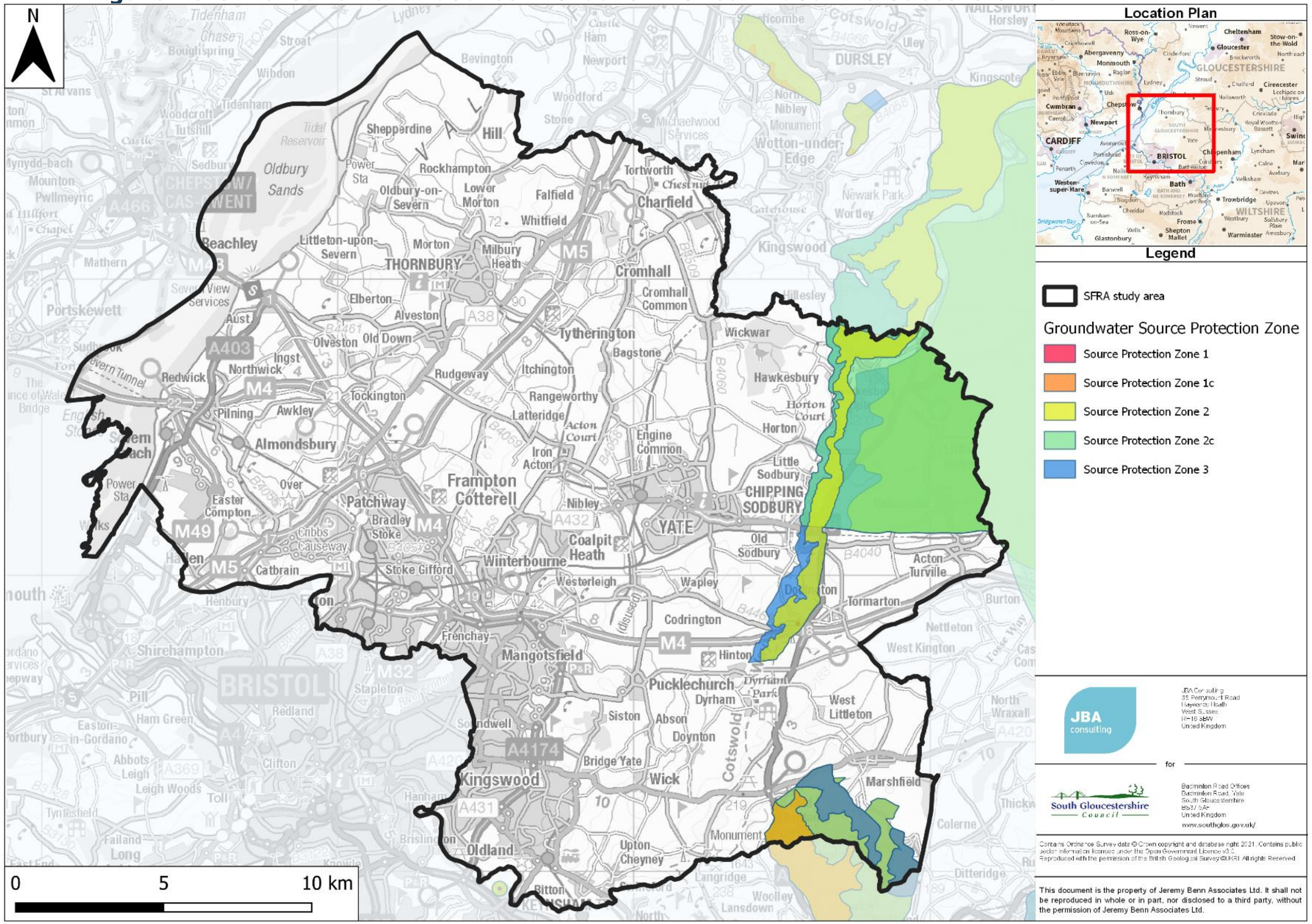
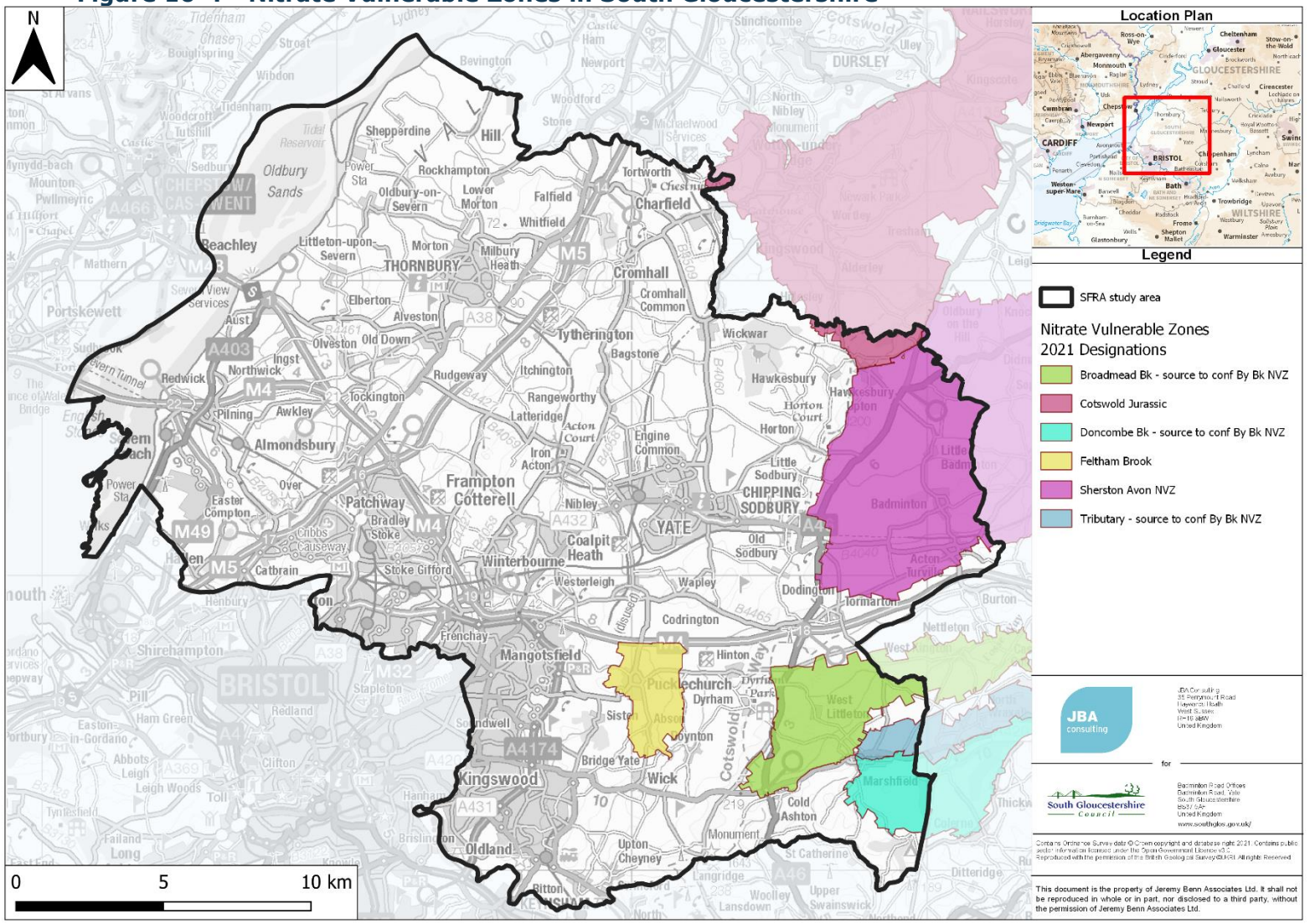


Figure 10-4 - Nitrate Vulnerable Zones in South Gloucestershire



11 Flood Warning and Emergency Planning

This chapter provides guidance and advice on managing flood related incidents before, during and after flooding occurs.

11.1 Emergency planning

Emergency planning is one option to help manage flood related incidents. From a flood risk perspective, emergency planning can be broadly split into three phases: before, during and after a flood. The measures involve developing and maintaining arrangements to reduce, control or mitigate the impact and consequences of flooding and to improve the ability of people and property to absorb, respond to and recover from flooding.

In development planning, a number of emergency planning activities are already integrated in national building control and planning policies e.g. the NPPF Flood Risk Vulnerability and Flood Zone 'Compatibility' table seeks to avoid inappropriate development in areas at risk from all sources of flooding. Flood warning and emergency planning is a last resort after using this SFRA to undertake the Sequential Test appropriately first.

However, safety is a key consideration for any new development and includes residual risk of flooding, the availability of adequate flood warning systems for the development, safe access and egress routes and evacuation procedures.

The Association of Directors of Environment, Economy, Planning and Transport (ADEPT) and the Environment Agency have published a **Flood Risk Emergency Plans for New Development**[78] document which provides guidance for Local Planning Authorities regarding their decisions over planning applications.

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

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

- It is a **requirement under the 2019 NPPF** that safe access and escape routes are included in an FRA where appropriate, as part of an agreed emergency plan.
- The **Environment Agency and Defra's standing advice**[79] for undertaking flood risk assessments for planning applications states that details of emergency escape plans will be required for any parts of the building that are below the estimated flood level.

It is recommended that Emergency Planners at South Gloucestershire Council are consulted prior to the production of any emergency flood plan.

In addition to the **flood warning and evacuation plan considerations listed in the NPPF / NPPG**, it is advisable that developers also acknowledge the following:

- How to manage the consequences of events that are un-foreseen or for which no warnings can be provided e.g. managing the residual risk of a breach

78 Flood Risk Emergency Plans for New Development. ADEPT, Environment Agency. (2019). https://www.adeptnet.org.uk/system/files/documents/ADEPT%20%26%20EA%20Flood%20risk%20emergency%20plans%20for%20new%20development%20September%202019....pdf

79Flood Risk Assessment Standing Advice. Environment Agency. (2021) https://www.gov.uk/guidance/flood-risk-assessment-standing-advice

- Proposed new development that places additional burden on the existing response capacity of the Councils will not normally be considered to be appropriate
- Developers should encourage those owning or occupying developments, where flood warnings can be provided, to sign up to receive these warnings. This applies even if the development is defended to a high standard
- The vulnerability of site occupants
- Situations may arise where occupants cannot be evacuated (e.g. prisons) or where it is safer to remain "in-situ" and / or move to a higher floor or safe refuge area (e.g. at risk of a breach). These allocations should be assessed against the outputs of the SFRA and where applicable, a site-specific Flood Risk Assessment to help develop emergency plans.

Further emergency planning information links:

- **2004 Civil Contingencies Act**[80]
- **DEFRA (2014) National Flood Emergency Framework for England**[81]
- **Sign up for Flood Warnings with the Environment Agency**[82]
- **National Flood Forum**[83]
- **GOV.UK Make a Flood Plan guidance and templates**[84]
- **FloodRe**[85]

11.2 Flood warning systems

Flood warnings can be derived and, along with evacuation plans, can inform emergency flood plans or flood response plans. The Environment Agency is the lead organisation for providing warnings of fluvial flooding (for watercourses classed as Main Rivers) and coastal flooding in England. Flood Warnings are supplied via the Flood Warning Service (FWS), to homes and business within Flood Zones 2 and 3. The different levels of warnings are shown in Table 11-1.

80Civil Contingencies Act. UK Government. (2004). https://www.legislation.gov.uk/ukpga/2004/36/contents

81 National Flood Emergency framework for England. Defra, Environment Agency, Public Health England. (2014). https://www.gov.uk/government/publications/the-national-flood-emergency-framework-for-england

82Sign up for Flood Warnings. Environment Agency. https://www.gov.uk/sign-up-for-flood-warnings

83National Flood Forum website. https://nationalfloodforum.org.uk/

84 Prepare for flooding. UK Government. https://www.gov.uk/prepare-for-flooding/future-flooding

85 FloodRe website. https://www.floodre.co.uk/

Table 11-1 - Environment Agency Flood Warnings

Flood Warning Symbol	What it means	What to do
	Flood Alerts are used to warn people of the possibility of flooding and encourage them to be alert, stay vigilant and make early preparations. It is issued earlier than a flood warning, to give customers advance notice of the possibility of flooding, but before there is full confidence that flooding in Flood Warning Areas is expected.	• Be prepared to act on your flood plan • Prepare a flood kit of essential items • Monitor local water levels and the flood forecast on the Environment Agency website • Stay tuned to local radio or TV • Alert your neighbours • Check pets and livestock • Reconsider travel plans
	Flood Warnings warn people of expected flooding and encourage them to take action to protect themselves and their property.	• Move family, pets and valuables to a safe place • Turn off gas, electricity and water supplies if safe to do so • Seal up ventilation system if safe to do so • Put flood protection equipment in place • Be ready should you need to evacuate from your home • 'Go In, Stay In, Tune In'
	Severe Flood Warnings warn people of expected severe flooding where there is a significant threat to life.	• Stay in a safe place with a means of escape • Co-operate with the emergency services and local authorities • Call 999 if you are in immediate danger
Warning no longer in force	Informs people that river or sea conditions begin to return to normal and no further flooding is expected in the area. People should remain careful as flood water may still be around for several days.	• Be careful. Flood water may still be around for several days • If you've been flooded, ring your insurance company as soon as possible

It is the responsibility of individuals to sign-up to the Flood Warning Service in order to receive the flood warnings via FWS. Registration and the service is free and publicly available through **https://www.gov.uk/sign-up-for-flood-warnings** or call 0345 988 1188.

It is recommended that any household considered at risk of flooding signs-up. Developers should also encourage those owning or occupying developments, where flood warnings can be provided, to sign up to receive them. This applies even if the development is defended to a high standard.

There are currently seven Flood Alert Areas (FAAs) and twenty-three Flood Warning Areas (FWAs) wholly or partially within South Gloucestershire and are displayed in Appendix A. The FAAs and FWAs in South Gloucestershire are listed below in Table 11-2 and

Table 11-3, respectively.

Table 11-2 - Flood Alert Areas within South Gloucestershire

Flood Alert Code	Flood Alert Name	Waterbody	Description
112WAFTBFC	Bristol Frome Catchment	River Frome	Bristol Frome, Ladden Brook, River Trym and tributaries between Chipping Sodbury and Tytherington to Bristol Floating Harbour and the Bristol Avon
112WAFTLAC	Little Avon catchment and the Vale of Berkeley	Little Avon	Little Avon River and other rivers and streams in the Vale of Berkeley
112WAFTLBA	Lower Bristol Avon Area	River Avon	Lower River Avon, River Boyd, By and Brislington Brooks and tributaries
112WAFTUBA	Upper Bristol Avon Area	River Avon	Upper River Avon and tributaries including Malmesbury and Chippenham
112WATAVN1	Tidal River Avon at Bristol, Pill and Shirehampton	River Avon	Tidal River Avon from Sea Mills to Conham in Bristol and between the Avonmouth Bridge and Shirehampton Park including Pill and Shirehampton
112WATSVN1	Severn Estuary at Severn Beach	Severn Estuary	Severn Estuary at Severn Beach including New Passage and Pilning
112WATSVN2	Severn Estuary at Oldbury-on-Severn, Northwick and Avonmouth	Severn Estuary	Severn Estuary at Oldbury-on-Severn, Northwick and Avonmouth including Aust and Old Passage

Table 11-3 - Flood Warning Areas within South Gloucestershire

Flood Warning Code	Flood Warning Name	Waterbody	Description
112FWTSHA03	Severn Estuary from Sharpness to Oldbury-on-Severn	Severn Estuary	Sanigar Lane, Lynch Road, Jumpers Lane and Hamfields Lane including Berkeley Power Station. Blackhall, Upper Hill, Yew Tree Farm area and Rockhampton
112FWTSHA02	Severn Estuary from Sharpness to Oldbury-on-Severn, Clapton, Hill and Nupdown areas	Severn Estuary	Woodlands Farm, Nupdown Farm, Hill, Manor Farm, Lowgoods Farm, Knights Farm, Holt Farm and Valley Farm areas
112FWTSHA01	Severn Estuary from Sharpness to Oldbury-on-Severn, Shepperdine and Oldbury Power Station areas	Severn Estuary	Severn Estuary from Sharpness to Oldbury-on-Severn including low lying properties on Severn Lane, Worldsend Lane, Nupdown Lane and Shepperdine Road including Oldbury Power Station
112FWTSEV03	Severn Estuary at Severn Beach and Pilning	Severn Estuary	Redwick and Pilning to the north to Easter Compton to the east including Avonmouth and Western Approach Distribution Centres, Swanmoor Bridge area, Avlon and Severnside Works and the Severn View Industrial Park
112FWTSEV02	Severn Estuary at Severn Beach, properties located behind the seafront	Severn Estuary	New Passage Road and Southworthy Farm areas in New Passage. Salthouse Farm Park, Beach Road, Beach Avenue, Gorse Cover Road, Church Road, Prospect Road, Abbott Road and Severnwood Gardens in Severn Beach
112FWTSEV01	Severn Estuary at Severn Beach, seafront properties	Severn Estuary	Severn Estuary from New Passage to the Severn View Industrial Park including low lying properties at New Passage and Shaft Road, Beach Road, Station Road and Riverside Park in Severn Beach
112FWTOLD03	Severn Estuary at Oldbury-on-Severn, Westend, Cowhill and Olveston areas	Severn Estuary	Pennywell Farm, Elm Farm, Park Mill Farm and Churnmead Farm areas. West End Lane, Camp Road and Westmarsh Lane in Oldbury-on-Severn and Cowhill, Lower Corston Farm and Ley Lane, Church Hill and Denys Court in Olveston
112FWTOLD02	Severn Estuary at Oldbury-on-Severn, Chapel Road and Olveston Common areas	Severn Estuary	Oldbury Lane including Great Leaze Farm area, Pickedmoor Lane, Chapel Road, Featherbed Lane and Church Road in Oldbury-on-Severn and Lower Farm, Whale Wharf Lane and Olveston Common

Flood Warning Code	Flood Warning Name	Waterbody	Description
112FWTOLD01	Severn Estuary at Oldbury-on-Severn, Oldbury Naite and Littleton Warth areas	Severn Estuary	Severn Estuary from Oldbury-on-Severn to the Old Severn Bridge including Oldbury Naite, Thornbury Sailing Club, Oldbury Pill, Whale Wharf and Rusholme
112FWTNOR03	Severn Estuary at Northwick and Aust	Severn Estuary	Sandy Lane, Orchard Drive, Main Road and Tanhouse Farm areas in Aust. Ingst Hill, Greenditch Street, Redham Lane, Pilning Street and Rookery Lane areas
112FWTNOR02	Severn Estuary at Northwick	Severn Estuary	Bilsham Lane and Northwick Road areas
112FWTNOR01	Severn Estuary at Northwick, Old Passage and Northwick Warth areas	Severn Estuary	Severn Estuary from the Old Severn Bridge to New Passage including low lying properties at Old Passage, Aust Road and Severn Road areas
112FWTBST01	Tidal River Avon from Sea Mills to Conham	River Avon	Low lying property and roads along the River Avon from Sea Mills to Conham including Sea Mills Road, The Portway, Cumberland Basin, Commercial Road, Bathurst Basin, Clarence Road, Albert Road, Central Trading Estate and Crews Hole Road
112FWTAVN02	Severn Estuary at Avonmouth	Severn Estuary	Industrial areas from Chittening Industrial Estate to the north to Avonmouth Docks to the south including the Lawrence Weston Road and St Andrews Road areas. Residential areas at Avonmouth including the Avonmouth Road, Portview Road and Portway areas
112FWTAVN01	Severn Estuary at Avonmouth, seafront properties	Severn Estuary	Severn Estuary from the Severn View Industrial Park to the tidal River Avon including Severn Road, Holesmouth, Smoke Lane Industrial Estate and Royal Edward Dock
112FWFBOY10A	River Boyd at Wick	River Boyd	River Boyd at Wick
112FWFBFR15A	Bristol Frome from downstream of Nibley to Stapleton	River Frome	Bristol Frome from downstream of Nibley to Wickham Bridge in Stapleton including Algars Mill, Mill Lane, Brookside Drive, Rectory Road, Damsons Bridge, Moorend, Cleeve Mill, Frenchay Mill, River View and Frome Bridge
112FWFBFR10E	Bristol Frome at Chipping Sodbury and Yate, Quarry Road, Streamside Road and Blenheim Drive	River Frome	Quarry Road and Streamside Road in Chipping Sodbury and Church Road, Blenheim Road and Celestine Road in Yate
112FWFBFR10D	Bristol Frome at Chipping Sodbury and Yate, Wickham and Jenner Close, Walshe Avenue and Hatters Lane	River Frome	Blanchards Farm, Wickham Close, Jenner Close, Hartley Close, Ridings Close, Walshe Avenue, Horton Road, Brookfield Close, Couzens Close, Hatters Lane and Ross Close in Chipping Sodbury
112FWFBFR10C	Bristol Frome at Chipping Sodbury and Yate, Brook Street, Highway, Broadway and Melrose Avenue	River Frome	Brook Street, Highway, Ridgeway, Newlyn Way, Broadway, Firgrove Crescent, Melrose Avenue, Mercier Close and St Marys Way in Yate
112FWFBFR10B	Bristol Frome at Chipping Sodbury and Yate, Grace Close, Bennetts Court, Station Road and Oak Close	River Frome	Grace Close in Chipping Sodbury and Bennetts Court, Station Road and Oak Close in Yate
112FWFBFR10A	Bristol Frome at Chipping Sodbury and Yate, Vayre Close, Manor Way, Celestine Road and Nibley Lane	River Frome	Vayre Close and Manor Way in Chipping Sodbury, properties closest to the river at Celestine Road in Yate and the Stover Bridge and Nibley area
112FWFAVN70A	Bristol Avon (lower) from Twerton to Bristol	River Avon	Bristol Avon from New Bridge to Netham including Saltford, Mead Lane, Swineford, Broad Mead, Keynsham Road, Hanham Mills, Riverside Cottages and St Annes Park

11.2.1 Local arrangements for managing flood risk

South Gloucestershire Council's Flood Risk webpage[86] provides information and advice for residents for managing flood risk, including emergency contact numbers and guidance documents on how to identify whether properties are at risk, types of flooding, preventing flooding, and instructions of what to do in a flood emergency.

11.3 Emergency planning and development

11.3.1 The NPPF

The NPPF Flood Risk Vulnerability and Flood Zone 'Compatibility' table seeks to avoid inappropriate development in areas at risk from all sources of flooding. It is essential that any development which will be required to remain operational during a flood event is located in the lowest flood risk zones to ensure that, in an emergency, operations are not impacted on by flood water or that such infrastructure is resistant to the effects of flooding such that it remains serviceable/operational during 'upper end' events, as defined in the Environment Agency's Climate Change allowances (July 2021). For example, the NPPF classifies police, ambulance and fire stations and command centres that are required to be operational during flooding as Highly Vulnerable development, which is not permitted in Flood Zones 3a and 3b and only permitted in Flood Zone 2 providing the Exception Test is passed. Essential infrastructure located in Flood Zone 3a or 3b must be operational during a flood event to assist in the emergency evacuation process. All flood sources such as fluvial, surface, groundwater, sewers and artificial sources (such as canals and reservoirs) should be considered. In particular sites should be considered in relation to the areas of drainage critical problems highlighted in the relevant SWMPs.

The outputs of this SFRA should be compared and reviewed against any emergency plans and continuity arrangements. This includes the nominated rest and reception centres (and prospective ones), so that evacuees are outside of the high-risk Flood Zones and will be safe during a flood event.

11.3.2 Safe access and egress

The **NPPF** Planning Practice Guidance outlines how developers can secure safe access and egress to and from development in order to demonstrate that development satisfies the second part of the Exception Test[87]. Access considerations should include the voluntary and free movement of people during a 'design flood' as well as for the potential of evacuation before a more extreme flood. A 'design flood' in this context is defined as a fluvial 1% AEP and tidal 0.5% AEP plus climate change flood event. The access and egress must be functional for changing circumstances over the lifetime of the development. The NPPF Planning Practice Guidance sets out that:

- Access routes should allow occupants to safely access and exit their dwellings in design flood conditions. In addition, vehicular access for emergency services to safely reach development in design flood conditions is normally required; and
- Where possible, safe access routes should be located above design flood levels and avoid flow paths including those caused by exceedance and blockage. Where this is unavoidable, limited depths of flooding may be acceptable providing the proposed access is designed with appropriate

86 Flood Risk webpage. South Gloucestershire Council. (2021) https://www.southglos.gov.uk/environment/drainage-and-flood-risk-management/flood-risk-2/

87 NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 039, Reference ID: 7-056-20140306) March 2014

signage etc. to make it safe. The acceptable flood depth for safe access will vary as this will be dependent on flood velocities and risk of debris in the flood water. Even low levels of flooding can pose a risk to people in-situ (because of, for example, the presence of unseen hazards and contaminants in floodwater, or the risk that people remaining may require medical attention).

The depth, velocity and hazard mapping from hydraulic modelling should help inform the provision of safe access and egress routes.

As part of an FRA, the developer should review the acceptability of the proposed access in consultation with South Gloucestershire Council and the Environment Agency. Site and plot specific velocity and depth of flows should be assessed against standard hazard criteria to ensure safe access and egress can be achieved.

11.3.3 Potential evacuations

During flood incidents, evacuation may be considered necessary. The **NPPF** Planning Guidance states practicality of safe evacuation from an area will depend on[88]:

1. the type of flood risk present, and the extent to which advance warning can be given in a flood event;
2. the number of people that would require evacuation from the area potentially at risk;
3. the adequacy of both evacuation routes and identified places that people could be evacuated to (and taking into account the length of time that the evacuation may need to last); and
4. sufficiently detailed and up to date evacuation plans being in place for the locality that address these and related issues.

The vulnerability of the occupants is also a key consideration. The NPPF and application of the Sequential Test aims to avoid inappropriate development in flood risk areas. However, developments may contain proposals for mixed use on the same site. In this instance, the NPPF Planning Practice Guidance states that layouts should be designed so that the most vulnerable uses are restricted to higher ground at lower risk of flooding, with development which has a lower vulnerability (parking, open space etc.) in the highest risk areas, unless there are overriding reasons to prefer a different location[89]. Where the overriding reasons cannot be avoided, safe and practical evacuation routes must be identified.

The Environment Agency and Defra provide standing advice for undertaking flood risk assessments for planning applications. Please refer to **the government website**[90] for the criteria on when to follow the standing advice. Under these criteria, you will need to provide details of emergency escape plans for any parts of the building that are below the estimated flood level. The plans should show;

- single storey buildings or ground floors that do not have access to higher floors can access a space above the estimated flood level, e.g. higher ground nearby;
- basement rooms have clear internal access to an upper level, e.g. a staircase; and

88 NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 057, Reference ID: 7-057-20140306) March 2014

89 NPPF Planning Practice Guidance, Reducing the causes and impacts of flooding Paragraph: 053 Reference ID: 7-053-20140306

90 Flood risk assessments if you're applying for planning permission. Defra and the Environment Agency. (2017). https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications

- occupants can leave the building if there is a flood and there is enough time for them to leave after flood warnings[91].

Situations may arise where occupants cannot be evacuated (e.g. prisons) or where it is safer to remain "in-situ" and / or move to a higher floor or safe refuge area (e.g. developments located immediately behind a defence and at risk of a breach). These allocations should be assessed against the outputs of the SFRA and where applicable, a site-specific Flood Risk Assessment to help develop appropriate emergency plans.

11.3.4 Flood warning and evacuation plans

Flood warning and evacuation plans are potential mitigation measures to manage the residual risk, as stated in the NPPF Planning Practice Guidance. It is a requirement under the NPPF that a flood warning and evacuation plan is prepared for sites at risk of flooding used for holiday or short-let caravans and camping and are important at any site that has transient occupants (e.g. hostels and hotels).

A flood warning and evacuation plan should detail arrangements for site occupants on what to do before, during and after a flood as this will help to lessen its impact, improve flood response and speed up the recovery process. The Environment Agency provides practical advice and templates on how to prepare flood plans for individuals, communities and businesses (see text box below for useful links).

It is recommended that emergency planners at South Gloucestershire Council are consulted prior to the production of any emergency flood plan. The council will provide guidance to help local communities to protect their home and valuables and understand what to do before, during and after a flood.

Once the emergency flood plan is prepared, it is recommended that it is distributed to emergency planners at South Gloucestershire Council and the emergency services. When developing a flood warning and evacuation plan, it is recommended that it links in with any existing parish / community level plan. Local Parish Councils should be contacted to establish if a community level plan exists for an area.

Guidance documents for preparation of flood response plans

- **Environment Agency (2012) Flooding – minimising the risk, flood plan guidance for communities and groups**
- **Environment Agency (2014) Community Flood Plan template**
- **Environment Agency Personal flood plans**
- **ADEPT and the Environment Agency (2019) - Flood Risk Emergency Plans for New Development**

91 Environment Agency and DEFRA (2012) Flood Risk Assessment: Standing Advice: https://www.gov.uk/flood-risk-assessment-standing-advice

12 Strategic Flood Risk Solutions

This chapter provides information on strategic flood risk solutions (for example flood storage schemes and natural flood management) and how these could be implemented.

12.1 Introduction

Strategic flood risk solutions may offer a potential opportunity to reduce flood risk in the study area. The following sections outline different options which could be considered for strategic flood risk solutions. Any strategic solutions should ensure they are consistent with wider catchment policy and the local policies. It is important that the ability to deliver strategic solutions in the future is not compromised by the location of proposed development. When assessing the extent and location of proposed development consideration should be given to the requirement to secure land for flood risk management measures that provide wider benefits.

Not all measures will be appropriate for all development sites, however this is intended as a guide to identify some of the more common solutions. Discussions should be held with South Gloucestershire Council as the LLFA and the Environment Agency where strategic solutions are being considered to confirm their appropriateness. Design guides for many of these solutions are published by **CIRIA**[92].

12.2 Flood storage schemes

Flood storage schemes aim to reduce the flows passed downriver to mitigate downstream flooding. Development increases the impermeable area within a catchment, creating additional and faster runoff into watercourses. Flood storage schemes aim to detain this additional runoff, releasing it downstream at a slower rate, to avoid any increase in flood depths and/or frequency downstream. According to the **Environment Agency's Fluvial Design Guide**[93], methods to provide these schemes include:

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

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

There are currently 3 flood storage areas in the South Gloucestershire area – a significant area on the River Frome west of Yate; a small area on the Siston Brook north of Warmley; and a small area on the Henbury Trym at Catbrain.

12.3 Natural Flood Management

Developments provide opportunities to work with natural processes of catchments, floodplains, rivers and the coast to reduce flood and erosion risk, benefit the natural environment and reduce costs of schemes. Natural flood management requires integrated catchment management and involves those who use and shape the land. It also requires partnership working with neighbouring authorities, organisations and water management bodies. The Environment Agency has developed **Natural Flood Management (NFM) mapping**[94] which displays opportunities for NFM.

92 CIRIA website. https://www.ciria.org/

93 Environment Agency: Fluvial Design Guide – Chapter 10. (2010). https://assets.publishing.service.gov.uk/media/60549b7a8fa8f545cf209a29/FDG_chapter_10_-_Flood_storage_works.pdf

94 Working with Natural Processes. JBA Consulting, Defra, Environment Agency. (2021) wwnp.jbahosting.com

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

A number of the different NFM approaches and techniques are summarised in the following sections.

12.3.1 Catchment and floodplain restoration

Compared to flood defences and flood storage, floodplain restoration represents the most sustainable form of strategic flood risk solution, by allowing watercourses to return to a more naturalised state, and by creating space for naturally functioning floodplains working with natural processes.

Although the restoration of floodplain is difficult in previously developed areas where development cannot be rolled back, the following measures should be adopted:

- Promoting existing and future brownfield sites that are adjacent to watercourses to naturalise banks as much as possible. Buffer areas around watercourses provide an opportunity to restore parts of the floodplain (see Section 9.7)
- Removal of redundant structures to reconnect the river and the floodplain
- Apply the Sequential Approach to avoid new development within the floodplain.

For those sites considered within the Local Plan Review and/or put forward by developers, that also have watercourses flowing through or past them, the sequential approach should be used to locate development away from these watercourses. This will ensure the watercourses retain their connectivity to the floodplain. Loss of floodplain connectivity could potentially increase flooding.

12.3.2 Re-naturalisation

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

12.4 Structure removal and/ or modification

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

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

must be recognised that some artificial structures may have important functions or historical/cultural associations, which need to be considered carefully when planning and designing restoration work.

In the case of weirs, whilst removal should be investigated in the first instance, in some cases it may be necessary to modify a weir rather than remove it. For example, by lowering the weir crest level or adding a fish pass. This will allow more natural water level variations upstream of the weir and remove a barrier to fish migration.

12.5 Bank stabilisation

Bank erosion should be avoided, and landowners encouraged to avoid using machinery and vehicles close to or within the watercourse except where required for maintenance.

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

12.6 Flood defences

There are a number of formal flood defences present within the Local Plan area (see Section 8 for further information). The flood risk at several potential sites identified within South Gloucestershire could be influenced by the presence of these defences. At these locations it will be important to understand the benefit that defences can have on reducing flooding, and consequences if their design standard is exceeded or they fail. Residual risk of these defences should be understood and managed. Maintenance arrangements, including funding mechanisms, for the defences will need to be evidenced for the lifetime of development.

12.7 Green Infrastructure

Green infrastructure (GI) is a planned and managed network of natural environmental components and green spaces that intersperse and connect the urban centres, suburbs and rural fringe and consist of:

- Open spaces – parks, woodland, nature reserves, lakes
- Linkages – River corridors and canals, and pathways, cycle routes and greenways
- Networks of "urban green" – private gardens, street trees, verges and green roofs.

The identification and planning of Green Infrastructure is critical to sustainable growth. It merits forward planning and investment as much as other socio-economic priorities such as health, transport, education and economic development. GI is also central to climate change action and is a recurring theme in planning policy. With regards to flood risk, green spaces can be used to manage storm flows and free up water storage capacity in existing infrastructure to reduce risk of damage to urban property, particularly in city centres and vulnerable urban regeneration areas. Green infrastructure can also improve accessibility to waterways and improve water quality, supporting regeneration and improving opportunity for leisure, economic activity and biodiversity.

12.8 Engaging with key stakeholders

Flood risk to an area or development can often be attributed to a number of sources such as fluvial, surface water and/or groundwater. In rural areas the definition between each type of flood risk is more distinguished. However, within urban areas flooding from multiple sources can become intertwined. Where complex flood risk issues are highlighted

it is important that all stakeholders are actively encouraged to work together to identify issues and provide suitable solutions.

Engagement with riparian owners is also important to ensure they understand their rights and responsibilities including:

- maintaining river bed and banks;
- allowing the flow of water to pass without obstruction; and
- controlling invasive alien species e.g. Japanese knotweed.

More information about riparian owner responsibilities can be found in the Environment Agency's guidance on **Owning a Watercourse**[95] (2018).

12.9 Potential future strategic flood risk schemes

As part of the government's new **Flood and Coastal Resilience Innovation Programme**[96], the Environment Agency will manage the Frome Catchment Innovation Programme, which aims to restore the River Frome catchment by using a mix of flood resilience measures that mirror the rural to city nature of the river's catchment. Although administered by Bristol City Council, the scheme will have cross-boundary relevance with South Gloucestershire Council, and will be delivered via the Yate Masterplan and Frome Gateway regeneration initiative.

95 Guidance: Owning a watercourse. Environment Agency. (2018). https://www.gov.uk/guidance/owning-a-watercourse

96 Press release - Innovative projects to protect against flooding selected. Defra, Environment Agency. (2021). https://www.gov.uk/government/news/innovative-projects-to-protect-against-flooding-selected

13 Level 1 summary assessment of potential development locations

This section details the site screening of potential development sites that was carried out as part of the Level 1 SFRA, as well as the cumulative impact assessment. Refer to Appendix D for recommendations and details and details on how to apply the Sequential and Exception tests using the data set out in this section.

Introduction

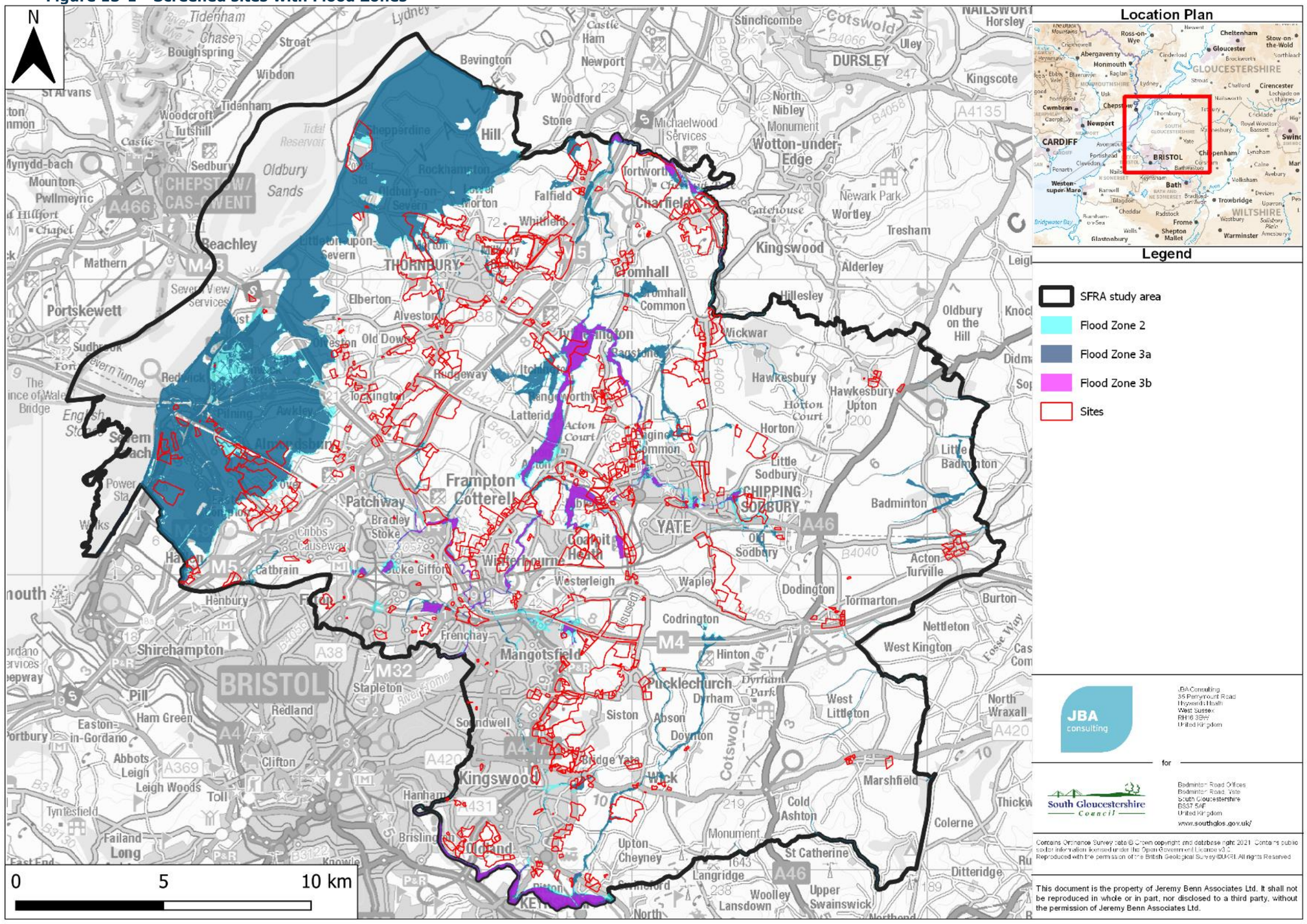
A total of 496 sites were provided by South Gloucestershire Council as shown in Figure 13-1. These sites were identified through South Gloucestershire Council's recent Call for Sites processes, including the most recent 2020 Call for Sites. They have been screened against a suite of available flood risk information and spatial data to provide a summary of risk to each site (see Appendix C).

The information considered includes the flood risk datasets listed below:

- Environment Agency Flood Zones 1, 2 and 3
- Flood Zone 3b
- Environment Agency Risk of Flooding from Surface Water
- Environment Agency Historic Flood Map
- JBA Groundwater Flood Map

A site screening spreadsheet has been prepared which identifies the proportion of each site that is affected by the different sources of flooding. The information provided is intended to enable a more informed consideration of the sites when applying the sequential approach. The site screening spreadsheet has been used to determine whether more detailed assessment of sites is needed to further identify those that should be taken forward as potential development allocations for a Level 2 assessment.

Figure 13-1 - Screened sites with Flood Zones



13.1 Overview of flood risk at identified sites

A summary of flood risk at each of the sites in light of the screening is provided below:

- The majority of the sites have Flood Zone 1 comprising the largest proportion of their area, with 373 sites completely located within Flood Zone 1.
- 123 sites are wholly or partially located in Flood Zone 2
- 118 sites are wholly or partially located in Flood Zone 3a
- 39 sites are partially located in Flood Zone 3b
- 358 sites are predicted to be at risk during a current day 0.1% AEP surface water flood event
- 238 sites are predicted to be at risk during a current day 1% AEP surface water flood event
- 179 sites are predicted to be at risk during a current day 3.33% AEP surface water flood event
- 35 sites intersect the Environment Agency's historic flood outlines
- 91 sites are predicted to have groundwater levels which are either at or very near (within 0.025m of) the ground surface
- 191 sites are predicted to have groundwater levels which are between 0.025m and 0.05m of the ground surface

13.2 Sequential Testing

The SFRA does not include the Sequential Test of the development sites that were screened. However, Appendix K summarises the flood risk to the potential and confirmed development sites and provides evidence for use in the completion of the Sequential Test.

NPPF Planning Practice Guidance for Flood Risk and Coastal Change describes how the Sequential Test should be applied in the preparation of a Local Plan Review. The assessments undertaken for this SFRA will assist South Gloucestershire Council in the preparation of the Sequential Test.

13.3 Cumulative impacts of development on flood risk

Cumulative impacts are defined as the effects of past, current and future activities on the environment. Since the publication of the 2018 NPPF, strategic policies and their supporting Strategic Flood Risk Assessments, are required to 'consider cumulative impacts in, or affecting, local areas susceptible to flooding' (para 156).

When allocating land for development, consideration should be given to the potential cumulative impact on flood risk within a catchment. Development increases the impermeable area within a catchment, which if not properly managed, can cause loss of floodplain storage, increased volumes and velocities of surface water runoff, and result in heightened downstream flood risk. Whilst individual development with appropriate site mitigation measures should not result in measurable local effects with respect to hydrology and flood risk, the cumulative effect of multiple development may be more severe at downstream locations in the catchment. Locations where there are existing flood risk issues with people, property or infrastructure will be particularly sensitive to cumulative effects.

The cumulative impact should be considered throughout the planning process, from the allocation of sites within the Local Plan, to the planning application and development design stages. The cumulative impacts will be considered in more detail on an individual site basis in a Level 2 SFRA, if this is required. In addition, site-specific FRAs must consider the

cumulative impact of the proposed development on flood risk within the wider catchment area if there are potentially material effects.

As part of the Level 1 SFRA, an assessment of the cumulative effects within catchments in South Gloucestershire has been undertaken.

13.3.1 Approach and methodology

The approach is based on providing an assessment of catchments where the allocation of more than one site could result in effects that increase the flood risk to third parties. At a strategic level this involves comparison of catchments, to assess the quantum of proposed development and the sensitivity of the catchment to changes in flood risk. Historic flooding incidents are also included in the assessment, as these are an indicator of the actual sensitivity of locations within a catchment to flood events.

The methodology deploys a range of metrics to assess the potential cumulative impacts, which provide a balance between predicted and observed flooding data recorded by South Gloucestershire Council and the Environment Agency. In addition, it was considered important to identify those catchments where an increase in flows (as a result of development) would potentially have the greatest impact upon downstream flood risk.

13.3.2 Datasets

Catchments

The WFD river catchments defined in the River Basin Management Plans and LIDAR data were used to divide South Gloucestershire into manageable areas on which to base a cumulative impact assessment.

Current developed area

OS Open Zoomstack data buildings layer was used to assess the current developed area in each catchment.

Proposed level of growth

To understand areas of South Gloucestershire that are likely to experience the greatest pressure for future growth, all potential future development sites received for consideration though the Call for Sites have been analysed. The sites allocated through the Local Plans of neighbouring authorities have also been taken into account within the proposed level of growth for each catchment.

This allowed the calculation of the overall increase in development from the existing scenario to identify catchments likely to be under the greatest pressure for development. The context for this being that in circumstances where the proportion of proposed new development is greater, then it is more likely to give rise to cumulative effects.

It should be noted that it was assumed that all sites will be developed, and that the entire site footprint would be developed.

Historic Flood Risk

A historic flood risk score was derived for each catchment within the study area using the total current number of National Receptor Database (NRD) properties within the Environment Agency's historic flood map extent in each catchment.

Properties sensitive to increased flood risk

It is important to understand which catchments are most sensitive to increases in flood flows which may theoretically be caused by new development. Predicted flood risk was assessed using the following datasets:

- Total number of NRD properties within the merged 1% AEP surface water flooding extent and Flood Zone 3a for each catchment

- Total number of NRD properties within the merged 0.1% AEP surface water flooding extent and Flood Zone 2

The difference in the number properties at risk in these two datasets has then been used as an indicator to identify which catchments are more sensitive to increases in flood flows.

13.3.3 Ranking of catchments

To identify which catchments are more sensitive to cumulative impacts, each catchment was given a ranking for each of the three metrics (proposed level of growth, historic flood risk and properties sensitive to growth). These rankings were then combined to give an overall ranking which was divided into three categories - high, medium, and low according to how sensitive each catchment is to cumulative impacts relative to one another.

13.3.4 Conclusions of the Cumulative Impact Assessment

A summary of the Cumulative Impacts Assessment results is shown in Figure 13-2. The Cumulative Impact Assessment highlights areas where there is a high chance of encountering cumulative effects from planned development. In these catchments this should be considered by developers and specifically addressed within FRAs for proposed development.

Including consideration of cumulative effects requires that FRAs should assess:

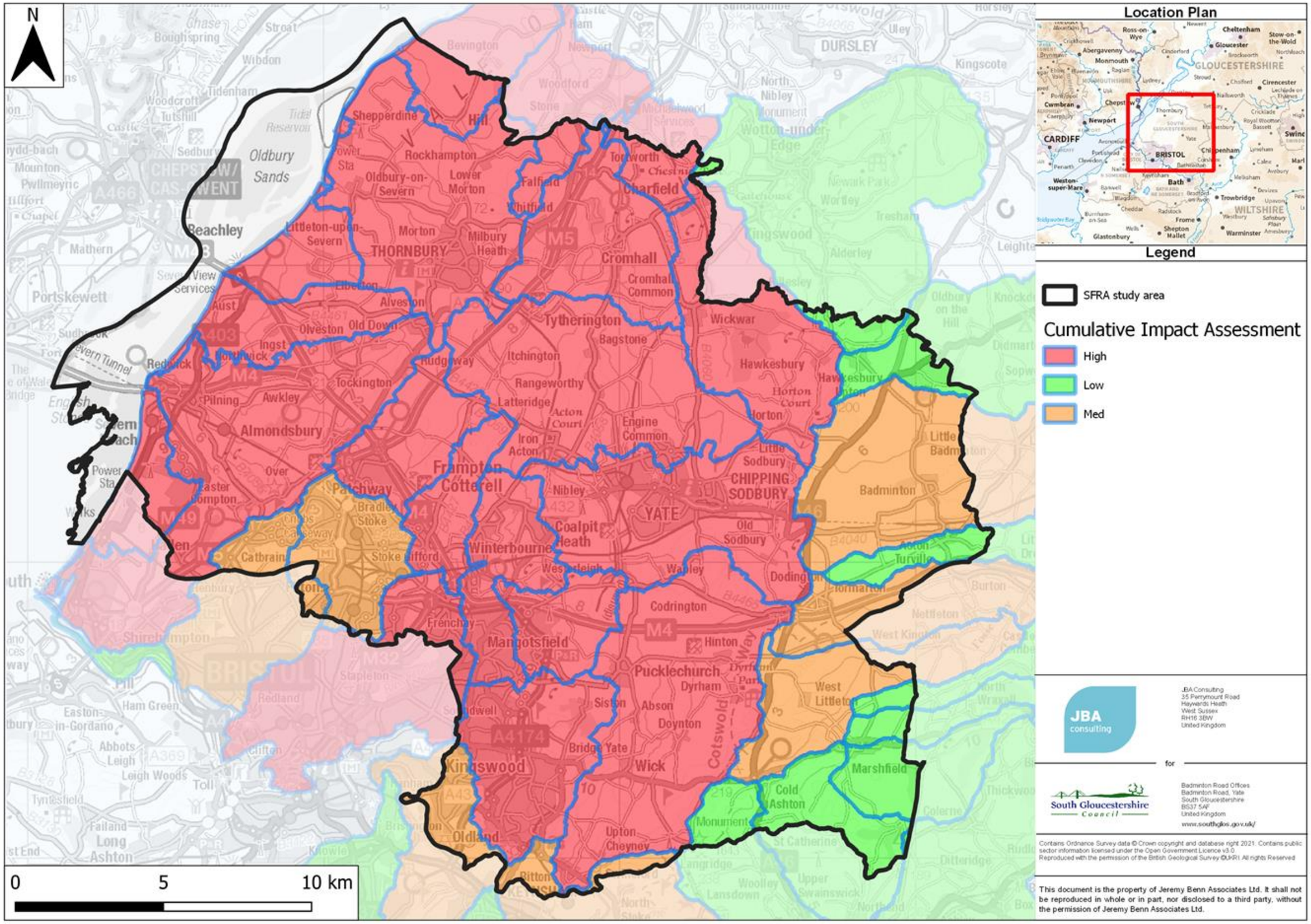
- The location and sensitivity of receptors to cumulative effects and the mechanisms that potentially result in flooding (e.g. locations that are reliant on the performance of pumped drainage systems to manage flood risk, locations where existing flooding is experienced and can be exacerbated by relatively small changes in flood flow magnitude, volume or flood duration, etc).
- The potential quantum of proposed cumulative development within a River Basin and assessment of the effect on sensitive receptors of the cumulative benefit afforded by piecemeal mitigation at the respective allocation sites.
- The requirement for measures to address potential cumulative effects (these can be both 'on-site' measures and contributions to strategic 'off-site' measures).
- The opportunity to integrate site mitigation measures with strategic flood risk management measures planned in the River Basin.
- The long-term commitments to management and maintenance.

13.3.5 Next steps

The Cumulative Impact Assessment is used in the following ways:

- The assessment highlights the catchments in South Gloucestershire where the cumulative impacts of development on flood risk could potentially be greatest. Developers and South Gloucestershire Council should take the assessment into consideration when identifying appropriate sites for development.
- For sites in catchments identified as being at high or medium risk of cumulative impacts FRAs should contain an assessment of the potential cumulative impacts of development further as outlined within Section 13.4.4.
- If sites are taken forward to a Level 2 SFRA, the cumulative impacts of development will be considered in further detail.

Figure 13-2 - Cumulative Risk Assessment of WFD catchments within South Gloucestershire



14 Summary

14.1 Overview

This Level 1 SFRA delivers a strategic assessment of all sources of flooding in the Local Plan area. It also provides an overview of policy and provides guidance for planners and developers.

The study area comprises the administration area of South Gloucestershire Council.

14.2 Sources of flood risk

The sources of flood risk in the study area have been assessed, further information on the data sources used can be found in Section 6 and the findings can be found in Section 7. A summary is outlined below.

14.2.1 Historic flooding

There have been several recorded flood incidents across the area of South Gloucestershire, with the most frequent sources of flooding being fluvial and surface water in the inland catchments, tidal flooding along the coastline, and a combination of both fluvial and tidal on the coastal plain. The most significant food incidents occurred in 1977, when tidal flooding occurred in Severn Beach; 2009, when high surface water runoff combined with reduced rhine capacity and sewer flooding caused internal flooding of properties in Aust,; and in 2013/14, when extensive rainfall caused a number of localised flood incidents, the majority associated with main rivers, including the Avon, Frome, and Ladden Brook.

14.2.2 Fluvial flood risk

The River Frome, River Avon, Little Avon and the Ladden Brook are the main watercourses within the Local Plan area identified to be contributing to fluvial flood risk. Flooding on the lower reaches of ordinary watercourses discharging into the Severn Estuary, such as in Oldbury-on-Severn, can be influenced by tidal levels with the potential for tidal locking to occur where incoming high tides prevent fluvial flows from discharging into the sea.

Flood Zone mapping of the fluvial flood risk in the Local Plan area has been prepared as part of the Level 1 SFRA and can be found in Appendix A and D. The key settlements identified to be at risk from fluvial flooding include Yate, Chipping Sodbury, and Bitton.

14.2.3 Tidal flood risk

South Gloucestershire is bounded to the north-west by the Severn Estuary. As such, the coastline is at risk of tidal flooding. A number of tidal flood events have been recorded along the coast, including in Severn Beach and Oldbury-on-Severn due to overtopping of defences.

Appendix A shows the tidal Flood Zones.

The tidal flood risk to the Local Plan area has been based on the Severn House Farm and North Coast tidal models.

14.2.4 Surface water flood risk

The Risk of Flooding from Surface Water dataset shows that surface water predominantly follows topological flow paths of existing watercourses, dry valleys or roads, with some areas of ponding upslope of topographic features including railway lines and roads. The areas of greatest risk within the Local Plan area include properties within Yate, Thornbury, and Mangotsfield.

High groundwater can increase surface water risk. This is largely present on the coastal plain near Thornbury and inland between Tytherington and Yate, where the water table lies close to the surface increasing ground saturation. Tide locking is also an issue where high

tides prevent surface water from draining from gravity outfalls along the defended coastal plain.

14.2.5 Groundwater flood risk

The JBA Groundwater Flood Map identifies the majority of South Gloucestershire to be at a negligible risk of groundwater flooding. Localised areas of higher risk are located in the coastal plain near Thornbury, and in the Frome/Ladden Brook catchment between Tytherington and Yate.

It should be noted that as this information is based on a national dataset there may be localised differences in groundwater flood risk. Planners and developers should consult the LLFA to find out if they hold any local information.

14.2.6 Sewer flood risk

Historical incidents of sewer flooding are detailed by the Wessex Water's SIRF. This database records incidents of flooding related to public foul, combined or surface water sewers and identifies which postcode areas have been impacted by flooding. A total of 32 incidents have been recorded in South Gloucestershire between April 2004 and August 2020.

14.2.7 Flooding from reservoirs

Outlines from the Risk of Flooding from Reservoirs dataset (informed from the National Reservoir Inundation Mapping) shows worst case inundation extents of nine reservoirs impacting the Local Plan area. Areas at risk of flooding from reservoirs include Bitton and Warmley, Pucklechurch and land near Lyde Green.

14.3 Flood defences

A high-level review of formal flood defences was carried out using existing information to provide an indication of their condition and standard of protection. Details of the flood defence locations and condition were provided by the Environment Agency for the purpose of preparing this assessment and can be found in Appendix J.

All main rivers in South Gloucestershire have fluvial defences along their lengths, largely consisting of high ground and embankments along with sections of walls, demountable defences, and flood gates. The majority of the coastline in South Gloucestershire is protected by coastal defences including embankments, beaches, demountable defences, cliffs, and flood walls. Most of the flood defences provide a standard of protection between 20% and 50% (i.e. protection will be provided for an event with an annual exceedance probability of up to 50%). Many of the defences are classed as "high ground" which can be the natural ground level, and therefore these defences have a relatively low standard of protection. The Environment Agency defence data shows that most defences within the Local Plan area are in a 'Very good', 'Good' or 'Fair' condition, with a small percentage of defences classified as 'Poor' or 'Very Poor'.

14.4 Key policies

There are many relevant regional and local key policies which have been considered within the SFRA, such as the Severn Estuary Shoreline Management Plan, the Bristol and Avon and Severn Tidal Tributaries Catchment Flood Management Plans, the Severn River Basin District Flood Risk Management Plan, and the South Gloucestershire Local Flood Risk Management Strategy. Other policy considerations have also been incorporated, such as sustainable development principles, climate change and flood risk management.

14.5 Development and flood risk

The Sequential and Exception Test procedures for both Local Plans and Flood Risk Assessments have been documented, along with guidance for planners and developers.

Links have been provided for various guidance documents and policies published by Risk Management Authorities, such as the LLFA and the Environment Agency.

15 Recommendations

A review of national and local policies has been conducted against the information collected on flood risk in this SFRA. Following this, several recommendations have been made for South Gloucestershire Council to consider as part of Flood Risk Management in the study area.

15.1 For South Gloucestershire Council

The Local Plan 2020 will contain strategic and non-strategic policies relating to flood risk management and development. South Gloucestershire Council should consider the following recommendations for when drafting its policies for the Local Plan 2020.

15.1.1 Requirements for Level 2 SFRA

This report fulfils Level 1 SFRA requirements. Following the application of the Sequential Test, where sites cannot be appropriately accommodated in Flood Zone 1, South Gloucestershire Council may need to apply the NPPF's Exception Test. In these circumstances, a Level 2 SFRA may be required, to consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

If a Level 2 Assessment is required, any updates to the Environment Agency's climate change allowances will be considered when preparing more detailed assessments of hazards and actual risks.

15.1.2 Buffer Strips Policy

The provision of buffer strips is important in preserving watercourse corridors, flood flow conveyance and future watercourse maintenance and improvement. It also enables the avoidance of disturbing ecology and the structural integrity of riverbanks.

Developers should:

- Not build within 8m from the edge of bank of any Ordinary Watercourse within the District
- Not build within 8m from the edge of bank of any Main River within the District in accordance with the **Environment Permitting Regulations (2016)**[97].
- Maintain a minimum distance of 8m between development and the edge of bank of any Ordinary Watercourse within the Lower Severn IDB maintained by the board, in accordance with local Byelaws.
- Seek opportunities on a site-by-site basis to increase these buffer distances to 'make space for water', allowing additional capacity to accommodate climate change.

An 8m buffer strip around all watercourses in South Gloucestershire is provided in Appendix A.

15.1.3 Sustainable Drainage Policy

- Planning applications for phased developments should 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.

97 Environmental Permitting regulations. UK Government. (2016). https://www.legislation.gov.uk/uksi/2016/1154/contents/made

15.2 For developers

15.2.1 Reduction of flood risk through site allocations and appropriate site design

- Locate new development in areas of lowest risk, in line with the Sequential Test, by steering sites to Flood Zone 1. If a Sequential Test is undertaken and a site at risk of flooding is identified as the only appropriate site for the development, the Exception Test shall be undertaken.
- After application of Exception Test, a sequential approach to site design must be used to reduce risk. Any re-development within areas of flood risk which provide other wider sustainability benefits should provide flood risk betterment and be made resilient to flooding.
- Identify long-term opportunities to remove development from the floodplain and to make space for water.
- Ordinary watercourses not currently afforded flood maps should be modelled to an appropriate level of detail to enable a sequential approach to the layout of the development.
- Differences in flood extents from climate change should be considered by the Council when allocating sites, to understand how much additional risk there could be, where this risk is in the site, whether the increase is marginal or activates new flow paths, whether it affects access/ egress and how much land could still be developable overall
- Ensure development is 'safe', dry pedestrian egress from the floodplain and emergency vehicular access should be possible for all residential development. If at risk, then an assessment should be made to detail the flood duration, depth, velocity and flood hazard rating in the 1% AEP plus climate change fluvial flood event and the 0.5% AEP plus climate change tidal event, in line with FD2320.
- Where there is a residual risk of flooding (from any source) to properties within a development, residential and commercial finished floor levels should be raised above whichever is higher of either 300mm above the 1% AEP plus climate change fluvial flood level, 300mm above the 0.5% AEP plus climate change coastal flood level or 300mm above the general ground level of the site. Finished floor levels for sleeping accommodation should be raised above whichever is higher of either 600mm above the 1% AEP plus climate change fluvial flood level, 600m above the 0.5% AEP plus climate change coastal flood level or 300mm above the general ground level of the site.
- Protect and Promote Areas for Future Flood Alleviation Schemes.
- Safeguard functional floodplain (Flood Zone 3b in Appendix A) from future development.
- Identify opportunities for brownfield sites at risk of flooding to reduce risk and provide flood risk betterment elsewhere, for example, by incorporating flood storage into sites.
- Identify opportunities to help fund future flood risk management through developer contributions (S106 and Community Infrastructure Levy) to reduce risk for surrounding areas.
- Seek opportunities to make space for water to accommodate climate change.

15.2.2 Promote SuDS to mimic natural drainage routes to improve water quality

- SuDS design should demonstrate how constraints have been considered and how the design provides multiple benefits e.g. landscape enhancement, biodiversity, recreation, amenity, leisure and the enhancement of historical features.
- Planning applications for phased developments should 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.
- Use of the SuDS management train to prevent and control pollutants to prevent the 'first flush' polluting the receiving waterbody.
- SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.

15.2.3 Reduce surface water runoff from new developments and agricultural land

- SuDS should be considered and implemented as part of all new development, in line with South Gloucestershire Council's **Supplementary Planning Document on SuDS** document
- Space should be provided for the inclusion of SuDS on all allocated sites and outline proposals
- Promote biodiversity, habitat improvements and **Countryside Stewardship schemes**[98] to help prevent soil loss and to reduce runoff from agricultural land

15.2.4 Enhance and restore river corridors and habitat

- Liaise with other asset owners to assess condition of existing assets and upgrade, if required, to ensure that the infrastructure can accommodate pressures / flows for the lifetime of the development.
- Natural drainage features should be maintained and enhanced.
- Identify opportunities for river restoration / enhancement to make space for water.
- A presumption against culverting of open watercourses except where essential to allow highways and / or other infrastructure to cross, in line with CIRIA's Culvert screen and outfall manual, (C786 PR) and to restrict development over culverts.
- There should be no built development within 8m from the top of a Main River or ordinary watercourses outside of IDB areas within the Local Plan area. No built development should take place within 8m of a watercourse within the Lower Severn IDB where these are maintained by the Board. These restrictions are in place for the preservation of the watercourse corridor, wildlife habitat, flood flow conveyance and future watercourse maintenance or improvement.
- There should be no built development within 15m of the foot of the landward side of any sea defences or between the low water mark of medium tides and the seaward side of any sea defence.

98 Runoff and soil erosion risk assessment: Countryside Stewardship. UK Government. (2020). https://www.gov.uk/government/publications/countryside-stewardship-runoff-and-soil-erosion-risk-assessment

15.2.5 Mitigate against risk, improved emergency planning and flood awareness

- Work with emergency planning colleagues and stakeholders to identify areas at highest risk and locate most vulnerable receptors away from these areas.
- Exceedance flows, both within and outside of the site, should be appropriately designed to minimise risks to both people and property.
- For a partial or completely pumped drainage system, an assessment should be undertaken to assess the risk of flooding due to any failure of the pumps. The design flood level should be determined if the pumps were to fail; if the attenuation storage was full, and if a design storm occurred.
- An emergency overflow should be provided for piped and storage features above the predicted water level arising from a 100-year rainfall event, inclusive of climate change and urban creep.
- Consideration and incorporation of flood resilience measures up to the 1 in 1,000-year event.
- Ensure robust emergency (evacuation) plans are produced and implemented for major developments.
- Increase awareness and promote sign-up to the Environment Agency Flood Warnings Direct (FWD) within South Gloucestershire.

15.2.6 Internal Drainage Boards

When carrying out development within the Lower Severn Internal Drainage Board district developers should:

- Consult with (where relevant) Lower Severn Internal Drainage Board at an early stage to discuss flood risk including requirements for site-specific Flood Risk Assessments, detailed hydraulic modelling, and drainage assessment and design.
- For development outside of the IDB but where the site is intended to discharge into a hydrological catchment of the Board developers should:
- Consult with (where relevant) Lower Severn Internal Drainage Board at an early stage to discuss whether a site-specific FRA is required.
- Consult with (where relevant) Lower Severn Internal Drainage Board at an early stage to confirm the maximum discharge rate from the site.
- Pay the necessary discharge consents.

15.3 Technical recommendations

15.3.1 Potential modelling improvements

The Environment Agency regularly reviews its flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a site-specific FRA. It should be noted that parts of the North Coast Tidal model, which covers much of the Severnside area has not been updated since 2012.

15.3.2 Climate change modelling

This SFRA is based on the best available data at the time of publication and no climate change modelling has been undertaken for this study. New allowances for peak river flows and peak rainfall intensity are expected to be published by the Environment Agency later in 2021. It is recommended that existing modelling is updated to take advantage of the new climate change allowances.

15.3.3 Updates to SFRA

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

Other datasets used to inform this SFRA may also be periodically updated and following the publication of this SFRA, new information on flood risk may be available from Risk Management Authorities.

It is recommended that the SFRA is reviewed internally, in line with the Environment Agency's Flood Zone map updates to ensure latest data is still represented in the SFRA, allowing a cycle of review and a review of any updated data by checking for any new information available from RMAs including the Environment Agency, South Gloucestershire Council and the Lower Severn Internal Drainage Board.

Appendices

Offices at

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