Horsham Strategic Flood Risk Assessment

Horsham District Council

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Quality information

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Revision History

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Abbreviations

ACRONYM	DEFINITION
AEP	Annual Exceedance Probability
AOD	Above Ordnance Datum
AStGWF	Areas Susceptible to Groundwater Flooding
BGS	British Geological Survey
CFMP	Catchment Flood Management Plan
Defra	Department for Environment, Flood and Rural Affairs
MHCLG	Ministry of Housing, Communities and Local Government
FRA	Flood Risk Assessment
FWMA	Flood and Water Management Act 2010
GIS	Geographical Information System
HDPF	Horsham District Planning Framework
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
LRF	Local Resilience Forum
PPG	Planning Practice Guidance
NPPF	National Planning Policy Framework
RoFSW	Risk of Flooding from Surface Water
SA	Sustainability Appraisal
SDNPA	South Downs National Park Authority
SFRA	Strategic Flood Risk Assessment
SPD	Supplementary Planning Document
SuDS	Sustainable Drainage Systems
TWUL	Thames Water Utilities Limited
WFD	Water Framework Directive

Glossary of Terms

GLOSSARY	DEFINITION
1D Hydraulic Model	Hydraulic model which computes flow in a single dimension, suitable for representing systems with a defined flow direction such as river channels, pipes and culverts
2D Hydraulic Model	Hydraulic model which computes flow in multiple dimensions, suitable for representing systems without a defined flow direction including topographic surfaces such as floodplains
Annual Exceedance Probability (AEP)	Annual Exceedance Probability (AEP) refers to the probability of a flood event occurring in any year. The probability is expressed as a percentage. For example, a large flood which may be calculated to have a 1% chance to occur in any one year is described as 1%AEP.
Aquifer	A source of groundwater comprising water bearing rock, sand or gravel capable of yielding significant quantities of water.
Attenuation	In the context of this report - the storing of water to reduce peak discharge of water.
Catchment Flood Management Plan	A high-level plan through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions. For fluvial events a 70% increase in river flow is applied and for rainfall events, a 30% increase. These climate change values are based upon information within the NPPF and Planning Practice Guidance as at 3rd February 2017.
Design flood	This is a flood event of a given annual flood probability, which is generally taken as: fluvial (river) flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year) including an allowance for climate change, or; The suitability of a proposed development is assessed and mitigation measures, if any, are designed against the design flood. Both should contain a suitable allowance for climate change. https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances .
DG5 Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years. Refer to Map 9 included in Appendix A.
Exception Test	The exception test should be applied following the application of the sequential test. The exception test is a method to demonstrate and help ensure that flood risk to people and property will be managed satisfactorily, while allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available. Conditions need to be met before the exception test can be applied.
Flood Defence	Infrastructure used to protect an area against floods, such as floodwalls and embankments; they are designed to a specific standard of protection (design flood) which is the largest flood that a given project is designed to safely accommodate.
Flood Resilience	Measures that minimise water ingress (e.g. to buildings) and promotes fast drying and easy cleaning, to prevent permanent damage.
Flood Resistant	Measures that prevent flood water entering a building or damaging its fabric. This has the same meaning as flood proof.
Flood Risk	The level of flood risk is the product of the frequency or likelihood of the flood events and their consequences (such as loss, damage, harm, distress and disruption).
Flood Zone	Flood Zones refer to the probability of river and sea flooding ignoring the presence of existing flood defences (i.e. the natural floodplain). It should be noted that Flood Zones on the Environment Agency Flood Map for Planning do not take account of the potential impact of climate change. See Section 6 for further information on Flood Zones https://flood-map-for-planning.service.gov.uk/
Fluvial	Relating to the actions, processes and behaviour of a watercourse (river or stream).
Freeboard	A freeboard is used to account for residual uncertainty within design, often an extra 300mm or 600mm added to finished floor level above the design flood level to account for any uncertainty in flood levels. Refer to section 9.3 for further guidance.
Functional Floodplain	Land where water has to flow or be stored in times of flood.
Groundwater	Water that is in the ground, this is usually referring to water in the saturated zone below the water table.
Impounded Reservoir	A reservoir with outlets controlled by gates that release stored surface water as needed in dry months; may also store water for domestic or industrial use or for flood control. Also known as storage reservoir.
ISIS	A commonly-used 1D hydraulic modelling software package, now under the name of Flood Modeller.

Lead Local Flood Authority (LLFA)	As defined by the Flood and Water Management Act, West Sussex County Council as LLFA are responsible for developing, maintaining and applying a strategy for local flood risk management (flooding from surface water, groundwater and ordinary watercourses) in their areas and for maintaining a register of flood risk assets.
Light Detection and Ranging (LiDAR)	Airborne ground survey mapping technique, which uses a laser to measure the distance between the aircraft and the ground. Within this report, LiDAR has been used to map topography across the District as illustrated in Figure 1.
Local Planning Authority (LPA)	The public authority that is responsible for controlling planning and development through the planning system.
Main River	Watercourse defined on a 'Main River Map' designated by Defra. The Environment Agency has permissive powers to carry out flood defence works, maintenance and operational activities for Main Rivers only.
Mitigation measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere.
Ordnance Datum	In the British Isles, an ordnance datum is a vertical datum used by an ordnance survey as the basis for deriving altitudes on maps. A spot height may be expressed as AOD (Above Ordnance Datum), in this instance meaning above mean sea level at Newlyn in Cornwall.
Ordinary Watercourse	A watercourse that does not form part of a Main River. This includes "all rivers and streams and all ditches, drains, cuts, culverts, dikes, sluices (other than public sewers within the meaning of the Water Industry Act 1991) and passages, through which water flows" according to the Land Drainage Act 1991.
Residual Flood Risk	The remaining flood risk after risk reduction measures have been taken into account. An example of residual flood risk includes the failure of flood management infrastructure, or a severe flood event that exceeds a flood management design standard, such as a flood that overtops a raised flood defences, or an intense rainfall event which the drainage system cannot cope with.
Return Period	Also known as a recurrence interval is an estimate of the likelihood of an event, such as a flood to occur.
Risk	Risk is a factor of the probability or likelihood of an event occurring multiplied by consequence: Risk = Probability x Consequence. It is also referred to in this report in a more general sense.
Sequential Test	Aims to steer vulnerable development to areas of lowest flood risk.
Sewer Flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
Surface Water	Flooding caused when intense rainfall exceeds the capacity of the drainage systems or when, during prolonged periods of wet weather, the soil is so saturated such that it cannot accept any more water.
Sustainable drainage systems (SuDS)	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Topographic survey	A survey of ground levels.
TUFLOW	A modelling package for simulating depth averaged 2D free-surface flows that is in widespread use in the UK and elsewhere for 2D inundation modelling.
Water Framework Directive	The WFD, combines water quantity and water quality issues together. An integrated approach to the management of all freshwater bodies, groundwaters, estuaries and coastal waters at the river basin level has been adopted. The overall requirement of the directive is that all river basins must achieve 'Good ecological status' by 2015 or by 2027 if there are no grounds for derogation. The Environment Agency is the body responsible for the implementation of the WFD in the UK. The Environment Agency have been supported by UKTAG[1], an advisory body which has proposed water quality, ecology, water abstraction and river flow standards to be adopted in order to ensure that the water bodies in the UK (including groundwater) meet the required status[2]. Standards and waterbody classifications are published via River Management Plans (RBMP) the latest of which were completed in 2015.

[1] The UKTAG (UK Technical Advisory Group) is a working group of experts drawn from environment and conservation agencies. It was formed to provide technical advice to the UK's government administrations and its own member agencies. The UKTAG also includes representatives from the Republic of Ireland.
[2] UK Environmental Standards and Conditions (Phase I) Final Report, April 2008, UK Technical Advisory Group on the Water Framework Directive.

User Guide

It is anticipated that this Level 1 SFRA will have a number of end users with slightly different requirements; this Section describes how to use the SFRA and how to navigate the report and mapping deliverables. The report is set out as follows:

- Section 1 Introduction
- Section 2 Study Area
- Section 3 National and Local Policy
- Section 4 Stakeholders and Consultation
- Section 5 SFRA Methodology
- Section 6 Horsham District SFRA
- Section 7 Guidance on the application of the Sequential and Exception Test
- Section 8 Site Specific FRA Guidance
- Section 9 Managing and Mitigating Flood Risk
- Section 10 Summary and Recommendations
- Appendix A- Flood Maps

Strategic Planning and Policy

The main purpose of the Level 1 SFRA for Horsham District Council (DC), as explained in the National Planning Policy Framework (NPPF)[3], is to provide a strategic overview of flood risk within the Planning Authority Area in order to enable effective risk-based strategic planning for the future, through the preparation of the Local Plan. Sections 5 and 6 presents the information that should be used by Horsham DC to inform their knowledge of flood risk from all sources throughout their area.

As part of this SFRA, a number of policy options have been developed for the District and presented in Section 9. These should be taken forward to inform the application of the Sequential and Exception Test during the process of allocating development within the Planning Authority Area.

Applying the Sequential Test

The NPPF sets strict tests to protect people and property from flooding which all Local Planning Authorities (LPAs) are expected to follow. The aim of the Sequential Test, under the NPPF, is to steer new development to areas with the lowest probability of flooding. Section 6 provides specific guidance on applying both the Sequential and, where appropriate, Exception Test.

The Exception Test is applied in situations where suitable sites at lower risk of flooding are not available. The Test requires the following three criteria to be fulfilled:

- The development must provide wider sustainability benefits which outweigh the risks of flooding;
- The development must be safe throughout its lifetime and must not increase flood risk elsewhere, and;
- Where possible, the development should reduce flood risk overall.

Compliance with the Exception Test requires a detailed assessment of flood risk to a specific site, for example to quantify flood hazard. This level of information is provided in a Level 2 SFRA and is not addressed in this Level 1 SFRA report.

[3] MHCLG (July 2018 - updated February 2019). *Revised National Planning Policy Framework*. Available at: https://www.gov.uk/government/collections/revised-national-planning-policy-framework

Emergency Planning

Horsham DC is a Category One Responder under the Civil Contingencies Act 2004[4] and therefore has a responsibility, along with other organisations, to develop emergency plans to help reduce, control or ease the effects of an emergency. Horsham DC is part of the Sussex Resilience Forum, a partnership of local organisations including emergency services, the Environment Agency, health providers and volunteer and private agencies.

The Level 1 SFRA deliverables should be used by Horsham DC's Emergency Planning team as a useful source of up to date information about flood risk. The SFRA should be reviewed by the team, such that the findings can be incorporated into their understanding of flood risk. Section 6 provides detail on Emergency Planning and Flood Warnings within the Planning Authority Area.

Preparing Site Specific FRAs

The Level 1 SFRA can provide a useful starting point for the preparation of site-specific Flood Risk Assessments (FRAs) for individual development sites as follows;

1. Sections 5 and 6 provide an overview of the key issues within the Planning Authority Area in relation to flood risk;
2. Section 7 provides guidance on the application of the Sequential Test for sites that have not yet been tested by the LPA, as well as details on when the Exception Test is required, and how to apply it;
3. Section 8 provides specific guidance for preparing site specific FRAs in accordance with the checklist presented in the Planning Practice Guidance (PPG)[5]; and,
4. Section 9 provides details of measures that may need to be implemented to manage and mitigate flood risk.

Assessing Planning Applications

Development Management officers who are reviewing site-specific FRAs as part of the planning application process should consult Sections 5 and 6 of the Level 1 SFRA to provide background for flood risk in the area relating to the planning application. Section 8 can also be used by those assessing applications as a checklist for issues that need to be addressed as part of site specific FRAs.

Living Document

New information may influence future development control decisions within Horsham District. Therefore, it is important that a SFRA is adopted as a 'living' document and is reviewed regularly in light of emerging policy directives, flood risk datasets and an improving understanding of flood risk within the Planning Authority Area. The Level 1 SFRA for Horsham District was first undertaken in 2007 and was updated in 2010. This 2019 SFRA represents the second update of this living document.

This Level 1 SFRA has been developed building heavily upon existing knowledge with respect to flood risk within the Planning Authority Area and considering cross boundary flood risk issues. The Environment Agency review and update the Flood Map for Planning (Rivers and Sea)[6] on a quarterly basis and a rolling programme of detailed flood risk mapping is ongoing. Horsham DC and West Sussex County Council maintain records of flooding and the causes of flooding which are updated as new events occur. This SFRA reviews the available information which was current at the time of publication (2019).

It is important to note that this SFRA does not cover the whole of Horsham District, the South Downs National Park is covered in the South Downs National Park Authority (SDNPA) Level 1 SFRA[7] and the Upper River Mole catchment is covered by the Crawley Borough Strategic Flood Risk Assessment[8].

[4] HSMO (2004) Civil Contingencies Act. Available from: http://www.legislation.gov.uk/ukpga/2004/36/contents
[5] MHCLG (March 2014). Planning Practice Guidance: Flood Risk and Coastal Change. Available at: http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/
[6] Environment Agency (2018) Flood Map for Planning https://flood-map-for-planning.service.gov.uk/
[7] South Downs National Park Authority (2017) Level 1 Update and Level 2 Strategic Flood Risk Assessment. https://www.southdowns.gov.uk/wp-content/uploads/2018/05/TSF-45-Level-1-Update-and-Level-2-Strategic-Flood-Risk-Assessment.pdf
[8] Crawley Borough Council (2007) Strategic Flood Risk Assessment. http://www.crawley.gov.uk/pw/web/int147029

1. Introduction

In its role as the Local Planning Authority (LPA), Horsham DC is currently preparing documents that will form part of the Local Plan to guide future development from 2019 to 2036 and to set the vision for future development across parts of the District. As part of this process, evidence must be collated to inform key planning issues. Since the preparation of the SFRA for Horsham DC in 2007 and its subsequent update in 2010, there have been several changes to flood risk planning policy and guidance. In addition to this, updated datasets have been made available which include improvements to flood mapping and modelling. This updated SFRA builds upon and improves the level of information contained in the legacy 2007 and 2010 SFRA.

1.1 Approach to Flood Risk Management

The National Planning Policy Framework (NPPF)[3] and associated Planning Practice Guidance (PPG)[5] for Flood Risk and Coastal Change emphasise the active role LPAs should take to ensure that flood risk is assessed, avoided, and managed effectively and sustainably throughout all stages of the planning process. The overall approach for the consideration of flood risk set out in Section 1 of the PPG can be summarised as follows:

This has implications for LPAs and developers as described below.

1.1.1 Assess flood risk

The NPPF[3] outlines that Strategic Policies should be informed by a SFRA and should manage flood risk from all sources. Figure 1-1 reproduced from the PPG[5], illustrates how flood risk should be taken into account in the preparation of the Local Plan by Horsham DC. Certain sites will require a site specific FRA as defined in the NPPF. The FRA process is described in further detail in Section 8.

1.1.2 Avoid flood risk

Horsham DC should apply a sequential approach to site selection so that development is, as far as reasonably possible, located where the risk of flooding from all sources is lowest, taking account of current and future impacts of climate change and the vulnerability of future users and property to flood risk.

In plan-making this involves applying the Sequential Test, and where necessary the Exception Test to Local Plans, as described in Figure 1-1.

In decision-making this involves applying the Sequential Test and if necessary, the Exception Test for specific development proposals.

1.1.3 Manage and mitigate flood risk

Where alternative sites in areas at lower risk of flooding are not available, it may be necessary to locate development in areas at risk of flooding. In these cases, Horsham DC and developers must ensure that development is appropriately flood resilient and resistant, safe for its users for the lifetime of the development and will not increase flood risk overall. Horsham DC and developers should seek flood risk management opportunities (e.g. safeguarding land), and to reduce the causes and impacts of flooding (e.g. through the use of sustainable drainage systems).

Figure 1-1 Taking flood risk into account in the preparation of a Local Plan (Planning Practice Guidance for Flood Risk and Coastal Change)

1.2 Purpose of a SFRA

This Level 1 SFRA will help stakeholders consider flood risk when making planning decisions about the design and location of any development and flood risk management features and structures. In order to this, the SFRA will assess and identify:

- The risk of flooding from all sources;
- The cumulative impact that development or changing land use would have on the risk of flooding;
- The effect of climate change on risk;

- Opportunities to reduce the causes and impacts of flooding;
- Ways to manage and mitigate flood risk;
- Guidance on the application of the Sequential and Exceptions Tests; and,
- Guidance on producing site specific flood risk assessments.

The SFRA will help Horsham DC make decisions about:

- the local plan;
- individual planning applications;
- how to adapt to climate change;
- future flood management; and,
- emergency planning (the resources needed to make development safe).

This Level 1 SFRA will collate and analyse the most up to date flood risk information to assess the risks associated with all types of flooding in accordance with the NPPF[3] and PPG[5] and will assess the risks both now and in the future. The SFRA will build on existing hydraulic modelling and available information. A User Guide is available at the start of the document which provides guidance for the sections various parties should refer to for certain tasks.

The purpose of this Level 1 SFRA is not to provide detailed modelling or site specific information. This work would be carried out to inform a Level 2 SFRA which aims to assess the risk of flooding to sites identified within the Local Plan.

2. Study Area

2.1 Local Planning Authority Area

The Horsham Local Plan reviews the strategic issues affecting the Horsham District outside of the South Downs National Park and the Upper River Mole catchment. This area is known as the Planning Authority Area. There are two river catchments within the planning authority area, the River Arun and the River Adur.

The Horsham District is located in the County of West Sussex and is bordered by the authority areas of the South Downs National Park Authority, Waverley Borough Council, Mole Valley District, Crawley Borough Council, Mid Sussex District Council, Brighton and Hove City Council, Adur and Worthing Councils, Arun District Council and Chichester District Council.

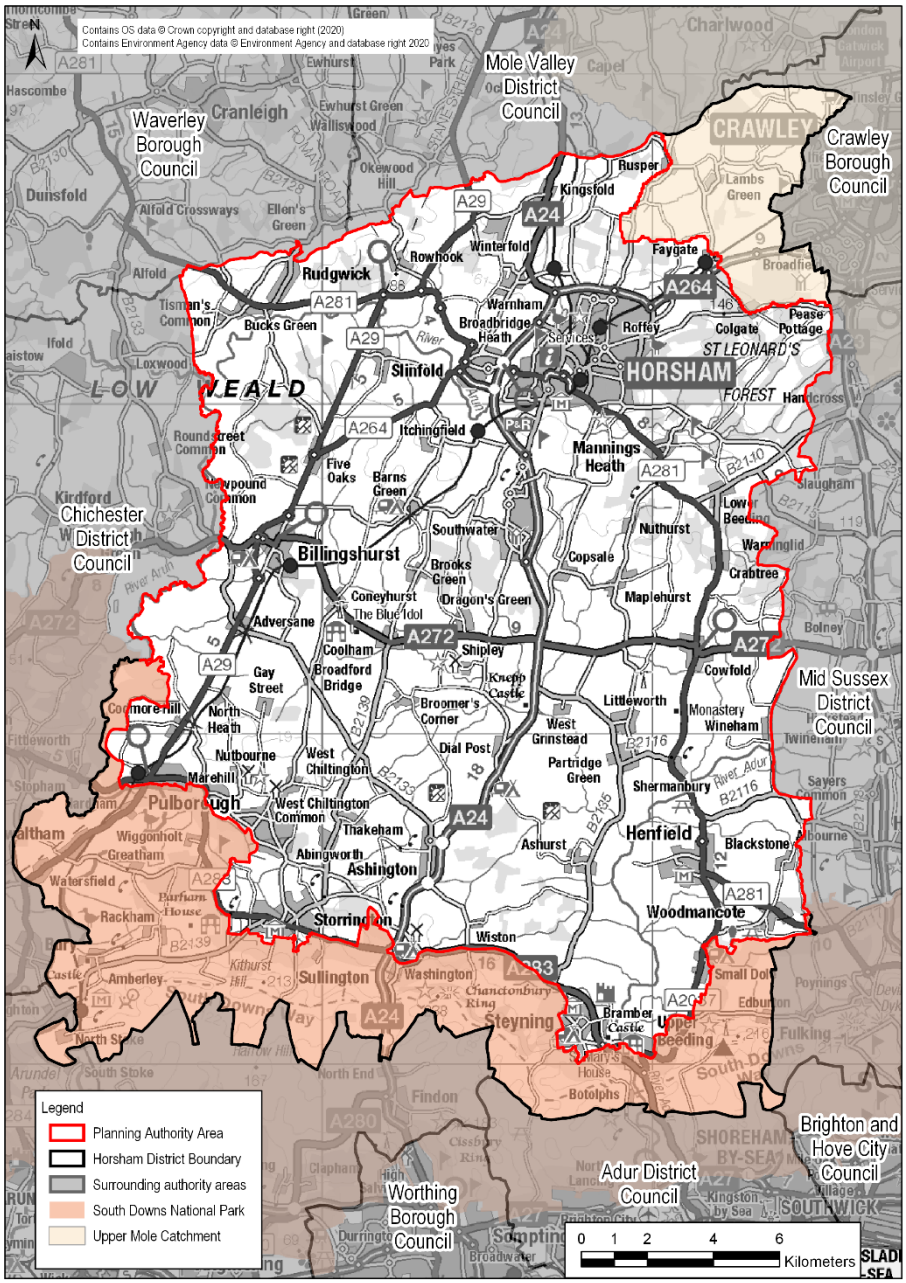

Figure 2-1 Study area and surrounding districts

2.2 Topography

Light Detection and Ranging (LiDAR) topographic survey data[9] is presented in Appendix A Figure 1. The highest point of the District is approximately >120m Above Ordnance Datum (AOD) to the north east of the District, with the lowest point, >25m AOD, along the main rivers and to the south east of the District.

Appendix A, Figure 1 Topography and Watercourses

2.3 Geology

Datasets have been obtained from the British Geological Survey (BGS) website to provide a high-level identification of the superficial deposits and bedrock geology across the District. This is displayed in Appendix A Figure 2 and Figure 3.

Bedrock is the consolidated rock underlying the ground surface. Superficial deposits refer to the more geologically recent deposits (typically of Quaternary age) that may be present above the bedrock such as floodplain deposits, beach sands and glacial drift. Underlying geology can influence the presence and nature of groundwater in an area, and therefore potential groundwater flood risk. The geology can also impact on the potential for infiltration-based drainage systems.

The Wealden Group, consisting of mudstone, siltstone and sandstone, covers the majority of Horsham District. The Lower Greensand Group, Gault Formation and Upper Greensand Formation (undifferentiated) and Grey Chalk Subgroup are present to the south of the District.

In small areas of the District, superficial deposits, of varying thicknesses, overlie the solid deposits. These include Alluvium to the south and River Terrace Deposits (undifferentiated) to the north).

Appendix A, Figures 2A and 2B Bedrock Geology and Superficial Geology

2.4 Hydrogeology

Aquifers are defined as layers of permeable rock or unconsolidated material (sand, gravel, silt etc.) capable of storing and transporting large quantities of water. The understanding of the behaviour and location of aquifers is important as they can provide an indication of the potential for groundwater flooding.

Parts of the Lower Greensand Group bedrock that underlay the study area is described by the Environment Agency as being Principal Aquifers. The Environment Agency describes Principal Aquifers as:

> *'layers of rock or drift deposits that have a high intergranular and / or fracture permeability – meaning they usually provide a high level of water storage. They may support water supply and / or river base flow on a strategic scale'.*

Parts of the Wealden Group bedrock that underlies the study area and the Alluvium and River Terrace Deposits superficial deposits are described by the Environment Agency as being Secondary A Aquifers. The Environment Agency describes Secondary A Aquifers as:

> *'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.'*

Further information on groundwater flooding from aquifers is provided within Section 5.4.

[9] Light Detection and Ranging (LiDAR) is an airborne mapping technique, which uses a laser to measure the distance between the aircraft and the ground. Up to 100,000 measurements per second are made of the ground, allowing highly detailed terrain models to be generated at spatial resolutions of between 25 cm and 2 m. The data covering HORSHAM DC has a spatial resolution of 1m. The Environment Agency's LiDAR data archive contains digital elevation data derived from surveys carried out since 1998.

2.5 Main Rivers

Within the Arun and Adur catchments there are 19 Main rivers (as defined by the Environment Agency) located within the Planning Authority Area and as detailed in Table 2-1. The main rivers are mapped below in

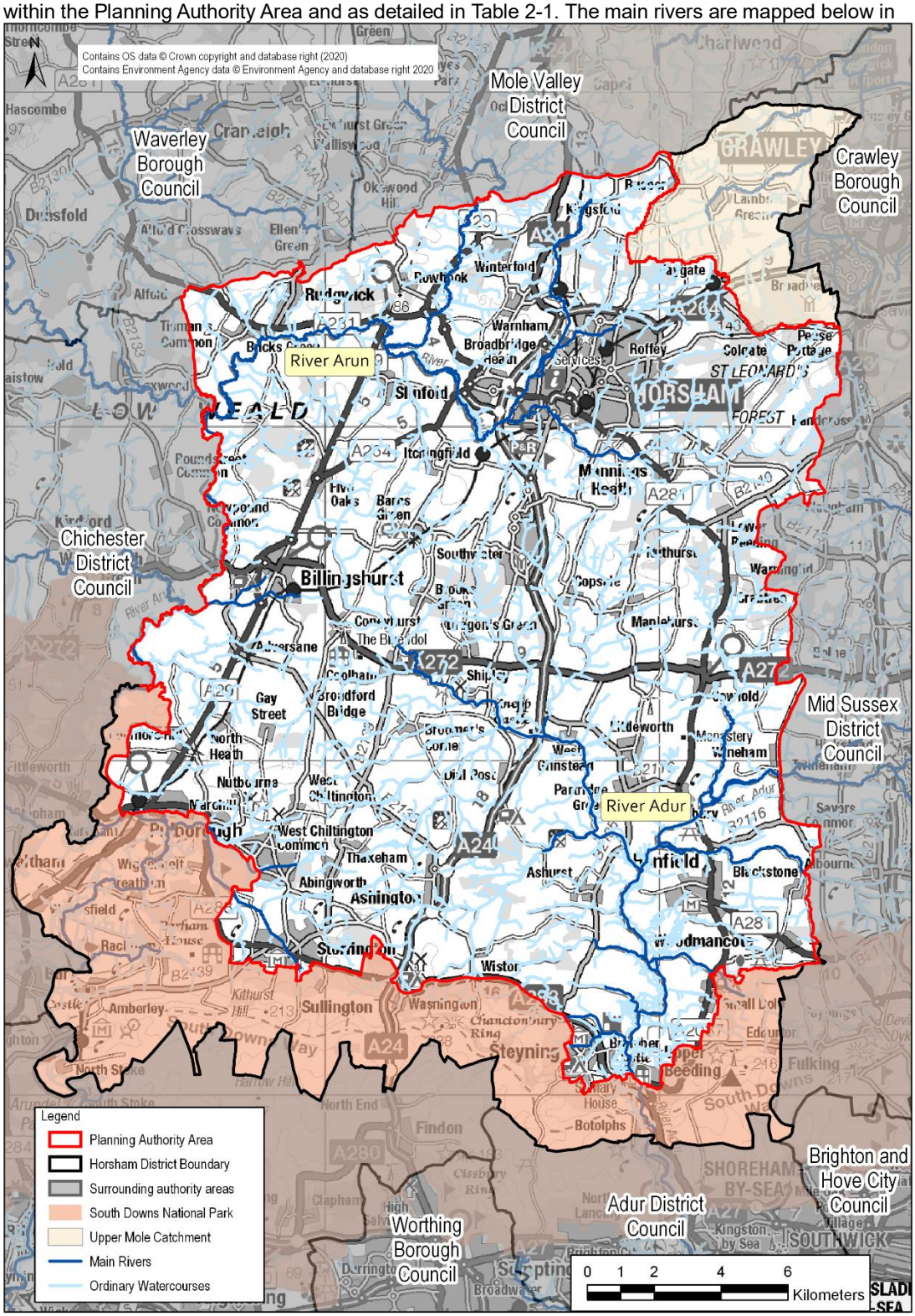

Figure 2-2 and Appendix A Figure 1.

Table 2-1 Rivers and Watercourses in the Planning Authority Area

River Name	Catchment
Channels Brook	River Arun

Warnham Mill Pond	River Arun
Boldings Brook	River Arun
North River	River Arun
River Arun	River Arun
River Lox	River Arun
Par Brook	River Arun
Brockhurst Brook	River Arun
River Stor	River Arun
River Chilt	River Arun
River Adur West Branch	River Adur
Honeybridge Stream	River Adur
Knappmill Stream	River Adur
Blake's Gill	River Adur
River Adur East Branch	River Adur
Cowford Stream	River Adur
Chess Stream	River Adur
Woodsmill Stream	River Adur
Black Sewer	River Adur

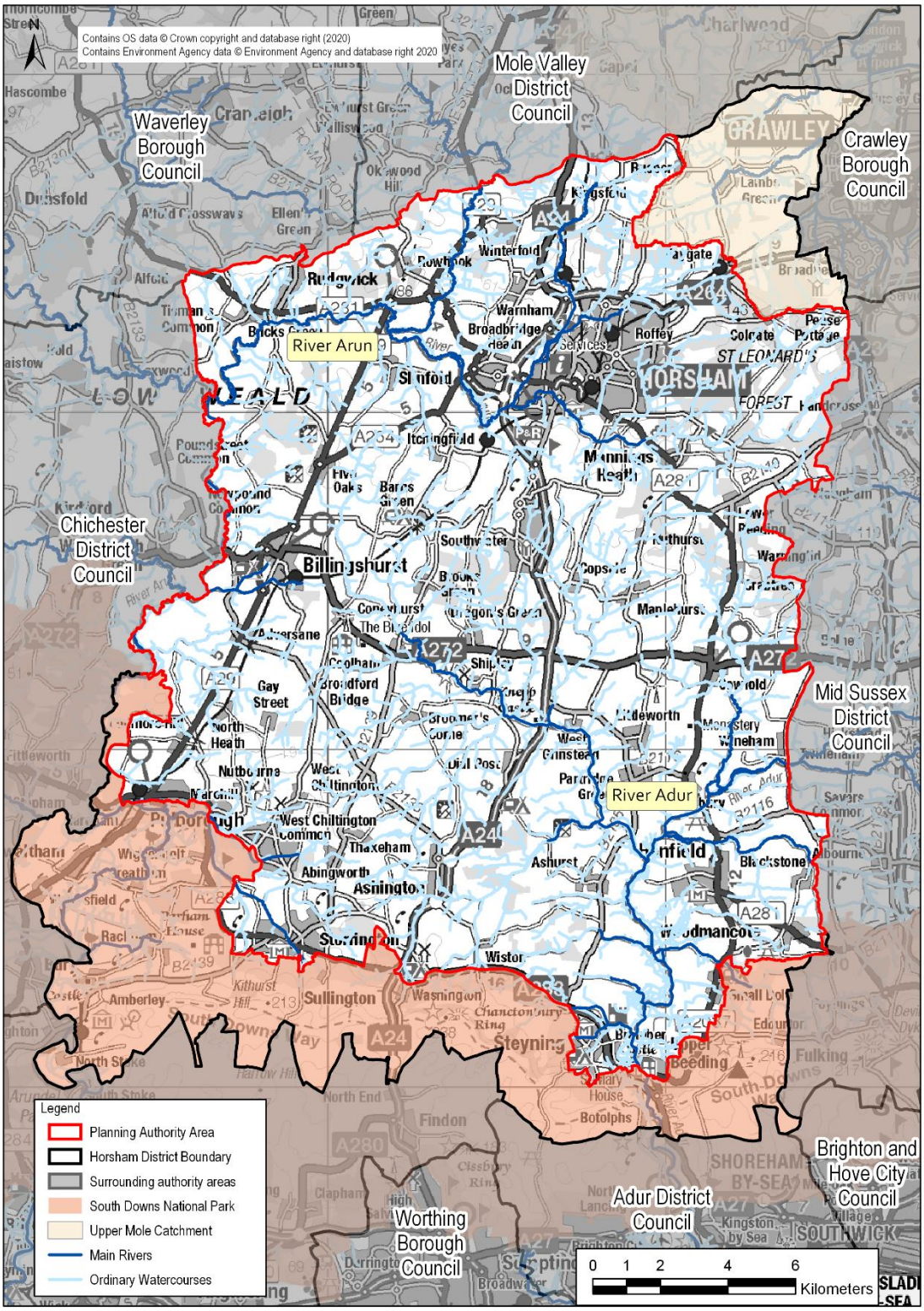

Figure 2-2 Main Rivers and Ordinary Watercourses in Horsham District

2.5.1 The River Arun & Tributaries

The catchment of the River Arun covers the north and western sections of the study area (Figure 2-2). Its source is located at St Leonard's Forest near Horsham, approximately 120m AOD and, like much of the River Adur in Horsham District, it has a flashy nature and responds quickly to heavy rainfall events due to the underlying impermeable Weald Clay and steep topography.

The Upper Arun collects water from the High and Low Weald, which mainly comprises of low permeability Weald Clay, and transfers it downstream to the confluence with the River Rother at Pulborough, which is also the tidal limit. The Upper and Eastern Arun is the reach of the river that covers most of the study area. There are few or no flood defences within this reach of the Arun and no major urban areas are at risk, however, a number of properties in rural areas and in parts of Horsham have been flooded in the past.

The Lower Arun extends from the confluence with the Rother at Pulborough downstream as far as Littlehampton and is influenced by the tide throughout its length. Flood defences exist on both banks of the river along the whole of this section, which currently prevent flooding during events with a return period less than about 3% per year (that is about 1 in 30 years on average). The embankments are overtopped during more severe events, leading to widespread inundation of the floodplain, although recent improvements to the defences within Littlehampton aimed to increase the standard of protection in the town. At Pulborough, floodplain flows are complicated by the presence of road and rail crossings on embankments with culverts/bridge openings as well as abrupt bends in both the rivers and the flanking defences. Overall, there is little risk of property flooding in this middle part of the catchment, although there can be local problems where drains are blocked, or pumps fail in parts of Pulborough where the surface water is pumped into the river (the IDB is now operated by the Environment Agency). There is, however; considerable disruption to transport and extensive flooding of agricultural land during severe events[10].

2.5.2 The River Adur & Tributaries

The River Adur and its tributaries are situated in the High Weald and South Downs Areas of Outstanding Natural Beauty (AONBs). The catchment is largely rural with a few urban centres such as Horsham and the urbanised coastal strip of Brighton and Hove, Shoreham and Worthing.

The entire catchment of the River Adur is in excess of 600km^2 and extends from the south coast at Littlehampton in the west, Brighton and Hove in the east, northwards to Horsham and Haywards Heath. The upper and western branch of the Adur catchment spans most of Horsham District and is underlain by the Weald Clay. As a result, the watercourses respond rapidly to rainfall due to rapid runoff from the low permeability soils. During and after heavy rainfall, areas just outside the various flood zones have experienced surface water flooding as runoff cannot enter the already overloaded watercourses. Although there is little history of flooding to properties in this sub catchment of the Adur, and the risk to existing people and property in this area is considered to be low, it should be noted that increasingly the existing land drainage network over the whole area is struggling to cope with the current and predicted rainfall. Risk to new development may therefore be significant and may increase flood risk elsewhere should there be a significant increase in surface water runoff rates. The risk of flooding to and from sites in the Adur valley should be assessed in detail as part of planning applications.

The mechanisms of flooding in the lower parts of the Adur catchment as this area overlies more permeable chalk soils and geology. Watercourses respond more slowly to rainfall but the chalk can be a source of groundwater flooding. Flooding occurs from a number of sources such as rivers overtopping their defences (fluvial flooding), urban surface water run-off and inadequate local drainage, run-off from fields and groundwater flooding as well as a mixture of tidal and fluvial flooding[11].

2.6 Tidal Influences

Tidal flooding affects both the River Arun and River Adur within the southern areas of the study area. On the River Arun, the tidal limit is at Pallingham Locks, where raised embankment flood defences provide a standard of protection of between 1 in 5 years (20% Annual Exceedance Probability (AEP)) and 1 in 10 years (10% AEP). The River Adur has its normal tidal limit near Partridge Green. The raised embankment flood defences in the area are have a standard of protection of around 1 in 30 years (3% AEP).

There is therefore a risk of tidal flooding within Horsham District (Section 6.2).

[10] Environment Agency (2009) Arun and Western Streams Catchment Flood Management Plan https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/293864/Arun_and_Western_Streams_Catchment_Flood_Management_Plan.pdf

[11] Environment Agency (2009) Adur Catchment Flood Management Plan https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/293867/Adur_Catchment_Flood_Management_Plan.pdf

3. National and Local Policy

3.1 Policy and Guidance Overview

There is an established body of policy and guidance documents which are of particular importance when considering development and flood risk. These are identified in Table 3-1 along with links for where these documents can be found for further detail.

Table 3-1 Flood Risk Policy and Guidance Documents

National Legislative and Policy Documents		
Flood and Water Management Act (2010)	Provides for a more comprehensive management of flood risk, designating roles and responsibilities for different Risk Management Authorities. Designates West Sussex County Council as the Lead Local Flood Authority, with duties and responsibilities for managing local flood risk (defined as flooding from surface water, groundwater and ordinary watercourses).	https://www.legislation.gov.uk/ukpga/2010/29/contents
Flood Risk Regulations (2009)	The Flood Risk Regulations transpose the EU Floods Directive into law in England. It aims to provide a consistent approach to flood risk across Europe.	http://www.legislation.gov.uk/uksi/2009/3042/contents/made
Revised National Planning Policy Framework	The NPPF was published by the UK's MHCLG and updated in February 2019, consolidating over two dozen previously issued documents called Planning Policy Statements (PPS) and Planning Policy Guidance Notes (PPG) for use in England.	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/810197/NPPF_Feb_2019_revised.pdf
National Flood and Coastal Erosion Risk Management Strategy for England (2011)	The National FCERM Strategy sets out the long-term objectives for managing flood and coastal erosion risks and the measures proposed to achieve them. It provides a framework for the work of all flood and coastal erosion risk management authorities.	https://www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england
The Environmental Permitting (England and Wales) Regulations (2016)	In order to complete works on or near a main river, on or near a flood defence structure, in a floodplain or on or near a sea defence. Guidance on obtaining an environmental permit is available from the Environment Agency.	https://www.gov.uk/guidance/flood-risk-activities-environmental-permits http://www.legislation.gov.uk/uksi/2016/1154/contents/made
Water Framework Directive (WFD) 2000/60/EC	The WFD combines water quantity and water quality issues together. An integrated approach to the management of all freshwater bodies, groundwaters, estuaries and coastal waters at the river basin level has been adopted. The overall requirement of the directive is that all river basins must achieve 'Good ecological status' by 2015 or by 2027 if there are no grounds for derogation.	https://ec.europa.eu/environment/water/water-framework/index_en.html
Regional Flood Risk Policy		
Arun and Western Streams Catchment Flood Management Plan (CFMP) and River Adur CFMP	The purpose of the CFMP is to establish flood risk management policies which will deliver sustainable flood risk management for the long term (an Environment Agency Document).	https://www.gov.uk/government/collections/catchment-flood-management-plans
Guidance Documents		
Planning Policy Guidance – Flood Risk and Coastal Change	Advises how to take account of and address the risks associated with flooding and coastal change in the planning process.	http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/
Environment Agency Standing Advice	Guidance on information to be included within robust site-specific Flood Risk Assessments (FRAs).	https://www.gov.uk/guidance/flood-risk-assessment-standing-advice
Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities	A supporting note for the National FCERM Strategy. It provides the UK Climate Projections (UKCP09) climate change factors for river flood flows, extreme rainfall, storm surge and wave climate for each river basin district and provides advice on applying climate change projections in the FCERM. Further detail is presented in Section 3.2.	https://www.gov.uk/government/publications/adapting-to-climate-change-for-risk-management-authorities

Local Documents and Strategies

Horsham District Planning Framework	The Horsham District Planning Framework (HDPF) sets out the planning strategy for Horsham District, excluding the South Downs National Park Authority. The HDPF was agreed in 2015 and sets out our planning strategy up to 2031.	https://www.horsham.gov.uk/__data/assets/pdf_file/0006/28563/Horsham-District-Planning-Framework-2015.pdf
West Sussex Preliminary Flood Risk Assessment (PFRA) and PFRA Addendum	In accordance with the Flood Risk Regulations 2009, West Sussex County Council prepared a PFRA to provide a high-level overview of flood risk from local sources for provision to the Environment Agency, ultimately reporting to Europe. The report was published in 2011 with an addendum published in 2017.	https://www.westsussex.gov.uk/media/1626/west_sussex_pfra.pdf https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/698548/PFRA_West_Sussex_County_Council_2017.pdf
West Sussex Local Flood Risk Management Strategy (LFRMS)	As LLFA, West Sussex County Council has created the LFRMS to understand and manage flood risk within the County.	https://www.westsussex.gov.uk/media/1595/local_flood_risk_management_strategy.pdf
West Sussex LLFA Policy for the Management of Surface Water	The West Sussex policy statement sets out the requirements that the LLFA has for drainage strategies and surface water management provisions associated with applications for development.	https://www.westsussex.gov.uk/media/12230/ws_llfa_policy_for_management_of_surface_water.pdf
West Sussex LLFA Culvert Policy	The Culvert policy document provides an explanation of the agreed West Sussex County Council (LLFA) and District and Borough Council policy regarding the culverting of ordinary watercourses, and a guide to good practice and design principles.	https://www.westsussex.gov.uk/media/10390/culvert_policy.pdf

3.2 Climate Change Policy

Environment Agency guidance 'Flood Risk Assessment Climate Change Allowances'[12], sets out the climate change allowances that should be considered for net sea level rises, peak river flow and peak rainfall intensity across England and Wales. The allowances were updated in December 2019 in line with the findings of UK Climate Projections 2018 (UKCP18).

The lifetime of the development should be considered when determining which future climate change allowance time period should be used. The lifetime of a proposed development should be judged based on the characteristics of the development. In the case of residential developments, a minimum lifetime of 100 years should be taken when selecting climate change allowance percentages. For other types of development, the applicant should assess how long they anticipate the development to be in place for and justify the lifetime of the development. Otherwise, a 75-year lifetime should be used. Therefore, in most cases, it is suggested that applicants used the '2060 to 2115' allowances.

3.2.1 Peak River Flow Climate Change Allowances

Horsham District is within the South East River Basin District. Table 3-2 below outlines the peak river flow allowances which should be used in site-specific FRAs to determine design flood levels. There is no longer a 'blanket %' to be added for climate change allowances. The Environment Agency Flood Zone, the NPPF flood risk vulnerability classification and the lifetime of the development should be used to determine which climate change allowance should be applied to the assessment (as shown in Table 3-3)[12].

Table 3-2 Peak river flow allowances for the South East River basin district (use 1961 to 1990 baseline)[12]

Allowance Category	2010 to 2039	2040 to 2059	2060 to 2115
Upper end	25%	50%	105%
Higher central	15%	30%	45%
Central	10%	20%	35%

[12] Environment Agency (2019) Flood risk assessments: climate change allowances. Available at https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

Table 3-3 Flood Zone and development vulnerability classification used to identify peak river flow allowance category[12]

	Flood Zone 2	Flood Zone 3a	Flood Zone 3b
Essential Infrastructure	Upper End allowance	Upper End allowance	Upper End allowance
Highly Vulnerable	Higher Central and Upper End allowances	Development should not be permitted	Development should not be permitted
More Vulnerable	Higher Central and Upper End allowances	Higher Central and Upper End allowances	Development should not be permitted
Less Vulnerable	Central and Higher Central allowances	Central and Higher Central allowances	Development should not be permitted
Water Compatible	Central allowance	Central allowance	Central allowance

3.2.2 Peak Rainfall Intensity Climate Change Allowance

Table 3-4 shows anticipated changes in extreme peak rainfall intensity in small and urban catchments. The anticipated increase in rainfall intensity may cause greater volumes and rates of rainfall to enter the sewer network during storm events. For the purposes of both site level and strategic flood risk assessments, both the central and upper end allowance should be applied to rainfall allowances to understand a potential range of impact on development changes in climate change could have.

Table 3-4 Peak rainfall intensity allowance in small and urban catchments (use 1961 to 1990 baseline)[12]

Allowance Category	2010 to 2039	2040 to 2059	2060 to 2115
Upper end	10%	20%	40%
Central	5%	10%	20%

3.2.3 Sea Level Allowance

Climate change will increase sea levels and tidal watercourse levels. Although Horsham District is not on the coast, the tidal limit of the Rivers Arun and Adur are within the District Boundary and modelled flood levels within the tidal reaches will need to be adjusted to reflect UKCP18 allowances if carrying out flood risk assessments for sites at risk of tidal flooding. For sites on the west Adur this will apply downstream of the B2135 at Bines Green, and for sites on the east Adur this will apply downstream of St Giles Church Shermanbury. The River Arun is tidal to Pallingham Quay, near Burdocks, so sites downstream of this will also need to be risk assessed using the updated sea level change allowances. Note that these updated allowances are not currently considered in the existing fluvial flood models for these watercourses.

Table 3-5 shows the sea level allowance to be applied to the 1981 to 2000 baseline sea level for each epoch for the South East region.

Table 3-5 Sea level allowance for the South East of England for each epoch in millimetres (mm) per year with cumulative sea level rise for each epoch in brackets (use 1981 to 2000 baseline)[12]

Allowance	2000 to 2035	2035 to 2065	2066 to 2095	2096 to 2125	Cumulative rise 2000 to 2125 / metres (m)
Higher Central	5.7 (200 mm)	8.7 (261 mm)	11.6 (348 mm)	13.1(393 mm)	1.2 m
Upper End	6.9 (242)	11.3 (339)	15.8 (474)	18.2 (546)	1.6 m

4. Stakeholders and Consultation

4.1 Responsibilities

Within the Horsham DC area there are a number of authorities responsible for or involved with flood and/or water management. Table 4-1 shows who is responsible within the District.

Table 4-1 Responsibilities and duties for managing flood risk in Horsham

Source of Flooding	Environment Agency	West Sussex County Council	Horsham DC	Southern Water and TWUL	Highways England	Riparian Owners
Fluvial Flooding from Main Rivers	✓					✓
Fluvial Flooding from Ordinary Watercourses		✓	✓[13]			✓
Surface Water flooding		✓	✓[10]			
Groundwater Flooding		✓	✓[10]			
Sewer Flooding				✓		
Reservoir Flooding	✓					✓
Highways flooding		✓			✓	✓

Table 4-2 shows the organizations that are statutory and non-statutory planning consultees for flood risk issues within the District.

Table 4-2 Planning consultees for flood risk issues in Horsham District

Flood Risk Issue	Environment Agency	West Sussex County Council	Horsham DC Drainage	Southern Water and TWUL
Flood Zones 2 & 3	All development (except minor development and access & egress issues).		Development with access and egress issues & Minor development.	
Surface water drainage from site		All major developments (≥10 dwellings, commercial ≥ 1000m^2).	1-9 dwellings and new commercial buildings ≤1000m^2.	Where development connects to a Southern Water/TWUL sewer (non-statutory).
Surface Water Indicative Flood Problem Areas			All new buildings/ change of use to dwellings.	
Groundwater Indicative Flood Problem Areas			All new buildings/ change of use to dwellings.	
Ordinary watercourses		Works in Ordinary Watercourses (Non-Statutory).		
Main river	Works within 20m of a designated Main River.			
Sewerage	Major development not using a main sewer.			Where development connects to a Southern Water sewer (non-statutory).

[13] Under the amended Land Drainage Act 1991 section 14A, district councils do have some limited powers. These powers include maintaining, repairing, operating and improving existing works; construct or repair new works; maintain or restore natural processes, monitor, investigate and survey a location or natural process, alter the water level, and alter or remove works as long as this is in line with West Sussex County Council's Local Flood Risk Management Strategy

4.2 Consultation

Under the Localism Act 2011[14], there is now a legal duty on Horsham DC to co-operate with other local LPAs, County Councils and other Prescribed Bodies to maximise the effectiveness within which certain activities are undertaken as far as they relate to a 'strategic matter'.

In complying with the duty to cooperate, Government Guidance recommends that LPAs 'scope' the strategic matters of Local Plan documents at the beginning of the preparation process taking account of each matters 'functional geography' and identify those LPAs and Prescribed Bodies that need to be constructively and actively engaged.

Flood risk is identified as a strategic matter and specific engagement activities are proposed with a number of adjoining LPAs and Prescribed Bodies, both in relation to the preparation of the SFRA and the Local Plan. As part of the SFRA, a number of organisations were contacted and requested to provide data to inform the SFRA. A summary of the roles of each organization, and their involvement through the SFRA project, is provided in Table 4-3.

Table 4-3 SFRA Stakeholder Organisations and Roles

Stakeholder Organisation	Role with respect to Horsham DC SFRA
Horsham DC	As an LPA Horsham DC has a responsibility to consider flood risk in their strategic land use planning and the development of their Local Plan. The NPPF requires LPAs to undertake a SFRA and to use their findings, and those of other studies, to inform strategic land use planning including the application of the Sequential Test which seeks to steer development towards areas of lowest flood risk prior to consideration of areas of greater risk. Horsham DC is also required to consider flood risk and, when necessary, apply the Sequential and Exception Tests when assessing applications for development. During the preparation of the SFRA, Horsham DC has provided access to available datasets held by the Council regarding flood risk across the District and the Planning Authority Area. The SFRA will be used by Horsham DC's Emergency Planning team to ensure that the findings are incorporated into their understanding of flood risk and the preparation of their Multi-Agency Flood Plan (MAFP).
Environment Agency	The Environment Agency has a duty to manage the risk of flooding from Main Rivers and to provide a strategic overview for all flooding sources and coastal erosion. The Environment Agency has a role to provide technical advice to LPAs and developers on how best to avoid, manage and reduce the adverse impacts of flooding. Part of this role involves advising on the preparation of spatial plans, sustainability appraisals and evidence base documents, including SFRAs as well as providing advice on higher risk planning applications. The Environment Agency undertakes systematic modelling and mapping of fluvial flood risk associated with all Main Rivers in the study area, as well as supporting Lead Local Flood Authorities (LLFA) with the management of surface water flooding by mapping surface water flood risk across England. The Environment Agency has supplied available datasets for use within the SFRA.
West Sussex County Council	As the LLFA, under the Flood and Water Management Act (FWMA) West Sussex County Council has a duty to take the lead in the coordination of local flood risk management, specifically defined as flooding from surface water, groundwater and ordinary watercourses and to this end has prepared the Local Flood Risk Management Strategy (LFRMS) for Horsham. West Sussex County Council is responsible for regulation and enforcement on ordinary watercourses and is a statutory consultee for future sustainable drainage systems (SuDS) for major developments in the county, following changes to the Town and Country Planning (Development Management Procedures) (England) Order 2015. West Sussex County Council is the Highways Authority and therefore has responsibilities for the effectual drainage of surface water from adopted roads insofar as ensuring that drains, including kerbs, road gullies and ditches and the pipe network which connect to the sewers, are maintained.

[14] HMSO (2011) Localism Act Available from: http://www.legislation.gov.uk/ukpga/2011/20/contents/enacted

Stakeholder Organisation	Role with respect to Horsham DC SFRA
Southern Water	Southern Water serves the majority of the Horsham District. It is responsible for surface water drainage from development via adopted sewers and for maintaining public sewers into which much of the highway drainage connects. Southern Water have provided information regarding past sewer flooding for the study area.
Thames Water	Thames Water sewerage administrative area covers a small area in the north of Horsham District. It is also responsible for surface water drainage from development via adopted sewers and for maintaining public sewers into which much of the highway drainage connects. Thames Water have provided information regarding past sewer flooding for the study area.
Neighbouring LPAs and other consultees	Horsham District is covered by two planning authorities, the Horsham DC Planning Authority and the SDNPA. The SDNPA has its own SFRA evidence base. The neighbouring LPA's SFRAs have been consulted for any cross-boundary flood risk issues.

5. Level 1 SFRA – Methodology

The Level 1 SFRA is a desk-based study, using readily available existing information and additional modelling datasets to enable the application of the Sequential Test and to identify where the Exception Test may be required. In order to provide this assessment of all sources of flooding in the study area, an extensive set of datasets was referenced for use. This information was subject to a quality review to determine the best datasets for inclusion in the Level 1 SFRA update.

5.1 Flooding from Rivers and Sea

Flooding from rivers occurs when water levels rise higher than bank levels causing floodwater to spill across adjacent land (floodplain). The main reasons for water levels rising in rivers are:

- Intense or prolonged rainfall causing runoff rates and flows to increase in rivers, exceeding the capacity of the channel. This can be exacerbated by wet conditions and where there is significant groundwater base flow.
- Constrictions in the river channel causing flood water to back up; and
- Constrictions preventing discharge at the outlet of the river e.g. locked flood gates.

Tidal flooding may occur during storm surge conditions characterised by wind driven waves and low atmospheric pressure coupled with high spring tides. In areas protected from flooding by sea defences, tidal flooding can occur as a result of a breach in the defences, failure of a mechanical barrier or overtopping of defences.

5.1.1 Flood Map for Planning (Rivers and Sea)

The risk of flooding is a function of the *probability* that a flood will occur and the *consequence* to the community or receptor as a direct result of flooding. The NPPF[3] seeks to assess the *probability* of flooding from rivers by categorising areas within the fluvial floodplain into zones of low, medium and high probability, as defined in Table 5-1 and presented on the Flood Map for Planning (Rivers and Sea) available on the Environment Agency website. These Flood Zones have been presented in Figure 8 included in Appendix A.

Table 5-1 Fluvial and Tidal Flood Zones (extracted from the PPG[Error! Bookmark not defined.] 2014)

Flood Zone	Flood Zone Definition for River Flooding	Probability of Flooding
Flood Zone 1	Land having a less than 1 in 1,000 annual probability (0.1% annual exceedance probability (AEP)) of river or sea flooding. All land outside Zones 2 and 3.	**Low**
Flood Zone 2	Land having between a 1 in 100 and 1 in 1,000 annual probability (between 1% and 0.1% AEP) of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability (between 0.5% and 0.1% AEP) of sea flooding. Shown light blue on the Flood Map for Planning.	**Medium**
Flood Zone 3a	Land having a 1 in 100 or greater annual probability (greater than 1% AEP) of river flooding or 1 in 200 or greater annual probability (greater than 0.5% AEP) of sea flooding. Shown dark blue on the Flood Map for Planning.	**High**
Flood Zone 3b	Land where water has to flow or be stored in times of flood, or land purposely designed to be flooded in an extreme flood event (flood storage area). Not shown on the Flood Map for Planning. Flood Zone 3b is defined by the LPA in the SFRA, in this instance the 1 in 20 year (5% AEP) has been used to define Flood Zone 3b.	**Functional Floodplain**

The Environment Agency 'Flood Map for Planning (Rivers and the Sea)' provides information on the areas that would flood if there were no flood defences or buildings in the "natural" floodplain. The 'Flood Map for Planning (Rivers and Sea)' dataset is available on the Environment Agency website[15] and is the main reference for planning purposes as it contains the Flood Zones which are referred to in the NPPF[3].

[15] Environment Agency Flood Map for Planning (Rivers and Sea) http://apps.environment-agency.gov.uk/wiyby/37837.aspx

The 'Flood Map for Planning (Rivers and Sea)' was first developed in 2004 using national generalised modelling (JFLOW) and is routinely updated and revised using results from the Environment Agency's ongoing programme of river catchment studies. The studies can include topographic surveys and hydrological and/or hydraulic modelling as well as incorporating information from recorded flood events.

It is noted that the Flood Zones shown on the Environment Agency Flood Map for Planning do not take account of the possible impacts of climate change. Further information on climate change can be found in Section 5.1.4 of this report.

Appendix A, Figures 8, 8A-8F Fluvial Flood Zones

It is also noted that a separate map is available on the Environment Agency website which is referred to as 'Risk of Flooding from Rivers and Sea'[16]. This map accounts for the presence of flood defences and so describes the actual chance of flooding, rather than the chance if there were no defences present. While flood defences reduce the level of risk, they do not completely remove it as they can be overtopped or fail (breach) in extreme weather conditions, or if they are in poor condition.

5.1.2 Functional Floodplain

The Functional Floodplain is defined in the NPPF[3] as 'land where water has to flow or be stored in times of flood'. The Functional Floodplain (also referred to as Flood Zone 3b), is not separately distinguished from Flood Zone 3a on the Flood Map for Planning. Rather the SFRA is the place where LPAs should identify areas of Functional Floodplain in discussion with the Environment Agency.

For the purposes of this SFRA, existing hydraulic modelling data has been interrogated to identify areas with a 1 in 20 or 1 in 25 annual probability (4% or 5% AEP), or greater to be delineated as Flood Zone 3b. Unlike Flood Zones 2 and 3a, flood defences are included in the modelling scenario for Flood Zone 3b and therefore the defended flood outlines have been used for the River Adur upstream of Beeding where there are raised flood defences present. The fluvial flood defences in Horsham District consist of areas of high ground and embankments and the defended model flood outlines are the same as the undefended scenario. The extents are presented in Figure 8 in Appendix A.

Appendix A, Figures 8, 8A-8F Fluvial Flood Zones

5.1.3 Flood Defences

The 'Flood Map for Planning (Rivers and Sea)' also identifies areas which, in the event of a fluvial flood with a 1% AEP, or a tidal flood with a 0.5% AEP, would be protected from flooding by the presence of flood defences. These areas are described as 'Areas Benefitting from Defences' (ABD).

Flood defences are structures which affect flow in times of flooding in order to reduce the risk of water entering property. They generally fall into one of two categories described as 'formal' or 'informal':

- A 'formal' flood defence is a structure which has been specifically built to control floodwater. It is maintained by its owner or statutory undertaker so that it remains in the necessary condition to function. The Environment Agency has powers to construct and maintain defences to help against flooding.
- An 'informal' defence is a structure that has not necessarily been built to control floodwater and is not maintained for this purpose. This includes road and rail embankments and other linear infrastructure (buildings and boundary walls) which may act as water retaining structures or create enclosures to form flood storage areas in addition to their primary function.

A detailed study of informal flood defences has not been made as part of this assessment. Should any changes be planned in the vicinity of road or railway crossings over rivers in the study area it would be necessary to assess the potential impact on flood risk to ensure that flooding is not made worse either upstream or downstream. Smaller scale informal flood defences should be identified as part of site-specific FRAs and the residual risk of their failure assessed.

[16] https://flood-warning-information.service.gov.uk/long-term-flood-risk/map

A high-level review of formal flood defences has been carried out using the Environment Agency Spatial Flood Defences dataset. This dataset contains details of flood defence assets associated with main rivers and tidal defences and provides a good starting point for identifying significant local defences and potential areas benefiting from defences, but the quantity and quality of information provided differs considerably between structures. The dataset is intended to provide a reasonable indication of the condition of an asset and should not be considered to contain consistently detailed and accurate data (this would be undertaken as part of a Level 2 SFRA or site-specific FRA where the need arises).

Flood defences and areas benefitting from flood defences in the study area are presented in Appendix A Figure 8. Areas which are protected by a defence with a low standard of protection (SOP) will not have an associated ABD as the defence will not reduce the magnitude or the extent of flooding under the 1% AEP fluvial flood event or the 0.5% AEP tidal flood event.

5.1.4 Climate Change

The climate change allowances for the River Adur and River Arun catchments (Table 5-2) have been modelled and mapped in Appendix A Figure 9. In line with the Environment Agency guidance[17], the peak river flow allowances for the South East river basin (which includes Horsham District) have been modelled, applying 35% (central allowance category), 45% (higher central allowance category) and 105% (upper end allowance category) allowances to the 1% AEP scenario. However, the models do not account for the updated projections for increases in sea level so the results should be used with caution within the tidal river reaches. Flood defences are included in the modelled scenarios for future climate change.

Appendix A, Figures 9A-9F Climate change

Climate change is likely to cause many areas within Horsham District to be susceptible to more frequent, more severe flooding in future years. This is because the changes in climate patterns and resulting change in physical conditions can increase the volume and frequency of precipitation. It is essential therefore that the development control process influencing the design of future development within the District carefully mitigates against the potential impact that climate change may have upon the risk of flooding.

For this reason, all of the development control recommendations set out in Section 9 require floor levels, access routes, drainage systems and flood mitigation measures to be designed with an allowance for climate change; and the potential impact that climate change may have over the lifetime of a proposed development should be considered as part of a site-specific FRA. This provides a robust and sustainable approach to the potential impacts that climate change may have in Horsham District over the next 100 years, ensuring that future development is considered in light of the possible increases in flood risk over time.

5.1.5 Hydraulic Modelling Studies

Table 5-2 provides a summary of the hydraulic modelling studies that have been undertaken for the Main Rivers in the Horsham District and used to inform the Environment Agency's Flood Map for Planning (Rivers and Sea).

The scope of these modelling studies typically covers flooding associated with Main Rivers, and therefore Ordinary Watercourses that form tributaries to the Main Rivers may not always be included in the model. Modelling of Ordinary Watercourses available on the Flood Map for Planning (Rivers and Sea) may be the result of the national generalised JFLOW modelling carried out by the Environment Agency and may need to be refined when determining the probability of flooding for an individual site and preparing a site-specific FRA.

Note that the extent of Flood Zone 3a (1% AEP event) and 3b (4% or 5% AEP event) on Rivers Arun and Adur are based on detailed modelling, Flood Zone 2 (0.1% AEP event) is based on JFLOW flood extents.

[17] Environment Agency (2019) Flood Risk Assessments: Climate Change Allowances, https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Table 5-2 Hydraulic models for Main Rivers in the Horsham District and outputs used in this SFRA

Watercourse	Model	Model Type	Modelling Study	Flood Extent Outputs
River Arun	Upper Arun Model	ISIS (1D) TUFLOW (2D)	Peter Brett Associates (2003) River Arun Flood Study	25yr_extent_arun-upper-corrected_region
River Adur	Lower Adur SFRM Model Dec05	ISIS (1D) HYDROF (2D)	Atkins (2005) River Adur Flood Mapping Study	AD04_TMHWS_F025_2
Lower River Tidal Arun	LTRAS model	Infoworks RS	Atkins (2010) LTRAS Model Development	Q20_defended_region
River Arun	ARUN_1D2D_RRv1.4_Q100_ath.dat	ISIS (1D) TUFLOW (2D)	JBA (Sept 2017) Horsham Flood Modelling Climate Change Modelling	HORS_Q100plus35pc_v5 HORS_Q100plus45pc_v5 HORS_Q100plus105pc_v5
River Arun	Upper Arun CC Runs	ISIS (1D only)	JBA (Nov 2017) Arun Climate Change Modelling JBA (Nov 2017) Billingshurst Climate Change Modelling JBA (Nov 2017) Horsham Climate Change Modelling – note the 1D-2D model should be used for Horsham where available JBA (Nov 2017) Loxwood Climate Change Modelling	Arun100plus35pc_001 Arun100plus45pc_001 Arun100plus105pc_001 Bill100plus35pc Bill100plus45pc Bill100plus105pc Hors100plus35pc Hors100plus45pc Hors100plus105pc Loxw100plus35pc Loxw100plus45pc Loxw100plus105pc
River Adur	Upper Adur CC Runs	ISIS (1D only)	JBA (Nov 2017) Upper Adur Climate Change Modelling JBA (Nov 2017) Steyning Climate Change Modelling	Adur_100yr_plus35pc Adur_100yr_plus45pc Adur_100yr_plus105pc Reach12A_100yr_plus35pc Reach12A_100yr_plus45pc Reach12A_100yr_plus105pc
River Adur and River Arun	West Sussex JFLOW Improvements		JBA (December 2008) JFLOW Improvements for Solent and South Downs Area (Re-run August 2010)	Q1000v17extentm Q100v15d

5.1.6 Historic Flooding

The Environment Agency and Horsham DC have provided their Flood History datasets for use in this SFRA. The Environment Agency has provided their 'Historic Flood Map', which shows the maximum extent of all individual recorded flood outlines in this area. The Historic Flood Map, displayed in Appendix 6 Figure 5, shows records of flooding in urban areas of Horsham, Billingshurst, and Steying.

As LLFA, West Sussex County Council maintain a flood incident database. However, this database has not been provided to inform this SFRA.

Appendix A, Figure 5 Historic Flooding

5.1.7 Flood Warning Areas and Flood Alert Areas

The Environment Agency operates a free Flood Warning Service[18] for many areas at risk of flooding from rivers and the sea. In some parts of England, the Environment Agency may also be able to tell when flooding from groundwater is possible. The Environment Agency has provided a GIS layer of Flood Warning Areas in Horsham District.

Appendix A, Figure 6 Flood Warning Areas

The Environment Agency has also provided a GIS layer of Flood Alert Areas in Horsham District.

Appendix A, Figure 7 Flood Alert Areas

Horsham DC has designated emergency rest centres across the District. Details of these centres have not been provided within the SFRA due to data sensitivity. It is advised that Horsham DC use the findings of the SFRA to inform the next regular review of the Multi-Agency Flood Plan as required.

5.2 Flooding from Surface Water

5.2.1 Risk of Flooding from Surface Water (RoFSW)

Overland flow and surface water flooding typically arise following periods of intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems. It can run quickly off land and result in localised flooding.

The Environment Agency has undertaken modelling of surface water flood risk at a national scale and produced mapping identifying and classifying those areas at risk of surface water flooding:

- 3.33% annual probability (1 in 30 year), 'high'
- 1% annual probability (1 in 100 year), 'medium'
- 0.1% annual probability (1 in 1,000 year) 'low'

The latest version of the mapping is referred to as the 'Risk of Flooding from Surface Water Map (RoFSW). Appendix A Figure 10 present the RoFSW mapping for the Planning Authority Area in combination with historical surface water flooding data recorded by West Sussex County Council. This dataset is also available nationally on the Environment Agency website and is referred to as 'Risk of Flooding from Surface Water'[19].

Appendix A, Figure 10, 10A-10F Surface Water Flooding (RoFSW)

5.2.2 Climate Change

The RoFSW does not include a specific scenario to determine the impact of climate change on the risk of surface water flooding. However, a range of three annual probability events have been modelled, 3.3%, 1% and 0.1%, and therefore it is possible to use with caution the 0.1% outline as a substitute dataset to provide an indication of how the risk of surface water flooding may increase in the future as a result of climate change.

5.3 Flooding from Sewers

During heavy rainfall, flooding from the sewer system may occur

1. *if the rainfall event exceeds the capacity of the sewer system/drainage system.*

[18]Environment Agency Flood Warning Service http://apps.environment-agency.gov.uk/wiyby/37835.aspx
[19] https://flood-warning-information.service.gov.uk/long-term-flood-risk/map

Sewer systems were historically designed and constructed to accommodate rainfall events with an annual probability of 3.3% (1 in 30 chance each year) or greater. Therefore, rainfall events with an annual probability less than 3.3% would be expected to result in surcharging of some of the existing sewer system.

While Southern Water and Thames Water, as the sewerage undertakers, recognise the impact that more extreme rainfall events may have, it is not cost beneficial to construct sewers that could accommodate every extreme rainfall event.

2. *The system becomes blocked by debris or sediment:*

Over time there is potential that road gullies and drains become blocked from fallen leaves, build-up of sediment and debris (e.g. litter). There is now new CIRIA guidance on the design of new sewers to reduce sediment problems (R141) but this guidance will not apply to existing sewer systems.

3. *The system surcharges due to high water levels in receiving watercourses:*

Within the Planning Authority Area there is potential for surface water outlets to become submerged due to high river levels. Once storage capacity within the sewer system itself is exceeded, the water will overflow into streets and potentially into houses.

5.3.1 Historic Flooding

Water companies are required to maintain a register of properties which are at risk of flooding due to hydraulic overloading of the sewers (the sewer pipe is too small, or at too shallow a gradient). This is called the DG5 risk register.

Appendix A Figure 11 shows the internal and external sewer flood incident records for the last 10 years from the DG5 Risk Register that has been supplied by Southern Water. Thames Water have confirmed that there are no reported incidents of sewer flooding with the area of Horsham DC that they cover.

It should be noted that the DG5 Risk Register are flooding incidents that have been reported to Southern Water and Thames Water by the home owners. It is likely that there will be incidents that don't get reported and therefore will not show on the database. Incidents of sewer flooding can be retrospectively reported to Southern Water and Thames Water via the links below:

Southern Water – https://www.southernwater.co.uk/flooding

Thames Water – https://www.thameswater.co.uk/help-and-advice/drains-and-sewers/sewer-flooding-who-to-contact

Appendix A, Figure 11 Sewer Flooding

5.4 Flooding from Groundwater

Groundwater flooding usually occurs in low lying areas underlain by permeable rock and aquifers that allow groundwater to rise to the surface through the permeable subsoil following long periods of wet weather. Low lying areas may be more susceptible to groundwater flooding because the water table is usually at a much shallower depth and groundwater paths tend to travel from high to low ground.

There are many mechanisms associated with groundwater flooding which are linked to high groundwater levels and can be broadly classified as:

- Direct contribution to channel flow – where the river channel intersects the water table and groundwater enters the streambed increasing water levels and causing flooding;
- Springs erupting at the surface;
- Exceptionally large flows from perennial springs or large flows from intermittent or dormant springs;
- Rise of typically high groundwater levels to extreme levels in response to prolonged extreme rainfall.

The main impacts of groundwater flooding are:

- Flooding of basements of buildings below ground level – in the mildest case this may involve seepage of small volumes of water through walls, temporary loss of services etc. In more extreme cases larger volumes may lead to the catastrophic loss of stored items and failure of structural integrity;
- Overflowing of sewers and drains – surcharging of drainage networks can lead to overland flows causing significant but localised damage to property. Sewer surcharging can lead to inundation of property by polluted water. Note: it is complex to separate this flooding from other sources, notably surface water or sewer flooding;
- Flooding of buried services or other assets below ground level – prolonged inundation of buried services can lead to interruption and disruption of supply;
- Inundation of roads, commercial, residential and amenity areas – inundation of grassed areas can be inconvenient; however, the inundation of hard-standing areas can lead to structural damage and the disruption of commercial activity. Inundation of agricultural land for long durations can have financial consequences; and
- Flooding of ground floors of buildings above ground level – can be disruptive and may result in structural damage. In addition, typically a groundwater flood event will have a long duration (when compared to other flood sources) which adds to the disruptive nature of the flood event.

5.4.1 Areas Susceptible to Groundwater Flooding

The Environment Agency's dataset Areas Susceptible to Groundwater Flooding (AStGWF) is presented in Appendix A Figure 3A, which indicates where in Horsham District groundwater may emerge due to certain geological and hydrogeological conditions, and the distribution of risk is discussed further in Section 6.4. The susceptible areas are represented by one of four categories showing the proportion of each 1km square where there is potential for groundwater emergence. The data does not show where flooding is likely to occur, but instead should be used at a strategic level to indicate areas for further investigation. The absence of values for any grid square means that no part of that square is identified as being susceptible to groundwater emergence.

Appendix A, Figure 3A Areas Susceptible to Groundwater Flooding

5.4.2 Areas at Risk of Groundwater Flooding

The Geosmart Groundwater Flood Risk Map (GW5) dataset for Horsham District has mapped and presented in Appendix A Figure 3B. GeoSmart GW5 mapping is based on the outputs of the Geosmart hydrogeological and risk models, which use the following datasets: topographical data produced by the Ordnance Survey, LIDAR Digital Terrain Models produced by the Environment Agency, Geological Maps produced by the British Geological Survey, and Groundwater Level data produced by the British Geological Survey[20].

GeoSmart GW5 mapping is available on a 5m grid and classifies cells into one of four categories: Negligible, Low, Moderate, and High risk of groundwater flooding with a 1% annual probability (Table 8-3). For each classification it provides recommendations for further investigation to support a detailed flood risk assessment.

The map is a general-purpose indicative screening tool and is intended to provide a useful initial view for a wide variety of applications. It does not provide an alternative to a detailed site-specific assessment. The GeoSmart Groundwater Flood Risk Map highlights areas where there is sufficient evidence to suggest that flooding could occur.

[20] Geosmart Information website (accessed 30th October 2019) https://geosmartinfo.co.uk/data/groundwater-flood-risk-map/

Table 5-3 GeoSmart SuDs Infiltration Suitability Map infiltration potential classes[21]

Classification	Comments	Recommendations
Negligible Risk	There is a negligible risk of groundwater flooding in this area and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.	No further investigation of risk is deemed necessary unless proposed site use is unusually sensitive. However, data may be lacking in some areas, so assessment as 'negligible risk' on the basis of the map does not rule out local flooding due to features not currently represented in the national datasets used to generate this version of the map.
Low Risk	There is a low risk of groundwater flooding in this area with a chance of greater than 1% annual probability of occurrence.	There will be a remote possibility that incidence of groundwater flooding could lead to damage to property or harm to other sensitive receptors at, or near, this location. For sensitive land uses further consideration of site topography, drainage, and historical information on flooding in the local area should be undertaken by a suitably qualified professional. Should there be any flooding it is likely to be limited to seepages and waterlogged ground, damage to basements and subsurface infrastructure, and should pose no significant risk to life. Surface water flooding, however, may be exacerbated when groundwater levels are high.
Moderate Risk	There is a moderate risk of groundwater flooding in this area with a chance of greater than 1% annual probability of occurrence.	There will be a significant possibility that incidence of groundwater flooding could lead to damage to property or harm to other sensitive receptors at, or near, this location. Where flooding occurs, it is likely to be in the form of shallow pools or streams. There may be basement flooding, but road or rail closures should not be needed, and flooding should pose no significant risk to life. Surface water flooding and failure of drainage systems may be exacerbated when groundwater levels are high. Further consideration of the local level of risk and mitigation, by a suitably qualified professional, is recommended.
High risk	There is a high risk of groundwater flooding in this area with a chance of greater than 1% annual probability of occurrence or more frequent.	It is likely that incidence of groundwater flooding will occur, which could lead to damage to property or harm to other sensitive receptors at, or near, this location. Flooding may result in damage to property, road or rail closures and, in exceptional cases, may pose a risk to life. Surface water flooding and failure of drainage systems will be exacerbated when groundwater levels are high. Further consideration of the local level of risk and mitigation, by a suitably qualified professional, is recommended.

Appendix A, Figure 3B GEOSMART Areas at Risk of Groundwater Flooding

It is important to note that there are significant limitations in the assessment of the likelihood of groundwater flooding. For example, groundwater flooding events in one location may correspond to a 1 in 50 year (2% AEP) flood with the same event representing a 1 in 500 year (0.2% AEP) event elsewhere. Therefore the 1 in 100 year (1% AEP) return period should be regarded as 'indicative'[21].

5.5 Flooding from Artificial Sources

Artificial sources of flood risk include canals and reservoirs. There are no canals within Horsham District but there are a large number if reservoirs. The Environment Agency dataset 'Risk of Flooding from Reservoirs' identifies areas that could be flooded if a large reservoir were to fail and release the water it holds. This information is only available via the online "Long Term Risk of Flooding" map.[22]

[21] GeoSmart Information (Accessed 2019), Geosmart Groundwater Flood Risk Map ?User Guide, notes to accompany GW5 version 2.2
[22] https://flood-warning-information.service.gov.uk/long-term-flood-risk/map

6. Level 1 SFRA – Flood Risk Review

This Section provides the strategic assessment of flood risk from each of the sources of flooding across the Planning Authority Area, based on the datasets described in Section 5. For each source of flooding, details of any historical incidents are provided, and where appropriate, the impact of climate change on the source of flooding is described. This Section should be read with reference to the figures in Appendix A.

6.1 Tidal Flooding

The Lower River Arun and Lower River Adur are tidally influenced and therefore pose a risk of tidal flooding. Due to the local topography, only relatively small rural areas in the south are identified to be at risk of tidal flooding.

The Environment Agency Flood Map for Planning (Rivers and Sea), shown in Appendix A Figure 8, incorporates both tidal and fluvial flood risk extents. The definition of tidal Flood Zone 3a is based on the 1 in 200 year flood event (0.5% AEP).

6.1.1 Tidal flood defences

The Environment Agency Spatial Flood Defences data shows that downstream of the Pallingham locks on the River Arun, land is protected from tidal flooding by raised earth embankments. These defences have a design standard of protection (SOP) of 1 in 5 years (20% AEP) and 1 in 10 years (10% AEP). There is a flood defence wall along the northern bank of the tidal River Arun in Pulborough, approximately 150m in length, with a crest level of 2.39 mAOD and a SOP of 1 in 2 years (50% AEP).

The western and eastern branches of the River Adur are tidally influenced up to upstream of Partridge Green. The Environment Agency Spatial Flood Defences data shows the raised embankment flood defences along the tidal reaches have a SOP of around 1 in 30 years (3.33% AEP).

The SOP of the flood defences in the Horsham District are lower than the 1 in 100 annual probability (1% AEP) event, therefore flood levels are likely to exceed these defences in a 1% AEP event. There are no Environment Agency defined ‘Areas Benefiting from Defences’ (ABD) in Horsham District, as this is based on the 1% AEP event.

6.2 Fluvial Flooding

6.2.1 Flood Zones

Approximately 91% of the Horsham District within the Arun and Adur catchments is defined as Flood Zone 1 Low Probability of flooding from rivers. 6% is defined as Flood Zone 2 Medium Probability, 5% as Flood Zone 3a High Probability, and 4% as Flood Zone 3b Functional Floodplain.

The flood zones associated with the River Arun (and its tributaries) affects areas to the north and east of the Planning Authority Area, including Horsham town and the surrounding villages. The flood zones associated with the River Adur affects the southeast of the Planning Authority Area including the villages of Upper Beeding and Bramber.

6.2.2 Climate change

The results of the climate change hydraulic modelling studies for the main rivers suggest that climate change will significantly increase the extent of river flooding within the tidally influenced areas of the Planning Authority Area.

The majority of the areas showing a significant increase in the extent of the 1% AEP modelled scenario are rural fields and existing floodplain and would therefore not impact current developed areas. However, in the upper River Arun catchment, the climate change scenarios would increase the number of properties at risk of flooding in Billingshurst and Horsham, along Channel Brook and Bolding Brook. In the River Adur catchment, the climate change scenarios would increase the number of residences at risk in Upper Beeding, Bramber and Steyning.

6.2.3 Flood defences

The Environment Agency Spatial Flood Defences dataset shows that the River Arun and River Adur are predominantly defended by embankments along the tidal reaches and high ground along the fluvial reaches. The SOP of these defences is lower than the 1 % AEP event, therefore there are no ABD in Horsham District.

6.2.4 Flood Warning Areas

There are seven Flood Warning Areas (FWAs) within the District, as shown in Appendix A Figure 6 and Table 6-1. The Environment Agency issues flood warnings to residents and businesses that have registered for the service in these specific areas when flooding is expected.

Table 6-1 Environment Agency Flood Warning Areas in Horsham District

Flood Warning Area Name	Description
Amberley on the River Arun	The River Arun at Amberley, including Bury, Houghton Bridge and South Stoke
Broadbridge Heath to Pallingham Quay on the River Arun	The River Arun from Broadbridge Heath to Pallingham Quay, including Broadbridge Heath, Slinfold, Wanford Mill, Gibbons Mill, Newbridge, and Pallingham Lock
Coolham and Shipley on the River Adur	The River Adur West Branch at Coolham and Shipley
Horsham on the River Arun	The River Arun at Horsham, from Amiesmill Bridge to Hills Farm Lance, including Millbay Lane, Tanbridge Park, Arunside and Ridgehurst Drive
Loxwood on the River Lox	Loxwood Stream at Loxwood, including Loxwood Village and Brewhurst Mill
Pulborough on the River Arun	The River Arun at Pulborough, including Greatham Bridge
Upper Beeding and Bramber on the River Adur	The River Adur at Upper Beeding and Bramber, including Newbrook Farm and Beeding Manor.

6.3 Surface Water Flooding

The Risk of Flooding from Surface Water Map (RoFSW) presented in Appendix A Figure 10A-10F illustrates how surface water ponds in the flat low-lying areas within the District, within the floodplains of the primary watercourses and adjacent to roads and railway embankments. The surface water drainage paths follow the topography of the study area and generally drain rural fields to the nearest river or ordinary watercourse. The existing urban areas at greatest risk of surface water flooding are Horsham, Barns Green, Billinghurst and Southwater, and there is also some risk in Ashington, West Chiltingham and Partridge Green.

The West Sussex County Council LFRMS[23] identifies six wet spots within Horsham District; Horsham, Pulborough, Storrington, Southwater, Bramber & Upper Beeding and Billingshurst. These are areas that have an increased risk of flooding compared to the rest of the West Sussex county. Wet spots have been classified as areas where a significant number (generally greater than ten properties and/or businesses) of adjacent properties may be susceptible to flooding. Surface water flood risk poses the most likely flood risk in each of these areas.

Information of historic surface water flood events within the Planning Authority Area is provided in Section 6.7. The Environment Agency Flood and Coastal Erosion Risk Management (FCERM) investment programme (2015-2021)[24] identified the Billingshurst Surface Water Management Plan (SWMP) and Actions as a potential scheme at appraisal stage and forecast for completion in 2021. West Sussex County Council have confirmed that this SWMP and the Actions are now complete and that no further work is planned in this area.[25]

[23] West Sussex County Council (2013) Local Flood Risk Management Strategy https://www.westsussex.gov.uk/media/1595/local_flood_risk_management_strategy.pdf
[24] Environment Agency website, Programme of flood and coastal erosion risk management (FCERM) schemes. Accessed on 30th October 2019 https://www.gov.uk/government/publications/programme-of-flood-and-coastal-erosion-risk-management-schemes
[25] Response from West Sussex County Council to the draft 2019 SFRA submitted for comment in November 2019

Surface water drainage systems constructed for new development within Horsham District should be designed to ensure that there is no increase in runoff rates as a result of development. The system should also be designed to manage the 1% AEP flow, taking the effects of climate change into account. Further details are provided in Section 8.4 and Section 9.10. Compliance with guidance on management of surface water drainage should ensure that there is no increase in surface water flooding downstream.

6.4 Groundwater Flooding

The AStGWF dataset provided by the Environment Agency, and presented in Appendix A Figure 3, indicates where groundwater may emerge when water tables are high due to geological and hydrogeological conditions. This information is shown as a proportion of 1km grid squares where there is potential for groundwater emergence. The data does not show where flooding is likely to occur or allow an estimate of flood frequency or consequence, but it does indicate areas for further investigation. The majority of the District has less than 25% risk of groundwater emergence but there are areas at >75% risk of groundwater emergence to the south of the District, where the underlying geology is Greensand and Chalk. There are areas at 25%-50% and 50%-75% risk of groundwater emergence along the tributaries of the River Arun and River Adur.

It should be noted that due to the resolution of the AStGWF dataset, i.e. at 1km grid squares, the AStGWF data should not be used on its own to make planning decisions at any scale, and, in particular, should not be used to inform planning decisions at the site scale. Where available, site-specific information, including ground investigations and monitoring, should be used to support planning decisions for individual developments.

The Geosmart 'Areas at risk of groundwater flooding' dataset presented in Appendix A Figure 3a indicates that there are areas of low to moderate risk of groundwater flooding along the tributaries of the River Arun and River Adur, and small areas of high risk of groundwater flooding to the south of the District (Bramber, Upper Beeding and Pulborough), adjacent to the SDNPA boundary.

Horsham DC have confirmed that there are no reported incidences of groundwater flooding in the District and therefore the risk of groundwater flooding is considered to be low. However, on the basis of the available information, the risk of groundwater flooding should be assessed as part of site specific flood risk assessments for sites along the Arun Valley, the Adur Valley and in the south of the District in areas of Greensand and Chalk geology.

6.5 Sewer Flooding

Southern Water has supplied records of sewer flooding for the District through their DG5 register on the total number of properties affected by and at risk of sewer flooding (both internally and externally) based on historic flooding. This highlights that the areas of Rudgwick, Southwater and Pulborough have experienced a greater number of sewer flooding incidents than the rest of the District.

Thames Water have confirmed that there are no reported incidents of sewer flooding with the area of Horsham DC that they cover.

Appendix A Figure 11 shows the DG5 Register that has been supplied by Southern Water for the SFRA. It should be noted that Southern Water focus their efforts on removing properties from the DG5 register and therefore this information may not accurately represent those properties currently at risk. Southern Water have not provided information on their current programme of works to improve sewer capacity in areas affected by sewer flooding and more detailed information should be sought on a site specific basis if development is proposed in areas at significant risk of sewer flooding.

The West Sussex County Council LFRMS states that river flooding contributes to sewer flooding in Beeding and Bramber, and to flooding in Wet Spots generally, because the urban sewer network discharges to watercourses and cannot discharge if river water levels are high. This is a particular problem where the sewers discharge to the Rivers Arun and Rother, although the urban sewer system is maintained to assist drainage of surface water from towns.

Where new development is proposed in areas with an existing risk of sewer flooding, discharge of surface water to existing sewers should only be permitted if there is sufficient capacity within the system, and if disposal of runoff through other methods (infiltration or discharge to a watercourse) is not permitted.

Climate change is anticipated to increase the potential risk from sewer flooding as summer storms become more intense and winter storms more prolonged. This combination is likely to increase the pressure on the existing

efficiency of sewer systems, thereby reducing their design standard and leading to more frequent localised flooding incidents. Any sewer flooding that may occur could be exacerbated as a result of surface water runoff during extreme rainfall events.

6.6 Flooding from Artificial Sources

The failure of a reservoir has the potential to cause catastrophic damage due to the sudden release of large volumes of water. The NPPG encourages LPAs to identify any impounded reservoirs and evaluate how they might modify the existing flood risk in the event of a flood in the catchment it is located within, and / or whether emergency draw-down of the reservoir will add to the extent of flooding.

The Environment Agency dataset 'Risk of Flooding from Reservoirs'[26] identifies areas that could be flooded if a large reservoir were to fail and release the water it holds. This map shows that areas along the River Arun Valley from mid Horsham to Kings Hanger are at risk of reservoir flooding, including urban areas in south Horsham. The relevant reservoirs which are the source of this risk are:

- Reservoir on the Horn Brook, Park Wood, east of Horsham;
- Whitevane Pond near Forest Grange Manor;
- Roosthole Reservoir at Hammerpond Road;
- Hawkins Pond and Hammer Pond on Goldings Stream;
- Impounded waterbodies on The Hanger, east of Bury St Austens;
- Impounded waterbody south of Horsham upstream of the A281 Brighton Road; and
- Impounded waterbody south of Horsham and west of Kerves Lane.

Development in central and east Horsham is also at risk of reservoir flooding along the valley of Boldings Brook. This is associated with possible failure of the impounding wall at Warnham Mill Pond.

Properties along the River Adur may also be at risk of reservoir flooding associated with failure of Kingsmill Pond, upstream of the A24. The area at risk extends to just upstream of Upper Beeding.

With the exception of the areas noted in Horsham, the majority of the area within Horsham District which is at risk of reservoir flooding is rural and flooding would not cause a risk to property. However, it should be noted that the Environment Agency risk map only considers large reservoir and there are numerous small reservoirs and impounded waterbodies within the District which are not considered in the mapping. This includes two dams upstream of Horsham, Rookfield and Dabsongill Dams, which are owned and maintained by Crawley Borough Council and which would potentially cause flooding in north Horsham in the event of a breach.

Reservoirs in the UK have an extremely good safety record. The Environment Agency is the enforcement authority for the Reservoirs Act 1975 in England and Wales. All large reservoirs must be inspected and supervised by reservoir panel engineers. It is assumed that these reservoirs are regularly inspected, and essential safety work is carried out such that large reservoirs therefore present a minimal risk. In the event that the condition of the dam deteriorates, and a breach becomes likely, the emergency plan for the dam will include identification and rapid evacuation of areas at risk as well as emergency repair works.

However, monitoring and management of smaller reservoirs depends on actions carried out by the owner of the dam and will vary widely. Assessment of risk to development immediately downstream of a small impounded waterbody will require identifying the owner of the dam, the dam's condition, measures for monitoring and maintenance and the consequences of failure for the development.

6.7 Historic Flood Records

The Environment Agency, Horsham DC and West Sussex County Council have provided their Flood History datasets for use in this SFRA. The Environment Agency has provided their 'Historic Flood Map' datasets for use in this SFRA, which shows the maximum extent of all individual recorded flood outlines in this area. The Historic Flood Map, displayed in Appendix 6 Figure 5, shows records of flooding in urban areas of Horsham, Billingshurst, and Steying.

[26] Environment Agency website, accessed 30th October 2019 https://flood-warning-information.service.gov.uk/long-term-flood-risk/

The previous SFRA indicates a number of records of fluvial flooding, based on the Arun and Western Streams and Adur CFMPs. These have been displayed in Table 6-2. It should be noted that these records of flooding may not be complete and may not show the location of all the records of flooding within the Planning Authority Area.

Table 6-2 Historic flooding records from the 2010 Horsham DC Level 1 SFRA

Year of flooding	Catchment	Details
1911	Adur	Heavy rains in November caused flooding of the Adur valley from Ashurst, Partridge Green, Henfield, and Steyning to Bramber. Lower floors of properties were inundated.
1925	Adur	Widespread flooding of Adur valley.
February 1966	Adur	Roads and fields flooded at Cuckfield and Bolney
September 1968	Arun	Flood damage at Chiddingfold (15 properties), Horsham (up to 50 properties) and Pulborough (5 properties). A29 and several minor roads blocked.
11th-14th November 1974	Adur	Widespread flooding across catchment - Ashurst, Bramber, Coombes, Shipley, Twineham, Upper Beeding, West Grinstead, Lancing, Steyning. Properties flooded in Lancing. A281 closed at Henfield.
22nd – 23rd November 1974	Adur	Flooding in Burgess Hill, Ashurst, Clayton, Cuckfield, Ditchling, East Preston, Ferring, Findon, Fulking, Shipley and Henfield. Surface water flooding at Steyning High Street, river flooding at Steyning affected some properties. Road flooding at Burgess Hill. Shopping area in Findon covered in an inch of silt. Shoreham airport access disrupted. Kimp Barn Lane flooded cutting off access to properties and the sewage treatment works.
1977	Adur	Properties flooded in Ashington.
1979	Adur	Flooding in Henfield, Burgess Hill and Ashington.
October 1980	Adur	Steyning - the High Street was closed.
1981	Arun/Adur	A significant event occurred in Billingshurst after heavy rains that caused flooding in the High Street and Rosehill area due to inadequate highway drainage and blockages of surface water flow to sewers. The same event affected Southwater Street in Pulborough and Southwater
December 1993	Arun	Heavy rainfall throughout the autumn caused the River Larent to overtop. Flooding at Storrington damaged 15 properties. Storrington flood relief scheme implemented as a result.
1994	Adur	Heavy runoff from the downs caused property flooding in Sompting and North Lancing.
Autumn 2000	Adur	Flooding in Sayers Common and Steyning. Severe flooding in Bramber following overtopping of defences on the main river.
Autumn 2000	Arun	Flooding from main river/surface water and/or groundwater at Pulborough (5 properties) and Bury (3 properties). Flooding from groundwater and/or surface water at Chiddingfold (12 properties) and Midhurst (3 properties).

The West Sussex County Council PRFA identifies a surface water flood incident on 20th September 1968 in Horsham, where a main road flooded, and adjacent properties flooded to 0.6m. It states that 422 properties were impacted by the event.

West Sussex County Council has produced a Flood Investigation Report (FIR) for the June 2012 flood event[27]. This event was the result of prolonged heavy rainfall for 12 – 24 hours. Some places in West Sussex received over 100mm of rainfall within 16 hours. The average for the month of June is 50-60mm. Although Horsham District was not the worst area to be affected in West Sussex, the FIR identifies the following number of properties flooded in the District (Table 6-3).

[27] West Sussex County Council (Nov 2012) Report on June 2012 Flood Event https://www.westsussex.gov.uk/media/1623/final_report.pdf

Table 6-3 Horsham District flood records for the June 2012 flood event [24]

Town	Number of properties
Ashington	7
Henfield	2
Horsham	1
Hurstpierpoint	1
Littleworth	2
Rock	1
Small Dole	3
Sullington	1
Washington	4
Wiston	2
TOTAL	**24**

6.8 Flood Risk Management Schemes

A Catchment Flood Management Plan (CFMP) is a high-level strategic planning document that provides an overview of the main sources of flood risk and how these can be managed in a sustainable framework for the next 50 to 100 years. The Environment Agency engages stakeholders within the catchment to produce policies in terms of sustainable flood management solutions whilst also considering local land use changes and effects of climate change. CFMPs were consolidated into Flood Risk Management Plans (FRMPs) in 2015.

The CFMPs are used to inform and support planning policies, statutory land use plans and implementation of the Water Framework Directive (WFD), so that future development in the catchment is sustainable in terms of flood risk. There are two CFMPs of importance to the study area; the River Adur CFMP (Environment Agency 2009) and the River Arun and Western Streams CFMP (Environment Agency 2009). As part of these CFMPs, a number of policies have been adopted for various parts of the study area covered by this SFRA. These have been summarised in the following sections.

6.8.1 River Adur CFMP

Upper Adur – Policy 6: *take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits.*

The risk of flooding from the Adur in this sub-area is currently relatively low and future predictions for increases in flood risk are predicted to be relatively small. The majority of the land at risk is moderate grade agricultural land, and less than 10 residential properties are at risk.

The implementation of policy 6 will assist in controlling or reducing flood risk downstream in urban areas such as Steyning, Upper Beeding and Shoreham. The increased flooding could result in an increase of wetland around the River Adur Water Meadow and Wyckham Wood Site of Nature Conservation Interest.

A number of proposed actions to implement this approach in this sub-area are outlined in the CFMP, including a tidal strategy for the Adur to investigate the potential for large scale flood attenuation and wetland creation; encouraging the use of Whole Farm Plans to provide advice on better land use practice with respect to surface water runoff; a study to investigate the potential for flood defence removal, floodplain restoration and re-naturalisation and creation of floodplain storage.

Steyning and Upper Beeding – Policy 3: *Areas of low to moderate flood risk is currently appropriately managed and where the risk of flooding is not expected to increase significantly in the future.*

The River Adur is tidally influenced in this area; high tides and increased river levels can lead to overtopping of flood defences and almost 100 residential properties are at risk during the 1 % annual probability flood event. Flood risk from surface water and urban drainage also causes localised flooding. It is proposed to continue with

asset maintenance and provision of Flood Warning services in Steyning and Upper Beeding to ensure continued management of flood risk in this area.

6.8.2 River Arun & Western Streams CFMP

Rother Valley / Middle Arun / Weald – Policy 6: *take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits.*

This large rural area offers opportunities for changing land use and possible flood storage to reduce some of the current rapid runoff which results from the soils, slope and land use. The Middle Arun has raised defences in the form of embankments which were originally designed to protect the farmland and natural habitats on either side of the river up to a 2% AEP flood event. This level is now considered to provide protection from 3% AEP event.

It is emphasised that flooding often brings positive benefits to the environment and the policy adopted for this area supports increased flooding and keeping water on the land for longer. Application of this policy will contribute to reducing flood risk downstream.

Specific proposals for the area include investigating opportunities to work with landowners to create wetland habitat throughout the area; working with National Farmers Union and Natural England to develop a Land Management Plan exploring the possibilities for changes in land use and land management practices aiming to reduce run-off from surrounding countryside, to reduce soil erosion and to achieve local flood risk benefits; and preparation of a tidal strategy for the Arun to address the gap in understanding of tidal flood risk in Lower and Middle Arun and to explore the feasibility of lowering the flood banks on the lower tidal Arun to allow more use of the extensive flood plain for flood storage.

Horsham – Policy 4: *Areas where flood risk is currently being managed effectively but further actions may need to be taken to keep pace with climate change.*

It is considered that urban development and increased flows will place more pressure on the existing drainage network in Horsham and will result in more surface water flooding, urban drainage capacity being exceeded with greater frequency, and more extensive flooding from urban watercourses. Flooding from surface water has not been quantified, but it is known to be significant and is predicted to increase in the future.

The adopted policy for this area is to take action to ensure that Horsham continues to be protected from flood risk to the same standard of protection in the face of climate change and continued urban development. To ensure this policy is fulfilled, it is proposed to continue working alongside HDC to influence spatial development in the area with the aims of ensuring no increase in runoff from new developments and to encourage the use of SuDS. In addition, it is proposed to prepare a Surface Water Management Plan (SWMP) with HDC and the Water Companies to address the effects of climate change and development.

Pulborough – Policy 4: *Areas where flood risk is currently being managed effectively but further actions may need to be taken to keep pace with climate change.*

The River Arun flows through Pulborough; the watercourse is embanked, and flood defence walls protect the town of Pulborough. The area is also served by a small pumping station which discharges excess water which is prone to collect behind the main river defences when water levels in the Arun are high.

In order to implement the preferred approach it is proposed to work with Horsham DC to provide development control advice to ensure no increase in run-off from new developments and seek opportunities to reduce current run-off rates where possible; improve flood warning service to properties in Pulborough and surrounding villages through more accurate flood forecasting and more timely warnings; and as part of Lower Tidal River Arun Strategy, assess the integrity and long term sustainability of existing tidal defences in and around Pulborough.

6.9 Cross Boundary Issues

6.9.1 Fluvial and Tidal Flooding

The River Arun and River Adur catchments extend out of the Planning Authority Area and Horsham District into neighbouring local authority areas. The neighbouring local authority SFRAs[28] have been reviewed to identify any cross-boundary issues arising from fluvial flood risk.

The River Lox, a tributary of the Arun, drains south east through Waverley Borough and Chichester District before joining the River Arun at the confluence located at the border of Horsham District. The Arun and Western Steams CFMP policy for the south eastern River Lox catchment is Policy 6: Take actions to store water or manage runoff in locations that provide overall flood risk reduction or environmental benefits which would be implemented in specific areas following a detailed assessment. This could reduce cross boundary issues for Horsham.

The source of the North River and the Bolding Brook, both tributaries of the River Arun, are located in Mole Valley District. The North River flows south eastwards into Horsham District before joining the River Arun to the north of Slinfold. The Bolding Brook flows south into Horsham District and joins the River Arun to the south west of Horsham town. An increase of flows from either of these tributaries from Mole Valley District may result in flooding in Horsham District.

The source of the River Mole and some of its tributaries are located in the north east of Horsham District. The rivers flow north east into Crawley Borough Council. Any areas developed in Horsham District adjacent to the River Mole or its tributaries would need to make sure that there is no increase in flood risk downstream in Crawley Borough.

The source of the River Adur and a number of its tributaries are located in Mid Sussex District and flow west into Horsham District. An increase of flows from these rivers due to development in Mid Sussex District has the potential to result in flooding in Horsham District.

The tidal River Adur and tidal River Arun extend south of Horsham District to the SDNPA. An increase of flows from Horsham District may result in flooding in the SDNPA. Additionally, any change in tidal flood management of in SDNPA may impact the tidal areas in Horsham District.

The West Sussex Flood Risk Management Group (WSFRMG) was set up in 2009 in order to better manage cross boundary flooding and erosion issues. This group meets quarterly and is attended by West Sussex County Council and all relevant local authorities. Cross boundary fluvial flooding issues will be considered by this group.

6.9.2 Surface Water Flooding

Surface water drainage catchments are defined by topography and local infrastructure, such as railway embankments etc. This means that there is potential for cross boundary issues where the surface water catchment covers more than one LPA. Cross boundary surface water flooding issues will be considered by WSFRMG.

The local topography, RofSWF mapping and historic flood records from neighbouring LPA SFRAs[16] suggest that there are potential surface water flood risk cross boundary issues with SDNP, Waverley, Mole Valley and Mid Sussex. Any development within these drainage catchments should provide SuDS to mitigate the impact of flood risk elsewhere in the catchment (See Section 9.10).

6.10 Properties at Risk of Flooding in Horsham District

The West Sussex LFRMS[23] provides an assessment of the number of residential properties and businesses susceptible to flood risk from; solely surface water, solely rivers and sea, and the number of properties at risk of flooding from both sources for each of the wet spots defined in the LFRMS. The numbers of properties are

[28] South Downs National Park Authority (2017) Level 1 Update and Level 2 SFRA
Waverly Borough Council (2018) Level 1 SFRA
Reigate & Banstead Borough Council. Mole Valley District Council and Tandrige District Council (2017) Level 1 SFRA
Crawley Borough Council (2014) Level 1 SFRA
Mid Sussex District Council (2015) Level 1 SFRA

derived from address data and have been rounded to the nearest five properties, except where less than five properties are at risk. The number of residential properties and businesses susceptible to flood risk (including flats above the ground floor level) for the wet spots in Horsham District are shown in Table 6-4.

Table 6-4 Residential properties and businesses susceptible to flood risk (including flats above the ground floor level) in Horsham District [23]

Wet Spots	Surface Water Flood Risk only (no. of properties)	River and sea flood risk only (no. of properties)	Combined flood risk from both surface water and rivers and sea (no. of properties)	Total no. of properties
Billingshurst	600	0	25	625
Bramber and Upper Beeding	325	60	0	385
Horsham	4000	0	0	4000
Pulborough	325	0	10	335
Southwater	700	0	0	700
Storrington	525	0	25	550

Note that the numbers in Table 6-4 will be updated following revision of the LFRMS which is currently ongoing.

7. Guidance on the application of the Sequential and Exception Tests

7.1 Overview

This Section guides the application of the Sequential Test and Exception Test in the Plan-making and planning application processes. Not all development will be required to undergo these tests, as described below, but may still be required to undertake a site specific FRA, guidance about which is included in Section 8.

The sequential approach is a decision-making tool designed to ensure that sites at little or no risk of flooding are developed in preference to sites at higher risk. This will help avoid the development of sites that are inappropriate on flood risk grounds. The subsequent application of the Exception Test where required will ensure that new developments in flood risk areas will only occur where flood risk is clearly outweighed by other sustainability drivers and where development can be made safe from flooding and not increase the risk of flooding elsewhere.

The sequential approach can be applied at all levels and scales of the planning process, both between and within Flood Zones. All opportunities to locate new developments (except Water Compatible) in reasonably available areas of little or no flood risk should be explored, prior to any decision to locate them in areas of higher risk.

7.2 Applying the Sequential Test for the Local Plan

As the LPA, Horsham DC must demonstrate that throughout the site allocation process a range of possible sites have been considered in conjunction with the flood risk and vulnerability information from the SFRA, and that the Sequential Test, and where necessary the Exception Test, has been applied.

The Sequential Test requires an understanding of the Flood Zones in the study area and the vulnerability classification of the proposed developments. Flood Zone definitions are provided in Table 5-1 and mapped in Figure 8 in Appendix A (and the Environment Agency's Flood Map for Planning (Rivers and Sea)). Flood risk vulnerability classifications, as defined in the PPG are presented in Table 7-1. The NPPF[3] acknowledges that some areas will (also) be at risk of flooding from sources other than fluvial.

All sources must be considered when planning for new development including: flooding from land or surface water runoff; groundwater; sewers; and artificial sources.

If a location is recorded as having experienced repeated flooding from the same source this should be acknowledged within the Sequential Test.

The flow diagram presented in Figure 7-1 illustrates how the Sequential Test process should be applied to identify the suitability of a site for allocation, in relation to the flood risk classification.

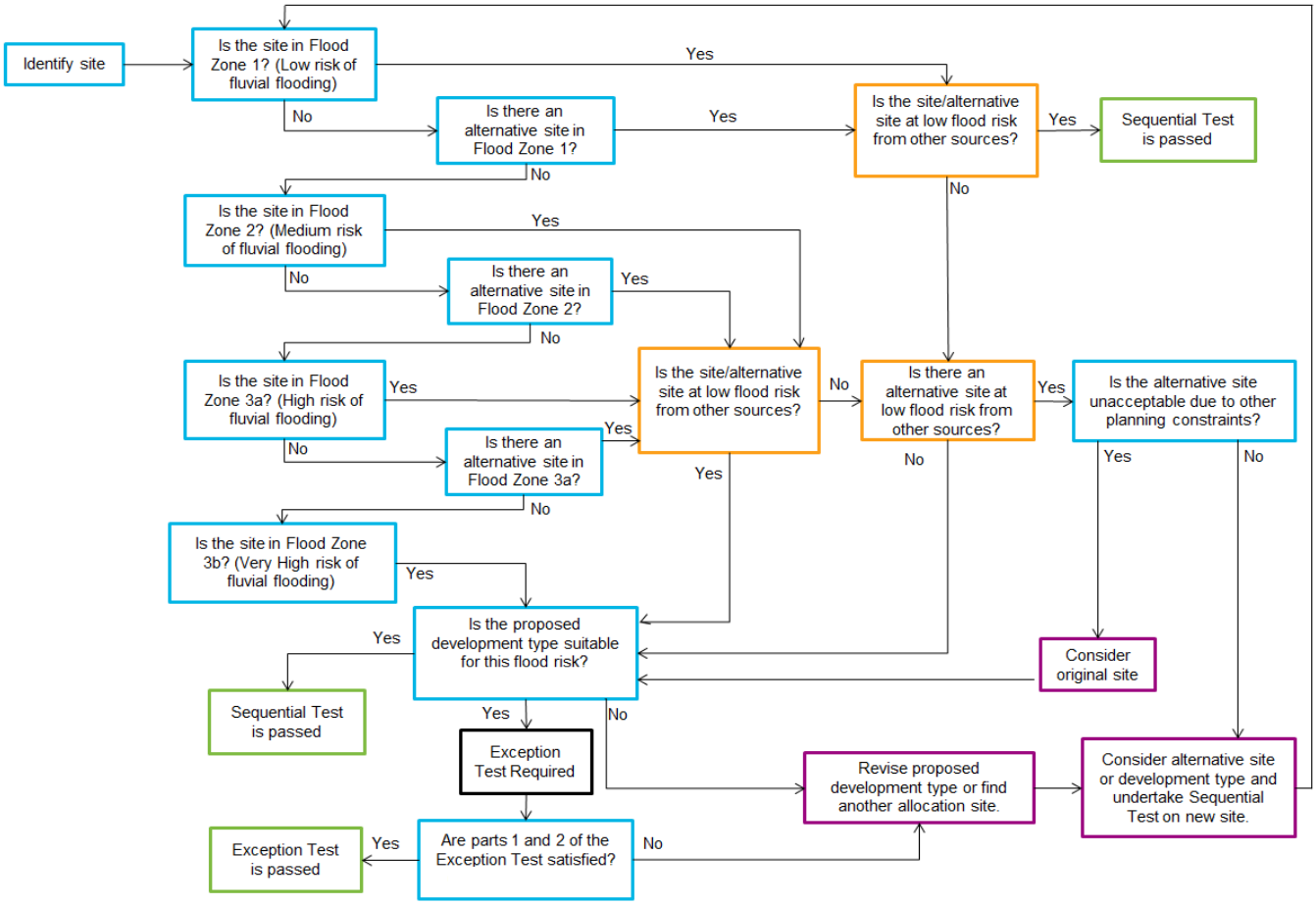

Figure 7-1 Application of Sequential Test for Local Plan preparation

Table 7-1 Flood Risk Vulnerability Classification (PPG[5])

Vulnerability Classification	Development Uses
Essential Infrastructure	Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. Wind turbines.
Highly Vulnerable	Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding. Emergency dispersal points. Basement dwellings. Caravans, mobile homes and park homes intended for permanent residential use. Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as “essential infrastructure”).
More Vulnerable	Hospitals. Residential institutions such as residential care homes, children’s homes, social services homes, prisons and hostels. Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. Non–residential uses for health services, nurseries and educational establishments. Landfill and sites used for waste management facilities for hazardous waste. Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable	Police, ambulance and fire stations which are not required to be operational during flooding.

Vulnerability Classification	Development Uses
	Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non–residential institutions not included in "more vulnerable", and assembly and leisure. Land and buildings used for agriculture and forestry. Waste treatment (except landfill and hazardous waste facilities). Minerals working and processing (except for sand and gravel working). Water treatment works which do not need to remain operational during times of flood. Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).
Water-Compatible Development	Flood control infrastructure. Water transmission infrastructure and pumping stations. Sewage transmission infrastructure and pumping stations. Sand and gravel working. Docks, marinas and wharves. Navigation facilities. MOD defence installations. Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. Water-based recreation (excluding sleeping accommodation). Lifeguard and coastguard stations. Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

The NPPF indicates suitability of a development based on its vulnerability and location within a fluvial flood zone as set out in Table 7-2. However, the vulnerability classification of types of development is still relevant in considering flood risk from other sources. For example, a basement dwelling will still be more vulnerable to surface water flooding than an office development.

Table 7-2 Flood Risk Vulnerability and Flood Zone 'Compatibility' (PPG[Error! Bookmark not defined.])

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	1	✓	✓	✓	✓	✓
	2	✓	✓	Exception Test Required	✓	✓
	3a	Exception Test Required	✓	×	Exception Test Required	✓
	3b	Exception Test Required	✓	×	×	×

✓ – Development is appropriate × – Development should not be permitted

The recommended steps in undertaking the Sequential Test are detailed below.

7.2.1 Recommended Stages for LPA Application of the Sequential Test

The information required to address many of these steps is provided in the accompanying maps presented in Appendix A. When preparing a Local Plan, a database of the potential allocation sites across Horsham should be generated and populated using flood risk information from all sources contained within this SFRA. This database can be used by Horsham DC when applying the steps below.

1. Assign potential developments a vulnerability classification. Where development is mixed, the development should be assigned the highest vulnerability class of the developments proposed.
2. The location and identification of potential development should be recorded.
3. The risk of flooding should be identified for each potential development site and access to that site, including:
    a. A review of the Flood Map for Planning (Rivers and Sea). Where a site spans more than one Flood Zone, all zones should be noted, preferably using percentages.
    b. The proximity of Main River and Ordinary Watercourses (the later may not be modelled and mapped on the Flood Map for Planning).
    c. The risk of flooding from surface water, groundwater, sewer flooding, based on available datasets and historic records. Identify existing flood defences serving the potential development sites. (However, it should be noted that for the purposes of the Sequential Test, Flood Zones ignoring defences should be used).
4. The design life of the development should be considered with respect to climate change:
    - 100 years – up to 2120 for residential developments; and
    - 75 years – up to 2095 for commercial / industrial developments, or other time horizon specific to the non-residential use proposed.
5. Highly Vulnerable developments to be accommodated within the Planning Authority Area should be located on those sites identified as being within at low risk of flooding from all sources. If these cannot be located in areas of low risk, because the identified sites are unsuitable or there are insufficient sites in areas of low risk, sites in areas of greater risk can then be considered. Highly Vulnerable sites in Flood Zone 2 will require application of the Exception Test. If sites in Flood Zone 2 are inadequate, then the LPA may have to identify additional sites in Flood Zones 1 or 2 to accommodate development or seek opportunities to locate the development outside their administrative area. It should be noted that Highly Vulnerable development is not appropriate in Flood Zones 3a and 3b.
6. Once all Highly Vulnerable developments have been allocated to a development site, consideration can be given to those development types defined as More Vulnerable. In the first instance More Vulnerable development should be located in any unallocated sites in areas of lowest risk from all sources. Where these sites are unsuitable or there are insufficient sites remaining, sites of slightly greater risk can be considered. If there are insufficient sites in Flood Zone 1 or 2 to accommodate More Vulnerable development, sites in Flood Zone 3a can be considered. More Vulnerable developments in Flood Zone 3a will require application of the Exception Test. It should be noted that More Vulnerable development is not appropriate in Flood Zone 3b.
7. Once all More Vulnerable developments have been allocated to a development site, consideration can be given to those development types defined as Less Vulnerable. In the first instance Less Vulnerable development should be located within areas of lowest risk from all sources, continuing sequentially with areas of increasing risk. Less Vulnerable development types are not appropriate in Flood Zone 3b – Functional Floodplain.
8. Essential Infrastructure should be preferentially located in the lowest flood risk areas, however this type of development may be located in Flood Zones 3a and 3b, provided the Exception Test is satisfied.
9. Water Compatible development has the least constraints with respect to flood risk and it is considered appropriate to allocate these sites last. The sequential approach should still be followed in the selection of sites; however, it is appreciated that Water Compatible development by nature often relies on access and proximity to water bodies.
10. On completion of the Sequential Test, consideration may need to be given to the risks posed to a site within an area at risk of flooding in more detail in a Level 2 SFRA (as explained in Section 7.2.3). By undertaking the Exception Test, this more detailed study should consider the detailed nature of the risk posed by all sources of flooding, and potential flood hazard to allow a sequential approach to site allocation. Consideration of flood hazard within a flood zone would include:
    - Flood risk management measures,

- The rate of flooding,
- Flood water depth,
- Flood water velocity.

11. Where the development is Highly Vulnerable, More Vulnerable, Less Vulnerable or Essential Infrastructure and a site is found to be impacted by a recurrent flood source (other than tidal or fluvial), the site and flood sources should be investigated further regardless of any requirement of the Exception Test. It is noted that for any development at risk of flooding, a site-specific FRA will be required.

7.2.2 Windfall Sites

Windfall sites are those which have not been specifically identified in the development plan. In cases where development needs cannot be fully met through the provision of site allocations, a realistic allowance for windfall development should be assumed, based on past trends. It is recommended that the acceptability of windfall applications in flood risk areas should be considered at the strategic level through a policy setting out broad locations and quantities of windfall development that would be acceptable or not in Sequential Test terms.

7.2.3 Level 2 SFRA

If, following the application of the Sequential Test, it is not possible to locate all of the sites within areas of low flood risk, it may be necessary for a Level 2 SFRA to be prepared to provide additional information to support the application of the Exception Test.

The Level 2 SFRA should consider the flood risk to each site from all sources, based on available datasets. Further detail on the nature of flood risk from rivers including flood depth and hazard rating should be considered where detailed modelling outputs are available, as well as the condition and location of flood defences. A Level 2 SFRA should also continue to use this information to apply the sequential approach to steer development to those areas with the lowest risk of flooding.

7.3 Applying the Sequential Test for Planning Applications

It is necessary to undertake a Sequential Test for a planning application if both of the following apply:

1. The proposed development is in Flood Zone 2 or 3.
2. A Sequential Test hasn't already been done for a development of the type you plan to carry out on your proposed site.

The Environment Agency publication 'Demonstrating the flood risk Sequential Test for Planning Applications[29]' sets out the procedure for applying the sequential test to individual applications as follows:

- Identify the geographical area of search over which the test is to be applied; this could be the District area, or a specific catchment if this is appropriate and justification is provided (e.g. school catchment area or the need for affordable housing within a specific area).
- Identify the source of 'reasonably available' alternative sites; usually drawn from evidence base / background documents produced to inform the Local Plan.
- State the method used for comparing flood risk between sites; for example, the Environment Agency Flood Map for Planning, the SFRA mapping, site-specific FRAs if appropriate, other mapping of flood sources.
- Apply the Sequential Test; systematically consider each of the available sites, indicate whether the flood risk from all sources is higher or lower than the application site, state whether the alternative option being considered is allocated in the Local Plan, identify the capacity of each alternative site, and detail any constraints to the delivery of the alternative site(s).

[29] Environment Agency (2012) Demonstrating the flood risk Sequential Test for Planning Applications, Version 3.1. Available from: https://www.gov.uk/guidance/flood-risk-assessment-the-sequential-test-for-applicants

- Conclude whether there are any reasonably available sites in areas with a lower probability of flooding from all sources that would be appropriate to the type of development or land use proposed.
- Where necessary, as indicated by Table 7-2, apply the Exception Test.
- Apply the Sequential approach to locating development within the site.

It should be noted that it is for Horsham DC, taking advice from the Environment Agency as appropriate, to consider the extent to which Sequential Test considerations have been satisfied, considering the particular circumstances in any given case. The developer should justify with evidence what area of search has been used when making the application.

Ultimately, after applying the Sequential Test, Horsham DC needs to be satisfied in all cases that the proposed development would be safe and not lead to increased flood risk elsewhere. This needs to be demonstrated within a site-specific FRA and is necessary regardless of whether the Exception Test is required.

7.3.1 Sequential Test Exemptions

It should be noted that the Sequential Test does not need to be applied in the following circumstances:

- Individual developments proposed on sites which have been allocated in development plans through the Sequential Test.
- Minor development, which is defined in the NPPF[3] as:
    - Minor non-residential extensions: industrial / commercial / leisure etc. extensions with a footprint <250m^2.
    - Alterations: development that does not increase the size of buildings e.g. alterations to external appearance.
    - Householder development: for example; sheds, garages, games rooms etc. within the curtilage of the existing dwelling, in additional to physical extensions to the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling e.g. subdivision of houses into flats.
- Change of Use applications, unless it is for a change of use of land to a caravan, camping or chalet site, or to a mobile home site or park home site.
- Development proposals in Flood Zone 1 (land with a low probability of flooding from rivers or the sea) unless the SFRA, or other more recent information, indicates there may be flooding issues now or in the future (for example, through the impact of climate change).
- Redevelopment of existing properties (e.g. replacement dwellings), provided they do not increase the number of dwellings in an area of flood risk (i.e. replacing a single dwelling within an apartment block).

7.4 Exception Test

The purpose of the Exception Test is to ensure that, following the application of the Sequential Test, new development is only permitted in Flood Zone 2 and 3 where flood risk is clearly outweighed by other sustainability factors and where the development will be safe during its lifetime, considering climate change.

For the Exception Test to be passed:

- Part 1 - It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by the SFRA where one has been prepared; and
- Part 2 - A site-specific Flood Risk Assessment must demonstrate 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.

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

When determining planning applications, Horsham DC should ensure flood risk is not increased elsewhere. In order to consider development to be appropriate in an area at risk of flooding, it should be informed by a site-specific FRA, follow the Sequential Test, and if required the Exception Test, before demonstrating the following:

- Within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location;
- Development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including any emergency planning carried out by the resident and/or owner; and it gives priority to the use of sustainable drainage systems.

There are a number of ways a new development can be made safe:

- Avoiding flood risk by not developing in areas at risk from floods;
- Substituting higher vulnerability land uses for lower vulnerability uses in higher flood risk locations and locating higher vulnerability uses in areas of lower risk on a strategic scale, or on a site basis;
- Providing adequate flood risk management infrastructure which will be maintained for the lifetime of the development; and
- Mitigating the potential impacts of flooding through design and resilient construction.

Further guidance is provided in Section 9.

8. Site Specific FRA Guidance

8.1 What is a Flood Risk Assessment?

A site-specific FRA is a report suitable for submission with a planning application which provides an assessment of flood risk to and from a proposed development, and demonstrates how the proposed development will be made safe, will not increase flood risk elsewhere and where possible will reduce flood risk overall in accordance with paragraph 155 of the NPPF[3] and PPG[5]. An FRA must be prepared by a suitably qualified and experienced person and must contain all the information needed to allow Horsham DC to satisfy itself that the requirements have been met.

8.2 When is a Flood Risk Assessment required?

The NPPF states that a site-specific FRA is 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.
- Proposals in Flood Zone 1 where land is identified in a Strategic Flood Risk Assessment as being at increased flood risk in future.
- Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.

8.3 How detailed should an FRA be?

The PPG states that site-specific FRAs should be proportionate to the degree of flood risk, the scale and nature of the development, its vulnerability classification (Table 7-1) and the status of the site in relation to the Sequential and Exception Tests. Site-specific FRAs should also make optimum use of readily available information, for example the mapping presented within this SFRA and available on the Environment Agency website, although in some cases additional modelling or detailed calculations will need to be undertaken. For example, where the development is an extension to an existing house (for which planning permission is required) which would not significantly increase the number of people present in an area at risk of flooding, Horsham DC would generally need a less detailed assessment to be able to reach an informed decision on the planning application. For a new development comprising a greater number of houses in a similar location, or one where the flood risk is greater Horsham DC may require a more detailed assessment, for example, the preparation of site-specific hydraulic modelling to determine the flood risk to and from the site pre and post-development, and the effectiveness of any management and mitigation measures incorporated within the design.

As a result, the scope of each site-specific FRA will vary considerably. Table 8-1 presents the different levels of site-specific FRA as defined in the CIRIA publication C624[30] and identifies typical sources of information that can be used. The list is not exhaustive, and the level of detail could vary depending on the location, scale and nature of the proposed works. Sufficient information must be included to enable the Council and where appropriate, consultees, to determine that the proposal will be safe for its lifetime, not increase flood risk elsewhere and where possible, reduce flood risk overall. Failure to provide sufficient information will result in applications being refused.

[30] CIRIA (2004) Development and flood risk – guidance for the construction industry C624.

Table 8-1 Levels of site-specific FRA

Description
Level 1 Screening study to identify whether there are any flooding or surface water management issues related to a development site that may warrant further consideration. This should be based on readily available existing information. The screening study will ascertain whether a FRA Level 2 or 3 is required. Typical sources of information include: • Horsham DC SFRA • Flood Map for Planning (Rivers and Sea) • Environment Agency Standing Advice • NPPF Tables 1, 2 and 3
Level 2 Scoping study to be undertaken if the Level 1 FRA indicates that the site may lie within an area that is at risk of flooding, or the site may increase flood risk due to increased run-off. This study should confirm the sources of flooding which may affect the site. The study should include: • An appraisal of the availability and adequacy of existing information; • A qualitative appraisal of the flood risk posed to the site, and potential impact of the development on flood risk elsewhere; and, • An appraisal of the scope of possible measures to reduce flood risk to acceptable levels. The scoping study may identify that sufficient quantitative information is already available to complete a FRA appropriate to the scale and nature of the development. Typical sources of information include those listed above, plus: • Local policy statements or guidance. • Adur and Arun and Western Streams Catchment Flood Management Plans. • West Sussex County Council PFRA and LFRMS. • Data request from the Environment Agency to obtain result of existing hydraulic modelling studies relevant to the site and outputs such as maximum flood level, depth and velocity. • Consultation with Environment Agency/West Sussex County Council/sewerage undertakers and other flood risk consultees to gain information and to identify in broad terms, what issues related to flood risk need to be considered including other sources of flooding. • Historic maps. • Interviews with local people and community groups. • Walkover survey to assess potential sources of flooding, likely routes for floodwaters, the key features on the site including flood defences, their condition. • Site survey to determine general ground levels across the site, levels of any formal or informal flood defences
Level 3 Detailed study to be undertaken if a Level 2 FRA concludes that further quantitative analysis is required to assess flood risk issues related to the development site. The study should include: • Quantitative appraisal of the potential flood risk to the development; • Quantitative appraisal of the potential impact of the development site on flood risk elsewhere; and • Quantitative demonstration of the effectiveness of any proposed mitigations measures. Typical sources of information include those listed above, plus: • Detailed topographical survey. • Detailed hydrographic survey. • Site-specific hydrological and hydraulic modelling studies which should include the effects of the proposed development. • Monitoring to assist with model calibration/verification. • Continued consultation with the LPA, Environment Agency and other flood risk consultees.

8.3.1 Environment Agency Data Requests

The Environment Agency offers a series of 'products' for obtaining flood risk information suitable for informing the preparation of site-specific FRAs as described on their website https://www.gov.uk/planning-applications-assessing-flood-risk.

- **Products 1 – 4** relate to mapped deliverables including flood level and flood depth information and the presence of flood defences local to the proposed development site;
- **Product 5** contains the reports for hydraulic modelling of the Main Rivers;
- **Product 6** contains the model output data so the applicant can interrogate the data to inform the FRA.
- **Product 7** comprises the hydraulic model itself.

Products 1 – 6 can be used to inform a Level 2 FRA. In some cases, it may be appropriate to obtain Product 7 and to use as the basis for developing a site-specific model for a proposed development as part of a Level 3 FRA. This can be requested via either their National Customer Contact Centre via enquiries@environment-agency.gov.uk.

8.3.2 Modelling of Ordinary Watercourses

It should be noted that the scope of hydraulic modelling studies undertaken by the Environment Agency typically cover flooding associated with Main Rivers, and therefore Ordinary Watercourses that form tributaries to the Main Rivers may not always be included in the model. Where a proposed development site is in close proximity to an Ordinary Watercourse and either no hydraulic modelling exists, or the available modelling is considered to provide very conservative estimates of flood extents (due to the use of national generalised JFLOW modelling), applicants may need to prepare a simple hydraulic model to enable more accurate assessment of the probability of flooding associated with the watercourse and to inform the site-specific FRA. This should be carried out in line with industry standards and in agreement with the Environment Agency and West Sussex County Council (as the LLFA).

8.4 What needs to be addressed in a Flood Risk Assessment?

The PPG[Error! Bookmark not defined.] states that the objectives of a site-specific flood risk assessment are to establish:

- Whether a proposed development is likely to be affected by current or future flooding from any source;
- Whether it will increase flood risk elsewhere;
- Whether the measures proposed to deal with these effects and risks are appropriate;
- The evidence for the LPA to apply (if necessary) the Sequential Test, and;
- Whether the development will be safe and pass the Exception Test, if applicable.

8.5 Flood Risk Assessment Checklist

Table 8-2 provides a checklist for site-specific FRAs including the likely information that will need to be provided along with references to sources of relevant information. As described earlier in this Section, the exact level of detail required under each heading will vary according to the scale of development and the nature of the flood risk. It is expected that this Checklist is completed for all planning applications.

Table 8-2 Site specific FRA Checklist (developed from guidance in PPG[Error! Bookmark not defined.])

What to include in the FRA		*Source(s) of Information*
1. Site Description		
Site address	-	-
Site description	-	
Location plan	*Including geographical features, street names, catchment areas, watercourses and other bodies of water*	*OS Mapping* *SFRA Appendix A*
Site plan	*Plan of site showing development proposals and any structures which may influence local hydraulics e.g. bridges, pipes/ducts crossing watercourses, culverts, screens, embankments, walls, outfalls and condition of channel*	*OS Mapping* *Site Survey*
Topography	*Include general description of the topography local to the site. Where necessary, site survey may be required to confirm site levels (in relation to Ordnance datum).* *Plans showing existing and proposed levels.*	*SFRA Appendix A* *Site Survey*
Geology	*General description of geology local to the site.*	*SFRA Appendix A* *Ground Investigation Report*
Watercourses	*Identify Main Rivers and Ordinary Watercourses local to the site.*	*SFRA Appendix A*
Status	*Is the development in accordance with the Council's Spatial Strategy?*	*See advice from Horsham DC if necessary.*

2. Assessing Flood Risk		
The level of assessment will depend on the degree of flood risk and the scale, nature and location of the proposed development. Not all of the prompts listed below will be relevant for every application.		
Flooding from Rivers	*Provide a plan of the site and Flood Zones.* *Identify any historic flooding that has affected the site, including dates and depths where possible.* *How is the site likely to be affected by climate change?* *Determine flood levels on the site for the 1% annual probability (1 in 100 chance each year) flood event including an allowance for climate change.* *Determine flood hazard on the site (in terms of flood depth and velocity[31]).* *Undertake new hydraulic modelling to determine the flood level, depth, velocity, hazard, rate of onset of flooding on the site.*	*SFRA Appendix A* *Environment Agency Flood Map for Planning (Rivers and Sea).* *Environment Agency Products 1-7.* *New hydraulic model (where EA data not available)*
Flooding from Land	*Identify any historic flooding that has affected the site.* *Review the local topography and conduce a site walkover to determine low points at risk of surface water flooding.* *Review the Risk of Flooding from Surface Water mapping.* *Where necessary, undertake modelling to assess surface water flood risk.*	*SFRA Appendix A* *Topographic survey.* *Site walkover.* *Risk of Flooding from Surface Water mapping (EA website).*
Flooding from Groundwater	*Desk based assessment based on high level BGS mapping in the SFRA.* *Ground survey investigations.* *Identify any historic flooding that has affected the site.*	*SFRA Appendix A* *Ground Investigation Report*
Flooding from Sewers	*Identify any historic flooding that has affected the site.*	*SFRA Appendix A* *Where appropriate an asset location survey can be provided by Thames Water Utilities Ltd http://www.thameswater-propertysearches.co.uk/ and Southern Water https://www.southernwater.co.uk/drainage-water-searches*
Reservoirs, canals and other artificial sources	*Identify any historic flooding that has affected the site.* *Review the Risk of Flooding from Reservoirs mapping.*	*Risk of Flooding from Reservoirs mapping (EA website)*
3. Proposed Development		
Current use	*Identify the current use of the site.*	-
Proposed use	*Will the proposals increase the number of occupants / site users on the site such that it may affect the degree of flood risk to these people?*	-
Vulnerability Classification	*Determine the vulnerability classification of the development. Is the vulnerability classification appropriate within the Flood Zone?*	*SFRA* *Figure* 7-1 Application of Sequential Test for Local Plan preparation Table 7-1
4. Avoiding Flood Risk		
Sequential Test	*Determine whether the Sequential Test is required.* *Consult Horsham DC to determine if the site has been included in the Sequential Test.*	*SFRA Section 7.3*

[31] FD2320 Flood risk to people calculator http://evidence.environment-agency.gov.uk/FCERM/Libraries/FCERM_Project_Documents/FD2320_3364_TRP_pdf.sflb.ashx

	If required, present the relevant information to Horsham DC to enable their determination of the Sequential Test for the site on an individual basis.	
Exception Test	*Determine whether the Exception Test is necessary.* *Where the Exception Test is necessary, present details of:* *Part 1) how the proposed development contributes to the achievement of wider sustainability objectives as set out in the Horsham DC Sustainability Appraisal Report.* *(Details of how part 2) can be satisfied are addressed in the following part 5 'Managing and Mitigating Flood Risk'.)*	*SFRA 7.4* *Refer to Horsham DC sustainability objectives*
5. Managing and Mitigating Flood Risk		
Section 9 of the SFRA presents measures to manage and mitigate flood risk and when they should be implemented. Where appropriate, the following should be demonstrated within the FRA to address the following questions: *How will the site/building be protected from flooding, including the potential impacts of climate change, over the development's lifetime?* *How will you ensure that the proposed development and the measures to protect your site from flooding will not increase flood risk elsewhere?* *Are there any opportunities offered by the development to reduce flood risk elsewhere?* *What flood-related risks will remain after you have implemented the measures to protect the site from flooding (i.e. residual risk) and how and by whom will these be managed over the lifetime of the development (e.g. flood warning and evacuation procedures)?*		
Development Layout and Sequential Approach	*Plan showing how sensitive land uses have been placed in areas within the site that are at least risk of flooding.*	*SFRA Section 9.2*
Finished Floor Levels	*Plans showing finished floor levels in the proposed development in relation to Ordnance Datum taking account of indicated flood depths.*	*SFRA Section 9.3*
Flood Resistance	*Details of flood resistance measures that have been incorporated into the design. Include design drawings where appropriate.*	*SFRA Section 9.4*
Flood Resilience	*Details of flood resilience measures that have been incorporated into the design. Include design drawings where appropriate.*	*SFRA Section 9.5*
Safe Access / Egress	*Provide a figure showing proposed safe route of escape away from the site and/or details of safe refuge. Include details of signage that will be included on site.* *Where necessary this will involve mapping of flood hazard associated with river flooding. This may be available from Environment Agency modelling or may need to be prepared as part of hydraulic modelling specific for the proposed development site.*	*SFRA Section 9.6*
Floodplain Compensation Storage	*Provide calculations or results of a hydraulic modelling study to demonstrate that the proposed development provides compensatory flood storage, and either will not increase flood risk to neighbouring areas or will result in an overall improvement. This should be located and designed to achieve level for level and volume for volume compensation, should be provided on land that is in hydrological continuity with the site within the applicant's ownership and subject to appropriate maintenance regimes for its lifetime. Include cross sectional drawings clearly showing existing and proposed site levels.*	*SFRA Section 9.7*
Flow Routing	*Provide evidence that proposed development will not impact flood flows to the extent that the risk to surrounding areas is increased. Where necessary this may require modelling.*	
Riverside Development Buffer Zone	*Provide plans showing how a buffer zone of relevant width will be retained adjacent to any Main River or Ordinary Watercourse in accordance with requirements of the Environment Agency or West Sussex County Council.*	*West Sussex County Council guidance on Ordinary Watercourse consent.* *Environment Agency Environmental permitting Regulations*

	https://www.gov.uk/guidance/flood-risk-activities-environmental-permits	*https://www.gov.uk/guidance/flood-risk-activities-environmental-permits*
Surface Water Management	*Completion of SuDS Proforma for all major development proposals in Flood Zones 1, 2 or 3.* *Details of the following within FRA for all other developments located within Flood Zones 2 and 3:* *Calculations (and plans) showing areas of the site that are permeable and impermeable pre and post-development.* *Calculations of pre and post-development runoff rates and volumes including consideration of climate change over the lifetime of the development.* *Details of the methods that will be used to manage surface water (e.g. permeable paving, swales, wetlands, rainwater harvesting).* *Where appropriate, reference the supporting Outline or Detailed Drainage Strategy for the site.* *Information on proposed management arrangements*	*SFRA Section 9.10* *West Sussex County Council SuDS planning advice*
Flood Warning and Evacuation Plan	*Where appropriate reference the Flood Warning and Evacuation Plan or Personal Flood Plan that has been prepared for the proposed development (or will be prepared by site owners).*	*SFRA Section 9.11*

8.6 Pre-application Advice

At all stages, Horsham DC, and where necessary the Environment Agency, West Sussex County Council and/or the Statutory Water Undertaker may need to be consulted to ensure the FRA provides the necessary information to fulfil the requirements for planning applications.

The Environment Agency, West Sussex County Council and Horsham DC each offer pre-application advice services which should be used to discuss particular requirements for specific applications.

- Horsham District Council https://beta.horsham.gov.uk/planning/planning-applications/planning-permission-advice-services/what-is-pre-application-planning-advice
- West Sussex County Council

  https://www.westsussex.gov.uk/planning/county-planning-pre-application-advice/
- Environment Agency https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion
- The following government guidance sets out when LPAs should consult with the Environment Agency on planning applications https://www.gov.uk/flood-risk-assessment-local-planning-authorities.

9. Managing and Mitigating Flood Risk

9.1 Overview

The NPPF[3] appreciates that it may not always be possible to avoid locating development in areas at risk of flooding. This section builds on the findings of the SFRA to provide guidance on the range of measures that could be considered on site in order to manage and mitigate flood risk. These measures should be considered when preparing a site-specific FRA as described in Section 8. This section outlines the approach that Horsham DC could adopt in relation to flood risk planning policy and development management decisions.

9.2 Development Layout and Sequential Approach

A sequential approach to site planning should be applied within new development sites

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development. Most large development proposals include a variety of land uses of varying vulnerability to flooding. The sequential approach should be applied within development sites to locate the most vulnerable elements of a development in the lowest risk areas (considering all sources of flooding) e.g. residential elements should be restricted to areas at lower probability of flooding whereas parking, open space or proposed landscaped areas can be accommodated in areas with a higher probability of flooding.

9.3 Finished Floor Levels

All More Vulnerable and Highly Vulnerable development within Flood Zones 2 and 3 should set Finished Floor Levels 600mm above the known or modelled 1 in 100 annual probability (1% AEP) flood level including an appropriate allowance for climate change.

Where developing in Flood Zone 2 and 3 is unavoidable, the recommended method of mitigating flood risk to people, particularly with More Vulnerable (residential) and Highly Vulnerable land uses, is to ensure internal floor levels are raised a freeboard level above the design flood level. Low Vulnerability development should also aim to raise floor levels. Where this is not achievable, flood resilience measures should be incorporated to make up the shortfall. These measures should be detailed within the FRA.

With reference to the 'Flood risk assessment: standing advice for flood risk'[32], finished floor levels should be a minimum of whichever is higher, 300mm above the general ground level of the site or 600mm above the estimated river or sea flood level.

In certain situations (e.g. for proposed extensions to buildings with a lower floor level or conversion of existing historical structures with limited existing ceiling levels), it could prove impractical to raise the internal ground floor levels to sufficiently meet the general requirements. In these cases, the Environment Agency and/or Horsham DC should be approached to discuss options for a reduction in the minimum internal ground floor levels provided flood resistance measures are implemented up to an agreed level.

There are also circumstances where flood resilience measures should be considered first. These are described further below. For both Less and More Vulnerable developments where internal access to higher floors is required, the associated plans showing the access routes and floor levels should be included within any site-specific FRA.

9.4 Flood Resistance 'Water Exclusion Strategy'

There is a range of flood resistance and resilience construction techniques that can be implemented in new developments to mitigate potential flood damage. The Ministry of Housing and Local Government have

[32] https://www.gov.uk/guidance/flood-risk-assessment-standing-advice

published a document 'Improving the Flood Performance of New Buildings, Flood Resilient Construction'[33], the aim of which is to provide guidance to developers and designers on how to improve the resistance and resilience of new properties to flooding through the use of suitable materials and construction details. Figure 9-1 provides a summary of the Water Exclusion Strategy (flood resistance measures) and Water Entry Strategy (flood resilience measures) which can be adopted depending on the depth of floodwater that could be experienced.

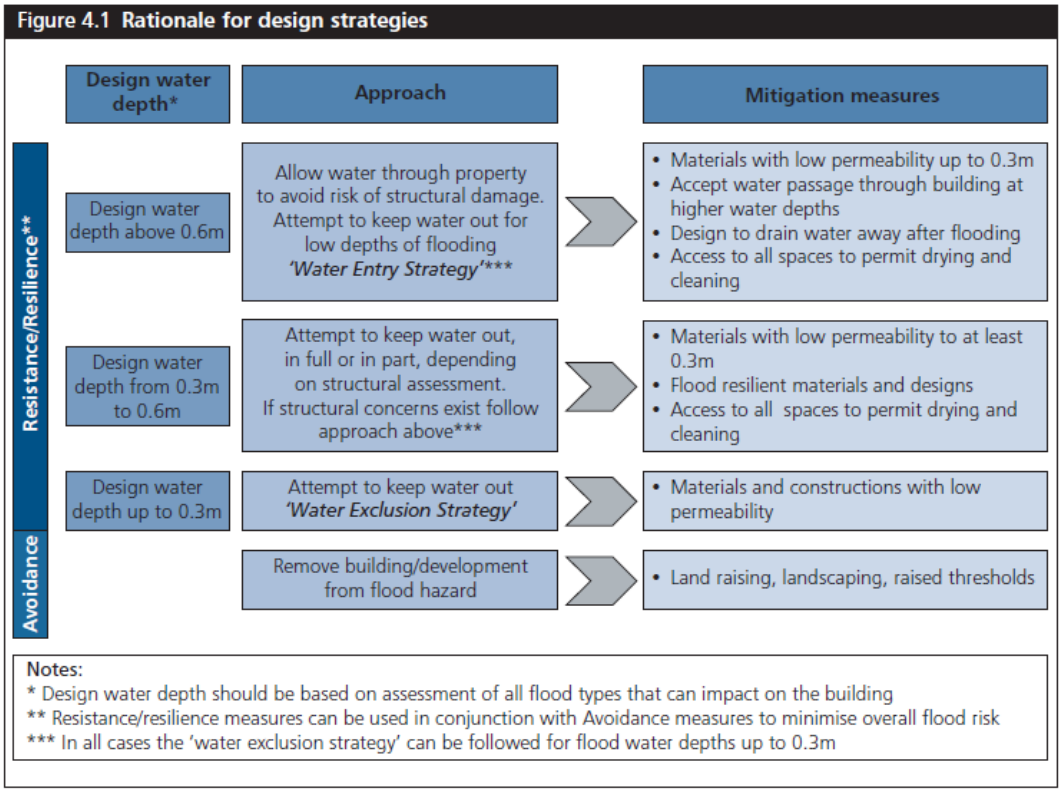

Figure 9-1 Flood Resistant / Resilient Design Strategies, Improving Flood Performance, CLG 2007

Resistance measures are aimed at preventing water ingress into a building (Water Exclusion Strategy); they are designed to minimise the impact of floodwaters directly affecting buildings and to give occupants more time to relocate ground floor contents. These measures will probably only be effective for short duration, low depth flooding, i.e. less than 0.3m, although these measures should be adopted where depths are between 0.3m and 0.6m and there are no structural concerns

In areas at risk of flooding of low depths (<0.3m), implement flood resistance measures such as:

- Using materials and construction with low permeability;
- Land raising;
- Landscaping e.g. creation of low earth bunds (subject to this not increasing flood risk to neighbouring properties);
- Raising thresholds and finished floor levels e.g. porches with higher thresholds than main entrance;
- Flood gates with waterproof seals; and,
- Sump and pump for floodwater to remove waste faster than it enters.

There are a range of property flood protection devices available on the market, designed specifically to resist the passage of floodwater. These include removable flood barriers and gates designed to fit openings, vent covers, and stoppers designed to fit WCs. These measures can be appropriate for preventing water entry associated with fluvial flooding as well as surface water and sewer flooding. The efficacy of such devices relies on their being deployed before a flood event occurs. It should also be borne in mind that devises such as air vent covers, if left

[33] CLG (2007) Improving the Flood Performance of New Buildings, Flood Resilient Construction. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7730/flood_performance.pdf

in place by occupants as a precautionary measure, may compromise safe ventilation of the building in accordance with Building Regulations.

9.5 Flood Resilience 'Water Entry Strategy'

For flood depths greater than 0.6m, it is likely that structural damage could occur in traditional masonry construction due to excessive water pressures. In these circumstances, the strategy should be to allow water into the building, but to implement careful design in order to minimise damage and allow rapid re-occupancy. This is referred to as the Water Entry Strategy. These measures are appropriate for uses where temporary disruption is acceptable and suitable flood warning is received.

Materials should be used which allow the passage of water whilst retaining their structural integrity and they should also have good drying and cleaning properties. Alternatively, sacrificial materials can be included for internal and external finishes; for example, the use of gypsum plasterboard which can be removed and replaced following a flood event. Flood resilient fittings should be used to at least 0.1m above the design flood level. Resilience measures are either an integral part of the building fabric or are features inside a building that will limit the damage caused by floodwaters.

In areas at risk of frequent or prolonged flooding, implement flood resilience measures such as:

- Use materials with either, good drying and cleaning properties, or, sacrificial materials that can easily be replaced post-flood.
- Design for water to drain away after flooding.
- Design access to all spaces to permit drying and cleaning.
- Raise the level of electrical wiring, appliances and utility meters.
- Coat walls with internal cement-based renders; apply tanking on the inside of all internal walls.
- Ground supported floors with concrete slabs coated with impermeable membrane.
- Tank basements, cellars or ground floors with water resistant membranes.
- Use plastic water resistant internal doors.

Further specific advice regarding suitable materials and construction techniques for floors, walls, doors and windows and fittings can be found in 'Improving the Flood Performance of New Buildings, Flood Resilient Construction'[34].

Structures such as bus, bike shelters, park benches and refuse bins (and associated storage areas) located in areas with a high flood risk should be flood resilient and be firmly attached to the ground and designed in such a way as to prevent entrainment of debris which in turn could increase flood risk and/or breakaway posing a danger to life during high flows.

[34] CLG (2007) Improving the Flood Performance of New Buildings, Flood Resilient Construction. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7730/flood_performance.pdf

9.6 Safe Access and Egress

For developments located in areas at risk of fluvial flooding safe access and egress must be provided for new development as follows in order of preference:

- Safe dry route for people and vehicles.
- Safe dry route for people.
- If a dry route for people is not possible, a route for people where the flood hazard (in terms of depth and velocity of flooding) is low and should not cause risk to people.
- If a dry route for vehicles is not possible, a route for vehicles where the flood hazard (in terms of depth and velocity of flooding) is low to permit access for emergency vehicles. However the public should not drive vehicles in floodwater.

For fluvial flooding, a 'dry' access/egress is a route located above the 1% AEP flood level (1 in 100 year) including an allowance for climate change.

Safe access and egress are required to enable the evacuation of people from the development, provide the emergency services with access to the development during times of flood and enable flood defence authorities to carry out any necessary duties during periods of flood.

A safe access/egress route should allow occupants to safely enter and exit the buildings and be able to reach land outside the flooded area (e.g. within Flood Zone 1) using public rights of way without the intervention of emergency services or others during design flood conditions, including climate change allowances. This is of particular importance when contemplating development on sites located on dry islands.

9.7 Flood Compensation Storage

All new development within Flood Zone 3 must not result in a net loss of flood storage capacity. Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage.

Where proposed development results in a change in building footprint, land raising or other structures such as bunds, the developer must ensure that it does not impact upon the ability of the floodplain to store water and should seek opportunities to provide betterment with respect to floodplain storage.

Similarly, where ground levels are elevated to raise the development out of the floodplain, compensatory floodplain storage within areas that currently lie outside the floodplain must be provided to ensure that the total volume of the floodplain storage is not reduced.

As depicted in Figure 9-2, floodplain compensation must be provided on a level for level, volume for volume basis on land which does not already flood and is within the site boundary. Where land is not within the site boundary, it must be in the immediate vicinity, in the applicant's ownership and linked to the site. When designing a scheme flood water must be able to flow in and out and must not pond. An FRA must demonstrate that there is no loss of flood storage capacity and include details of an appropriate maintenance regime to ensure mitigation continues to function for the life of the development. Guidance on how to address floodplain compensation is provided in Appendix A3 of the CIRIA Publication C624[35].

Floodplain compensation must be considered in the context of the 1% AEP flood level including an appropriate allowance for climate change. The current Environment Agency guidance in this allowance is that the allowance will depend on land use within the affected areas. In most cases the Higher Central allowance will be appropriate, however the Upper End allowances should be used if the catchment is particularly sensitive to small changes in flood storage volume or if the affected area contains essential infrastructure or vulnerable development (e.g. primary schools, nursing homes, caravans, bungalows, basement dwellings). The Central allowance can be applied if the affected area only contains less vulnerable or water compatible development. Future land uses within the affected area, as indicated by the Local Plan, should be taken into consideration. The process by which the appropriate allowance was selected should be made clear within the design report and/or site specific Flood Risk Assessment.

[35] CIRIA (2004) CIRIA Report 624: Development and Flood Risk - Guidance for the Construction Industry

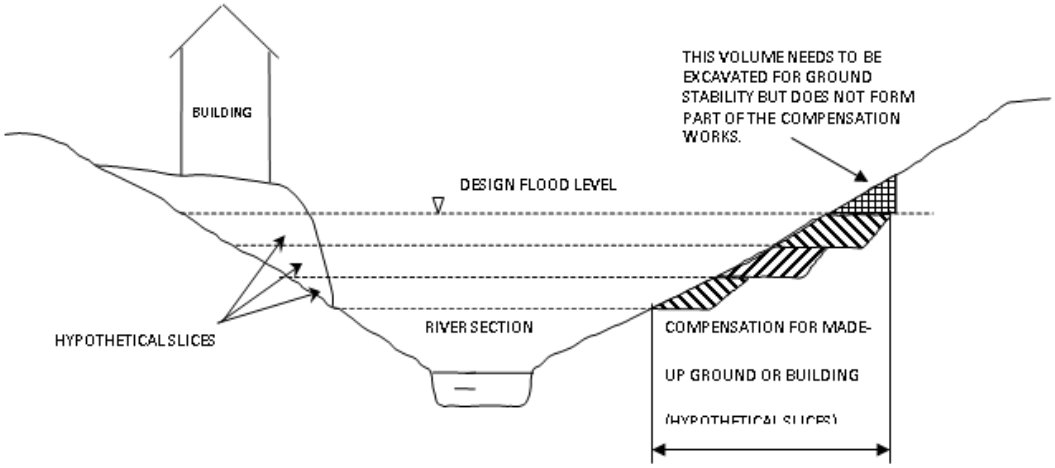

Figure 9-2 Example of Floodplain Compensation Storage (Environment Agency 2009)

The requirement for no loss of floodplain storage means that it is not possible to modify ground levels on sites which lie completely within the floodplain (when viewed in isolation), as there is no land available for lowering to bring it into the floodplain. It may be possible to provide off-site compensation within the local area e.g. on a neighbouring or adjacent site, or indirect compensation, by lowering land already within the floodplain, however, this would be subject to detailed investigations and agreement with the Environment Agency to demonstrate (using an appropriate flood model where necessary) that the proposals would improve and not worsen the existing flooding situation or could be used in combination with other measures to limit the impact on floodplain storage.

Should it not be possible to achieve all the level for level compensation required, the Environment Agency may consider that the remainder be provided through the use of under-floor voids instead. The amount of level for level compensation would need to be maximised and any under-floor voids would need to be appropriately designed and kept clear to enable them to function effectively. It should be noted that the Environment Agency generally does not consider it appropriate to rely entirely on underfloor voids to reduce displacement of floodwater as these voids can become blocked or infilled over time.

The use of under-floor voids with adequate openings beneath the raised finished floor levels can be considered for development in Flood Zone 2 and 3. They are generally considered to provide indirect compensation or mitigation, but not true compensation for loss of floodplain storage. The use of under-floor voids will typically require a legal agreement or planning condition and maintenance plan for them to remain open for the lifetime of the development and agreement that Horsham DC will enforce. Sole reliance on the use of under-floor voids to address the loss of floodplain storage capacity is generally not acceptable on undeveloped sites or for individual properties.

Ideally, void openings should be a minimum of 1m long and open from existing ground levels to at least the 1% AEP (1 in 100 year) plus climate change flood level. By setting finished floor levels at 300mm above the design flood level, there is usually enough space provision for voids below. There should be a minimum of 1m of open void length per 5m length of wall. Void openings should be provided along all external walls of the proposed extension. If security is an issue, 10mm diameter vertical bars set at 100mm centres can be incorporated into the void openings. The Environment Agency is likely to seek confirmation from Horsham DC that the voids be maintained in a free and open condition for the lifetime of the development.

Where car parks are specified as areas for the temporary storage of surface water and fluvial floodwaters, flood depths should not exceed 300mm given that vehicles may be moved by water of greater depths. Where greater depths are expected, car parks should be designed to prevent the vehicles from floating out of the car park. Signs should be in place to notify drivers of the susceptibility of flooding and flood warning should be available to provide sufficient time for car owners to move their vehicles if necessary.

It should be noted that the above guidance has been developed with a focus on fluvial flooding. However, if the site is at known and significant risk of flooding from other sources, e.g. pluvial flooding, then the same principles of ensuring that there is no increase in flood risk elsewhere should be followed. This will need to be assessed on a site by site basis in consultation with the LPA and LLFA because the existing datasets are not usually sufficient to allow detailed quantification of the risk of pluvial flooding and the potential for displacement of floodwater elsewhere.

9.8 Flood Routing

All new development should not adversely affect flood routing, either from rivers or from overland flows, and thereby increase flood risk elsewhere. Opportunities should be sought within the site design to make space for water, such as:

- Removing boundary walls or replacing with other boundary treatments such as hedges, fences (with gaps).
- Considering alternatives to solid wooden gates or ensuring that there is a gap beneath the gates to allow the passage of floodwater.
- On uneven or sloping sites, consider lowering ground levels to extend the floodplain without creating ponds. The area of lowered ground must remain connected to the floodplain to allow water to flow back to river when levels recede.
- Create under-croft car parks or consider reducing ground floor footprint and creating an open area under the building to allow flood water storage.
- Where proposals entail floodable garages or outbuildings, consider designing a proportion of the external walls to be committed to free flow of floodwater.

In order to demonstrate that 'flood risk is not increased elsewhere', development will need to prove that flood routing is not adversely affected by the development, for example giving rise to backwater affects in the event of fluvial flooding or by diverting floodwaters onto other properties.

Potential overland flow paths should be determined, and appropriate solutions proposed to minimise the impact of the development, for example by configuring road and building layouts to preserve existing flow paths and improve flood routing, whilst ensuring that flows are not diverted towards other properties elsewhere.

Careful consideration should be given to the use of fences and landscaping walls so as to prevent causing obstruction to flow routes and increasing the risk of flooding to the site or neighbouring areas.

9.9 Riverside Development

Retain an 8 metre wide undeveloped buffer strip alongside Main Rivers or flood defence structures and explore opportunities for riverside restoration. Retain a 16 metre wide buffer strip alongside tidal main rivers or tidal flood defence structures and a 5 metre wide buffer strip alongside Ordinary Watercourses. New development within 8m of a Main River or Ordinary Watercourse will require consent from either the Environment Agency or West Sussex County Council (as LLFA) respectively.

The Environment Agency will to seek an 8 metre wide undeveloped buffer strip alongside main fluvial rivers and a 16 metre wide undeveloped buffer strip alongside main tidal rivers[36] for maintenance purposes, and would also ask developers to explore opportunities for riverside restoration as part of any development in order to enhance the water environment in line with Water Framework Directive requirements and to provide net ecological gain.

Horsham District Council provide advice for riparian owners of land alongside ordinary watercourses. Horsham District Planning Framework Policy 2.4 states that proposals for development of sites which include watercourses and water dependant habitat (e.g. wet woodland or floodplain marsh) must include measures to preserve and enhance these features and, where possible, provide new similar habitats. A development-free buffer zone, usually a minimum of 5m wide, will be required on both sides of watercourses. Riparian owners should also seek to enhance watercourses on their land and carry out Water Framework Directive actions as set out in the South East River Basin District Management Plan.

West Sussex County Council will seek a minimum 3.5 metre wide undeveloped buffer strip, with easement and good access, to be retained alongside Ordinary Watercourses.

[36] Environment Agency (2016 – updated 2019) Flood Risk Activities: Environmental Permits. Available at https://www.gov.uk/guidance/flood-risk-activities-environmental-permits

Under the Environmental Permitting (England and Wales) Regulations (2016)[37], an environmental permit is required if works are to be carried out:

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

Since requirements of the consenting process in relation to flood risk, biodiversity and pollution may result in changes to development proposals or construction methods, the Environment Agency aims to advise on such issues as part of its statutory consultee role in the planning process. Should proposed works not require planning permission the Environment Agency can be consulted regarding permission to do work on or near a river, floor or sea defence by contacting enquiries@environment-agency.gov.uk.

As of 6 April 2012, responsibility for the consenting of works by third parties on Ordinary watercourses under Section 23 of the Land Drainage Act 1991 (as amended by the Flood and Water Management Act 2010) has transferred from the Environment Agency to the LLFA, West Sussex County Council. West Sussex County Council is responsible for the consenting of works to ordinary watercourses and has powers to enforce un-consented and non-compliant works. This includes any works (including temporary) within 8 metres that affect flow within the channel (such as in channel structures or diversion of watercourses). Enquiries and applications for ordinary watercourse consent can be submitted to West Sussex County Council on their website[38].

9.10 Surface Water Management

All major developments (10 or more dwellings, or 1000 m^2 floorspace) and other development should not result in an increase in surface water runoff, and where possible, should demonstrate betterment in terms of rate and volumes of surface water runoff.

Sustainable Drainage Systems (SuDS) should be used to reduce and manage surface water run-off to and from proposed developments as near to source as possible in accordance with the requirements of the Technical Standards and supporting guidance published by MHCLG and Department for the Environment, Food and Rural Affairs (Defra)[39]. In line with the West Sussex LLFA policy for management of surface water[40], SuDS must be implemented for all development sites unless it is demonstrated that SuDS are not suitable.

SuDS are typically softer engineering solutions inspired by natural drainage processes such as ponds and swales which manage water as close to its source as possible. Wherever possible, a SuDS technique should seek to contribute to each of the three goals identified below. Where possible SuDS solutions for a site should seek to:

- Reduce flood risk (to the site and neighbouring areas);
- Reduce pollution; and,
- Provide landscape and wildlife benefits.

Generally, the aim should be to discharge surface water run-off as high up the following hierarchy of drainage options as reasonably practicable:

- Into the ground (infiltration)
- To a surface water body
- To a surface water sewer, highway drain, or another drainage system
- To a combined sewer

[37] The Environmental Permitting (England and Wales) Regulations 2016 http://www.legislation.gov.uk/uksi/2016/1154/contents/made
[38] https://www.westsussex.gov.uk/fire-emergencies-and-crime/dealing-with-extreme-weather/flooding/flood-risk-management/ordinary-watercourse-land-drainage-consent/
[39] Sustainable drainage systems: non-statutory technical standards. Available from: https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards
[40] West Sussex County Council (2018), West Sussex LLFA Policy for the Management of Surface Water https://www.westsussex.gov.uk/media/12230/ws_llfa_policy_for_management_of_surface_water.pdf

SuDS techniques can be used to reduce the rate and volume and improve the water quality of surface water discharges from sites to the receiving environment (i.e. natural watercourse or public sewer etc.). The SuDS Manual[41] identified several processes that can be used to manage and control runoff from developed areas. Each option can provide opportunities for storm water control, flood risk management, water conservation and groundwater recharge.

- **Infiltration**: the soaking of water into the ground. This is the most desirable solution as it mimics the natural hydrological process. The rate of infiltration will vary with soil type and condition, the antecedent conditions and with time. The process can be used to recharge groundwater sources and feed baseflows of local watercourses, but where groundwater sources are vulnerable or there is risk of contamination, infiltration techniques are not suitable.
- **Detention/Attenuation**: the slowing down of surface flows before their transfer downstream, usually achieved by creating a storage volume and a constrained outlet. In general, though the storage will enable a reduction in the peak rate of runoff, the total volume will remain the same, just occurring over a longer duration.
- **Conveyance**: the transfer of surface runoff from one place to another, e.g. through open channels, pipes and trenches.
- **Water Harvesting**: the direct capture and use of runoff on site, e.g. for domestic use (flushing toilets) or irrigation of urban landscapes. The ability of these systems to perform a flood risk management function will be dependent on their scale, and whether there will be a suitable amount of storage always available in the event of a flood.

As part of any SuDS scheme, consideration should be given to the whole life management and maintenance of the SuDS to ensure that it remains functional for the lifetime of the development.

The 'Lead Local Flood Authorities of the South East of England' have prepared a guide for master panning sustainable drainage into developments[42]. The guidance provides descriptions and examples of different types of SuDs techniques, and how best to implement them into planning design of large and small developments. The guidance should be used as part of the initial planning and design process for all types of development and can be found following the link below:

https://www.westsussex.gov.uk/media/2270/suds_design_guidance.pdf

The application of SuDS is not limited to a single technique per site. Often a successful SuDS solution will utilise a combination of techniques, providing flood risk, pollution and landscape/wildlife benefits. In addition, SuDS can be employed on a strategic scale, for example with a number of sites contributing to large scale jointly funded and managed SuDS. It should be noted that each development site must offset its own increase in runoff and attenuation cannot be "traded" between developments.

9.10.1 Suitability for Infiltration SuDS

The use of infiltration techniques is highly dependent on the underlying ground conditions. As part of this SFRA, an assessment of the suitability of using infiltration SuDS techniques across the District has been undertaken using the Geosmart SuDS Infiltration Suitability Map (SD50), as presented in Appendix A Figure 4.

GeoSmart SD50 is available on a 50m grid and classifies cells into one of three categories: High Potential, Moderate Potential, and Low Potential for Infiltration SuDS (Table 8-3). For each classification it provides recommendations for further investigation to support the detailed design of the infiltration component.

The datasets used to derive the map include geological and hydrological datasets from the British Geological Survey and hydrological datasets produced by GeoSmart. The map is a general purpose indicative screening tool and is intended to provide a useful initial view for a wide variety of applications. It does not provide an alternative to a detailed site-specific assessment, which will be required under West Sussex County Council policy for all major developments (see Section 9.10.3 below).

[41] CIRIA C697 SuDS Manual. Available from: http://www.ciria.org/Resources/Free_publications/the_suds_manual.aspx
[42] Lead Local Flood Authorities of the South East of England, Water.People.Palces, A guide for master panning sustainable drainage into developments https://www.westsussex.gov.uk/media/2270/suds_design_guidance.pdf

Table 9-1 GeoSmart SuDs Infiltration Suitability Map infiltration potential classes43

Classification	Comments	Recommendations
Low infiltration potential	It is likely that the underlying geology at the Site, or in areas of the site, is relatively impermeable which would limit the effectiveness of a proposed infiltration SuDS scheme.	Infiltration SuDS should be focused in more suitable parts of the site. If a site investigation confirms that infiltration SuDS are not possible at the Site, then attenuation SuDS with a controlled discharge into a nearby surface water feature or existing surface water drainage is recommended.
Moderate infiltration potential	It is likely that the permeability of the underlying material at the site would be suitable for infiltration drainage. However, there may be constraints on the use of infiltration SuDS as a result of any of the following: a high water table, the limited thickness of the receiving formation, the potential for a significant range in permeability in the underlying geology. Therefore, confirmation of the infiltration capacity is recommended.	A site investigation is recommended to investigate groundwater levels and formation thickness and to confirm that infiltration rates at the Site are sufficient to accommodate an infiltration SuDS feature. If a site investigation confirms that infiltration SuDS are possible at the Site, then various options can be considered for infiltration SuDS. These include infiltration trenches, soakaways, swales, permeable pavements and infiltration basins without outlets.
High infiltration potential	It is likely that the underlying geology at the Site is highly permeable and an infiltration SuDS scheme should be possible at the Site. Groundwater levels are expected to be sufficiently deep at the site.	A site investigation is recommended to confirm the high infiltration capacity and the depth of the winter water table. Various options can be considered for infiltration SuDS. These include infiltration trenches, soakaways, swales, permeable pavements and infiltration basins without outlets.

Appendix A, Figure 4 GEOSMART SuDS Infiltration Suitability

Detention measures are not constrained by geology, though in areas of permeable geology there will also be a degree of infiltration of runoff taking place. The Environment Agency should be consulted on a site-specific basis as constraints and any required mitigation will vary between sites. Some infiltration of 'clean' water such as roof runoff may still be suitable in sensitive areas. Further information can be found in The Environment Agency's approach to Groundwater Protection[44].

9.10.2 Technical Standards

A set of non-statutory Technical Standards have been published by DEFRA[45], to be used in conjunction with supporting guidance in the PPG**Error! Bookmark not defined.**, which set the requirements for the design, construction, m aintenance and operation of sustainable drainage systems (SuDS).

The Technical Standards that are of chief concern in relation to the consideration of flood risk to and from development relating to peak flow control and volume control are presented below:

9.10.2.1 Peak flow control

Technical Standard S2 - For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.

Technical Standard S3 - For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for

[43] GeoSmart Information (Accessed 2019), Geosmart SuDS Infiltration Suitability Map User Guide, notes to accompany SD50 version 1.0
[44] Environment Agency (2018) The Environment Agency's approach to groundwater protection. February 2018 Version 1.2. Accessed October 2018 at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/692989/Envirnment-Agency-approach-to-groundwater-protection.pdf
[45]Department for Environment, Food and Rural Affairs, (2015) Sustainable Drainage Systems 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

the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

9.10.2.2 Volume control

Technical Standard S4 - Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.

Technical Standard S5 - Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.

Technical Standard S6 - Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

9.10.2.3 Flood risk within the development

Technical Standard S7 - The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.

Technical Standard S8 - The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.

Technical Standard S9 - The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property.

9.10.2.4 Climate Change

Surface water drainage systems should take the effects of climate change into account. This is expected to increase the depth and frequency of extreme rainfall events. The current Environment Agency guidance on allowances to be applied to rainfall depths is set out in Table 3-4 and the guidance also states that the Upper End allowance should be applied during drainage system design. There should be no increase in runoff rates during the design event, including the Upper End allowance, and if onsite flooding occurs during the design event then the risk to site users should be mitigated such that there is, at a minimum, no significant flood hazard on site during the design event, including the Central allowance.

9.10.3 SuDS Supporting Guidance

As of 6 April 2015, all major development should include provision for SuDS and, as the LLFA, West Sussex County Council is a statutory consultee on surface water management drainage issues for all such major developments. West Sussex County Council has set out clear advice and guidance documents on their website[46]. In line with the West Sussex LLFA policy for management of surface water[47], planning applications for development should be accompanied by a site-specific drainage strategy that demonstrate the drainage scheme proposed complies with West Sussex County Council's SuDS policies.

Applicants are strongly encouraged to discuss their proposals with West Sussex County Council at the pre-application stage. A request can be made via the West Sussex County Council website[48]. Whilst West Sussex County Council has no legal remit to provide surface water management advice for sites which have not been classified as 'major', there are occasions where smaller sites are liable to flooding or are particularly sensitive and specialist advice on surface water management is required. West Sussex County Council is able to provide

[46]West Sussex County Council SuDS Planning Advice https://www.westsussex.gov.uk/fire-emergencies-and-crime/dealing-with-extreme-weather/flooding/flood-risk-management/sustainable-drainage-systems/
[47] West Sussex County Council (2018), West Sussex LLFA Policy for the Management of Surface Water https://www.westsussex.gov.uk/media/12230/ws_llfa_policy_for_management_of_surface_water.pdf
[48] West Sussex County Council Pre Application Planning Advice https://www.westsussex.gov.uk/planning/county-planning-pre-application-advice/

information and guidance on a specific site with regard to surface water flood risk and whether the proposed surface water management scheme appears to be appropriate for the development as a chargeable service.

9.11 Flood Warning and Evacuation Plans

Evacuation is where flood alerts and warnings provided by the Environment Agency (Section 6.2.4) enable timely actions by residents or occupants to allow evacuation to take place unaided, i.e. without the deployment of trained personnel to help people from their homes, businesses and other premises. Rescue by the emergency services is likely to be required where prior evacuation has not been possible.

For all developments (excluding minor developments and change of use) proposed in Flood Zone 2 or 3, a Flood Warning and Evacuation Plan should be prepared to demonstrate what actions site users will take before, during and after a flood event to ensure their safety, and to demonstrate their development will not impact on the ability of the local authority and the emergency services to safeguard the current population.

For sites in Flood Zone 1 that are located on 'dry islands', it may also be necessary to prepare a Flood Warning and Evacuation Plan to determine potential egress routes away from the site through areas that may be at risk of flooding during the 1% annual probability (1 in 100 year) flood event including an allowance for climate change.

Guidance on Flood Risk Emergency Plans for new development has been produced by the Environment Agency and the Association of Directors of Environment, Economy, Planning and Transport (ADEPT). The guidance aims to assist Local Authorities in producing and advising on Flood Warning and Evacuation Plans within their area, ensuring that Plans are suitable and fit for purpose, ensuring that the development is safe.[49]

In addition. the Environment Agency has a tool on their website to create a Personal Flood Plan[50]. The Plan comprises a checklist of things to do before, during and after a flood and a place to record important contact details. Where proposed development comprises non-residential extension <250m^2 and householder development (minor development), it is recommended that the use of this tool to create a Personal Flood Plan will be appropriate.

Flood Warning and Evacuation Plans should include:

- How flood warning is to be provided, such as:
  - Availability of existing flood warning systems;
  - Where available, rate of onset of flooding and available flood warning time; and,
  - How flood warning is given.
- What will be done to protect the development and contents, such as:
  - How easily damaged items (including parked cars) or valuable items (important documents) will be relocated;
  - How services can be switched off (gas, electricity, water supplies);
  - The use of flood protection products (e.g. flood boards, airbrick covers);
  - The availability of staff/occupants/users to respond to a flood warning, including preparing for evacuation, deploying flood barriers across doors etc.; and,
  - The time taken to respond to a flood warning.
- Ensuring safe occupancy and access to and from the development, such as:
  - Occupant awareness of the likely frequency and duration of flood events, and the potential need to evacuate;
  - Safe access route to and from the development;
  - If necessary, the ability to maintain key services during an event;

[49] ADEPT/Environment Agency (2019) Flood Risk Emergency Plans for New Development. Available from https://www.adeptnet.org.uk/floodriskemergencyplan

[50] Environment Agency Tool 'Make a Flood Plan'. Available from: https://www.gov.uk/government/publications/personal-flood-plan

- Vulnerability of occupants, and whether rescue by emergency services will be necessary and feasible; and,
- Expected time taken to re-establish normal use following a flood event (clean-up times, time to re-establish services etc.)

There is no statutory requirement for the Environment Agency or the emergency services to approve evacuation plans. Horsham DC is accountable via planning conditions or agreement to ensure that plans are suitable. This should be done in consultation with emergency planning staff.

9.12 Strategic Flood Risk Management

9.12.1 Natural Flood Management

Natural flood management involves techniques that aim to work with natural hydrological and morphological processes, features and characteristics to manage the sources and pathways of flood waters. Techniques include the restoration, enhancement and alteration of natural features and characteristics, but exclude traditional flood defence engineering that works against or disrupts these natural processes. The NPPF[3] , paragraph 157 specifically cites considering opportunities for Natural Flood management where appropriate within new developments to reduce the causes and impacts of flooding. Further guidance on the use of natural flood management processes is available from the Environment Agency in their 'Working with Natural Processes – Evidence Directory'[51].

9.12.2 River Restoration

One of the methods for reducing flooding using natural flood management is river restoration. During the last century, many rivers were modified using hard engineering techniques to straighten or canalise them. The disadvantages of these techniques have now become apparent which include the damage to the environment and ecosystems as well as an increase in flooding.

River restoration contributes to flood risk management by supporting the natural capacity of rivers to retain water. By re-connecting brooks, streams and rivers to floodplains, former meanders and other natural storage areas, and enhancing the quality and capacity of wetlands, river restoration increases natural storage capacity and reduces flood risk. Excess water is stored in a timely and natural manner in areas where values such as attractive landscape and biodiversity are improved and opportunities for recreation can be enhanced.

Returning rivers to a more natural state can often include the removal of structures such as weirs or culverts which can have multiple benefits for biodiversity in addition to improving the flow regime[52].

Further guidance on river restoration is available from the Environment Agency[53].

9.12.3 Flood Storage

Flood Storage Areas (FSA's) are natural or man-made areas that temporarily fill with water during periods of high river level, retaining a volume of water which is released back in to the watercourse after the peak river flows have passed. There are two main reasons for providing temporary detention of floodwater:

- to compensate for the effects of catchment urbanisation;
- to reduce flows passed downriver and mitigate downstream flooding.

Providing flood storage within a development area or further upstream of a development can manage and control the risk of flooding. In some cases, it can provide sufficient flood protection on its own; in other cases, it may be chosen in conjunction with other measures. The advantage of flood storage is that the flood alleviation benefit

[51] Working with Natural Processes – Evidence Directoryhttps://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/681411/Working_with_natural_processes_evidence_directory.pdf
[52] European Centre for River Restoration http://www.ecrr.org/RiverRestoration/Floodriskmanagement/HealthyCatchments-managingforfloodriskWFD/Environmentalimprovementscasestudies/Removeculverts/tabid/3125/Default.aspx
[53] Environment Agency, Fluvial Design Guidance Chapter 8 http://evidence.environment-agency.gov.uk/FCERM/en/FluvialDesignGuide/Chapter8.aspx?pagenum=4

generally extends further downstream, whereas the other methods benefit only the local area, and may increase the flood risk downstream.

Further guidance on Flood Storage is provided within Chapter 10 of the Environment Agency's Fluvial Design Guide[54].

[54] Environment Agency, Fluvial Design Guidance Chapter 10 http://evidence.environment-agency.gov.uk/FCERM/en/FluvialDesignGuide/Chapter10.aspx?pagenum=2

10. Summary and Recommendations

The NPPF[3] and accompanying PPG[5] emphasise the responsibility of LPAs to ensure that flood risk from all sources is understood and considered throughout all stages of the planning process. This SFRA aims to facilitate this process by identifying the spatial variation in flood risk across the Planning Authority Area, allowing an area-wide comparison of future development sites with respect to flood risk considerations. This updated SFRA provides an update to the 2010 version to ensure the most up-to-date flood risk information is used throughout the decision-making processes associated with the Local Plan. In addition to the SFRA report, planners and developers should use supporting mapping to inform site specific flood risk assessments.

The main watercourses within the Horsham DC administrative area are the Rivers Arun and Adur. These rivers, which are tidally influenced in the south of the Planning Authority Area, are the predominant source of flood risk within the Horsham District. There is also a notable risk of flooding from surface water and to a lesser extent from groundwater and sewer flooding. A summary of some of the locations at greatest risk from different flood sources in the Planning Authority Area is shown in Table 10-1.

Table 10-1 Areas at risk of flooding from all sources

Flood Risk Source	Areas at principal risk
Fluvial/Tidal	Horsham town and the surrounding villages, Pulborough, Upper Beeding and Bramber.
Surface	Horsham, Pulborough, Storrington, Southwater, Bramber & Upper Beeding and Billingshurst
Sewers	Rudgwick, Southwater and Pulborough
Groundwater	Bramber, Upper Beeding and Pulborough
Artificial Sources	No significant urban area

This SFRA identifies the floodplain areas associated with the River Arun and River Adur and presents maps that delineate the flood zones outlined in the NPPF. Mapping is also provided showing the flood risk from surface water and groundwater. These maps provide the necessary information to facilitate the NPPF risk-based approach to planning through the application of the Sequential Test.

It is expected that changing climate patterns will have a substantial impact on the level of flood risk from river and surface water within the Planning Authority Area. Given the proximity of the urban areas within the Planning Authority Area to the River Arun and the River Adur, there is potential for risk of property flooding to increase in the future.

Horsham DC will need to review the information contained within this Level 1 SFRA when allocating sites for development within the Local Plan. The Sequential Test should be applied to sites, as set out in Section 7, to ensure that development is directed to areas at lowest risk of flooding from all sources. The Level 1 SFRA should also be used to determine where the Exception Test needs to be applied, and sites where this is required should be taken forward for site specific analysis within a Level 2 SFRA.

This Level 1 SFRA also provides information which can be used to make and initial assessment of the risk of flooding to individual sites as part of site specific SFRA, and to apply the Sequential and Exception Tests to windfall sites. However, the information contained in the report constitutes a high level overview of the available datasets, some of which are of low resolution (e.g. groundwater flooding susceptibility). The information is therefore not a substitute for detailed site specific investigation as part of a FRA. Section 8 of this report sets out the information which should be provided within a FRA, which should consider the current extent of flood risk to development site from all sources, the potential for increasing flood risk elsewhere and provide details of mitigation measures. Section 9 provides examples of flood mitigation measures which may be appropriate, and the aim of these measures it to ensure that the development will be safe throughout its lifetime and will not increase flood risk elsewhere. The appropriate mitigation measures will depend on the source of flooding and extent of risk; for example, sustainable management of surface runoff, including attenuation storage, will be particularly important within and upstream of areas at risk of surface water or sewer flooding.

It is recommended that Horsham DC strengthen their policies to include greater emphasis on some of the items identified in Section 9; namely natural floodplain management, application of SuDS, and flood awareness. Robust emergency planning and response will additionally be critical to sustainable flood risk management into the future.

This Level 1 SFRA should be considered a “living document” and will require further updates in future to reflect changes in legislation, policy and knowledge. For example, river and tidal flooding models will be updated in future to take account of climate change allowances in line with UKCP18, and additional records of flooding from all sources will be collected. Future updates of this SFRA will be required to inform each Local Planning cycle.

Appendix A Flood Maps