

Level 1 Strategic Flood Risk Assessment

Final Report

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Quality information

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Abbreviations

Acronym	Definition
AIMS	Asset Information Management System
AEP	Annual Exceedance Probability
BGS	British Geological Survey
CFMP	Catchment Flood Management Plan
CCMA	Coastal Change Management Area
ESCC	East Sussex County Council
FCERM	Flood and Coastal Erosion Risk Management
FRA	Flood Risk Assessment
FRR	Flood Risk Regulations
FSA	Flood Storage Area
FWMA	Flood and Water Management Act
IDB	Internal Drainage Board
IUD	Integrated Urban Drainage
LDC	Lewes District Council
LLFA	Lead Local Flood Authority
LFRMS	Local Flood Risk Management Strategy
LFRZ	Local Flood Risk Zone
LPA	Local Planning Authority
NPPF	National Planning Policy Framework
PFRA	Preliminary Flood Risk Assessment
PPG	Planning Practice Guidance
RBD	River Basin District
RBMP	River Basin Management Plan
RFCC	Regional Flood and Coastal Committee
RMA	Risk Management Authority
RoFSW	Risk of Flooding from Surface Water
SFRA	Strategic Flood Risk Assessment
SMP	Shoreline Management Plan
SOP	Standard of Protection
SWMP	Surface Water Management Plan
SuDS	Sustainable Drainage Systems
WFD	Water Framework Directive
WWNP	Working with Natural Processes

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.
Asset Information Management System (AIMS)	Environment Agency database of assets associated with Main Rivers including defences, structures and channel types. Information regarding location, standard of service, dimensions and condition.
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 decisionmakers 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.
Coastal Change Management Area	An area identified in plans as likely to be affected by physical change to the shoreline through erosion, coastal landslip, permanent inundation or coastal accretion.
Culvert	A channel or pipe that carries water below the level of the ground.
Design Flood	A flood event of a given annual probability against which the suitability of a proposed development is assessed and mitigation measures, if any, are designed. The design event is generally taken as; a 1% AEP fluvial flooding event plus an appropriate allowance for climate change, a 0.5% AEP tidal flooding event plus an appropriate allowance for climate change, or a 1% AEP surface water flooding event plus an appropriate allowance for climate change.
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.
Exception Test	The Exception Test should be applied following the application of the Sequential Test. 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 standard).
Flood Resilience	Measures that minimise water ingress and promotes fast drying and easy cleaning, to prevent any permanent damage.
Flood Resistant	Measures to 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). Areas at risk of flooding are those at risk of flooding from any source, now or in the future. Flood risk also accounts for the interactions between these different flood sources.
Flood Storage Area	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 into the watercourse after the peak river flows have passed.
Flood Zone	Flood Zones show the probability of flooding, ignoring the presence of existing defences.
Fluvial	Relating to the actions, processes and behaviour of a watercourse (river or stream).
Freeboard	The difference between the design flood level and the finished floor level of a development or soffit level of a bridge/culvert.
Functional Floodplain	Land where water has to flow or be stored in times of flood.

Glossary	Definition
Groundwater	Water that is in the ground, this is usually referring to water in the saturated zone below the water table.
Glass-walling	When a hydraulic model or cross-sections within a 1D only hydraulic model do not sufficiently extend to include all floodplain flowpaths, water can abut the edges of the model domain and cannot reach its true extent. This is termed 'glass-walling' and should be avoided.
Lead Local Flood Authority (LLFA)	As defined by the Flood and Water Management Act, in relation to an area in England, this means the unitary authority or where there is no unitary authority, the county council for the area, in this case East Sussex County Council (ESCC).
Local Planning Authority (LPA)	Body 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.
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.
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.
SuDS Approval Body (SAB)	An organisation within County Councils and Unitary Authorities specifically established to deal with the design, approval and adoption of sustainable urban drainage systems (SUDS) within any new development consisting of two or more properties.

1 Introduction

1.1 Background

AECOM has been commissioned by Lewes District Council (LDC) to prepare an updated Level 1 Strategic Flood Risk Assessment (SFRA). An SFRA is a live document which provides an overview of the risk of flooding from all sources in the planning authority area, taking into the account the impacts of climate change, as well as assessing the impact that land use changes and development in the area could have on flood risk.

This SFRA does not consider sections of LDC that are shared with the South Downs National Park (SDNP) Authority, for which a separate SFRA was completed by the SDNP in 2017¹. The SDNP SFRA has been used to inform the identification of catchments spanning both LPA areas and to highlight the potential for developments in either LPA area to result in cross-boundary impacts to flood risk, as detailed in Section 7.2. The study area of this SFRA is divided into two main areas: a northern area encompassing settlements such as North Chailey, Plumpton Green and Barcombe, and a southern area including major settlements such as Newhaven, Peacehaven and Seaford. These two main areas are shown in Figure 1-1.

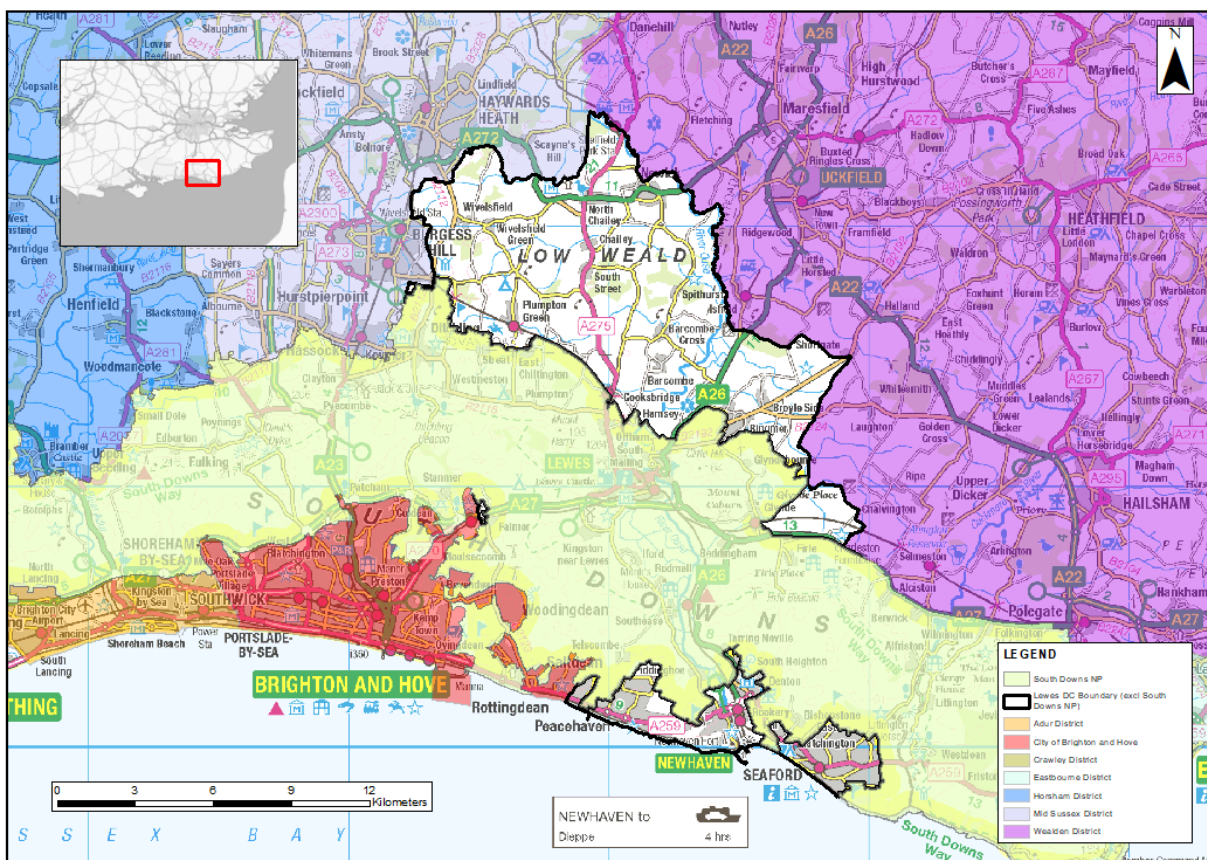


Figure 1-1: Lewes SFRA Study Area

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The LDC SFRA was previously published in 2009 and is now being updated following a number of changes in planning policy and improvements in available flood mapping and modelling datasets. This updated LDC SFRA has been prepared in line with the requirements of the National Planning Policy Framework (NPPF)², supporting Planning Practice Guidance (PPG)³, and Environment Agency guidance 'How to prepare a Strategic Flood Risk Assessment'⁴.

¹ South Downs National Park Level 1 Update and Level 2 Strategic Flood Risk Assessment September 2017:

<https://www.southdowns.gov.uk/wp-content/uploads/2017/02/Level-1-Update-and-Level-2-Strategic-Flood-Risk-Assessment.pdf> [Accessed September 2023].

² National Planning Policy Framework (NPPF): <https://www.gov.uk/government/publications/national-planning-policy-framework--2> [Accessed September 2023].

³ Planning Practice Guidance (PPG): <https://www.gov.uk/government/collections/planning-practice-guidance> [Accessed September 2023].

⁴ 'How to prepare a Strategic Flood Risk Assessment': <https://www.gov.uk/guidance/local-planning-authorities-strategic-flood-risk-assessment> [Accessed September 2023].

1.2 Stakeholders

Table 1-1 identifies the stakeholders that have been involved in the preparation of this SFRA, either directly through consultation or by providing publicly available data, and their roles and responsibilities with respect to flood risk management.

Table 1-1: Stakeholders

Stakeholder	Role/Responsibility
Local Planning Authority (LPA): Lewes District Council (LDC)	Responsible for preparing Local Plans including flood risk policies and development allocations. Local Drainage Authority under the Land Drainage Act. Risk Management Authority (RMA) under the Flood and Water Management Act. Category 1 responder under the Civil Contingencies Act.
Environment Agency	Lead RMA for the management of fluvial and tidal flooding.
Lead Local Flood Authority (LLFA): East Sussex County Council (ESCC)	Lead RMA for the management of local sources of flooding (surface water, groundwater, Ordinary Watercourses). Responsibility to develop a Local Flood Risk Management Strategy (LFRMS), investigate flood incidents, maintain a register and record of flood risk management structures and features, regulate works in Ordinary Watercourses, and to act as a statutory consultee to the planning system.
Water and Sewerage Companies: Southern Water and South East Water	Responsible for public water supply and sewerage systems. Statutory consultee for SuDS that connect to the public network. Required to co-operate and share flood risk information with the LLFA.
Ouse & Adur Rivers Trust	Environmental charity dedicated to the environmental protection and enhancement of the Sussex River Ouse and Adur including their tributaries, streams and still waters.
Southern Regional Flood and Coastal Committee (RFCC)	Involved in allocating government funding for flood defence and mitigation schemes.
Adur and Ouse Catchment Partnership	Partnership hosted by the Ouse & Adur Rivers Trust formed in 2011. Its role is to offer stakeholders a point of contact and place to set out actions to improve the management and health of the Adur & Ouse Catchment.
Local Planning Authorities (LPAs): Wealden District Council, South Downs National Park Authority, Mid Sussex District Council	Neighbouring LPAs with the same responsibilities as Lewes District Council within their respective areas.
Natural England	The non-departmental public body commissioned a study in 2015 ⁵ to identify a list of ten Coastal Change Management Areas (CCMAs) in England, where interactions between coastal change and new development need to be resolved.
Sussex Wildlife Trust	Independent conservation charity dedicated to the protection of wildlife and natural environment across the historic county of Sussex.

⁵ Coastal Change Management Areas Opportunities for sustainable solutions in areas subject to coastal change (NECR275): <http://publications.naturalengland.org.uk/publication/6167783398440960> [Accessed September 2023].

1.3 Objectives

The objectives of the SFRA are as follows:

- Assess and describe all potential sources of flooding, both now and in the future as a result of climate change, based on readily available datasets,
- Update existing coastal and river models with new climate change allowances where required,
- Identify existing flood risk management measures as well as areas that need to be safeguarded for future flood risk management features and structures, through reference to Environment Agency data and the Shoreline Management Plan,
- Identify opportunities to reduce the causes and impacts of flooding,
- Describe the risk of coastal erosion to the LDC area through reference to the Environment Agency's National Coastal Erosion Risk Mapping⁶ dataset which is expected to be updated by the end of 2023⁷,
- Identify potential spaces for water using mapping provided by LDC, Sussex Wildlife Trust, and the Ouse & Adur Rivers Trust,
- Provide guidance for applying the Sequential Test and developing flood risk policies in the preparation of the LDC Local Plan,
- Provide guidance for the identification of CCMA's and the development of appropriate flood risk policies for these areas,
- Provide recommendations of how to address flood risk in development, and,
- Demonstrate how the adaptation to climate change has been undertaken.

1.4 User Guide

It is anticipated that the SFRA will have a variety of end users including LPA officers, developers, planning consultants, neighbourhood planning bodies, LLFAs, emergency planners and local resilience forums. This Section sets out the structure of the SFRA and describes how to use it (Table 1-2).

Table 1-2: SFRA User Guide

Section Name and No.	Content
1. Introduction	Explains the need for the study and the objectives. Provides a user guide and identifies who has been consulted and where data has been collected. Identifies when the SFRA may need to be updated in the future.
2. Legislation and Policy Framework	Provides an overview of the latest legislation and national and regional policies in relation to flood risk and coastal change.
3. Datasets and Methodologies	Identifies the datasets used to inform the SFRA and describes the approaches taken to use and update data as part of the SFRA.
4. Applying the Sequential Test	Describes how the Sequential Test should be applied using the SFRA.
5. Preparing Flood Risk Assessments	Describes how site-specific Flood Risk Assessments (FRAs) should be prepared.
6. Sources of flood risk and expected effects of climate change	Describes the local geology and hydrology in the study area, and assessment of the risk of flooding from all sources based on available datasets.

⁶ National Coastal Erosion Risk Mapping 2018-2021: <https://www.data.gov.uk/dataset/7564cf7-2dd2-4878-bfb9-11c5cf971cf9/national-coastal-erosion-risk-mapping-ncerm-national-2018-2021> [Accessed September 2023].

⁷ Flood and coastal erosion risk management report: 1 April 2020 to 31 March 2021: <https://www.gov.uk/government/publications/flood-and-coastal-risk-management-national-report/flood-and-coastal-erosion-risk-management-report-1-april-2020-to-31-march-2021> [Accessed September 2023].

Section Name and No.	Content
7. Cumulative impact of development and land use change	Identifies the potential for cumulative impacts on flood risk within the catchment, and cross-boundary impacts on flood risk in catchments downstream, resulting from land-use change.
8. Flood Management and Defences	Describes flood defences and flood warning services within the district.
9. Opportunities to reduce the causes and impacts of flooding	Identifies opportunities to reduce the causes and impacts of flooding in the local area and land required for flood risk management purposes.
10. Recommendations of how to address flood risk in development	Provides guidance on the range of measures that could be considered as part of development in order to manage and mitigate flood risk. These measures should be considered when preparing a site-specific FRA.

1.5 Future monitoring and update

This SFRA should be reviewed when there are changes to:

- The predicted impacts of climate change on flood risk,
- Detailed flood modelling - such as from the Environment Agency or LLFA,
- Local Plans, spatial development strategies or relevant local development documents,
- Local flood management schemes,
- Flood Risk Management Plans (FRMPs),
- Shoreline Management Plans,
- Local Flood Risk Management Strategies (LFRMS), and,
- National planning policy or guidance.

The SFRA should also be reviewed after a significant flood or coastal erosion event.

2 Legislation and Policy Framework

This Section provides a high level overview of the national and regional planning context for coastal change and flood risk management in the LDC SFRA study area.

2.1 National

2.1.1 National Planning Policy Framework

The NPPF sets out the government's planning policies for England and provides a framework within which LPAs can produce Local Plans to deliver sustainable development in the face of the challenges presented by climate change, flooding, and coastal change.

The NPPF stipulates that Local Plans should be supported by SFRAs and should develop policies to manage flood risk from all sources, taking into the advice from the Environment Agency and other relevant risk management bodies such as LLFAs and Internal Drainage Boards (IDBs).

The Sequential and Exception Tests are established by the NPPF as the primary decision-making tools which LPAs should use to direct development to areas with the lowest risk of flooding wherever possible. This SFRA provides the basis for applying these tests. Further guidance on the application of these tests can be found in Section 4.

2.1.2 Planning Practice and Guidance 'Flood Risk and Coastal Change'

The PPG is a living document that supports the NPPF and is periodically updated. The 'Flood Risk and Coastal Change' PPG outlines how the risks associated with flooding and coastal change should be assessed and addressed, including clear guidance regarding the contents of SFRAs and the application of the Sequential and Exception Tests to the siting of proposed developments.

The PPG also sets out the key principles of 'Integrated Coastal Zone Management' and provides guidance on the identification of CCMA's. 'Integrated Coastal Zone Management' is defined as a "joined-up and participatory approach towards the planning and management of coastal areas (land and marine)". CCMA's are areas where rates of shoreline change are expected to be significant over the next 100 years taking account of climate change. They should be defined where the identified shoreline management policy during the Shoreline Management Plan period is anything other than hold the line.

Specific PPG paragraphs are referenced throughout this document in the relevant sections.

2.1.3 Flood and Water Management Act

The Flood and Water Management Act (FWMA)⁸ (2010) aims to provide sustainable and consistent management of flooding in England and Wales. It defines the roles of RMAs as the bodies with flood risk related responsibilities. RMAs include the Environment Agency, IDBs, Water and Sewerage Companies and LLFAs. The FWMA designates county councils and unitary authorities as the LLFAs. The LLFA for the LDC area is ESCC who pursuant to the FWMA have the following responsibilities:

- Carry out work to manage flooding from local sources (surface water, groundwater, and Ordinary Watercourses),
- Prepare and maintain a LFRMS,
- Investigate significant local flood incidents and publish the results of these investigations,
- Maintain a register of flood risk assets,
- Regulate work on Ordinary Watercourses,
- Share information about flood risk,
- Perform a lead role in emergency planning and recovery after a flood event, and,
- Co-operate with other RMAs.

⁸ Flood and Water Management Act (2010): <https://www.legislation.gov.uk/ukpga/2010/29/contents> [Accessed September 2023].

At present, ESCC as LLFA is a statutory consultee to LDC for matters relating to surface water management in new development. Schedule 3 of the FWMA places a duty on the local authority, likely to be the LLFA, to become a SAB. Schedule 3 will remove the automatic right to connect surface water to the public sewer network and will require all new development over a prescribed threshold (to be confirmed by secondary legislation) to use SuDS to manage surface water. In addition to the normal planning application process, developers will have to submit a SuDS application to the SAB, demonstrating compliance with National Standards. The SAB will approve applications and then adopt the SuDS for the lifetime of the development, with responsibility for maintenance.

At the time of writing (September 2023), Schedule 3 has not been enacted. However, the Jenkins Review published in January 2023, made recommendations that Schedule 3 be enacted by Defra. The current indication by Defra is that Schedule 3 is likely to be enacted during 2024.

2.1.4 Flood Risk Regulations

The Flood Risk Regulations (FRR)⁹ (2009) transpose the requirements of the EU Floods Directive 2007 into law in England. They outline the duties of LLFAs and the Environment Agency to produce PFRAs, flood risk maps displaying the flooding extents and hazards, and Flood Risk Management Plans (see Section 2.2 for further details). These FRR requirements are completed on a six-year cycle. The FRR will be revoked once the Retained EU Law Bill (Revocation and Reform) has been passed¹⁰.

2.1.5 National Flood and Coastal Erosion Risk Management Strategy

In accordance with the FWMA, the Environment Agency has developed a National Flood and Coastal Erosion Risk Management (FCERM) Strategy for England¹¹ (2020) which sets out the long-term objectives for managing flood and coastal erosion risks and the measures proposed to achieve them. The strategy's vision is a nation ready for, and resilient to, flooding and coastal change – today, tomorrow and to the year 2100. It delineates three primary ambitions for realising this strategy, together with a framework for how risk management authorities should work to support these. The three ambitions are as follows:

- Climate resilient places: working with partners to bolster resilience to flooding and coastal change across the nation, both now and in the face of climate change.
- Today's growth and infrastructure resilient in tomorrow's climate: making the right investment and planning decisions to secure sustainable growth and environmental improvements, as well as infrastructure resilient to flooding and coastal change.
- A nation ready to respond and adapt to flooding and coastal change: ensuring local people understand their risk to flooding and coastal change and know their responsibilities and how to take action.

2.1.6 Environmental Permitting (England and Wales) Regulations

The Environmental Permitting (England and Wales) Regulations (2016)¹² stipulate the regulated activities for which an environmental permit may be required when undertaken:

- in, under, over or near a Main River (including culverted sections);
- on or near a flood defence on a Main River;
- in the flood plain of a Main River; and/or,
- on or near a sea defence.

Further guidance on obtaining an environmental permit is available from the Environment Agency.

⁹ Flood Risk Regulations (2009): <https://www.legislation.gov.uk/uksi/2009/3042/contents/made> [Accessed September 2023].

¹⁰ Retained EU Law Bill (Revocation and Reform): <https://bills.parliament.uk/publications/51204/documents/3436> [Accessed September 2023].

¹¹ National Flood and Coastal Erosion Risk Management Strategy (2020): <https://www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england--2> [Accessed September 2023].

¹² Environmental Permitting Regulations (2016): <https://www.legislation.gov.uk/uksi/2016/1154/contents/made> [Accessed September 2023].

2.2 Regional

2.2.1 South Marine Plan

The South Marine Plan¹³ (2018) introduces a strategic approach to planning within the inshore and offshore waters between Folkstone, Kent and the River Dart in Devon. The inshore component of the South Marine Plan includes areas submerged at mean high water spring tide, areas extending between the mean high water spring tide and 12 nautical miles from the coastline, as well as the waters of any estuary, river, or channel, as far the limit of tidal waters at mean high water spring tide.

The offshore component of the plan refers to areas that lie between 12 nautical miles offshore and the maritime border with France. Therefore, within the LDC area, the South Marine Plan encompasses the coastline from Cuckmere Haven to East Saltdean (this includes the settlements of Peacehaven, Newhaven, and Seaford), as well as tidal sections of the River Ouse. Through its vision, the South Marine Plan will safeguard environments, encourage growth in local sectors and protect and enhance essential natural defences against climate change and flooding. Implementation of the plan's objectives will help decision makers to optimise the marine area's natural capital, realising greater protection of vulnerable habitats and species and natural defences against climate change and flooding, as well as improving the well-being of coastal communities and supporting a stronger marine economy.

2.2.2 Shoreline Management Plans

SMPs¹⁴ form part of Defra's strategy for flood and coastal defences. They provide a large-scale assessment of risks associated with coastal change and present the policy framework to address these risks in a sustainable manner. The SMP policies defined by Defra are:

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

The SMP relevant to the study area is the Beachy Head to Selsey Bill (2006)¹⁵. There are variations in policy definition within this SMP, relative to the generic policies described above, with two additional policies defined: 'Monitor, Manage and Review' and 'Hold Cliff Base'.

SMP areas have been further divided into frontages, each of which is has been assigned one of the four policies described above for three time periods; short term (0-20 years), medium term (20-50 years), and long-term (50-100 years). The short-term, medium-term, and long-term policies for each frontage in the LDC area are presented in Appendix A Figure 1. These polices for each time period and frontage were derived through reference to the National Coastal Erosion Risk Mapping dataset¹⁶. The short-term, medium-term, and long-term policies for each coastal frontage section in the LDC area are presented in Table 2-1.

Table 2-1: SMP Policies for Coastal Frontages in the LDC area¹⁶

Policy Unit	Short Term Policy (2005-2025)	Medium Term Policy (2025-2055)	Long Term Policy (2055-2105)
Seaford Head to Cuckmere Haven	No Active Intervention	No Active Intervention	No Active Intervention
Seaford Town to Newhaven West Breakwater	Hold the Line	Hold the Line	Hold the Line

¹³ South Marine Plan: <https://www.gov.uk/government/collections/south-marine-plans> [Accessed September 2023].

¹⁴ Shoreline Management Plans (SMPS): <https://www.gov.uk/government/publications/shoreline-management-plans-smps> [Accessed September 2023].

¹⁵ Beachy Head to Selsey Shoreline Management Plan (2006): <https://www.southdowns.gov.uk/wp-content/uploads/2018/04/TLL-19-Beachy-Head-to-Selsey-Shoreline-Management-Plan-2006.pdf> [Accessed September 2023].

¹⁶ National Coastal Erosion Risk Mapping 2018-2021 (2022): <https://www.data.gov.uk/dataset/7564fcf7-2dd2-4878-bfb9-11c5cf971cf9/national-coastal-erosion-risk-mapping-ncerm-national-2018-2021> [Accessed September2023].

Policy Unit	Short Term Policy (2005-2025)	Medium Term Policy (2025-2055)	Long Term Policy (2055-2105)
Newhaven West Breakwater to Peacehaven Heights	No Active Intervention	No Active Intervention	Managed Realignment
Peacehaven Heights to Saltdean	Hold the Line	Hold the Line	Hold the Line

2.2.3 River Basin Management Plans & Catchment Flood Management Plans

River Basin Management Plans (RBMPs) are prepared in accordance with the WFD and they assess the pressure facing the water environment in River Basin Districts (RBD). Each RBMP comprises a collection of documents that describes the framework by which the quality of waterbodies will be protected or enhanced in each respective RBD.

Data tables and online interactive maps with information regarding the current conditions of, and pressures on, waterbodies within each RBD, are also provided. The entirety of the LDC area is covered by the South East RBD River Basin Management Plan (2022)¹⁷.

Catchment Flood Management Plans (CFMPs) are high-level strategic plans providing an overview of flood risk across each river catchment. The Environment Agency use CFMPs to work with other decision makers to identify and agree long-term policies for sustainable flood risk management. The LDC area encompasses the River Ouse CFMP (2009)¹⁸ and the River Adur CFMP (2009)¹⁹. The policies for those sub-areas within the River Ouse and the River Adur CFMPs that overlap with the LDC area are summarised in Table 2-2. Sub-areas within the River Ouse and the River Adur CFMPs that do not fall within the LDC area have been excluded from Table 2-2.

Table 2-2: List of relevant CFMP sub-areas¹⁸

Sub-area	Preferred Policy	Relevant CFMP
High Weald and Middle Ouse	Policy Option 6 – areas of low to moderate flood risk where we will take action with others to store water or manage runoff in locations that provide overall flood risk reduction or environmental benefits.	River Ouse
Haywards Heath	Policy Option 4 – areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change.	River Ouse
Low Weald	Policy Option 2 – areas of low to moderate flood risk where we can generally reduce existing flood risk management actions.	River Ouse
Newhaven	Policy Option 4 – areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change.	River Ouse
South Downs Saltdean & Peacehaven	Policy Option 1 – areas of little or no flood risk where we will continue to monitor and advise.	River Ouse
Seaford	Policy Option 1 – areas of low to moderate flood risk where we are generally managing existing flood risk effectively.	River Ouse
Burgess Hill and Hassocks	Policy Option 4 – areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change.	River Adur

¹⁷ South East RBD River Basin Management Plan: <https://www.gov.uk/guidance/south-east-river-basin-district-river-basin-management-plan-updated-2022> [Accessed September 2023].

¹⁸ Ouse Sussex Catchment Flood Management Plan (2009): <https://www.gov.uk/government/publications/ouse-sussex-catchment-flood-management-plan> [Accessed September 2023].

¹⁹ River Adur Catchment Flood Management Plan (2009): <https://www.gov.uk/government/publications/adur-catchment-flood-management-plan> [Accessed September 2023].

Flood Risk Management Plans (FRMPs) explain the objectives and actions needed to manage flood risk at a national and local level in England. Under the FRR (2009), FRMPs must be reviewed by the Environment Agency and LLFAs every 6 years. The current FRMPs cover the period 2021-2027²⁰, and are separated into a part a²¹, which provides an overview of national measures that apply to all river basin districts, and part b, which is composed of ten local flood risk management plans that outline the measures that apply to specific River Basin Districts. The entirety of the LDC area is covered by the South East RBD Flood Risk Management Plan 2021 to 2027.

2.3 Local Plan

2.3.1 Lewes District Local Plan Joint Core Strategy

The LDC's primary planning policy document is the Lewes District Local Plan Part 1 Joint Core Strategy²² which was adopted in 2016 and will guide development in the LDC area up to 2030. Within this document, Core Policy 12 (Flood Risk, Coastal Erosion, Sustainable Drainage, and Slope Stability), relates directly to flood risk and drainage. Core Policy 12 stipulates that the impact and extent of flood risk within the LDC area will be achieved through the following measures:

- Steering development away from areas of flood risk. where possible. Development in areas of flood risk will be required to meet the national Sequential and Exception Tests, where relevant.
- Where site-specific FRAs are required, directing applicants to demonstrate that the development and its means of access will be safe from flooding without increasing the risk of flooding elsewhere. Development should seek to reduce overall flood risk where possible.
- Liaising closely with the Environment Agency and ESCC on development and flood risk.
- Seeking the appropriate management of surface water runoff and ensuring there is no increase in surface water runoff from new developments. This will include requiring new development to incorporate SuDS, unless it is demonstrated that SuDS are not technically appropriate.
- Ensuring development avoids areas of undeveloped coastline unless it specifically requires a rural coastal location, meets the Sequential Test and does not have other adverse impacts.
- Preventing development on unstable areas of coastline and areas at risk of erosion and slope failure.

2.3.2 East Sussex County Council Preliminary Flood Risk Assessment

Under the 2009 FRR all LLFAs are required to prepare a PFRA, as undertaken by ESCC in 2011. The PFRA (2011)²³ provides a high-level overview of flood risk from local flood sources such as surface water, groundwater, and Ordinary Watercourses for which ESCC are responsible. However, the ESCC PFRA also considers flooding from Main Rivers, the sea, and large reservoirs (all of which are the responsibility of the Environment Agency). Information contained within the PFRA informed the development of the LFRMS and helped to identify areas that should be prioritised for Surface Water Management Plans (SWMPs). The Environment Agency has established a national methodology for identifying Flood Risk Areas, which refer to areas at risk with populations in excess of 30,000. PFRAs act as a screening exercise by which the Environment Agency's Flood Risk Areas can be revised and updated. The ESCC PFRA concluded that none of the Environment Agency's existing Flood Risk Areas were located in East Sussex, and that the local information did not warrant the reporting of new Flood Risk Areas to the Environment Agency.

An addendum to the 2011 PFRA was published in 2017²⁴, which identified two Flood Risk Areas in the county (Eastbourne and Hastings), however neither of these are located within the LDC area.

²⁰ Flood risk management plans 2021 to 2027: <https://www.gov.uk/government/collections/flood-risk-management-plans-2021-to-2027> [Accessed September 2023].

²¹ Flood risk management plans 2021 to 2027: national overview (part a): <https://www.gov.uk/government/publications/flood-risk-management-plans-2021-to-2027-national-overview-part-a> [Accessed September 2023].

²² Lewes District Local Plan Part 1 Joint Core Strategy 2010 to 2030: <https://www.lewes-eastbourne.gov.uk/article/1832/Lewes-Core-Strategy-Local-Plan-Part-1> [Accessed September 2023].

²³ East Sussex County Council Preliminary Flood Risk Assessment (2011): <https://webarchive.nationalarchives.gov.uk/ukgwa/20140328094441/http://www.environment-agency.gov.uk/research/planning/135538.aspx#2> [Accessed September 2023].

²⁴ East Sussex County Council Preliminary Flood Risk Assessment Addendum (2017): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/698543/PFRA_East_Sussex_County_Council_2017.pdf [Accessed September 2023].

2.3.3 East Sussex County Council Local Flood Risk Management Strategy

The ESCC LFRMS (2016)²⁵ provides the framework for the management of flood risk from surface water, groundwater, and Ordinary Watercourses in the county for the ten-year period 2016-2026, and builds upon the previous FRMS released for the period 2013-2016. The strategy is a high level, statutory document that establishes a strategic framework within which flood risk management authorities can operate and provides new advice on drainage issues in the county.

The Strategy outlined the following objectives:

- Establish and maintain effective partnerships with key organisations and local communities in order to develop collective knowledge, share best practice and secure funding for local flood risk management measures.
- Improve the evidence base and understanding of local flood risk to ensure that limited resources are targeted in the areas of highest risk and vulnerability.
- Empower local communities and land owners to take action in order to be prepared for and limit the impacts of flooding.
- Avoid increasing flood and coastal erosion risk by encouraging best practice for the maintenance of assets and preventing inappropriate development.
- Work in partnership to deliver cost-effective flood and coastal erosion risk management measures which take a catchment wide approach and contribute to wider social, economic, and environmental benefits.

2.3.4 Peacehaven, Newhaven and Seaford Surface Water Management Plan

As an LLFA, ESCC must examine and manage local flood risk within East Sussex, with the development of SWMPs being integral to the fulfilment of those responsibilities. Peacehaven, Newhaven and Seaford were highlighted as areas potentially at risk of local flooding in the East Sussex LFRMS. Therefore, ESCC commissioned a Stage 1 SWMP (2014)²⁶ for the towns of Peacehaven, Newhaven and Seaford, in order to determine whether there were any significant local flood risks and what further work would be required.

The SWMP covered Phase 1 of the Defra SWMP process, as well as aspects of Phases 2 and 3. In line with Defra's SWMP Technical Guidance (2010)²⁷, SWMPs are split into four phases:

- Phase 1 Preparation: This phase involves the identification of the need for a SWMP study, establishing a study partnership, outlining how, why and when stakeholders will be engaged, assessing the availability of information for the study, and identifying the level of assessment required as part of the SWMP study.
- Phase 2 Risk Assessment: Depending on the level of assessment chosen during Phase 1, this phase may include a strategic assessment, an intermediate assessment, and a detailed assessment, in order to identify locations at greatest risk of surface water flooding, and to identify potential mitigation measures on the basis of the evidence collected as a part of the risk assessment. The outputs of the risk assessment for surface water flooding should be mapped, and then communicated to professional stakeholders (spatial and emergency planners) and the public.
- Phase 3 Options: Identification and short-listing of measures and options for mitigating the risk of surface water flooding. The requirements of the options assessment should be defined at this stage, and utilised to undertake an assessment of the short-listed options. A preferred option should be taken forward to the surface water management action plan.
- Phase 4 Implementation and Review: The surface water management action plan should be prepared, reviewed and published.

The SWMP identified 10 Local Flood Risk Zones (LFRZs) within Peacehaven, Newhaven and Seaford. A LFRZ is defined as a discrete area of flooding that does not exceed the national criteria for a 'Flood Risk Area' but still

²⁵ East Sussex County Council Local Flood Risk Management Strategy 2016-2026 (2020):

<https://www.eastsussex.gov.uk/environment/flooding/local-flood-risk-management-strategy> [Accessed September 2023].

²⁶ Stage 1 Surface Water Management Plan for Peacehaven, Newhaven and Seaford:

<https://www.eastsussex.gov.uk/environment/flooding/surface-water-management-plans> [Accessed September 2023].

²⁷ Surface Water Management Plan Technical Guidance March 2010:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69342/pb13546-swmp-guidance-100319.pdf [Accessed September 2023].

affects properties, businesses, or infrastructure. The report recommended that further investigation of flooding mechanisms and severity for a range of rainfall events should be conducted with a detailed Integrated Urban Drainage (IUD) model of the study area, with a particular focus on the 10 LFRZs. In addition, it was advised that the benefits of drafting a community flood plan for all of the ten LFRZs should be appraised.

2.3.5 Guide to Sustainable Drainage Systems in East Sussex

In 2015, ESCC published a guide defining SuDS, explaining the importance, and detailing the process of designing and implementing SuDS within the ESCC area²⁸.

A series of flow charts and accompanying documentation set out the delivery stages that should be followed by designers of SuDS to ensure that there are no delays in determining planning applications. These delivery stages extend from the outline business case to the eventual adoption, operation and maintenance. Appendix B of the SuDS guide lists the documents and information that should be consulted at each delivery stage, whilst Table 3G.1 of the SuDS guide lists the information that should be submitted with a detailed drainage design.

The guide also provides strategic-level mapping of the potential constraints and opportunities for SuDS imposed by geology, ground stability, groundwater depth, landscape and ecological classifications, topography, and archaeological remains, within the ESCC area.

2.3.6 East Sussex County Council SuDS Decision Support Tool for Small Scale Development

Royal Haskoning DHV has developed a web-based tool for East Sussex County Council²⁹ to assist planning authorities and developers in assessing the suitability of SuDS provision for small scale development proposals in East Sussex. The tool is designed for small scale development up to a maximum of 5000m² of residential development or 10,000m² of non-residential development.

The tool utilises a number of user inputted variables such as site location, site area, development type, and total impermeable area of the existing and proposed sites, in order to calculate an indicative greenfield and brownfield runoff rate from the site, plus an indicative storage requirement. Further information regarding the use and interpretation of this tool can be found in the user guide³⁰.

2.3.7 Water, People, Places - A guide for master planning sustainable drainage into developments

AECOM, in partnership with the LLFAs in South East England prepared a guidance document³¹ for the integration of SuDS into the master planning of large and small developments. The guidance document intends to provide a consistent approach to the best practice design of SuDS at the master planning stage in the South East of England, and to be used as part of the initial planning and design process for all types of residential, commercial, and industrial development in the region.

²⁸ Guide to Sustainable Drainage Systems in East Sussex: <https://www.eastsussex.gov.uk/media/1qgio4mx/guide-to-sustainable-drainage-systems-in-east-sussex2.pdf> [Accessed September 2023].

²⁹ East Sussex County Council SuDS Decision Support Tool for Small Scale Development: <http://eastsussex.suds-tool.co.uk/> [Accessed September 2023].

³⁰ East Sussex SuDS Decision Support Tool for Small Scale Development User Guide: http://eastsussex.suds-tool.co.uk/ESCC_SuDS_Tool_User_Guide_FINAL_21082017_with_App.pdf [Accessed September 2023].

³¹ Water, People, Place - A guide for master planning sustainable drainage into developments: https://www.susdrain.org/files/resources/other-guidance/water_people_places_guidance_for_master_planning_sustainable_drainage_into_developments.pdf [Accessed September 2023].

3 Datasets and Methodologies

SFRAs rely on a large number of datasets and information from a range of stakeholder organisations. This section describes the datasets that have been obtained and the methods that have been applied to assess the risk from all sources of flooding across the study area.

3.1 Risk of Flooding from Rivers

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 floodwater to back up.
- Constrictions preventing discharge at the outlet of the river e.g. locked flood gates or tidelocking at high tide.

To assess flooding from rivers the datasets described in Table 3-1 have been used.

Table 3-1: Datasets for river flooding

Datasets	Notes	Data source
OS Open River	GIS shapefile which provides a high level overview of watercourses. Contains over 144,000km of water bodies and watercourses. These include freshwater rivers, tidal estuaries, and canals.	Ordnance Survey free download: https://www.ordnancesurvey.co.uk/business-government/products/open-map-rivers
Catchment boundaries	GIS shapefiles obtained from the Catchment Data Explorer have been used to identify the river basin districts, management catchments in the LDC SFRA project area.	Environment Agency Catchment Data Explorer: https://environment.data.gov.uk/catchment-planning
Flood Zone 2 and Flood Zone 3a	GIS shapefiles which identify the probability of fluvial and tidal flooding, ignoring the presence of defences as mapped on the Environment Agency Flood Map for Planning (rivers and sea). Flood Zone 1: Land having a less than 0.1% annual exceedance probability (AEP) of fluvial or tidal flooding. Flood Zone 2: Land having between a 1% and 0.1% AEP of fluvial flooding, or land having between a 0.5% and 0.1% AEP of tidal flooding. Flood Zone 3a: Land having a 1% or greater AEP of fluvial flooding, or land having a 0.5% or greater AEP of tidal flooding.	Defra Data Services Platform: https://environment.data.gov.uk/dataset/86ec354f-d465-11e4-b09e-f0def148f590 https://environment.data.gov.uk/dataset/87446770-d465-11e4-b97a-f0def148f590
AIMS Spatial Flood Defences	Contains the locations of flood defences currently owned, managed or inspected by the Environment Agency, including structures, buildings, earth banks, stone and concrete walls, and sheet-piling.	Defra Data Services Platform: https://environment.data.gov.uk/dataset/8e5be50f-d465-11e4-ba9a-f0def148f590
Reduction in Risk of Flooding from Rivers and Sea due to Defences	This dataset indicates where flood defences may reduce the risk of flooding from the rivers and the sea and has replaced the Areas Benefiting from Flood Defences dataset.	Defra Data Services Platform: https://environment.data.gov.uk/dataset/7b5cf457-6853-4b50-a812-b041d9da003a
Recorded Flood Outlines	Contains all records of historic flooding from rivers, the sea, groundwater, and surface water since 1946. Takes account of the presence of defences, structures and other infrastructure that existed at the time of flooding. A companion Historic Flood Map contains a subset of these Recorded Flood Outlines which satisfy certain criteria.	Defra Data Services Platform: https://environment.data.gov.uk/dataset/8c75e700-d465-11e4-8b5b-f0def148f590

3.1.1 Hydraulic Models

A number of hydraulic river models were provided by the Environment Agency at the start of the project. This includes the Lower Ouse model which includes representation of the Newhaven Flood Alleviation Scheme. The models were checked for completeness, date of preparation and the hydrological methods used, however no changes to the model representation were undertaken. As part of the SFRA, the models have been re-simulated to define Flood Zone 3b (3.33% AEP, or 1 in 30 year) and to map the impact of climate change in the LDC area.

Table 3-3 summarises the models that have been received, how they have been used in the SFRA and any updates that have been undertaken as part of the SFRA. Full details of re-simulations are documented in a separate standalone Technical Note (Appendix B).

3.1.2 Functional Floodplain

The SFRA should identify areas of Flood Zone 3b functional floodplain, which is defined as land where floodwater from the river or sea has to flow or be stored in times of flooding. Within the latest NPPF update, this is now defined as land that would flood during a 3.33% AEP (1 in 30 year) event or greater, with flood risk management features and structures operating effectively.

3.1.3 Impact of climate change on peak river flow

It is anticipated that climate change will increase the frequency, extent and impact of flooding, as reflected in peak river flows. For example, wetter winters and more intense rainfall may increase fluvial flooding and surface water runoff. SFRAs should consider the risk of flooding from rivers in the future as a result of the impact of climate change on rainfall patterns and peak river flows. The Environment Agency sets out the current guidance³² on the climate change allowances that should be applied, with peak river flow allowances provided by management catchments. Management catchments are sub-catchments of RBDs. The LDC study area comprises a single river basin district (South East) and two management catchments (Adur and Ouse Management Catchment and the Cuckmere and Pevensy Levels Management Catchment).

The Environment Agency's peak river flow allowances are based on percentiles. A percentile describes the proportion of possible scenarios that fall below an allowance level.

- Central Allowance is based on the 50th percentile.
- Higher Central Allowance is based on the 75th percentile.
- Upper End Allowance is based on the 95th percentile.

An allowance based on the 50th percentile is exceeded by 50% of the projections in the range. At the 70th percentile it is exceeded by 30%. At the 95th percentile it is exceeded by 5%. These allowances (increases) are provided, in the form of figures for the total potential change anticipated, for three climate change periods:

- The '2020s' (2015 to 2039).
- The '2050s' (2040 to 2069).
- The '2080s' (2070 to 2115).

The time period that should be applied in the appraisal of a proposed development is contingent upon the expected lifetime of the development. A minimum of 100 years should be considered for a residential development, whereas the lifetime of a non-residential development should be determined on a case-by-case basis.

The Environment Agency's climate change guidance stipulates that SFRAs should assess both the Central and Higher Central allowances. The Higher Central allowance should be applied to developments classified as Essential Infrastructure in Flood Zones 2, 3a, and 3b, whereas the Central allowance should be applied for all other development categories in Flood Zones 2 and 3a. Table 3-2 provides the Central and Higher Central peak river flow allowances for the two management catchments in the LDC area.

³² Flood Risk Assessments: climate change allowances: <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances> [Accessed September 2023].

Table 3-2: Peak river flow allowances by management catchment (based on 1981 to 2000 baseline)³³

Management catchment	River basin district	Allowance category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Adur and Ouse	South East	Upper End	40%	57%	107%
		Higher Central	23%	28%	55%
		Central	16%	18%	37%
Cuckmere and Pevensey Levels	South East	Upper End	35%	44%	76%
		Higher Central	24%	26%	43%
		Central	18%	19%	32%

Table 3-3 summarises the models that have been received, how they have been used in the SFRA and any updates that have been undertaken as part of the SFRA.

³³ Adur and Ouse Management Catchment Peak River Flow Allowances: <https://environment.data.gov.uk/hydrology/climate-change-allowances/river-flow?mgmtcatid=3000> [Accessed September 2023].

Table 3-3: Hydraulic models for the LDC study area

Model	Type and date of received model	Model details	Tasks undertaken as part of this SFRA
Upper Ouse	ISIS 1D Only (2012)	<p>A 1D only fluvial model representing the upper catchment of the River Ouse.</p> <p>Defended model runs include the 20%, 5%, 3.33%, 2%, 1.33%, 1%, 0.4% and 0.1% AEP fluvial events. A climate change run has also been undertaken for the 1% AEP event.</p> <p>Undefended model runs include the 5%, 1% plus climate change and 0.1% AEP fluvial events.</p>	<p>The Upper Ouse model was simulated for the defended 1% AEP + 37% (Central climate change allowance for the 2080s epoch) and the defended 1% AEP + 55% (Higher Central climate change allowance for the 2080s epoch) events. The model was also re-run for the defended 3.33% AEP and 1% AEP events.</p> <p>The inflows for the 1% AEP event were re-scaled to apply the Central and Higher Central allowances. Due to the 1D nature of the model, significant glass-walling occurred and therefore results were not taken forward to the figures. An alternative approach was taken forward which is discussed in Section 6.4.1.</p>
Lower Ouse Fluvial	ISIS-TUFLOW 1D-2D (2012)	<p>A 1D-2D model of the middle and lower catchments of the River Ouse.</p> <p>Defended model runs include the 20%, 5%, 2%, 1.33%, 1%, 0.4% and 0.1% AEP fluvial events. A climate change run has also been undertaken for the 1% AEP event.</p> <p>Undefended model runs include the 5%, 1%, and 0.1% AEP fluvial events.</p>	<p>The Lower Ouse fluvial model was simulated for the defended 3.33% AEP + 55% (Higher Central climate change allowance for the 2080s epoch), the defended 1% AEP + 37% (Central climate change allowance for the 2080s epoch), and the defended 1% AEP + 55% (Higher Central climate change allowance for the 2080s epoch) events. The model was also re-run for the defended 3.33% AEP and 1% AEP events.</p> <p>The inflows for the 1% AEP event were re-scaled to apply the Central and Higher Central allowances. The inflows for the 3.33% AEP event were derived by interpolating between the 5% and 2% AEP events, in order to define the functional floodplain (Flood Zone 3b) in the present day. To define the functional floodplain in the future, the inflows derived for the 3.33% AEP event were uplifted by applying the Higher Central allowance (+55%).</p> <p>These results were taken forward to the figures in Appendix A.</p>
Adur	ISIS 1D only (2011)	<p>A 1D only fluvial model representing the River Adur.</p> <p>Model runs include the 20%, 5%, 2%, 1.33%, 1%, 0.4%, and 0.1% AEP fluvial events. Climate change runs have also been undertaken for the 1% AEP event. A fluvial climate change allowance of +20% has been applied.</p>	<p>The Adur model was simulated for the defended 3.33% AEP event, the defended 1% AEP event, the defended 1% AEP + 37% (Central climate change allowance for the 2080s epoch) and the defended 1% AEP + 55% (Higher Central climate change allowance for the 2080s epoch) events. The 3.33% AEP event was also simulated so that the functional floodplain (Flood Zone 3b) could be identified.</p> <p>The inflows for the 1% AEP event were re-scaled to apply the Central and Higher Central allowances, whilst the inflows of the 3.33% AEP event were derived by interpolating between the 5% and 2% AEP events.</p> <p>Due to the 1D nature of the model, significant glass-walling occurred and therefore results were not taken forward to the figures. It was agreed with LDC that mapping of results would not be produced for this watercourse as no development was being proposed within this location. Should development be proposed within this area in the future, site-specific modelling would be required.</p>

3.2 Risk of Flooding from the Sea

Some of the datasets described in Table 3-1 have been used in the assessment of flooding from tidal sources, including 'Flood Zones', 'Defences' and 'Reduction in Risk of Flooding from Rivers and Sea due to defences'.

3.2.1 Impact of climate change on sea level rise

LPAs are encouraged to make allowances for climate change in Local Plans to help minimise vulnerability and provide resilience to flooding. Current guidance on the climate change allowances that should be applied are set out by the Environment Agency³². There are a range of allowances for each RBD and epoch for sea level rise. The allowances for the South East RBD are included in Table 3-4.

Table 3-4: Sea level allowances in the South East RBD for each epoch in mm for each year (based on 1981 to 2000 baseline) – the total sea level rise for each epoch is in brackets³⁴

Area of England	Allowance	2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative rise 2000 to 2125 (metres)
South East	Higher Central	5.7 (200)	8.7 (261)	11.6 (348)	13.1 (393)	1.20
	Upper End	6.9 (242)	11.3 (339)	15.8 (474)	18.2 (546)	1.60

The Environment Agency guidance stipulates that SFRA and FRA should assess both the Higher Central and Upper End allowances for sea level rise. However, through liaison with the Environment Agency it was confirmed that for this SFRA, only the Higher Central allowances would be required.

The Environment Agency have supplied the JBA 2012 Newhaven/Seaford coastal model and the Lower Ouse tidal model, details of which can be found in Table 3-5. The Lower Ouse model includes representation of the Newhaven Flood Alleviation Scheme. Water levels for the 3.33% AEP (1 in 30 year), 0.5% AEP (1 in 200 year), and 0.1% AEP (1 in 1000 year) tidal events, with the Higher Central allowance for climate change allowance applied, in the 2025, 2055, and 2125 epochs were calculated along with water levels for the Mean High Water Springs (MHWS) for the 2025, 2055, and 2125 epochs. MHWS refers to the average height (m AOD) throughout the year of two successive high waters in a 24 hour period when the tidal range is greatest. Appendix B contains additional information on how the water levels for each of the epochs were generated.

The water levels for the 3.33% AEP (1 in 30 year) tidal event in the 2025 and 2125 epochs, as well as those for the 0.5% AEP (1 in 200 year) tidal event in the 2025, 2055, and 2125 epochs were applied to both the Lower Ouse Tidal and Seaford Coastal models. However, the water levels for the 0.1% AEP (1 in 1000 year) tidal event in the 2025, 2055, and 2125 epochs were only applied to the Seaford Coastal model.

³⁴ Environment Agency Sea Level Allowances: <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#sea-level-allowances> [Accessed September 2023].

Table 3-5: Coastal and tidal models for the LDC study area

Model	Type and date of received model	Model details	Tasks undertaken as part of this SFRA
Lower Ouse Tidal	ISIS-TUFLOW 1D-2D (2012)	<p>A 1D-2D model of the middle and lower catchments of the River Ouse.</p> <p>Defended model runs include the 5%, 1.33%, 0.5%, 0.1% AEP tidal events. Climate change runs for 2070 and 2115 have also been run for the 0.5% AEP event.</p> <p>Undefended model runs include the 5%, 0.5%, 0.1% tidal events. Climate change runs for 2070 and 2115 have also been run for the 0.5% AEP event.</p> <p>For all undefended and defended tidal model runs, a 20% AEP fluvial event was applied.</p>	<p>The Lower Ouse tidal model was simulated for the defended 0.5% AEP event with the Higher Central climate change allowances for the 2025, 2055, and 2125 epochs applied.</p> <p>The 3.33% AEP event was also run for the 2025 and 2125 epochs, to define the extent of the functional floodplain (Flood Zone 3b).</p> <p>These results were taken forward to the figures in Appendix A.</p>
Seaford Coastal	TUFLOW 2D (2012)	<p>A 2D only model stretching along the coastline from the mouth of the River Ouse to Seaford Head.</p> <p>Defended model runs include the 20%, 5%, 1.33%, 0.5%, 0.25%, 0.1%, AEP tidal events for the present day (2011), as well as the 0.5% and 0.1% AEP events for the year 2115.</p> <p>Undefended model runs include the 0.5% and 0.1% AEP tidal events for the present day (2011), as well as the 0.5% and 0.1% AEP events for the year 2115.</p>	<p>The Seaford Coastal model was run for the defended 0.5% and 0.1% AEP events with Higher Central climate change allowances applied for the 2025, 2055, and 2125 epochs.</p> <p>The 3.33% AEP event was also run for the 2025 and 2125 epochs, to define the extent of the functional floodplain (Flood Zone 3b).</p> <p>These results were taken forward to the figures in Appendix A.</p>

3.3 Risk of Flooding from Surface Water

Overland flow and surface water flooding typically arise following periods of intense rainfall, often of short duration, which is unable to soak into the ground or enter drainage systems. It can run quickly off land and result in localised flooding. It can be difficult to provide a detailed representation of such localised flooding in a strategic-scale document.

The PPG states that an SFRA should identify areas at risk from surface water flooding and drainage issues, taking account of the surface water flood risk published by the Environment Agency as well other available information. The Environment Agency has undertaken modelling of surface water flood risk at a national scale and produced mapping identifying those areas at risk of surface water flooding during three annual probability events: 3.33% AEP (1 in 30 year), 1% AEP (1 in 100 year) and 0.1% AEP (1 in 1000 year). The extents of the latest version of the mapping have been made available for the Level 1 SFRA as GIS layers. This mapping is referred to as 'Risk of Flooding from Surface Water' (RoFSW) and is also available online on the Long Term Flood Risk Map³⁵.

The RoFSW mapping provides all relevant stakeholders, such as the Environment Agency, LPAs, and the public with access to information on surface water flood risk. The modelling helps the Environment Agency take a strategic overview of flooding and assists LLFAs in their duties relating to management of surface water flood risk.

For the purposes of this SFRA, the mapping allows an improved understanding of areas within the study area which may have a surface water flood risk. It should be noted that this national mapping has the following limitations:

- Use of a single drainage rate for all urban areas,
- It does not show the susceptibility of individual properties to surface water flooding,
- The mapping has significant limitations for use in flat catchments,
- No explicit modelling of the interaction between the surface water network, the sewer systems, and watercourses,
- In a number of areas, modelling has not been validated due to a lack of surface water flood records, and,
- As with all models, the RoFSW mapping is affected by a lack of, or inaccuracies, in available data.

3.3.1 Impact of climate change on peak rainfall intensity

Climate change is predicted to result in wetter winters and increased summer storm intensity in the future. This will lead to an increased volume of water entering land and urban drainage systems, consequently resulting in surface water flooding.

LPAs are encouraged to make allowances for climate change in Local Plans to help minimise vulnerability and provide resilience to flooding. Table 3-6 shows the peak rainfall intensity allowance for all management catchments within LDC. The specific allowance to be used depends on the development, as well as its development lifetime. Current guidance on the climate change allowances that should be applied are set out by the Environment Agency³⁶. The Environment Agency advises that the peak rainfall allowances should only be used for surface water flood mapping in small catchments (under 5km²), urbanised drainage catchments, and for site-scale applications.

³⁵ Environment Agency Flood Risk for Surface Water Map: <https://www.gov.uk/check-long-term-flood-risk> [Accessed September 2023].

³⁶ Environment Agency Peak River Flow Allowances: <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#peak-river-flow-allowances> [Accessed September 2023].

Table 3-6: Peak rainfall intensity allowance in small catchments (less than 5km²) or urban drainage catchments (based on a 1981 to 2000 baseline)³⁷

Management Catchment	River basin district	AEP	Epoch 2050s (2022-2060) or 2070s (2061-2125)	Central Allowance	Upper End Allowance
Adur and Ouse	South East	3.33%	'2050s'	20%	35%
			'2070s'	20%	40%
		1%	'2050s'	20%	45%
			'2070s'	25%	45%
Cuckmere and Pevensey Levels	South East	3.33%	'2050s'	20%	40%
			'2070s'	20%	40%
		1%	'2050s'	20%	45%
			'2070s'	25%	45%

The guidance advocates for the use of the Upper End allowances for both the 1% (1 in 100 year) and 3.33% (1 in 30 year) AEP events when assessing the impacts of climate change on surface water flood risk within SFRAs. For site-specific assessments, developers should use the 2050s epoch for development with a lifetime up to 2060 and the 2070s epoch for development with a lifetime between 2061 and 2125.

3.4 Risk of 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, and,
- 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

³⁷ Adur and Ouse Management Catchment peak rainfall allowances: <https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall?mgmtcatid=3000> [Accessed September 2023].

disruption of commercial activity. Inundation of agricultural land for long durations can have financial consequences.

- 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.

The British Geological Survey (BGS) has produced the first national dataset on groundwater flooding, covering England, Wales and Scotland. The dataset can be used to identify areas where geological and hydrogeological information indicates that groundwater flooding may occur and where groundwater may come close to the ground surface. The dataset doesn't provide any information on the depth to which groundwater flooding occurs or the likelihood of the occurrence of an event of a particular magnitude. Where aquifers were present, areas were separated into 50m by 50m cells, each of which was assigned to one of three classes. Outside of these areas, the rock types were not considered prone to groundwater flooding.

The three classification categories utilised in the BGS's 'Groundwater Flooding' dataset were as follows:

- A: Limited potential for groundwater flooding to occur.
- B: Potential for groundwater flooding of property situated below ground level.
- C: Potential for groundwater flooding to occur at the surface.

According to the BGS user guide³⁸, the dataset is intended for regional or national planning purposes and should be supplemented by a range of other relevant information to inform land-use planning decisions. It might also be used in conjunction with a large number of other factors, e.g. records of previous incidence of groundwater flooding, rainfall, property type, and land drainage information, to establish relative, but not absolute, risk of groundwater flooding at a resolution of greater than a few hundred metres. The 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. The data cannot be used on its own to indicate risk of groundwater flooding. Any depth to water table data is likely to be more suitable for site-scale decisions.

3.4.1 Impact of climate change on groundwater flooding

Groundwater flooding occurs primarily as a response to extended periods of rain during late autumn and early winter. With climate change bringing wetter winters, an increased risk of groundwater flooding may be seen. However, the complex relationship between rainfall, recharge, groundwater storage and flow make the response to climate change uncertain.

3.5 Risk of Flooding from Sewers

During heavy rainfall, flooding from the sewer system may occur if:

- The rainfall event exceeds the capacity of the sewer system/drainage system: New sewer systems are typically designed and constructed to accommodate 3.33% AEP (1 in 30 year) rainfall events, or greater. Older sewer systems have a variable design standard. Therefore, rainfall events with an annual probability less than 3.33% (1 in 30 year) would be expected to result in surcharging of some of the sewer system. While 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.
- 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 without sufficient maintenance (e.g. litter).
- The system surcharges due to high water levels in receiving waterbodies: There is potential for surface water outlets to become submerged due to high river or tide levels. Once storage capacity within the sewer system itself is exceeded, the water will overflow into streets and potentially into houses.

³⁸ British Geological Survey (BGS) Groundwater Flooding User Guide: <https://www.bgs.ac.uk/datasets/groundwater-flooding/> [Accessed September 2023].

Within urban areas, rainwater is frequently drained into sewers conveying both surface and foul water known as 'combined sewers'. As a result, sewer flooding events where 'combined sewers' are particularly prevalent may be more frequent and associated with the potential contamination of floodwater by foul effluent.

3.5.1 Impact of climate change on sewer flooding

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.

Water companies continue to monitor the risk of sewer flooding and put plans in place to manage the risk, as required, based on their business plan and priorities. The LPAs can work with Southern Water to identify flooding hotspots and locations of known sewer capacity issues where risk could be exacerbated. Water companies prioritise investment for potential flood alleviation schemes depending on the severity and frequency of flooding, but this can only be identified where affected property owners report the incident to the water company.

3.6 Risk of Flooding from Reservoirs

The failure of a reservoir has the potential to cause catastrophic damage due to the sudden release of large volumes of water. The PPG 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. Areas at risk of reservoir flooding are presented on the Environment Agency's Long Term Flood Risk Map³⁹. Datasets showing the flood extents for all large, raised reservoirs in the event of their failure are available. Two flood extents are provided for each reservoir denoting the "dry day" scenario⁴⁰ during which river levels are normal, and the "wet day" scenario⁴¹ during which local rivers have already overflowed their banks.

The dataset represents the prediction of a credible worst-case scenario, although its improbable that any actual flood would be this large. The dataset gives no indication of the likelihood or probability of reservoir flooding. Flood extents are not provided for smaller reservoirs (i.e. those with a volume below the threshold of 25,000m³) or for reservoirs registered following the onset of the modelling programme beginning in October 2016.

Although the impacts emanating from the breach of a large, raised reservoir could be severe, these reservoirs are carefully monitored and maintained across England in line with the provisions of the Reservoirs Act 1975⁴², and consequently, the risk of reservoir failure is very low.

³⁹ Environment Agency Risk of Reservoir Flooding: <https://www.gov.uk/check-long-term-flood-risk> [Accessed September 2023].

⁴⁰ Reservoir Flood Extents Dry Day National: <https://environment.data.gov.uk/dataset/c66ee97f-49d2-454e-9a19-d48a47bd22ad> [Accessed September 2023].

⁴¹ Reservoir Flood Extents Wet Day National: <https://environment.data.gov.uk/dataset/d81646cf-37e5-4e71-bbcf-b7d5b9ca3a1c> [Accessed September 2023].

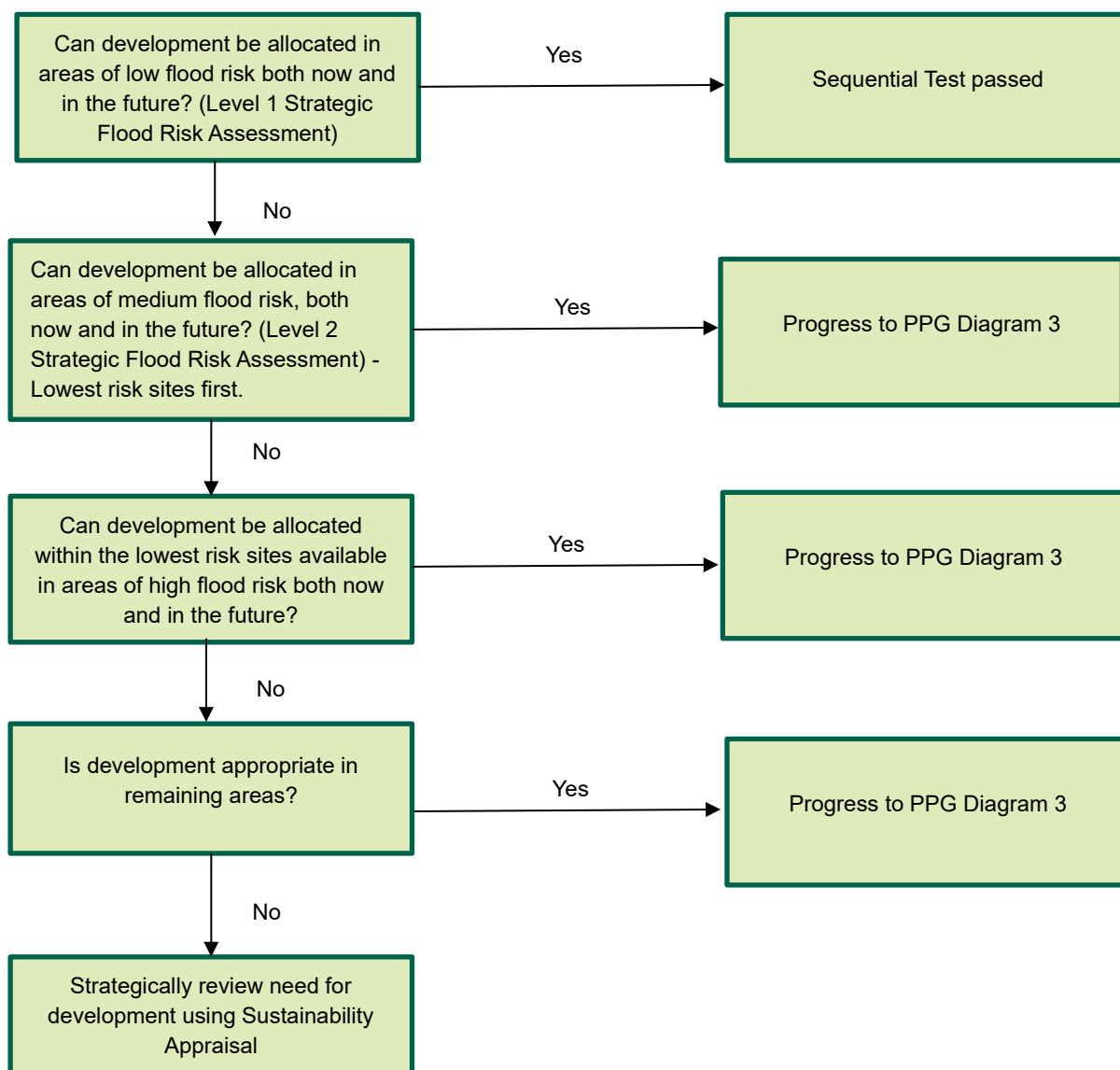
⁴² Reservoirs Act 1975: <https://www.legislation.gov.uk/ukpga/1975/23> [Accessed September 2023].

4 Applying the Sequential and Exception Tests

4.1 Sequential Test

The Sequential Test is a decision-making tool designed to ensure that development is steered away from areas at risk of flooding, and that areas with little or no risk of flooding (from any source) are developed in preference to areas at higher risk. When preparing a Local Plan, the LPA should demonstrate that a range of site allocations have been considered, using the SFRA to apply the Sequential and Exception Tests where necessary. The Sequential Test should be applied to the whole LPA area to increase the likelihood of allocating development in areas not at risk of flooding. 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 developments) 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. Figure 4-1 illustrates the approach for applying the Sequential Test that LDC should adopt in the allocation of sites as part of the preparation of the Local Plan.

Figure 4-1: Applying the Sequential Test in the preparation of a Local Plan (PPG Diagram 2)



The NPPF acknowledges that some areas may also be at risk of flooding from sources other than from rivers or the sea. 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 Environment Agency publication 'Demonstrating the flood risk Sequential Test for Planning Applications'⁴³ 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; this is 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's 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).
- 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, apply the Exception Test.
- Apply the sequential approach to locating development within the site.

Ultimately, after applying the Sequential Test, LDC 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 an FRA and is necessary regardless of whether the Exception Test is required.

4.1.1 Sequential Test Exemptions

According to the PPG and paragraph 174 of the NPPF, the Sequential Test does not need to be applied in the following circumstances:

- Individual developments proposed on sites which have already been allocated in development plans through the Sequential Test (on the assumption that the proposed development is consistent with the use for which the site was allocated, and that there have been no changes to the known level of flood risk, now and in the future).
- 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.
- The site is in an area at low risk from all sources of flooding 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).
- Some minor developments including householder development and non-residential extensions with a footprint >250m².

4.2 Exception Test

Following the application of the Sequential Test it may be concluded that there are no reasonable available alternative sites in areas of lower risk, and in some cases the Exception Test may be required.

Table 4-1 (reproduced from PPG Table 2) identifies when the Exception Test is required, based on the Flood Zone and the vulnerability classification of the proposed development.

⁴³ Demonstrating the flood risk Sequential Test for Planning Applications: <http://www.gwfoe.org.uk/wp-content/uploads/2014/01/EA-Sequential-Test-Process-v3.1-April-2012.pdf> [Accessed September 2023].

Table 4-1: Flood risk vulnerability and Flood Zone ‘incompatibility’⁴⁴

Flood Zone	Flood Risk vulnerability classification				
	Essential Infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a	Exception Test required†	X	Exception Test required	✓	✓
Zone 3b*	Exception Test required*	X	X	X	✓*

✓ Exception Test is not required.

X Development should not be permitted

Notes:

† In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.

* In Flood Zone 3b (functional floodplain) essential infrastructure that has passed the Exception Test, and water-compatible uses, should be designed and constructed to:

- remain operational and safe for users in times of flood
- result in no net loss of floodplain storage
- not impede water flows and not increase flood risk elsewhere

As set out in paragraph 170 of the NPPF, the Exception Test should be informed by a strategic or site-specific FRA, depending on whether it is being applied during plan production or at the application stage. To pass the exception test it should be demonstrated that:

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

(b) 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 Exception Test should be satisfied for development to be allocated or permitted.

In order to fulfil Part 1 of the Exception Test, the sustainability framework set out in LDC’s Sustainability Appraisal (SA) report⁴⁵ should be used to assess each potential development site. The sustainability framework includes a list of objectives and indicators which can be employed to appraise the sustainability of a proposed development.

In order to address Part 2, a site-specific FRA should be prepared for the proposed development that demonstrates how the site will be safe. Consideration should be made of the following as appropriate:

- Applying a sequential approach within the site layout.
- Development design to manage and reduce flooding.
- Safe access and egress.
- Design of flood defence infrastructure.

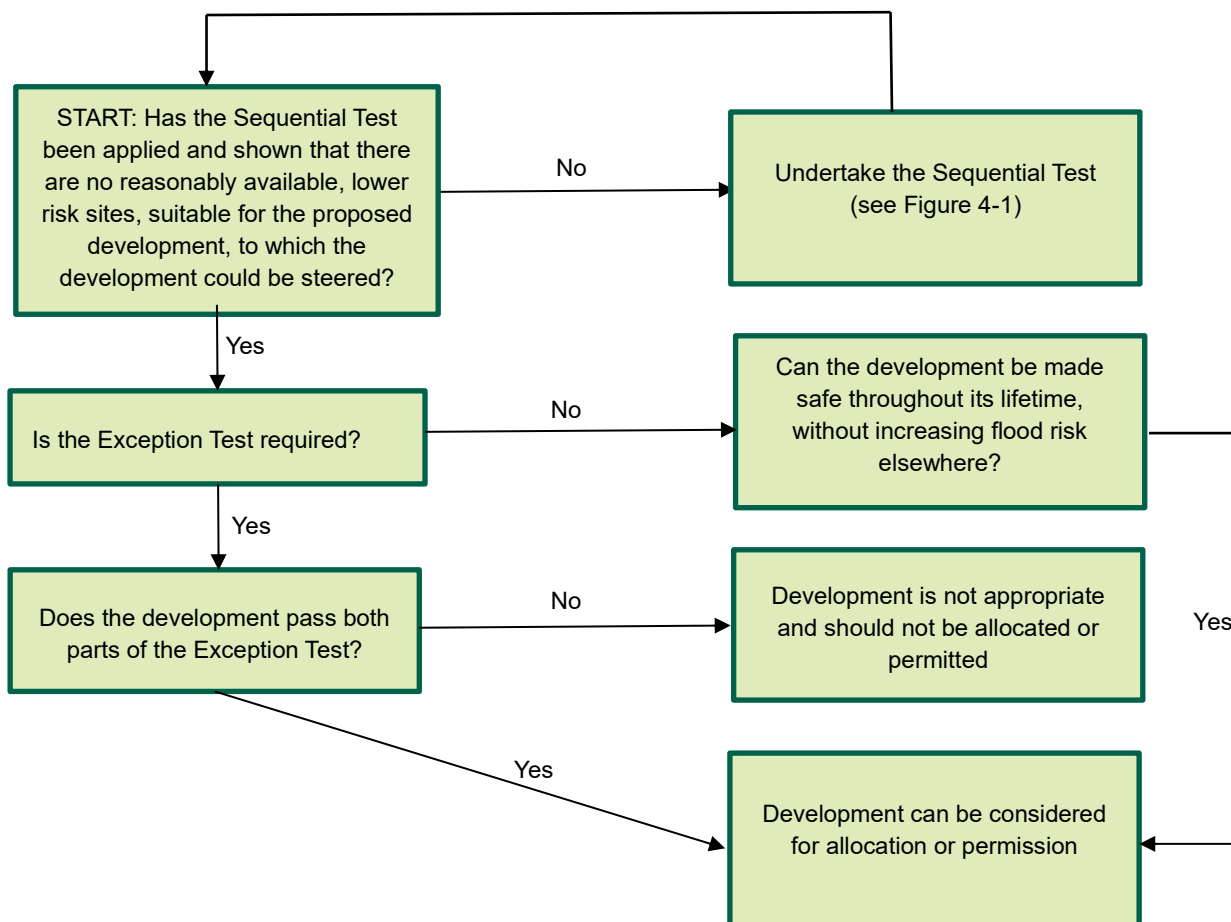
⁴⁴ Planning Practice Guidance Table 2 Flood Risk Vulnerability and Flood Zone incompatibility: <https://www.gov.uk/guidance/flood-risk-and-coastal-change#table2> [Accessed September 2023].

⁴⁵ Lewes Neighbourhood Plan Sustainability Appraisal Report: <https://www.southdowns.gov.uk/wp-content/uploads/2016/05/Lewes-NDP-SA-Main-Report.pdf> [Accessed September 2023].

- Operation and maintenance.
- Flood warning and evacuation procedures.
- Funding or maintenance arrangements for implementing measures.

Figure 4-2 (reproduced from PPG Diagram 3) sets out how the Exception Test should be applied in the preparation of a Local Plan.

Figure 4-2: Applying the Exception Test in the preparation of a Local Plan (PPG Diagram 3)



4.3 Impact of development on flood risk elsewhere

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

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

While the increase in runoff, or loss in floodplain storage, from individual developments may only have a minimal impact on flood risk, the cumulative effect of multiple developments may be more severe without appropriate mitigation measures. This must be considered at the planning application and development design stages and the appropriate mitigation measures undertaken, within an appropriate FRA, to ensure flood risk is not exacerbated, and in many cases the development should provide betterment when flood risk is considered. Maintenance and upkeep for mitigation measures, such as SuDS, must be set out as part of a site-specific drainage strategy and management funding for the lifetime of the development must be agreed.

Where the Sequential and the Exception Tests have been applied as necessary and not met, development should not be allowed.

4.4 Coastal Change Risk Assessment

Within the PPG the following is stated in relation to the suitability of different development types within CCMA:

- Essential Infrastructure may be permitted in CCMA, if there are clear plans in place to manage the impacts of coastal change, and it will not adversely impact on rates of coastal change elsewhere.
- Ministry of Defence Installations that require a coastal location may be permitted within a CCMA, provided that there are clear plans in place to manage the impacts of coastal change, and to minimise the adverse impacts on other parts of coast where the installation will have a material effect on coastal processes.
- Within short-term risk areas (losses expected within 20 years) development directly related to the coastal strip is likely to be appropriate such as beach huts, cafes, car parks, and sites used for holiday or short-let caravans and camping.
- Within medium (20-50 years) and long term (up to 100 year) risk areas a wider range of time-limited development such as hotels, shops, office, or leisure activities that require a coastal location and that will provide substantial socioeconomic benefits to local communities, may be appropriate.
- Permanent new residential development (including through change of use) will not be appropriate in a CCMA.

The PPG advises that applications for development in a CCMA may need to be accompanied by a coastal change vulnerability assessment, which demonstrates whether or not the requirements of NPPF paragraph 178 have been satisfied. The requirements of NPPF paragraph 178 are as follows:

- The development would not impair the ability of communities and the natural environment to adapt sustainably to the impacts of a changing climate;
- The development will be safe through its planned lifetime, without increasing flood risk to life or property, or requiring new or improved coastal defences;
- The development would not affect the natural balance and stability of the coast or exacerbate the rate of shoreline change to the extent that changes to the coast are increased nearby or elsewhere.

5 Preparing Flood Risk Assessments

5.1 What is an FRA?

A site-specific FRA is a report conducted by, or on behalf of, a developer to assess the flood risk from all sources to and from a development, and to demonstrate how the proposed development will be designed so that it remains safe over its lifetime, and not increase flood risk elsewhere. An FRA must be prepared by a suitably qualified and experienced person and must contain all the information needed to allow LDC to satisfy itself that the requirements have been met.

According to paragraph 173 of the NPPF, development should only be allowed in areas at risk of flooding where, in the light of an FRA, it can be demonstrated that:

- 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;
- The development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;
- It incorporates SuDS, unless there is clear evidence that this would be inappropriate;
- Any residual risk can be safely managed; and
- Safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

5.2 When is an FRA required?

According to footnote 59 of the NPPF a site-specific FRA is required in the following circumstances:

- Proposals for all developments in Flood Zones 2 and 3.
- Proposals of 1 hectare or greater in Flood Zone 1.
- Proposals for development in an area within which has critical drainage problems (as identified by the Environment Agency).
- Proposals in Flood Zone 1 where land is identified in an SFRA as being at increased flood risk in the future.
- Proposals for the change of use to a more vulnerable class on land that may be subject to other sources of flooding.

5.3 What needs to be addressed in an FRA?

The PPG states that the objectives of a site-specific FRA 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 manage these effects and risks are appropriate.
- The evidence for the local planning authority to apply (if necessary) the Sequential Test.
- Whether the development will be safe and pass the Exception Test, if applicable.

5.4 How detailed should an FRA be?

The PPG stipulates that site-specific FRAs should be proportionate to the scale and nature of the development, to the severity of flood risk, to the development's vulnerability classification, and to the status of the site in relation to the Sequential and Exception Test.

The report should employ readily available information such as the mapping presented within the LPA's SFRA and on the Environment Agency's website. In some cases, additional hydraulic modelling or detailed calculations may need to be undertaken. For example, an extension to an existing house (for which planning permission is required) which would not significantly increase the number of people in an area of flood risk, would typically need a less

detailed assessment than a new development comprising a greater number of houses, such as an apartment block. Likewise, LDC may require a more detailed assessment at a location where the flood risk is greater, such as the execution of site-specific hydraulic modelling to precisely determine the level of flood risk to and from the site both pre and post-development, and to appraise the effectiveness of any proposed mitigation measures.

The Environment Agency provides standing advice for FRAs⁴⁶ which should be followed for all development classed as⁴⁷:

- a minor extension (household extensions or non-domestic extensions less than 250m²) in Flood Zone 2 or 3.
- 'more vulnerable' development in Flood Zone 2 (except for landfill or waste facility sites, caravan or camping sites).
- 'less vulnerable' development in Flood Zone 2 (except for agriculture and forestry, waste treatment, mineral processing, and water and sewage treatment).
- 'water compatible' development in Flood Zone 2.
- a change of use into one of these vulnerable categories or into the water compatible category.

The Environment Agency's standing advice stipulates that the following information should be included in an FRA:

- site address.
- a description of the development.
- an assessment of the flood risk from all sources of flooding for the development, plus an allowance for climate change.
- the estimated flood level for the development, taking into account the impacts of climate change over its lifetime.
- details of the finished floor levels.
- details of the flood resistance and resilience plans.
- any supporting plans and drawings.

The estimated flood level is the maximum anticipated level of flooding on a development site in a 1% AEP (1 in 100 year) fluvial event (plus an allowance for climate change) or in a 0.5% AEP (1 in 200 year) tidal event (plus an allowance for climate change).

For all developments involving surface water drainage in flood risk areas and major developments involving surface water drainage, SuDS must be provided unless clear evidence detailing their unsuitability is provided to the LPA. The management of surface water, including the provision of SuDS, should be outlined in an FRA, or in a separate surface water drainage strategy. Surface water drainage strategies should be designed with reference to East Sussex County Council's 'Guide to Sustainable Drainage Systems in East Sussex'⁴⁸.

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/guidance/flood-risk-assessment-for-planning-applications>.

- Product 1: contains a flood map, including Flood Zones, defences and storage areas and areas benefitting from defences.
- Product 3: contains a basic FRA map, including Flood Zones, defences and storage areas, areas benefitting from defences, statutory Main River designations and some key modelled flood levels.

⁴⁶ Preparing a flood risk assessment standing advice: <https://www.gov.uk/guidance/flood-risk-assessment-standing-advice#standing-advice-for-vulnerable-developments> [Accessed September 2023].

⁴⁷ Flood risk assessments if you're applying for planning permission: <https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications> [Accessed September 2023].

⁴⁸ East Sussex County Council 'Guide to Sustainable Drainage Systems in East Sussex': <https://www.eastsussex.gov.uk/environment/flooding/sustainable-drainage-systems> [Accessed September 2023].

- Product 4: contains a detailed FRA map, including Flood Zones, defences and storage areas, areas benefiting from defences, statutory Main River designations, historic flood event outlines and more detailed information from our computer river models (including model extent, information on one or more specific points, flood levels, flood flows)
- Product 5: contains the flood modelling and hydrology reports for the specific hydraulic model.
- Product 6: contains the model output data so the applicant can interrogate the data to inform the FRA.
- Product 7: comprises the hydraulic model.
- Product 8: contains flood defences breach data including maximum flood depth, velocity and hazard maps. This allows the residual risk associated with defence breach to be assessed and is important for the consideration of mitigation if the site benefits from flood defences.

Modelling of Ordinary Watercourses

It should be noted that the scope of hydraulic modelling studies undertaken by the Environment Agency 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.

Where a proposed development site is in close proximity to an Ordinary Watercourse the LLFA and/or local authority should be contacted to see whether any modelling data exists (on the assumption that this has not been considered by the Environment Agency). If 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 modelling such as JFLOW), applicants may need to prepare a hydraulic model to enable more accurate assessment of the probability of flooding associated with the watercourse and to inform the site-specific FRA. The requirements of this should first be discussed with the LLFA. If required, modelling should be carried out in line with industry standards and in agreement with the Environment Agency and ESCC (as the LLFA).

Where a watercourse exists on, under, or adjacent to a property, the owner of that property is classified as a riparian owner. A 'watercourse' here is defined as any natural or artificial channel above or below ground through which water flows, such as a river, brook, ditch, gill or stream (which may be piped or culverted in sections). The responsibilities of riparian owners include:

- The clearance of silt and debris, including rubbish, from a watercourse;
- The management of vegetation within the channel; and
- Ensuring the flow of water within the watercourse is not obstructed.

Riparian owners have the right to protect their property from flooding or their land from erosion. However, riparian owners must not:

- Dispose of waste such as grass cuttings into the watercourse; and
- Fill in, obstruct, bridge, or pipe the watercourse without obtaining consent

Further information in relation to riparian ownership can be viewed on the ESCC website⁴⁹.

5.5 Pre-application advice

At all stages, LDC, and where necessary the Environment Agency, ESCC 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, ESCC and LDC each offer pre-application advice services which should be utilised to discuss particular requirements for specific applications:

⁴⁹ East Sussex County Council Riparian Ownership: <https://www.eastsussex.gov.uk/environment/flooding/riparian-ownership> [Accessed September 2023].

- LDC: <https://www.lewes-eastbourne.gov.uk/planning-and-building-control/development-management/apply-for-pre-application-planning-advice/>.
- ESCC: <https://www.eastsussex.gov.uk/planning/applications/planning-application-pre-application/pre-application>.
- 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>.

6 Sources of flood risk and expected effects of climate change

This Section provides a description of the local geology and hydrology in the study area, and an assessment of the risk of flooding from all sources based on available datasets.

6.1 Geology

The north of the LDC area forms parts of the southern limb of the Wealden anticline, which gently dips to the south-southwest, such that the rocks get progressively younger in this direction. For example, the rocks underlying the area between Haywards Heath and Barcombe Cross are of Lower Cretaceous age (100.5-66 million years ago), whilst those south of Barcombe are of Upper Cretaceous age (145-100.5 million years ago). Likewise, there is a general fall in elevation from northeast to southwest in the northern section of the LDC area. The incised valley of the River Ouse also forms another significant topographic feature in the northern segment of the LDC area, with higher lying areas to the east and west being dissected by the valley of this watercourse between Isfield and Hamsey.

The southern segment of the LDC area (i.e. the coastal sub-area) between Peacehaven and Seaford is primarily underlain by the Upper Cretaceous White Chalk subgroup. This is interspersed by pockets of the younger (Palaeocene age) Lambeth group. As in the northern segment of the LDC area, higher ground in the southern segment of the LDC area is dissected by the valley floor of the River Ouse as it cuts through Newhaven.

The geology of the LDC area is presented in Appendix A Figure 2.

6.2 Hydrology

The principal watercourses and associated catchments are shown in Appendix A Figure 3 and described in Table 6-1. The primary river system in the LDC area is the River Ouse, with the mainstem channel and tributaries covering the majority of the district. The headwaters of the River Ouse are floored by the Tunbridge Wells Sands formation, a geological unit that forms part of the Wealden Group, while the lower River Ouse's valley comprises thick alluvium underlain by chalk. The tidal limit is at Barcombe Mills (6.5km upstream of Lewes) just downstream of the confluence with the River Uck⁵⁰. The River Ouse flows through the northern segment of the LDC area before entering the SDNP at NGR TQ4123912394, and then flows through the southern segment of the LDC area for a reach of approximately 2.5km.

The River Ouse has an extensive catchment (approximately 650km²) and is fed by a large number of small streams. The 'canalisation' (straightening and deepening) of the main channel in the 1790s for navigation up to Barcombe and in the 1970s to drain agricultural land have drastically reduced the flood alleviation capacity upstream, increasing flood risk to settlements downstream⁵¹.

Within the northern section of the LDC area, the River Ouse is fed by a number of smaller tributaries, which generally rise from the sandstones and clays of the Wealden Group in the upper catchment, whilst those in the middle reaches of the catchment typically originated from the chalk uplands of the South Downs. The primary tributaries are as follows:

- River Uck
- Iron River
- Bevern Stream
- Longford Stream
- Glynde Reach
- Pellingford Brook

⁵⁰ Reassessing flood frequency for the Sussex Ouse, Lewes: the inclusion of historical flood information since AD 1650 (2014): https://purehost.bath.ac.uk/ws/portalfiles/portal/100645082/nhess_14_2817_2014.pdf [Accessed September 2023].

⁵¹ Sussex Flow Initiative The River Ouse Catchment: <http://www.sussexflowinitiative.org/ouse-catchment.html> [Accessed September 2023]

According to the Catchment Data Explorer⁵² the LDC area primarily falls into a single surface waterbody catchment: the Ouse Upper. However, a small section of the LDC area falls into a second operational catchment, the Adur Upper east of Burgess Hill.

Table 6-1: Watercourses in the LDC area

Watercourse	Classification	Tidal (Y/N)	Description	SFRA Mapping
Ouse	Main River	Y	56km long river that rises near Lower Beeding and has a mouth at Newhaven. The sections of the River Ouse under consideration here are the 19.7km stretch between Sheffield Bridge at TQ 40575 23633 and Hamsey at TQ 41250 12396 in the northern segment of the LDC area, as well as the 2.5km stretch in the southern segment of the LDC area from TQ 44375 02375 to TQ 45156 00082.	Appendix A Figure 3
Longford Stream	Main River	N	11km stream that rises at Godleys Green and flows through Chailey before its confluence with the River Ouse near Isfield at TQ4430516886. This watercourse rises as a chalk stream but becomes a clay stream further downstream. The entirety of this watercourse is located within the LDC area.	Appendix A Figure 3
Bevern Stream	Main River	N	14km stream that rises north of Streat and flows through Plumpton Green and Barcombe Cross before its confluence with the River Ouse near Barcombe Ho at TQ4386215171. This watercourse rises as a chalk stream but becomes a clay stream further downstream. The entirety of this watercourse is located within the LDC area.	Appendix A Figure 3
Uck	Main River	N	17.5km river that rises at Huggett's Furnace that flows in a south westerly direction through Buxted and Uckfield before its confluence with the River Ouse north of Isfield at TQ4437717702. Exempting the point where the River Uck confluences with the River Ouse, which is located on the boundary of the LDC area, the entirety of the River Uck falls outside the LDC area.	Appendix A Figure 3
Pellingford Brook	Main River	N	8.8km stream that rises near Hurstwood Ho before flowing in a north westerly direction towards its confluence with the River Ouse near Sheffield Bridge at TQ4051923658. Within the LDC area, there is a 2.5km reach of this watercourse that runs along the LDC boundary south of Scaynes Hill, and a second reach of 1.8km that is immediately upstream of its confluence with the River Ouse.	Appendix A Figure 3
Adur	Main River	Y (not tidal within study area)	27.4km river that rises at Ditchling Common (TQ 33413 18271) and then flows downstream to its mouth near Shoreham on Sea. Within the LDC area, only a 5.2km stretch of this river is included just east of Burgess Hill.	Appendix A Figure 3
Iron River	Main River	N	3.5km stream that rises from the River Ouse near Isfield at TQ4444717161 (boundary of the LDC area) before re-joining the River Ouse further downstream at TQ4402815321 near Barcombe Ho. Within the LDC area, only a 1.4km stretch of this watercourse is included just north of Barcombe Reservoir.	Appendix A Figure 3
Glynde Reach	Main River	N	12km stream that rises near Ringmer before flowing in a south westerly direction towards its confluence with the River Ouse in the SDNP area at TQ4361307276. There is a 2.7km reach of this watercourse in the LDC area close to its source, as well a second 3.0km reach that skirts along the boundary of the LDC area east of Glynde. The remaining sections of the watercourse are located outside the LDC area.	Appendix A Figure 3

⁵² Catchment Data Explorer: <https://environment.data.gov.uk/catchment-planning> [Accessed September 2023].

6.3 Historical Flooding

Information on previously recorded flood events is provided in this section. This information has been taken from the ESCC's 2017 PFRA and the Environment Agency's Recorded Flood Outlines.

6.3.1 Fluvial flooding

A number of relatively widespread fluvial flooding events have occurred within the study area. The Environment Agency's Recorded Flood Outlines dataset documents the following events, as seen in Appendix A Figure 4:

- January 1975: A 1km stretch of the Middle Ouse overtopped its banks near Barcombe Mills.
- October 2000: The entirety of the River Uck and a significant stretch of the middle and lower reaches of the Ouse from north of Spithurst to Southease, overtopped their banks leading to widespread floodplain inundation.
- January 2009: Channel capacity of River Ouse from Lindfield to South Malling, as well as the lower reaches of the River Uck, exceeded resulting in extensive floodplain inundation.

The Environment Agency's Southern Region produced a report⁵³ reviewing the autumn 2000 floods. The following points related to this flood event were extracted from this document:

- The cumulative rainfall figures exceeded the long-term monthly average by nearly 400% at Barcombe Mills in October and over 300% at Plumpton in November. A preliminary estimate of the return period for the rainfall on the Plumpton gauge on 12th October was 0.29% AEP to 0.33% AEP.
- The combination of high groundwater levels in Sussex and the weather conditions produced some of the worst flooding ever recorded in Sussex. The extreme levels in the Main Rivers caused flooding to occur elsewhere, where Ordinary Watercourses, surface water and highway drainage systems were overwhelmed.
- 817 domestic and 100 business properties suffered flooding in Lewes and Uckfield. Many of the outlying villages such as Barcombe, Isfield and Buxted also suffered flooding.

6.3.2 LDC Flood Incident Dataset

A 'Flood Incident Dataset' was received from LDC, detailing all reported floods in the area from 2012 to 2020, which are presented in Appendix A Figure 4. As visible in Appendix A Figure 4, the LDC data indicates that a number of significant number of flooding incidents have occurred across this time period in the study area. Within the southern segment of the LDC area, these flooding incidents are concentrated in the coastal areas of Peacehaven, Newhaven, and Seaford, while in the northern section of the LDC area, the reported flooding incidents are generally clustered around the settlements of North Chailey, Newick, Barcombe Cross, and Ringmer. The most significant flood events, with the highest number of reported flood incidents, have been detailed in Table 6-2.

Table 6-2: LDC Flood Incident Dataset

Date	Town	Source of Flooding	No. of Reported Flood Incidents	Infrastructure Impacted
December 2012	Lewes, Hamsey, Barcombe	Surface Water	7	Residential
October – November 2013	Lewes, Barcombe, Streat, East Chittington	Surface Water, Sewer	15	Roads, residential
January – February 2014	Lewes, Offham, East Chittington, Ditchling, Newhaven, Kingston, Glynde and Firle	Surface Water, Sewer, Fluvial	34	Roads, residential, commercial
October – November 2014	Lewes, Kingston, Firle	No data provided	21	Residential, non-residential buildings

⁵³ Environment Agency Autumn 2000 floods review regional report Southern Region: <http://ea-lit.freshwaterlife.org/archive/ealit:429/OBJ/20000801.pdf> [Accessed September 2023].

Date	Town	Source of Flooding	No. of Reported Flood Incidents	Infrastructure Impacted
January – February 2015	Lewes, East Chitington, Ditchling, Falmer, Northease, Plumpton, Westmeston	No data provided	19	No data provided
August – September 2015	Lewes, Offham, Glynde, Falmer, Kingston	Heavy Rainfall, Surface Water	20	Roads, commercial
January – February 2016	Lewes, East Chitington, Ditchling, Kingston, Northease, Firle, Westmeston, Plumpton	Blocked Drains, Blocked Gullies	19	Roads, residential, commercial
February 2020	Lewes	Blocked Drains	12	Roads, Residential
October – November 2020	Lewes, Kingston, Plumpton	Heavy Rainfall, Blocked Drains	54	Roads, residential

6.3.3 Sewer Flooding

Water companies are required to maintain a register of locations which are at risk of flooding due to hydraulic overloading of sewers (sewer pipe is too small or positioned at too shallow a gradient). The identification of these locations of previous flooding can inform LPAs of areas where additional development may have a significant impact on the capacity of the sewer system, and where water companies may need to prioritise investment in measures to improve the system's capacity to support proposed developments. However, it should be noted that historic incidents may have been addressed through water companies' asset management programmes and may no longer reflect an area where sewer incapacity is a problem or where flooding is probable.

Southern Water has provided an extract from their DG5 Flood Register for the study area, which records historic internal and external sewer flooding events. Due to data protection requirements the data has not been provided at individual property level; rather the register comprises the number of properties within four digit postcode areas that have experienced flooding either internally or externally within the last 10 years (2012-2022). It should be noted that records only appear on the DG5 register where they have been reported to Southern Water, and as such they may not include all instances of sewer flooding. Furthermore, given that Southern Water target these areas for maintenance and improvements, areas that experienced flooding in the past may no longer be at greatest risk of flooding in the future.

Appendix A Figure 5 shows the number of sewer flooding incidents reported by Southern Water over the last 10 years in each four-digit postcode in the LDC study area. However, 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. The figure shows that there is a high frequency of sewer flooding incidents in the LDC study area, with these being most prevalent in four-digit postcodes containing major watercourses (Longford Stream, Bevern Stream, and the River Ouse). This is suggestive of there potentially being a strong fluvial influence on incidents of sewer flooding within the district, namely that high water levels in receiving watercourses may prevent sewers from discharging, causing their designed capacity to be exceeded. The only exception to this are sewer flooding incidents associated with the River Ouse in the four-digit postcodes BN9 9 and BN9 0 in Newhaven, as this watercourse is tidal in this area.

6.4 Flood Mapping

6.4.1 River Flooding

Appendix A Figure 6 shows Flood Zones 2 and 3 for the principal watercourses within the study area (see Table 3-1 for more information on Flood Zones). Extensive areas of Flood Zones 2 and 3 are concentrated around the River Ouse. The Flood Zones cover many roads and several settlements, including Barcombe Ho and Newhaven. Less extensive areas of Flood Zones 2 and 3 are also associated with the tributaries of the Pellingford Brook, Bevern Stream, and Longford Stream upstream of Lewes. The Flood Zones for the Longford Stream encompass parts of the village of Plumpton Green. It should be highlighted here that the Environment Agency's Flood Zones ignore the effect of any flood defences.

The Environment Agency's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset indicates that with the exception of the defences around the Lower Ouse in Newhaven, no areas are recognised as having a reduced level of fluvial flood risk in the LDC area due to the presence of flood defences. More information on flood defences is included in Section 8.1.

Future flood risk

Climate change is expected to increase the frequency, extent, and impact of flooding, as reflected in higher peak river flows. Wetter winters and more intense rainfall may increase fluvial flooding and surface water runoff and there may be increased storm intensity in summer. Rising sea levels at the mouth of the River Ouse may also increase flood risk. Fluvial flood risk may also be increased due to rising tidal levels which can cause tide locking.

Appendix A Figure 7 provides a comparison of the modelled extent of the present day 1% AEP fluvial flood extent and the modelled flood extents for the 1% AEP fluvial events event using the Central and Higher Central climate change allowances in the 2080s epoch. These modelled flood extents have been derived from the Lower Ouse model which includes flood defences. The Lower Ouse model includes representation of the Newhaven Flood Alleviation Scheme.

Within Appendix A Figure 7, small, but noticeable increases in the size of the climate change extents, relative to the 1% AEP fluvial extent in the present day epoch, as a result of increased fluvial flooding are observable on the floodplain of the River Ouse between Barcombe Mills and Hamsey. A more significant change is observable in Newhaven, where large parts of the industrial estate, which are outside the modelled 1% AEP fluvial flood extent in the present day epoch, are located within the boundaries of the modelled 1% AEP fluvial flood extent with a higher central climate change allowance applied.

As a result of the limitations caused by the glass-walling in the two 1D only models (the Upper Ouse and the Adur), the modelled 1% AEP fluvial flood extents with appropriate climate change allowances applied have not been generated for the reaches encompassed by these two models. As this occurs in the 1D only Adur and Upper Ouse models, the Environment Agency's Flood Zone 2 has been employed as a proxy for the modelled 1% AEP fluvial flood extents inclusive of climate change in reaches covered by these two models.

When considering Functional Floodplain (Flood Zone 3b) and the impacts of climate change, this is discussed separately in Section 6.4.3 and presented within Appendix A Figure 8.

6.4.2 Coastal Flooding

Appendix A Figure 6 shows Flood Zones 2 and 3 for coastal areas within the LDC area (see Table 3-1 for more information on Flood Zones). Flood Zones 2 and 3 for tidal flooding are restricted to areas of seafront in Peacehaven and Seaford as well as the tidal reaches of the lower River Ouse in Newhaven. Within Peacehaven, Flood Zones 2 and 3 for tidal flooding encompass the coastal defences only, whereas in Seaford, Flood Zones 2 and 3 for tidal flooding also include residential properties. Parts of Newhaven at risk of tidal flooding include the ferry port, the harbour, and an industrial estate. It should be highlighted here that the Environment Agency's Flood Zones ignore the effect of any flood defences.

The Environment Agency's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset shows that parts of Newhaven and Seaford have a reduced risk of coastal and tidal flooding due to the presence of flood defences, most prominently in eastern sections of Newhaven. More information regarding flood defences can be viewed in Section 8.1.

Within Seaford there are areas which are shown to be at risk from wave overtopping, as shown on Appendix A Figure 8. From a review of the Seaford model results, even during the 3.33% AEP present day event, there are areas shown to be at risk from wave overtopping including developed areas to the east between Seaford Beach and Steyne Road. Policy regarding these areas is discussed in Section 10.

Future Flood Risk

Climate change is anticipated to augment the frequency, extent and impact of tidal flooding, as a result of increased still water levels, and the enhanced severity and frequency of storm surges.

Appendix A Figure 9 provides a comparison of the modelled extents for the 0.5% AEP tidal event in the 2025, 2055, and 2125 epochs with a higher central allowance for climate change applied. These were derived by merging the

modelled flood extents for the 0.5% AEP tidal event that were generated for each epoch by the Lower Ouse and the Seaford Coastal models. The Lower Ouse model includes the representation of flood defences.

For all three epochs, the modelled flood extent for 0.5% AEP tidal event encompasses the floodplain of the River Ouse between Barcombe Mills and Hamsey, as well as parts of Seaford in close proximity to the coastal frontage.

In both the 2025 and 2055 epochs, the extent of 0.5% AEP tidal event is restricted to isolated areas in Newhaven, suggesting that the Newhaven Flood Alleviation Scheme provided protection. During the 2125 epoch, the modelled extent of the 0.5% AEP tidal event includes large areas of Newhaven to the east of the River Ouse suggesting that the Newhaven Flood Alleviation Scheme may have been overtopped.

The combined modelled 1% AEP fluvial and 0.5% AEP tidal flood extents in the present day epoch and the 2080s epoch are shown in Appendix A Figure 10. The combined modelled tidal and fluvial flood extent for the present day epoch was derived by merging the 1% AEP fluvial flood extent and the 0.5% AEP tidal flood extent in the 2025 epoch. The combined modelled tidal and fluvial flood extent for the 2080s epoch was derived by merging the 1% AEP fluvial flood extent with the higher central climate change allowance in the 2080s epoch applied, and the 0.5% AEP tidal flood extent in the 2125 epoch with a higher central climate change allowance applied.

6.4.3 Functional Floodplain

Flood Zone 3b functional floodplain is defined as land where water has to flow or be stored in times of flooding. This is identified by the normal form of the river channel and land that would flood during a 3.33% AEP (1 in 30 year) event or greater in any year, with flood risk management features and structures operating effectively.

As flood extents for the 3.33% AEP event were not available from the received models, this AEP event has been simulated with the received models provided by the Environment Agency as part of this SFRA, and then utilised to delineate Flood Zone 3b (the functional floodplain). Where modelled outlines for the 3.33% AEP event still remain unavailable for watercourses that aren't covered by the received models, the extent of Flood Zone 3a should be used as a proxy for Flood Zone 3b to ensure that flood risk is not underestimated.

Appendix A Figure 8 shows the present-day Flood Zone 3b, or functional floodplain, as well as Flood Zone 3b in the 2080s epoch with a higher central climate change allowance applied. The present day Flood Zone 3b flood extent was generated by combining the flood extents for the 3.33% AEP fluvial event and the 3.33% AEP tidal event in the 2025 epoch. The future Flood Zone 3b extent was generated by combining the flood extents for the 3.33% AEP fluvial event with a higher central allowance for climate change in the 2080s epoch applied, and the 3.33% AEP tidal event in the 2125 epoch with a higher central allowance for climate change applied.

Within the 1D only Adur and Upper Ouse models, significant glass-walling occurs during all model simulations including the 3.33% AEP (1 in 30 year) event. Glass-walling occurs when the 1D cross-sections do not extend sufficiently to include all floodplain flow paths and consequently water abuts the edge of the model domain and can therefore not reach its true extent. As a result this impacts the accuracy of the results. As this occurs in the 1D only Adur and Upper Ouse models, the Environment Agency's Flood Zone 3a has been employed as a proxy for Flood Zone 3b in reaches covered by these two models. In the event of future developments in these areas which require the accurate delineation of Flood Zone 3b, floodplain elements should be added to the Upper Ouse and Adur models through extension of the 1D only sections, or through conversion of the model from 1D only to 1D-2D.

Within the parts of the LDC area for which modelling of the 3.33% AEP fluvial and tidal events could be undertaken, large sections of the River Ouse floodplain between Barcombe Mills and Hamsey, as well as isolated areas in Newhaven, and parts of Seaford close to the coastal frontage, are located within Flood Zone 3b.

The Environment Agency guidance 'How to prepare a Strategic Flood Risk Assessment'⁴ encourages the use of site-specific FRAs to determine whether a site is classified as functional floodplain. If sites are proposed for development in such areas in any of the LPA's Local Plans, it may be necessary to undertake additional assessment (which may include hydraulic modelling) to map the location of the functional floodplain as part of a Level 2 SFRA.

Future Flood Risk

As visible in Appendix A Figure 8, there are increases in the modelled extent of future Flood Zone 3b, relative to that modelled for the present day epoch, on the floodplain of the River Ouse between Barcombe Mills and Hamsey, as well as across large parts of Newhaven, where the defences of the Newhaven Flood Alleviation Scheme are potentially overtopped.

6.4.4 Groundwater Flooding

The BGS dataset 'Groundwater Flooding' is mapped in Appendix A Figure 11. This map does not show the risk of groundwater flooding, rather it identifies areas where geological conditions could enable groundwater flooding to occur.

Appendix A Figure 11 identifies areas in the south and east of the LDC area's northern segment as having the 'potential for groundwater flooding to occur at the surface' with these areas associated with the tributaries of the River Ouse such as the Bevern Stream and Longford Stream. These areas include settlements Broyle Side, Plumpton, Barcombe Cross, and Chailey.

LDC highlighted a number of locations within the study area, namely Newick, South Heighton and Ringmer, where groundwater flooding incidents have previously occurred. The locations of these areas within the LDC area are shown in Appendix A Figure 11. Within the southern section of the LDC area, the only areas shown as having the 'potential for groundwater flooding to occur at the surface' in Appendix A Figure 11 are the banks of the River Ouse in Newhaven.

Future Flood Risk

Most climate change models indicate an increased likelihood of drier summers, albeit with more intense rainfall when it occurs, and wetter winters. As groundwater flooding occurs primarily as a response to extended periods of rain during late autumn and early winter, there may be an increased risk of groundwater flooding arising from these changing rainfall patterns. However, the complex relationship between rainfall, recharge, groundwater storage and flow make the response to climate change uncertain. It is recommended that this figure should be updated once the groundwater dataset is updated.

6.4.5 Surface Water

The Environment Agency's RoFSW dataset is presented in Appendix A Figure 12. This map shows that the risk of surface water flooding is concentrated around watercourses in the district, most notably the River Ouse, the Longford Stream, the Bevern Stream. The risk of surface water flooding also increases markedly in urbanised areas, with this being most pronounced in Ringmer, Newhaven, Seaford and Peacehaven.

Future flood risk

Section 3.3 describes the impact of climate change on surface water flood risk and summarises the peak rainfall intensity climate change allowances for the study area which range from 20% - 45% depending on the specific location and epoch under consideration.

Climate change must be considered in evaluating the flood risk from all sources, including surface water. The RoFSW does not include a specific scenario to determine the impact of climate change on the risk of surface water flooding and it is not within the scope of this SFRA to undertake widespread surface water modelling to apply all the allowances within the guidance. However, a range of three annual probability events have been modelled within the RoFSW, 3.33%, 1% and 0.1%, and therefore it is possible to use with caution the 0.1% outline as a proxy dataset to provide an indication of the implications of climate change.

6.4.6 Reservoir Flooding

Six Reservoir Act registered impoundments with the potential to cause flooding within the LDC area have been identified, which are presented in Table 6-3.

Table 6-3: List of Reservoir Act registered impoundments with the potential to cause flooding within LDC

Name	Location	Grid Reference	Flood Risk in LDC?
Ardingly Reservoir	Ardingly	TQ 33040 29285	Floodplain of the River Ouse between Sheffield Park Station and Hamsey in the 'dry day' and 'wet day' scenarios. There are generally only isolated buildings in the affected area, although there are small concentrations of buildings in the Sheffield Park Station, Barcombe Mills and Anchor Inn areas. There are also small concentrations of buildings around old mill sites along the river.

Name	Location	Grid Reference	Flood Risk in LDC?
Searles Lake	North of Newick	TQ 43604 25696	Flooding on a small section of the River Ouse just east of Newick. There are no vulnerable receptors in the affected area.
Arlington Reservoir	Arlington	TQ 53293 07426	Flooding is restricted to the valley of the Cuckmere River and marginally crosses into the LDC area near Cuckmere Haven. There are no vulnerable receptors in the affected area, with the exception of a single residential property upstream of Cuckmere Inn.
Framfield Upper	South-east of Uckfield	TQ 48803 19702	Flooding is restricted in both the 'dry day' and 'wet day' scenarios to the middle reaches of the River Ouse between Isfield and Hamsey. There are generally only isolated buildings in the affected area, although there is a small concentration of buildings at Barcombe Mills.
Plashett Park Upper Lake	Rose Hill	TQ 46652 16520	Flooding is restricted in both the 'dry day' and 'wet day' scenarios to the middle reaches of the River Ouse between Isfield and Hamsey. There are generally only isolated buildings in the affected area, although there is a small concentration of buildings at Barcombe Mills.
Barcombe Reservoir	East of Barcombe Mills	TQ 44056 15013	Flooding is restricted in both the 'dry day' and 'wet day' scenarios to the middle reaches of the River Ouse between Isfield and Hamsey. There are generally only isolated buildings in the affected area, although there is a small concentration of buildings at Barcombe Mills.

Appendix A Figure 13 shows the potential extent of flooding in the unlikely event of a failure of these reservoirs when river levels are normal ('dry' day scenario) and when rivers have already overtopped their banks ('wet' day scenario). The mapping shows that the area at risk follows the floodplains and valleys of the Rivers Ouse and River Uck respectively, with the majority of this flooding occurring regardless of the river levels. Reservoir flood risk only extends to parts of the River Ouse Valley south of Lewes such as Newhaven when rivers are in flood (i.e. the 'wet' day scenario).

7 Cumulative impact of development and land use change

7.1 Cumulative impact assessment

The NPPF states that strategic policies should be informed by a SFRA and should consider cumulative impacts in, or affecting, local areas susceptible to flooding and take account of advice from the Environment Agency and other relevant flood risk management authorities. The 'How to prepare a Strategic Flood Risk Assessment' guidance⁴ also states that an SFRA should include as assessment of the cumulative impacts of development and land-use change which should include any impact expected from:

- Strategically planned development;
- Windfall development;
- Permitted development; and
- Significant changes in land use, such as paving over domestic gardens or reforestation of uplands.

Development, or the cumulative impacts of development, may result in an increase in flood risk elsewhere as a result of impacts such as the loss of floodplain storage, deflection or constriction of flood flow routes and/or through inadequate management of surface water.

Where flood storage from any source of flooding is to be lost as a result of development, on-site level-for-level, volume-for-volume compensatory storage for the 1% AEP flood event accounting for the predicted impacts of climate change over the lifetime of the development, should be provided. Where it is not possible to provide compensatory storage on site, it may be acceptable to provide off-site if it is hydraulically linked. More information is provided in Section 9.3.1.

Identification of those areas where changes in land use could potentially increase surface water runoff rates and volumes can strategically aid spatial planning in avoiding areas where significant mitigation of surface water runoff following development may be required. The provision of multifunctional sustainable drainage systems, natural flood management and green infrastructure can also make a valuable contribution to mitigating the cumulative impacts of development on flood risk.

Whilst individual development with appropriate site mitigation measures should not result in measurable local effects with respect to hydrology and flood risk, the cumulative impacts of multiple development may be more severe at downstream locations in the catchment. Locations where there are existing flood risk issues will be particularly sensitive to cumulative impacts.

The cumulative impact should be considered throughout the planning process, from the allocation of sites within the Local Plan, to the planning application and development design stages.

A detailed cumulative impact assessment could not be undertaken for the LDC area as part of this SFRA as future development sites had not been confirmed. However, from a review of all 378 sites being considered, there were multiple developments located in areas potentially at risk from fluvial and/or surface water flooding in Wivelsfield Green, Newick, Plumpton Green, Ringmer, Broyle Side and Cooksbridge. Depending on which sites are taken forward within these locations, a detailed cumulative impact assessment may be required through hydraulic modelling. This will be considered as part of the Level 2 SFRA, when the development sites have been confirmed. Where development is taken forward to design stages, aspects relating to floodplain compensation and the management of surface water should be considered to ensure that flood risk is not increased elsewhere.

7.2 Cross boundary considerations

Many of the catchments within the LDC area cross borders between LPA administrative areas, such that future development in another LPA could impact flood risk in the LDC area, and vice versa. It is important that LPAs work together and take a catchment-wide approach when considering the wider impacts of any proposed development.

The source of the River Ouse is near Lower Beeding in Horsham District. The River Ouse then flows through the Mid Sussex District Council, Wealden District Council, LDC, and SDNP before reaching the English Channel in Newhaven. Therefore, developments upstream of LDC in Horsham District, Wealden District Council, SDNP and the Mid Sussex District Council areas could have an impact downstream on flood risk in the LDC area, whilst developments in the LDC area could affect flood risk downstream in the SDNP.

The River Adur, whose source is located in the north western corner of the LDC area at Ditchling Common near Burgess Hill, flows through the Mid Sussex and Horsham District Council areas, before reaching its mouth at Shoreham on Sea in the Adur District Council area. Therefore, development in the Burgess Hill area could impact flood risk to other districts positioned further downstream in the River Adur catchment.

Other watercourses that cross the LDC area which could have cross-boundary impacts are the Bevern Stream, the source of which is near Streat in the SDNP; the River Uck, the source of which is near Huggett's Furnace in the Wealden District Council area, and the Glynde Reach which starts in the LDC area near Ringmer before flowing into both the Wealden District Council and SDNP areas.

8 Flood Management and Defences

8.1 Defences

The following details regarding flood management and defences within the LDC area were extracted from the Environment Agency's Asset Information Management System (AIMS) dataset:

- Much of the River Ouse's upper catchment, including tributaries such as the Iron River and Bevern, is not protected by high ground or engineered defences.
- There are small sections of natural high ground and embankments at Sheffield Park Station, Sutton Hall, and Newick with a design Standard of Protection (SoP) of 20% AEP (1 in 5 year). LDC have also sought to reinstate/ reconnect the River Ouse to the floodplain in the upper reaches to reduce flood risk in the lower Ouse catchment.
- There is natural high ground present on the Bevern Stream at Plumpton Green with a design SoP of 20% AEP (1 in 5 year).
- There is natural high ground and embankments abutting the River Ouse in, and downstream of Barcombe Ho, with a design SoP varying between 50% AEP (1 in 2 year) and 3.33% AEP (1 in 30 year).
- Embankments and natural high ground flank the River Ouse in Newhaven. There are also small sections of river wall present near Newhaven Harbour. The embankments and river walls in Newhaven are recorded as having a design SoP of either 1% AEP (1 in 100 year) or 0.5% AEP (1 in 200 year), whereas the reported design SoP for the natural high ground in Newhaven varies between 5% AEP (1 in 20 year) and 1% AEP (1 in 100 year).
- The entirety of the River Adur within the LDC area is protected by natural high ground which is recorded as having a design SoP varying between 100% (annual) and 1.33% (1 in 75 year).
- The coastal frontage at Seaford is protected by a sea wall with a recorded design SoP of 1% AEP (1 in 100 year), with this locally increasing to 0.1% AEP (1 in 1000 year) 800m north-west of Seaford train station.

8.2 Newhaven Flood Alleviation Scheme

In December 2013, 50-60 properties, as well as major national infrastructure such as the A26 and the Lewes to Seaford rail line, were affected by tidal flooding. The Environment Agency, in partnership with LDC, developed a scheme to reduce tidal flood risk for 430 homes and 390 businesses in and around the town of Newhaven, by providing a design SoP of 0.5% AEP (1 in 200 year) taking into account the effects of climate change⁵⁴. Protection is also conferred by the scheme to local infrastructure such as the A26, the aforementioned rail line, Newhaven train station, and the port. Construction on the scheme commenced in January 2017 and the defences became fully operational in summer 2021. The scheme itself consists of over 4km of flood defences including clay embankments, demountable barriers, reinforced concrete flood walls, grass bunds and temporary barriers.

8.3 Flood Warning Service

The Environment Agency operates a Flood Warning Service⁵⁵ in respect to Main River (including tidal) flooding across England. Three different codes are issued depending on the type of flooding forecasted:

- Flood Alert – Flooding is possible, be prepared.
- Flood Warning – Flooding is expected, immediate action is required.
- Severe Flood Warning – Severe flooding, danger to life.

The Environment Agency's website offers up-to-date flood information, monitoring information of river and sea levels and latest flood risk forecast, as well as a page to sign up to warnings by phone, text, email, or fax.

⁵⁴ Newhaven Flood Alleviation Scheme (2021): <https://www.gov.uk/government/publications/newhaven-flood-alleviation-scheme/newhaven-flood-alleviation-scheme>. [Accessed September 2023].

⁵⁵ Environment Agency Flood Warning Service: <https://check-for-flooding.service.gov.uk/> [Accessed September 2023].

There are 8 Flood Warning Areas in the LDC area which are shown in Appendix A Figure 14 including:

- River Ouse at Newhaven.
- River Ouse at Piddinghoe, South Heighton and Southease.
- Coastal areas of Seaford seafront.
- Parts of Seaford town at risk from high tide.
- River Ouse at Hamsey.
- River Uck and confluence with River Ouse at Isfield.
- River Ouse at Barcombe Mills.
- River Ouse from Freshfield Bridge to Sharpsbridge.

The Environment Agency publishes 'Water situation: area monthly reports for England'⁵⁶ for each of its areas. These reports identify monthly rainfall, soil moisture deficit, river flows, groundwater levels and reservoir levels. The Environment Agency also publishes 'Groundwater situation'⁵⁷ reports which provide the latest update on monitored groundwater levels and whether there are any groundwater alerts or warnings in force. These reports will give an indication as to when groundwater levels may be high and groundwater flooding may be imminent.

The Environment Agency also provide a targeted groundwater flood warning service through issue of groundwater "Flood Alerts" for specific locations and communities. Currently, the Environment Agency don't have any groundwater monitoring stations within the LDC area, although this may change in the future.

8.4 Residual Risk

The risk of flooding from rivers can never be fully mitigated, and there will always be a residual risk of flooding that will remain after measures have been implemented to protect an area or a particular site from flooding. This residual risk is associated with a number of potential risk factors including (but not limited to):

- a flooding event that exceeds that for which the flood risk management measures have been designed e.g. flood levels above the designed defence crest level,
- the structural deterioration of flood defence structures (including informal structures acting as a flood defence) over time resulting in a defence breach,
- blockage of key defence/conveyance structures,
- the occurrence of large, unpredictable cliff falls, and/or
- general uncertainties inherent in the prediction of flooding.

The modelling of flood flows and flood levels is not an exact science, therefore there are inherent uncertainties in the prediction of flood levels used in the assessment of flood risk. While the Flood Map for Planning Flood Zones provide a relatively robust depiction of flood risk for specific conditions all modelling requires the making of core assumptions and the use of empirical estimations relating to (for example) rainfall distribution and catchment response. No residual modelling (breach or overtopping of defences or structural blockages) has been undertaken as part of this SFRA. This should be included as part of a site-specific FRA, or a Level 2 SFRA, should development be located in an area where residual flood risk is considered to be an issue.

Steps should be taken to manage these residual risks through the use of flood warning and evacuation procedures, as described in Section 10.

⁵⁶ Water situation: area monthly reports for England 2022: <https://www.gov.uk/government/publications/water-situation-local-area-reports> [Accessed September 2023].

⁵⁷ Groundwater situation reports: <https://www.gov.uk/government/collections/groundwater-current-status-and-flood-risk> [Accessed September 2023].

8.5 River Ouse to Seaford Head Coastal Defence Strategy Appraisal

In May 2012, the Environment Agency published a Strategy Appraisal Report to present the business case and the preferred options for flood and coastal erosion risk management for the River Ouse from the A27 road bridge to the mouth at Newhaven, and the coastline between Seaford Head and Peacehaven Heights⁵⁸.

A high level assessment of the economic, technical, social, and environmental impacts for each option was undertaken, before a smaller number of options were shortlisted for detailed appraisal. The preferred Strategy option was to hold the existing line of defences on the basis that this would meet the Environment Agency's legal obligations and generate the optimum economic outcome. The recommended works are limited to the first 14 years rather than the full 100 year period of the Strategy so that the preferred option could be revised in line with the latest information available. At the time of writing (September 2023) the Environment Agency are carrying out further investigations and monitoring to determine what effect removing or altering the upstream banks may have on downstream areas. They are gathering data on the existing defences and riverbed materials, and in 2024-2025 they will review the Strategy using this data to identify to how best to manage flood and erosion risk in the future.

⁵⁸ River Ouse to Seaford Head Coastal Defence Strategy Appraisal Report May 2012: <https://southerncoastalgroup-scopac.org.uk/wp-content/uploads/2018/11/River-Ouse-to-Seaford-Head-Strategy-Appraisal-Report-2012.pdf> [Accessed September 2023].

9 Opportunities to reduce the causes and impacts of flooding

This Section identifies opportunities to reduce the causes and impacts of flooding in the local area and land required for flood risk management purposes.

9.1 Maintenance of watercourses

9.1.1 Main Rivers

The Environment Agency is likely to seek an 8m wide undeveloped easement alongside Main Rivers for maintenance purposes and is likely to also ask developers to explore opportunities for riverside restoration as part of any development.

Under Section 109 of the Water Resources Act 1991 and/or Environment Agency Byelaws, any works within 8m of any statutory Main River, flood defence or culvert (16m if it is a tidal Main River or defence structure) requires Environment Agency consent in the form of a Flood Risk Activity Permit. Under the Environmental Permitting (England and Wales) Regulations (2016), 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 floodplain,
- 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, or a flood or sea defence by contacting enquiries@environment-agency.gov.uk.

Policy Recommendation: Retain an 8m wide undeveloped easement alongside Main Rivers or flood defence structure (16m if it is a tidal Main River or defence structure) and explore opportunities for riverside restoration.

9.1.2 Ordinary Watercourses

Ordinary Watercourses are watercourses that are not part of a Main River and include streams, ditches, drains, cuts, culverts, dykes, sluices, sewers (other than public sewers) and passages, through which water flows.

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) lies with the LLFA. As the LLFA, ESCC is responsible for the consenting of works to Ordinary Watercourses it has powers to enforce un-consented and non-compliant works. This includes any works (including temporary) that place or alter a structure within an Ordinary Watercourse or affect the flow or storage of water within an Ordinary Watercourse. ESCC will seek an undeveloped easement to be retained alongside Ordinary Watercourses. Further information can be found on the ESCC's website⁵⁹.

ESCC intends to work with riparian owners⁴⁹ (those living adjacent to an Ordinary Watercourse) who are responsible for maintaining Ordinary Watercourses to ensure that the effectiveness of the existing ditches is improved and ensure that future maintenance is undertaken at appropriate intervals. The Environment Agency have prepared a guidance document which provides information on the rights and responsibilities of riparian owners relating to flood risk management⁶⁰.

Policy Recommendation: An undeveloped easement should be retained alongside Ordinary Watercourses for maintenance purposes. This should be discussed and agreed with the LLFA. Developers should explore opportunities for riverside restoration as part of any development adjacent to Ordinary Watercourses.

⁵⁹ ESCC Ordinary Watercourse consent: <https://www.eastsussex.gov.uk/environment/flooding/ordinary-watercourse-consent> [Accessed September 2023].

⁶⁰ Environment Agency's guide for riparian owners: <https://www.eastsussex.gov.uk/environment/flooding/riparian-ownership> [Accessed September 2023].

9.2 River Restoration

During the last century, many rivers were modified using hard engineering techniques to often straighten or canalise them. The disadvantages of these techniques have now become apparent which include the damage to the environment and ecosystems, and in some cases 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 can reduce 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 regime⁶¹. Further guidance on river restoration is available from the Environment Agency⁶².

The Adur and Ouse Catchment Partnership provide an online map⁶³ detailing the completed and ongoing river restoration projects within the catchment of the River Ouse. Within the LDC area, completed river restoration projects include:

- Establishment of greater connection between the channel of the Bevern Stream and the adjoining floodplain southeast of Plumpton Green through the inclusion of floodplain wetland features such as scrapes and ponds.
- Reconstruction of meanders along the course of the River Ouse upstream of Sheffield Park, resulting in the creation of 2.2ha of floodplain woodland.

9.3 Flood Storage

Flood Storage Areas (FSAs) 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 into 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, and
- 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 generally extends further downstream, whereas other methods tend to 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 Guide⁶⁴.

The River Ouse Catchment Flood Management Plan (2009)⁶⁵ recommended that pre-feasibility studies should be conducted to examine the opportunities for increasing flood storage and floodplain inundation in the 'High Weald and Middle Ouse' sub-area upstream of Lewes, as well as upstream of Newhaven and downstream of Lewes in the 'Brooks and Lower Ouse' sub-area.

Policy Recommendation: All new development close to rivers should consider the opportunity to improve and enhance the river environment. Developers should explore opportunities for river restoration, enhancement and

⁶¹ European Centre for River Restoration: <https://www.ecrr.org/River-Restoration/Flood-risk-management/Healthy-Catchments-managing-for-flood-risk-WFD/Environmental-improvements-case-studies/Remove-culverts> [Accessed September 2023].

⁶² Environment Agency, Fluvial Design Guidance Chapter 8: https://assets.publishing.service.gov.uk/media/60549ae1e90e0724c0df4619/FDG_chapter_8_-_Works_in_the_river_channel.pdf [Accessed September 2023].

⁶³ Adur and Ouse Catchment Partnership Catchment Map: <https://adurandousecatchment.org.uk/about/map/> [Accessed September 2023].

⁶⁴ Environment Agency's Fluvial Design Guide: https://assets.publishing.service.gov.uk/media/60549b7a8fa8f545cf209a29/FDG_chapter_10_-_Flood_storage_works.pdf [Accessed September 2023].

⁶⁵ River Ouse Catchment Flood Management Plan (2009): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/293870/Ouse_Sussex_Catchment_Flood_Management_Plan.pdf [Accessed September 2023].

provision of FSAs as part of the development. Options include backwater creation, de-silting, in-channel habitat enhancement and removal of structures. When designed properly, such measures can have benefits such as reducing the costs of maintaining hard engineering structures, reducing flood risk, improving water quality and increasing biodiversity. Social benefits are also gained by increasing green space and access to watercourses.

9.3.1 Floodplain Compensation

According to guidance provided in the PPG (notes to Table 2), 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 9-1, floodplain compensation should 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. Floodplain compensation must be considered in the context of the 1% AEP (1 in 100 year) flood level including an allowance for climate change. According to the Environment Agency's climate change allowances guidance⁶⁶, the appropriate allowance to assess off-site impacts and calculate floodplain storage compensation depends on land uses in affected areas. The allowances used should be:

- The Central allowance for most cases.
- The Higher Central allowance when the affected area contains essential infrastructure.

Likely future land uses should also be considered, shown by local plan allocations or unimplemented extant planning permissions.

When designing a scheme, floodwater should be able to flow in and out and must not pond. A 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 C624⁶⁷.

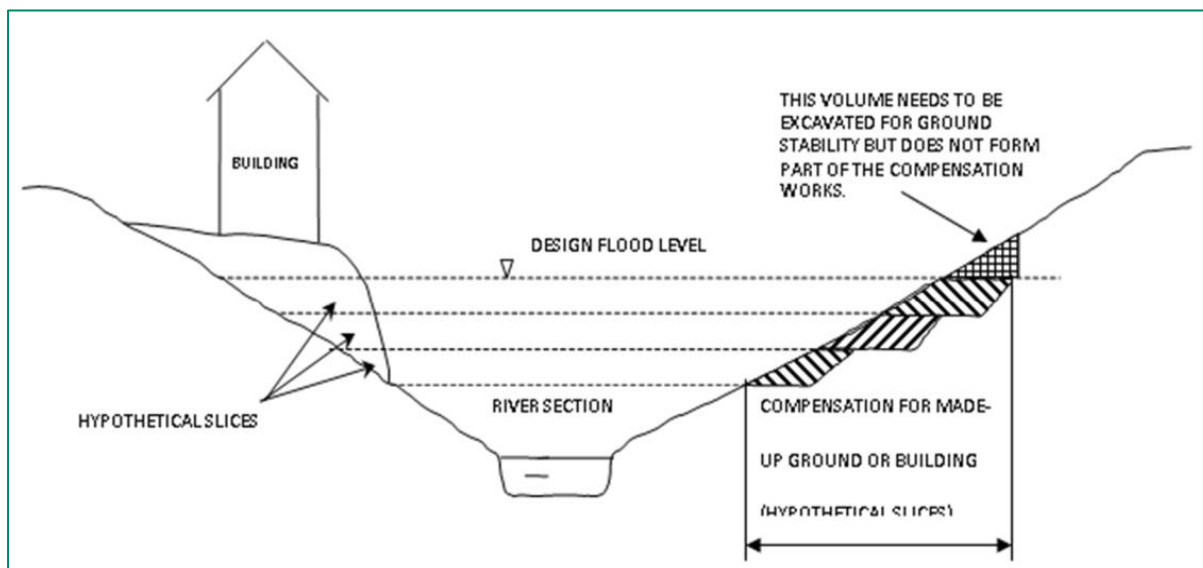


Figure 9-1: Example of Floodplain Compensation Storage (Environment Agency 2009)

⁶⁶ Flood Risk Assessments: Climate Change Allowances: <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances> [Accessed September 2023].

⁶⁷ CIRIA (2004) CIRIA Report 624: Development and Flood Risk - Guidance for the Construction Industry.

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 is 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 should be consulted to explore and discuss alternatives.

While the use of stilts and voids below buildings may be an appropriate approach to mitigating flood risk to the buildings themselves, such techniques should not normally be relied upon for compensating for any loss of floodplain storage. This is because voids do not allow the free flow of water, trash screens get blocked, voids get silted up, they have limited capacity, and it is difficult to stop them being used for storing belongings or other materials. In line with the latest planning guidance, it is recommended that voids are not used as a form of mitigation i.e. compensatory storage.

Policy Recommendation: As referenced within this section, all new development within Flood Zone 3 must not result in a net loss of flood storage capacity. 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. Floodplain compensation should 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. Floodplain compensation must be considered in the context of the 1% AEP (1 in 100 year) flood level including an allowance for climate change. This should be discussed and agreed with the Environment Agency.

9.4 Groundwater

Policy Recommendations: For all proposed developments in the LDC area, groundwater monitoring during periods of high groundwater (winter/spring) should be mandated for inclusion in all FRAs, unless adequate justification can be provided by the applicant to exempt the proposed development from this requirement.

Additionally, slope stabilisation and reprofiling measures shall be avoided wherever possible, to minimise/prevent disruption to groundwater flows, and the aggravation of groundwater flood risk elsewhere.

Where the installation of foundations and associated excavation works is required for proposed developments, these should either take place above the maximum height of the groundwater table (as confirmed by on-site groundwater monitoring), or shall implement appropriate pumping and SuDS to dewater the excavated area and to mitigate against the loss of groundwater storage.

9.5 Flood and Coastal Erosion Risk Management (FCERM) Schemes

The Government's programme of FCERM schemes identify two proposed schemes in the LDC administrative area for the 6 year period 2021-2027⁶⁸. The two schemes are Phase 2 of the shingle recycling at Seaford Beach, and the Southease Parish and Southease to A27 tidal embankment rebuilds.

As part of Phase 2 of the shingle recycling at Seaford Beach⁶⁹, the Environment Agency transported up to 60,000m³ of shingle to the central section of the 4km long beach between Newhaven and Seaford Head. The shingle beach, in tandem with the buried sea wall, confer protection from tidal flooding to 459 properties in east Newhaven and Seaford.

⁶⁸ Programme of flood and coastal erosion risk management (FCERM) schemes: <https://www.gov.uk/government/publications/programme-of-flood-and-coastal-erosion-risk-management-schemes> [Accessed September 2023].

⁶⁹Environment Agency Shingle moved to improve flood protection in East Sussex: <https://www.gov.uk/government/news/shingle-moved-to-improve-flood-protection-in-east-sussex> [Accessed September 2023].

The Southease Parish and Southease to A27 tidal embankment rebuilds scheme commenced in May 2021 and will be completed in April 2024 (it may extend to April 2025)⁷⁰. The scheme involves the repair of the embankments along the tidal River Ouse between Newhaven and the A27 and will ensure that the Environment Agency fulfils its legal obligation under the Newhaven Navigation Act, which requires it to protect the lands within the parish of Southease from coastal and fluvial flooding⁷¹.

9.6 Working with Natural Processes

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.

There are a number of opportunities available to reduce the causes and impacts of flooding through Working with Natural Processes (WWNP). This involves implementing measures that help to protect, restore, and emulate the natural functions of catchments, floodplains, rivers, and the coast. WWNP takes many forms and can be applied in urban and rural areas, and on rivers, estuaries, and coasts. Potential natural processes are detailed in Table 9-1.

The Wilder Ouse Project formed in 2023⁷², is a partnership between the Woodland Trust, the Sussex Wildlife Trust, the Environment Agency, and the Ouse and Adur Rivers Trust, with funding support from the Lewes District. The objective of this partnership is to deliver natural flood management solutions within the Ouse catchment, and to build on the work undertaken since 2012 by its predecessor, the Sussex Flow Initiative. Previous work undertaken as part of the Sussex Flow Initiative included the construction of leaky dams to intercept surface water flows on the hillslopes near Wivelsfield, as well as the creation of a series of flow attenuation ponds near Ringmer⁷³. As part of a research project undertaken by the Flood and Coastal risk Management Research and Development Programme and the Environment Agency⁷⁴, a series of spatial datasets have been generated for these natural processes, identifying their best estimate of locations in the country where the methods can be applied (Table 9-1). As well as reducing the causes and impacts of flooding, WWNP has a number of environmental, social, and cultural benefits, including water quality, habitat, climate regulation, health access, air quality, and aesthetic quality. Although WWNP methods have very promising benefits, they are relatively new concepts and more research is required to gain a greater understanding of their impacts in different conditions and representation in models. The WWNP data does not provide information on design, which may need to consider issues such as drain-down between flood events. It is important to note that land ownership and change to flood risk have not been considered. Locations identified may have more recent building or land use than available data indicates.

Appendix A Figure 15 provides information from the Environment Agency's 'Working with Natural Processes' spatial datasets⁷⁵ about where these measures could be applied. This map shows that although there a lot of existing woodland constraints within the LDC administrative area, most notably in the coastal areas, there are also a wide range of opportunities to implement natural processes to alleviate flooding. There are many potential opportunities for floodplain woodland planting and riparian woodland planting around the River Ouse and its tributaries, as well as some wider catchment woodland opportunities. Additionally, opportunities for floodplain reconnection have been identified at isolated locations along the River Ouse (Newhaven and its Goldstrow) and along a number of its tributaries (Glynde Reach, Bevern Stream, Longford Stream and Pellingford Brook).

Policy recommendation: Where possible, all new developments should explore the opportunity to implement natural processes to alleviate flooding. This should be discussed and agreed with LDC.

⁷⁰Raw Aggregate Supply, Southease Flood Alleviation Scheme, Tidal River Ouse, East Sussex A Tender Notice by Defra: <https://bidstats.uk/tenders/2020/W52/741474688> [Accessed September 2023].

⁷¹River Ouse to Seaford Head Coastal Defence Strategy Appraisal Report (May 2012): <https://southerncoastalgroup-scopac.org.uk/wp-content/uploads/2018/11/River-Ouse-to-Seaford-Head-Strategy-Appraisal-Report-2012.pdf> [Accessed September 2023].

⁷² Sussex Wildlife Trust Wilder Ouse Project: <https://sussexwildlifetrust.org.uk/get-involved/projects/wilder-ouse> [Accessed September 2023].

⁷³ Ouse and Adur Rivers Trust Natural Flood Management: <https://sussexwildlifetrust.org.uk/get-involved/projects/wilder-ouse> [Accessed September 2023].

⁷⁴ Working with natural processes to reduce flood risk: <https://www.gov.uk/flood-and-coastal-erosion-risk-management-research-reports/working-with-natural-processes-to-reduce-flood-risk> [Accessed September 2023].

⁷⁵ Working with natural processes datasets: <https://environment.data.gov.uk/searchresults?query=wwnp;searchtype=All;page=1;pagesize=20;orderby=Relevancy> [Accessed September 2023].

Table 9-1: Description of WWNP datasets

Natural Process	Benefits	Most Effective Conditions	Notes
Floodplain Woodland Planting Potential	Slows floodwaters and increases water depth on the floodplain. Reduces flood peaks, delays flood peak timing and desynchronises flood peaks. Enhances sediment deposition on the floodplain.	Middle and lower reaches of medium-sized and large catchments.	Based upon Flood Zone 2. Information is largely based on modelled data and open access constraints data. It is indicative rather than specific. Locations may have more recent building or land use than the available data indicates.
Riparian Woodland Planting Potential (woodlands on land immediately adjoining a watercourse)	Slows flood flows. Reduces sediment delivery to the watercourse. Reduces bankside erosion. Creates below ground storage.	At the reach scale in middle and upper catchments.	Based upon a 50m buffer of available OS Open Data river networks. Information is largely based on open data and is indicative rather than specific. Locations may have more recent building or land use than the available data indicates.
Wider Catchment Woodland	Intercepts, slows, stores and filters water. Reduces flood peaks, flood flows and frequency.	Small events on small catchments – extent of reduction decreases as flood magnitude increases.	Based upon the 1:50k BGS geology survey and relies upon identifying drift and bedrock geologies that are characteristic of slowly permeable soils. Information is largely based on the 100m gridded version of BGS data and open constraints data and is indicative rather than specific.
Floodplain Reconnection Potential (reconnecting watercourses and floodplains)	Encourages more regular floodplain inundation and floodwater storage. Decreases the magnitude and delays the onset of flood peaks. Reduces downstream floodplain depths.	High frequency, low return period floods	Designed to support signposting of areas where there is currently poor connectivity such that flood waters are constrained to the channel and flood waves may therefore propagate downstream rapidly. Based upon the Risk of Flooding from Rivers and Sea probability maps and identifies areas of low and very low probability that are close to a watercourse, but do not contain residential properties or key services (may contain non-residential properties).
Runoff Attenuation Features (3.33% and 1% AEP) (includes swales, ponds, and sediments traps)	Delays and flattens the hydrograph and reduces peak flow locally for small flood events.	A cluster of features working as a network throughout the landscape.	Based upon the Risk of Flooding from Surface Water datasets and identifies areas of high flow accumulations for the 1% and 3.33% AEP surface water maps. The areas of ponding or accumulation are between 100 and 5000 metres squared and have been tagged where they fall on an area of slope steeper than 6% as gully blocking opportunities.

9.7 Surface Water Management

Development should be designed so that there is no increase in flood risk elsewhere and the development will be safe from surface water flooding.

Drainage systems must be designed such that flooding does not occur in any part of a site for the 3.33% (1 in 30 year) rainfall event (including the relevant allowance for climate change), and so that flooding does not occur in any part of a building, or in any utility plant susceptible to water within the development for the 1% AEP (1 in 100 year) rainfall event (including the relevant allowance for climate change). Exceedance flows resulting from rainfall

in excess of the 1% AEP (1 in 100 year) rainfall event must be managed in such a way that minimises the risks to people and property⁷⁶.

With respect to peak runoff rates discharged from developments, these should never exceed the greenfield runoff rates for the annual (1 in 1 year) and 1% AEP (1 in 100 year) rainfall events (including relevant allowances for climate change) for greenfield developments. For developments on brownfield sites, the peak runoff rates must be as close to the greenfield runoff rates for the annual (1 in 1 year) and 1% AEP (1 in 100 year) rainfall events (including relevant allowances for climate change) as reasonably practicable and should not exceed the runoff rates from the site prior to redevelopment for these two events.

Proposed drainage systems should be able to accommodate multiple consecutive rainfall events by ensuring that they can empty within 48 hours. As it is not possible to design for every rainfall event, it is important that excess flows can be managed safely during rainfall events exceeding that for which the proposed drainage system has been designed for.

The ESCC 'Guide to Sustainable Drainage Systems in East Sussex' outlines the design requirements for SuDS, and the delivery stages for SuDS that should be followed by developers within the ESCC area⁷⁷.

For areas within the LDC corresponding to 'Drainage Risk Area 1' identified in the ESCC LFRMS (2016)⁷⁸, the ESCC will expect peak runoff rates from development sites to improve upon greenfield runoff rates, in order to minimise the downstream surface water flood risk.

The relevant allowances for climate change (described in Table 3-6) should be identified through reference to the lifetime of the development:

- For development with a lifetime beyond 2100, use the upper end allowances for the 2070s epoch.
- For development with a lifetime of between 2061 and 2100 use the central allowance for the 2070s epoch.
- For a development with a lifetime up to 2060 use the central allowances for the 2050s epoch.

Policy recommendation: All new developments should incorporate a range of SuDS to target the required water quantity, quality, amenity and biodiversity benefits, unless it can be demonstrated that SuDS are not technically appropriate. Proposed SuDS should be designed such that surface water runoff rates from greenfield developments should not exceed greenfield runoff rates for the annual (1 in 1 year) and 1% AEP (1 in 100 year) rainfall events, and so that surface water runoff rates for brownfield developments should not exceed existing runoff rates and should be as close to greenfield runoff rates as reasonably practicable.

For each new development, SuDS guidance should be developed to inform future management. A maintenance schedule must be prepared for all proposed SuDS, which will identify the body responsible for the maintenance and continuing funding of these. Developers should adhere to the guidance within the 'Guide to Sustainable Drainage' from East Sussex Council and for small scale development, developers should make use of the East Sussex Small Scale Sustainable Drainage Systems tool.

9.8 Sustainable Drainage Systems

Suitable surface water management measures should be incorporated into new development designs in order to reduce and manage surface water flood risk to, and posed by, a development. This should ideally be achieved by incorporating SuDS, as detailed in Table 9-2.

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. However, harder engineering solutions such as oversized pipes and tanks are often relied upon to provide adequate surface water storage to meet design requirements. It is recommended that preference be given to above ground SuDS in line with best practice.

⁷⁶ DEFRA Sustainable Drainage Systems Non-statutory technical standards for sustainable drainage systems (March 2015): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf [Accessed September 2023].

⁷⁷ Guide to Sustainable Drainage Systems in East Sussex: <https://www.eastsussex.gov.uk/media/1qgio4mx/guide-to-sustainable-drainage-systems-in-east-sussex2.pdf> [Accessed September 2023].

⁷⁸ East Sussex County Council Local Flood Risk Management Strategy 2016-2026 (2020): <https://www.eastsussex.gov.uk/environment/flooding/local-flood-risk-management-strategy> [Accessed September 2023].

Table 9-2: Typical SuDS Components (Y = primary process, * = some opportunities subject to design)

Technique	Description	Conveyance	Detention	Infiltration	Harvesting
Pervious Surfaces	Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, reuse, or release to surface water.		Y	Y	*
Filter Drains	Linear drains/trenches filled with a permeable material, often with a perforated pipe in the base of the trench. Surface water from the edge of paved areas flows into the trenches, is filtered, and conveyed to other parts of the site.	Y	Y		
Filter Strips	Vegetated strips of gently sloping ground designed to drain water evenly from impermeable areas and filter out silt and particulates.	*	*	*	
Swales	Shallow vegetated channels that conduct and/or retain water and can permit infiltration when unlined.	Y	Y	*	
Ponds	Depressions used for storing and treating water.		Y	*	Y
Wetlands	As ponds, but the runoff flows slowly but continuously through aquatic vegetation that attenuates and filters the flow. Shallower than ponds. Based on geology these measures can also incorporate some degree of infiltration.	*	Y	*	Y
Detention Basin	Dry depressions designed to store water for a specific retention time.		Y		
Soakaways	Sub-surface structures that store and dispose of water via infiltration.			Y	
Infiltration Trenches	As filter drains but allowing infiltration through trench base and sides.	*	Y	Y	
Infiltration Basins	Depressions that store and dispose of water via infiltration.		Y	Y	
Green Roofs	Green roofs are systems which cover a building's roof with vegetation. They are laid over a drainage layer, with other layers providing protection, waterproofing and insulation. It is noted that the use of brown/green roofs should be for betterment purposes and not to be counted towards the provision of on-site storage for surface water. This is because the hydraulic performance during extreme events is similar to a standard roof.		Y		
Rainwater Harvesting	Storage and use of rainwater for non-potable uses within a building e.g. toilet flushing. It is noted that storage in these types of systems is not usually considered to count towards the provision of on-site storage for surface water balancing, given the sporadic nature of the use of harvested water, it cannot be guaranteed that the tanks are available to provide sufficient attenuation for the storm event.	*	*	*	Y

Wherever possible, a SuDS technique should seek to contribute to each of the three following goals:

- To control the quantity and rate of surface water runoff from a development,
- To improve the quality of the surface water runoff,
- To provide wider landscape, amenity, and wildlife benefits to the development site and its surroundings.

According to the PPG, the aim should be to discharge surface water runoff 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, and,
- To a combined sewer.

SuDS techniques can be used to reduce the rate and volume, and to improve the water quality of surface water discharges from sites to the receiving environment (i.e. natural watercourse or public sewer etc). The SuDS manual⁷⁹ identifies 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. Reference should be made to the non-statutory technical standards⁸⁰ for guidance on the design, maintenance, and operation of SuDS.

- **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. Where infiltration is proposed, the findings of a detailed ground investigation undertaken at the same location and depth as the proposed infiltration system, should underpin the SuDS design.
- **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. All parts of the drainage system should be designed to be accessible at all times and location in private property should be avoided, wherever possible. It is advisable that a maintenance plan be submitted with the drainage application, including details of access arrangements, the safety of operatives, and the frequency of maintenance. The adopting organisation may require the developer to maintain the drainage system for a minimum period of one year, so that problems can be identified and addressed.

As per Policy 12 in the LDC Local Plan (Part 1 Joint Core Strategy), all new developments are required to incorporate SuDS, unless it is demonstrated that SuDS are not technically appropriate, to ensure there is no increase in surface water runoff from new developments. It is recommended that Policy 12 of the LDC Local Plan be reviewed once the imminent legislation regarding SABs is released.

⁷⁹ CIRIA C697 SuDS Manual

⁸⁰ Sustainable drainage systems non-statutory technical standards: <https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards> [Accessed September 2023].

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 a large scale jointly funded and managed SuDS. However, it should be noted that each development must offset its own increase in runoff and attenuation cannot be “traded” between developments.

SuDS should be considered and integrated into the site layout at the early stages of planning to reduce the risk of abortive work associated with needing to modify the site layout to include SuDS at a later stage, and so that the principles of a surface water drainage strategy can be agreed through consultation with the LLFA and LDC. The existing and proposed drainage outfall points for the site must be agreed with relevant stakeholders before fixing the site layout.

Georeferenced as built drawings of proposed SuDS must be supplied to ESCC as the LLFA, together with CCTV or any other surveys used to support the drainage design, for inclusion in their Asset Register.

9.9 Flow routing

Redevelopment in areas at risk of flooding from surface water, river flooding or groundwater flooding has the potential to affect flood routing and increase flood risk elsewhere. For example, redevelopment may give rise to backwater effects or divert floodwaters on to other properties.

Consideration should be given to configuring road and building layouts to preserve existing flow paths and improve flood routing, whilst ensuring that flows are not diverted towards other properties. 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.

Opportunities should be sought within site design to make space for water, such as:

- Identification of existing surface water or fluvial flow routes across the site, so that road and building layouts can be safely designed around them.
- Removing boundary walls or replacing with other boundary treatments such as hedges and 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.

Policy Recommendation: All new development should not adversely affect flood routing and thereby increase flood risk elsewhere. Opportunities shall be sought within the site design to make space for water.

10 Recommendations of how to address flood risk in development

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. The section outlines the approach that LDC should consider in relation to flood risk planning policy and development management decisions.

10.1 Sequential Approach

Flood risk should be considered at an early stage in deciding the layout and design of a site so that development in current and future medium and high flood risk areas can be avoided so far as possible. 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 may be placed on lower ground with a higher probability of flooding. Adopting a sequential approach is the most effective measure for addressing flood risk as it is not reliant on measures such as flood defences, property level resilience, and flood warnings.

As per the NPPF, development should only be allowed in areas at risk of flooding where it can be demonstrated that: 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; the development is appropriately flood resistant and resilient; it incorporates SuDS; any residual risk can be safely managed; and safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

Policy Recommendation: A sequential approach to site planning should be applied within new development sites.

10.2 Appropriate types of development

Table 2 in the PPG provides a compatibility matrix and determines which types of development are appropriate in areas of flood risk.

Policy Recommendation: Location of development shall take into account the vulnerability of users.

10.3 Previously developed sites

It is possible that some areas of previously developed land could come forward during the site allocation process which are now considered to be at risk from fluvial/tidal flooding.

Policy Recommendation: Where buildings have been demolished within the functional floodplain (Flood Zone 3b) for a significant length of time (i.e. over a year), the land should be reverted back to functional floodplain and consequently, development should be avoided within these areas.

10.4 Wave Overtopping

There are areas within Seaford which are shown to be at risk from waves overtopping the flood defences, even during the more frequent present day events.

Policy Recommendation: Where development is proposed within areas which are at risk from wave overtopping (as indicated by figures within this SFRA), developers must provide a site-specific FRA. This should ensure that the proposed development is appropriate to the site and that appropriate mitigation measures are in place to manage the risks associated with wave overtopping, so that the development will be safe for its users throughout its lifetime.

10.5 Access / egress

Where development may be proposed in areas at risk of flooding, 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. Where a dry route is not possible the FRA should provide an assessment of the flood hazard rating along the route and demonstrate that the route is a low hazard (as defined in the FD2320 Flood risk to people calculator⁸¹).

The guidance document 'Flood Risk Emergency Plans for New Development' published by the Environment Agency and ADEPT⁸² provides more detail on safe access and escape.

Policy recommendation: Safe access / egress must be provided for new development in areas which are at risk of flooding and must reflect the type of flooding (source of flooding, scale of flooding, floodwater depth, and floodwater velocity) that the location is vulnerable to.

10.6 Flood warning and evacuation

The Environment Agency operates an effective flood warning service with respect to Main River and tidal flooding across England. Three different codes are issued depending on the type of flooding forecasted including Flood Alerts, Flood Warnings and Severe Flood Warnings (Section 8.3).

Information on these warnings can be issued via a number of methods⁸³. The Environment Agency's website offers up-to-date flood information, monitoring information of river and sea levels and latest flood risk forecast, as well as a page to sign up to warnings by phone, text, email, or fax⁸⁴.

Evacuation is where flood alerts and warnings provided by the Environment Agency enable timely actions by residents or occupants to allow them to get to safety 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 flooding has occurred, and prior evacuation has not been possible.

For all developments 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 that 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% AEP (1 in 100 year) flood event including an allowance for climate change.

The Environment Agency has a tool on their website to create a Personal Flood Plan⁸⁵. 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 <250m² 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.

⁸¹ Defra Environment Agency Flood and Coastal Defence R&D Programme, 2004: https://assets.publishing.service.gov.uk/media/602a9348e90e070559970f9d/Operations_and_Maintenance_Concerted_Action_Report_pdf.pdf [Accessed September 2023].

⁸² ADEPT, Environment Agency, September 2019, Flood Risk Emergency Plans for New Development: <https://www.adeptnet.org.uk/floodriskemergencyplan> [Accessed September 2023].

⁸³ Environment Agency Flood Warnings: Flood Guidance Statement: <https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/services/government/hazard-manager-flood-guidance.pdf> [Accessed September 2023].

⁸⁴ Environment Agency, 2022, Check for Flooding in England: <https://check-for-flooding.service.gov.uk/> [Accessed September 2023].

⁸⁵ Environment Agency Tool 'Make a Flood Plan'. Available from: <https://www.gov.uk/government/publications/personal-flood-plan> [Accessed September 2023].

- 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,
 - 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. ESCC is accountable via planning condition or agreement to ensure that plans are suitable. This should be done in consultation with emergency planning staff.

Policy Recommendation: A Flood Warning and Evacuation Plan, including safe access/egress routes and emergency planning measures, should be prepared as part of an FRA for all developments sited within areas at risk of flooding and that have potentially vulnerable users.

10.7 Finished Floor Levels

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 development types (as outlined in Annex 3 of the NPPF), is to ensure internal floor levels are raised to a freeboard level above the design flood level including an appropriate allowance for climate change.

For fluvial flooding, the design flood is the 1% AEP (1 in 100 year) event plus an appropriate allowance for climate change, whilst for tidal flooding, the design flood is the 0.5% AEP (1 in 200 year) event plus an appropriate allowance for climate change. Less vulnerable development should also aim to raise the floor levels. Where this is not achievable, flood resilience measures should be incorporated. These measures should be detailed within the FRA.

With reference to the 'Flood risk assessment: standing advice for flood risk'⁸⁶, finished floor levels for vulnerable developments in Flood Zone 2 and 3 should be a minimum of whichever is higher, 300mm above the average ground level of the site, the adjacent road level to the building, or the estimated river or tidal flood level. The guidance document "Accounting for residual uncertainty: an update to the fluvial freeboard guide – technical report"⁸⁷ explains how to determine the appropriate residual uncertainty allowances. The process involves identifying sources of uncertainty in the datasets upon which the assessment is based, estimating the magnitude of residual uncertainties, and determining the appropriate response. The resulting residual uncertainty allowances range from 300mm to 900mm.

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

⁸⁶ Preparing a flood risk assessment standing advice: <https://www.gov.uk/guidance/flood-risk-assessment-standing-advice> [Accessed September 2023].

⁸⁷ Accounting for residual uncertainty an update to the fluvial freeboard guide: <https://www.gov.uk/flood-and-coastal-erosion-risk-management-research-reports/accounting-for-residual-uncertainty-an-update-to-the-fluvial-freeboard-guide?web=1&wdLOR=c7DCE6B52-35F0-469F-843D-3238FA827B79> [Accessed September 2023].

levels to the required height. The FRA standing advice for flood risk stipulates that in these cases the design should be made sufficiently flood resilient and resistant by:

- using flood resistant materials that have low permeability to at least 600mm above the estimated flood level.
- making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level.
- using flood resilient materials (for example lime plaster) to at least 600mm above the estimated flood level.
- by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
- making it easy for water to drain away after flooding such as installing a sump and a pump.
- making sure there is access to all spaces to enable drying and cleaning.
- ensuring that soil pipes are protected from back-flow such as by using non-return valves.

The FRA standing advice for flood risk also states that the details of emergency escape plans for any parts of a building below the estimated flood level should also be provided as part of an FRA.

In addition to the measures outlined in the FRA standing advice for flood risk, it is also recommended that the following steps be taken to ensure that the design of a building is flood resilient and resistant:

- ensuring that all waste pipes are protected from back-flow by using non-return valves.
- ensuring that all doors are flood-resistant doors and have not been tampered with, for example through the installation of a cat flap.
- all utilities servicing the building must be watertight.
- voids should have smart air bricks which utilise in-built sensors to regulate air flow in response to changes in humidity and temperature.

Policy Recommendation: For More Vulnerable and Highly Vulnerable developments within Flood Zones 2 and 3a the finished floor levels for the lowest room of a building should be set above the minimum ground level of the site, above the adjacent road to the building, or above the estimated flood level for the design flood, depending on which of these three values is highest. For minor extensions, the finished floor levels of the lowest room of a building should be no lower than existing floor levels or above the estimated flood level for the design flood. The design flood here pertains to either the 1% AEP (1 in 100 year) fluvial event with an appropriate allowance for climate change, or the 0.5% AEP (1 in 200 year) tidal event with an appropriate allowance for climate change. The required freeboard value for the finished floor levels of developments is defined within the Environment Agency's online standing advice for flood risk assessments⁸⁸.

10.8 Flood resistance and resilience strategies

There is a range of flood resistance and resilience construction techniques that can be implemented in new developments to mitigate potential flood damage. The Department for Levelling Up, Housing and Communities (DLUHC) have published a document 'Improving the Flood Performance of New Buildings, Flood Resilient Construction'⁸⁹, 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 10-1 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.

⁸⁸ Environment Agency 'Preparing a Flood Risk Assessment: Standing Advice': <https://www.gov.uk/guidance/flood-risk-assessment-standing-advice> [Accessed September 2023].

⁸⁹ CLG (2007) Improving the Flood Performance of New Buildings, Flood Resilient Construction: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/7730/flood_performance.pdf [Accessed September 2023].

Policy recommendation: Where proposing development or redevelopment in areas at risk of flooding, flood resilience and resistance strategies should be implemented to reduce damage in a flood and increase the speed of recovery. These measures should be designed to accommodate the 1% AEP event plus climate change flood level and should not be normally relied on for new development as an appropriate mitigation method. Where resilience and resistance measures are required, proposals must include details of their construction, removal, the party responsible for their maintenance, and the cost of replacement when they deteriorate.

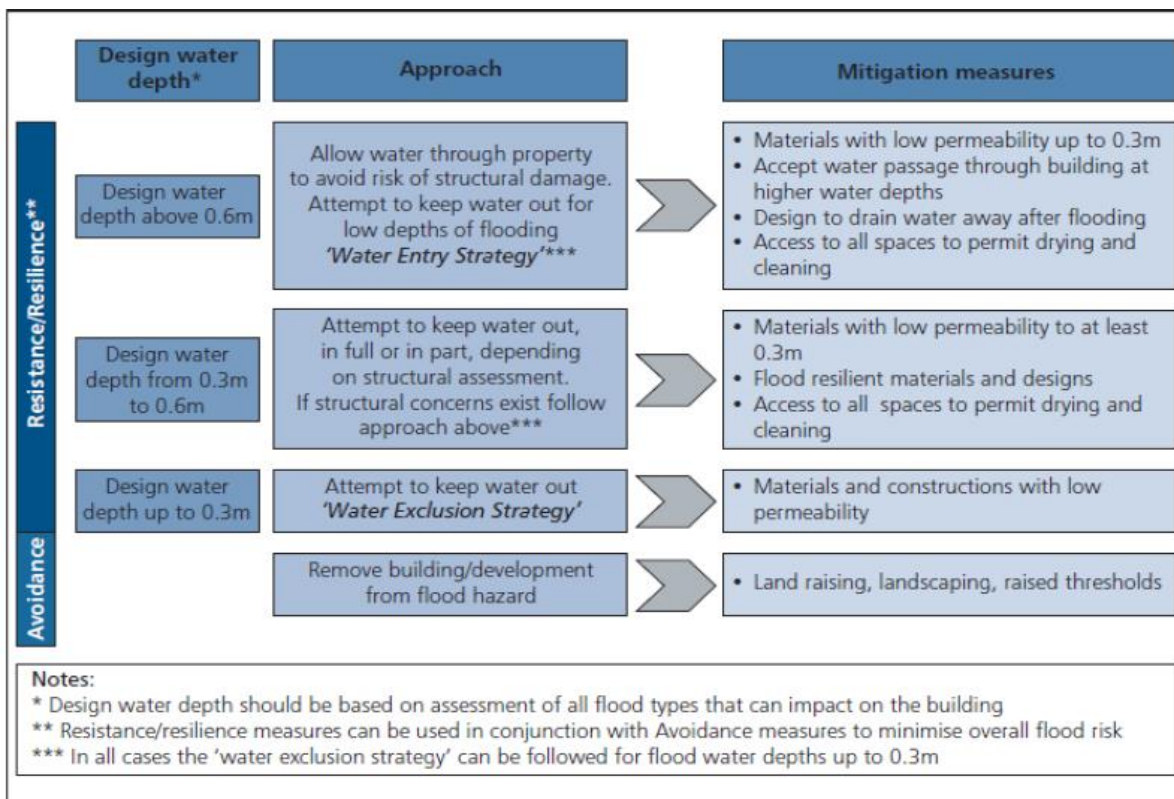


Figure 10-1: Flood Resistant/Resilient Design Strategies, Improving Flood Performance (DHLUC 2007)

10.8.1 Flood resistance design strategies

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 only be effective for short duration, low depth flooding i.e. less than 300mm, although these measures should be adopted where depths are between 300mm and 600mm and there are no structural concerns.

In areas at risk of flooding of low depths (<300mm), 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 seats, and,
- Sump and pump for floodwater to remove water faster than it enters.
- Properties (residential and commercial) to have smart water butts installed

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 them being deployed

before a flood event occurs. It should also be considered that devices such as air vent covers, if left in place by occupants as a precautionary measure, may compromise safe ventilation of the building in accordance with Building Regulations.

10.8.2 Flood resilience design strategies

For flood depths greater than 600mm, 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 100mm 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 of 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'⁸⁹.

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.

Appendix A - Figures

Figure 1: Shoreline Management Plan Policies

Figure 2: BGS Bedrock Geology and Superficial Deposits

Figure 3: Watercourses and River Catchments

Figure 4: Environment Agency Recorded Flood Outlines

Figure 5: Sewer Flooding Incidents over the Period 2012-2022

Figure 6: Environment Agency Flood Zones

Figure 7: Modelled Fluvial Flood Extents (Defended)

Figure 8: Functional Floodplain

Figure 9: Modelled Coastal Flood Extents (Defended)

Figure 10: Combined Present Day and Future (2080s) Modelled Tidal and Fluvial Extents

Figure 11: BGS Groundwater Flooding

Figure 12: Surface Water Flood Risk

Figure 13: Reservoir Flood Extent

Figure 14: Environment Agency Flood Warning and Alert Areas

Figure 15: Opportunities to Reduce the Causes & Impacts of Flooding

Appendix B – Modelling Technical Note

