Pilning and Severn Beach Neighbourhood Plan – Level 2 Strategic Flood Risk Assessment

Final Report

June 2025

Prepared for:

Pilning and Severn Beach Neighbourhood Plan Steering Group

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Abbreviations

AEP	Annual Exceedance Probability
AIMS	Asset Information Management System
ASEA	Avonmouth Severnside Enterprise Area
BGS	British Geological Survey
CIRIA	Construction Industry Research & Information Association
DCG	Design and Construction Guidance
DEFRA	Department of the Environment, Food and Rural Affairs
DTM	Digital Terrain Model
EA	Environment Agency
FRA	Flood Risk Assessment
HM	High Mileage
ID	Identifier
IDB	Internal Drainage Board
LFRMS	Local Flood Risk Management Strategy
LiDAR	Light Detection And Ranging
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
NaFRA2	National Flood Risk Assessment 2
NPPF	National Planning Policy Framework
PPG	Planning Policy Guidance
RMA	Risk Management Authority
RoFSW	Risk of Flooding from Surface Water
SFRA	Strategic Flood Risk Assessment
SPZ	[Groundwater] Source Protection Zone
SuDS	Sustainable Drainage Systems

1 Introduction

1.1 Background

Jeremy Benn Associates Limited have been commissioned by Pilning and Severn Beach Neighbourhood Plan Steering Group to undertake a Level 2 Strategic Flood Risk Assessment (SFRA) of proposed development sites in the Pilning and Severn Beach Neighbourhood Plan.

1.2 Purpose of the Strategic Flood Risk Assessment

Paragraph 171 of the National Planning Policy Framework (NPPF) (2024) states that:

'Strategic policies should be informed by a Strategic Flood Risk Assessment (SFRA) and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency (EA), and other relevant flood risk management authorities, such as Lead Local Flood Authorities (LLFAs) and Internal Drainage Boards (IDBs)'.

Planning Practice Guidance (PPG) (2024) advocates a staged approach to risk assessment and identifies two levels of SFRA:

- Level 1 SFRA (L1): where flooding is not a major issue and where development pressures are low. The assessment should be sufficiently detailed to allow application of the Sequential Test. Level 1 is completed first to understand whether a Level 2 assessment is required.
- Level 2 SFRA (L2): where land outside the EA's Flood Zones 2 and 3 (and land outside areas affected by other sources of flooding as per the Exception Test requirements) cannot accommodate all the necessary development creating the need to apply the NPPF's Exception Test. In these circumstances, the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

This SFRA report fulfils the requirements for a Level 2 assessment of strategic sites identified for potential allocation within the Pilning and Severn Beach Parish Council (P&SBPC) area and has been prepared in accordance with the NPPF (2024) and PPG. It meets the requirements outlined in the L2 SFRA specification provided by the NPSG.

1.3 SFRA Objectives

The objectives of this Level 2 SFRA are to:

- Provide individual flood risk analysis for proposed site allocations using the latest available flood risk data, thereby allowing the Neighbourhood Plan Steering Group to apply the Exception Test to its proposed site options in preparation of the Pilning and Severn Beach Neighbourhood Plan.
- Using available data to provide information and a comprehensive set of maps presenting flood risk from all sources for each site.
- Where the Exception Test is required, provide recommendations for making the site safe throughout its lifetime.
- Consider the most recent policy and legislation in the NPPF, PPG and LLFA Sustainable Drainage Systems (SuDS) guidance.

1.4 Consultation

SFRAs should be prepared in consultation with other risk management authorities. The following parties (external to the NPSG) have been consulted during the preparation of this Level 2 SFRA:

- Environment Agency
- Wessex Water
- South Gloucestershire Council (as LPA and LLFA)
- Lower Severn Internal Drainage Board

1.5 Documents Provided by the NPSG

A Level 2 SFRA specification was provided the Neighbourhood Plan Steering group, outlining the purpose and requirements of the L2 SFRA. The Sequential Test undertaken for the sites was also provided, demonstrating that development cannot be contained within Flood Zones 1 and 2 and that development in Flood Zone 3 must be considered in order to meet the objectives of the Neighbourhood Plan.

2 Study Area

2.1 Characteristics

The SFRA study area is located in South Gloucestershire on the Severn Estuary, approximately 5km northwest of Bristol. The study area spans the parish boundary for Pilning and Severn Beach and is approximately 30km². This includes the villages of Severn Beach and Pilning, north of which is the M4 and the Prince of Wales Bridge.

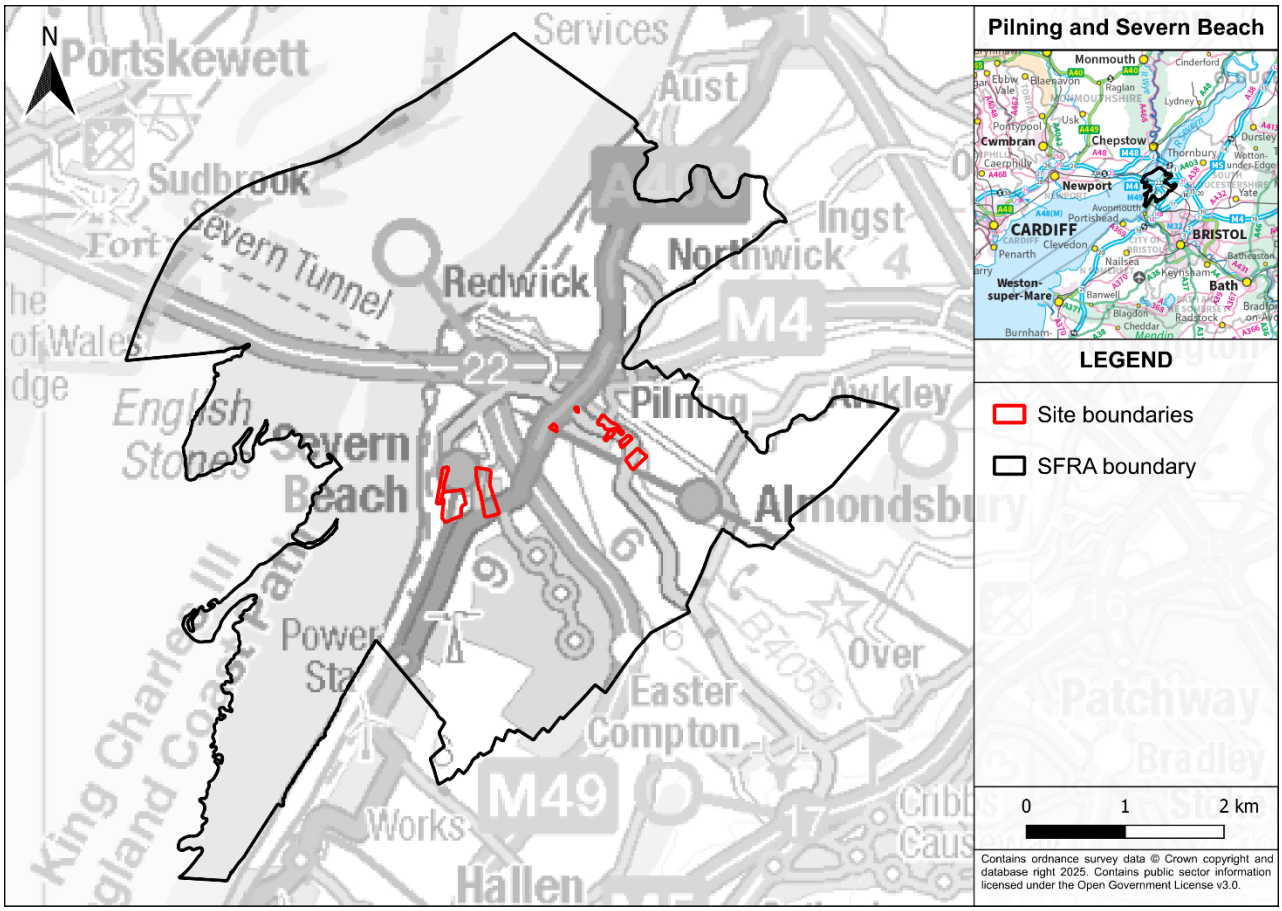

Figure 2-1: Study area overview

2.2 Topography

Topography data was obtained from the Environment Agency's 1m LiDAR Composite Digital Terrain Model (DTM) 2022.

LiDAR data indicates that the topography within the SFRA study area is relatively flat with approximately 5m of variation in elevation for most of the region. The highest point of elevation in the study area is 19.6m AOD and the lowest elevation, on the South Wales Main railway line, is -11.8m AOD. The highest elevation points are main roads, railway line embankments and the tidal defence wall running along the shore, as well as a raised stretch of greenfield land on the shore of the estuary. There are very few landscape features with drastic elevation gradients, and the sites themselves are all located on flat ground.

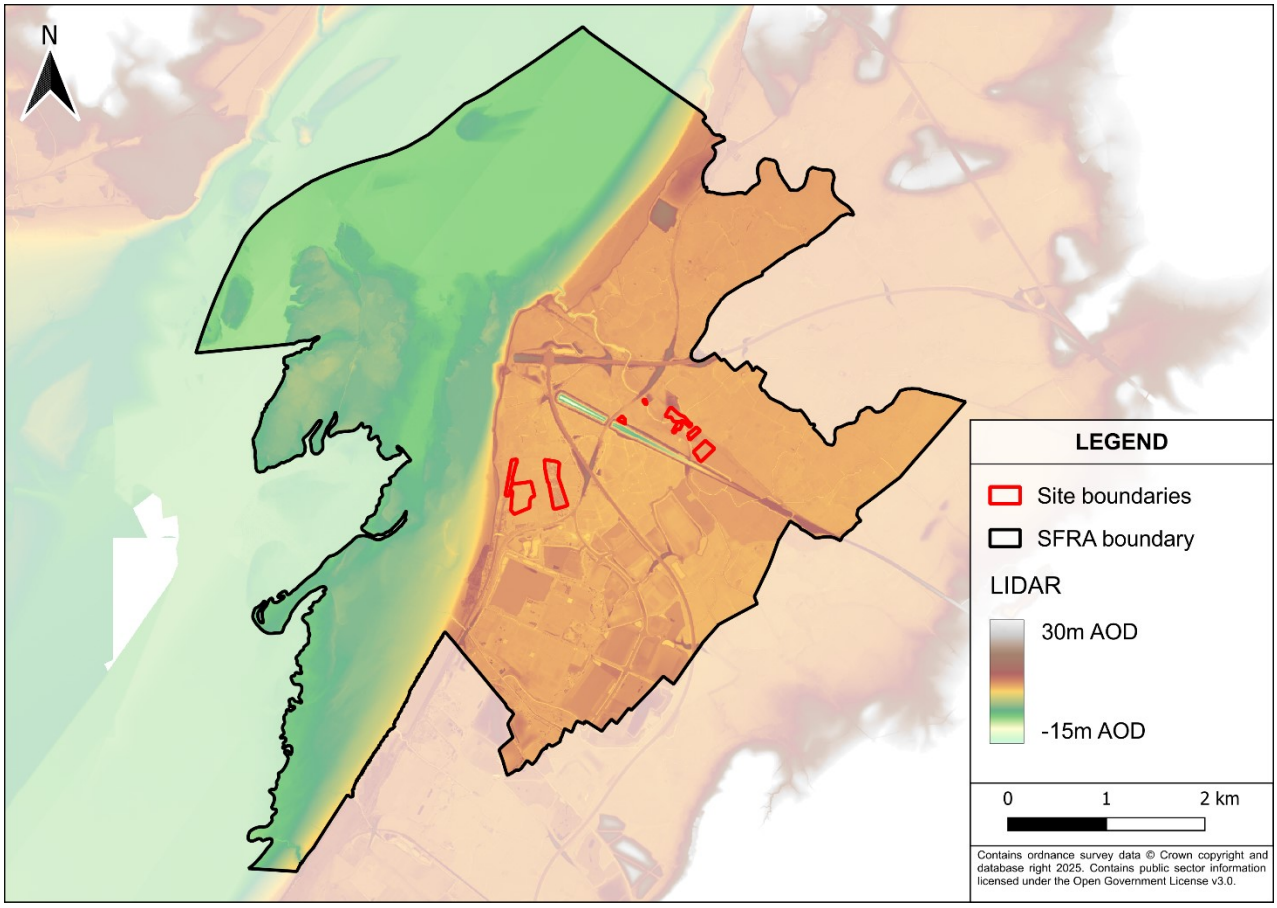

Figure 2-2: LiDAR Digital Terrain Model

2.3 Geology and soils

Bedrock Geology and Superficial Deposits data was obtained from the British Geological Society's (BGS) 50K mapping dataset.

British Geological Survey (BGS) data indicates that the study area is underlain by mudstone bedrock with subordinate siltstone (comprised of clay and silt). Overlying superficial mudflat and sandflat tidal deposits (clay, silt and sand) are present.

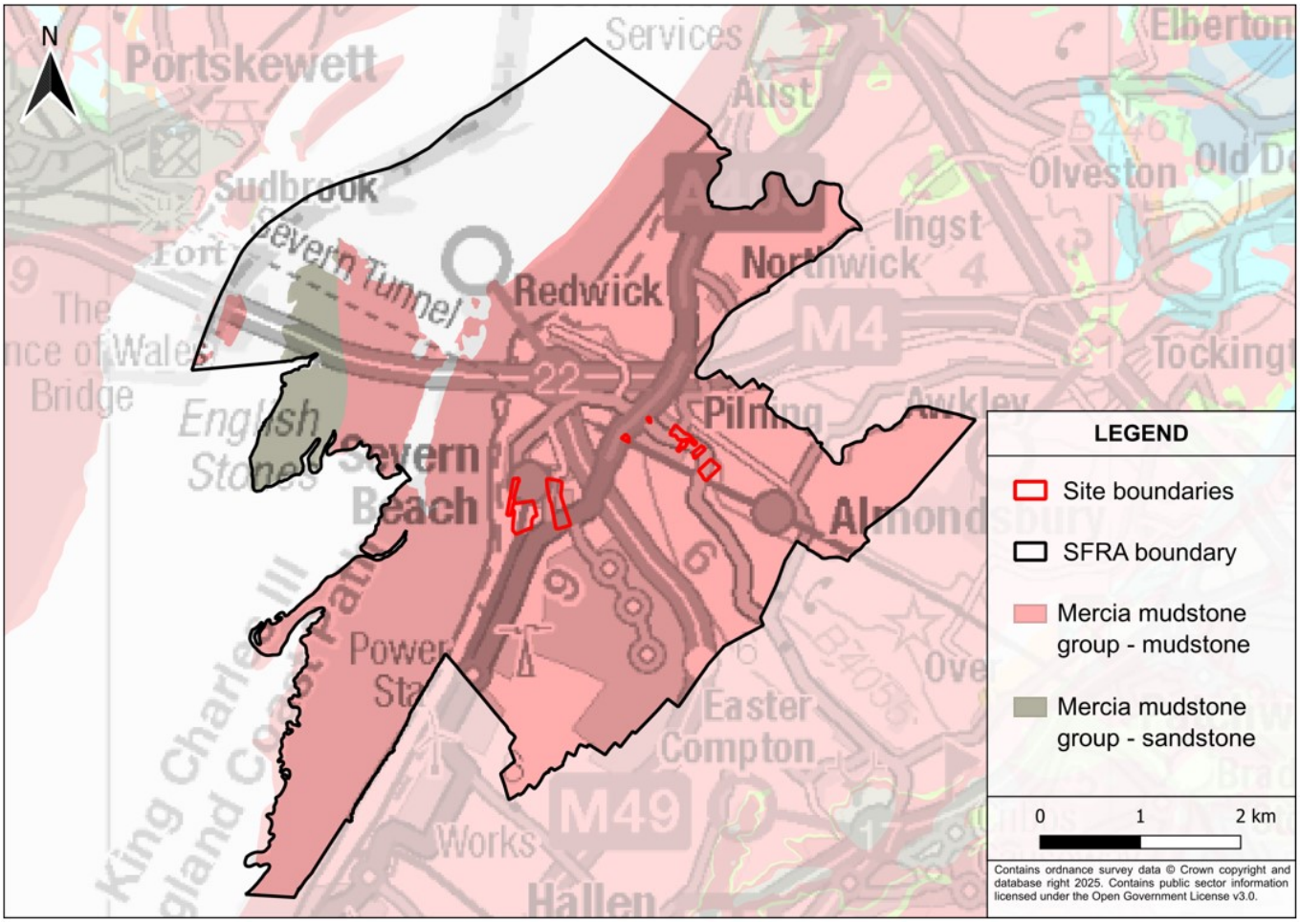

Figure 2-3: Bedrock Geology

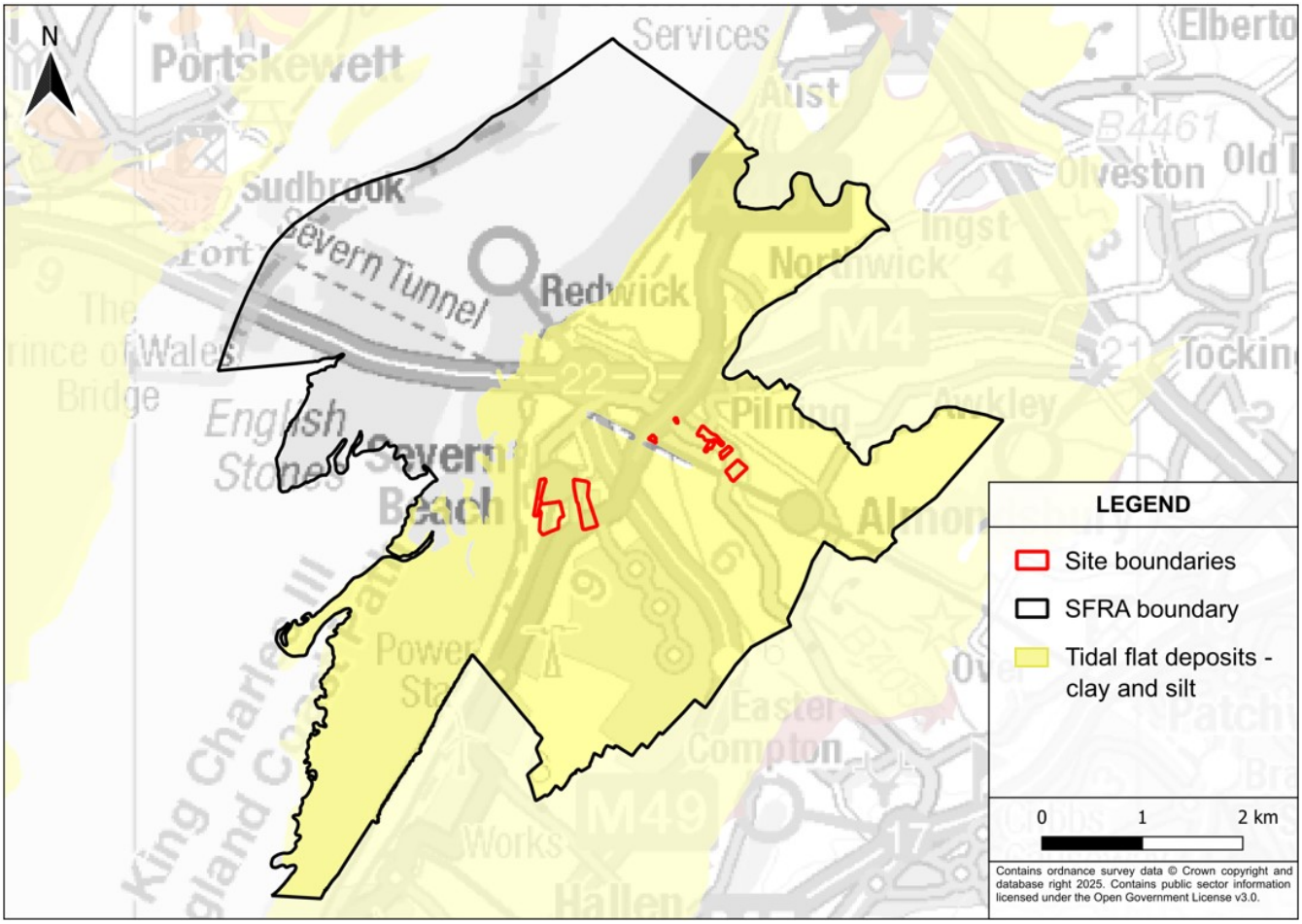

Figure 2-4: Superficial Geology

2.4 Hydrology

Hydrogeology information obtained from DEFRA's magic maps service indicates that the site is underlain by a low permeability secondary B bedrock aquifer and identifies the soil type as loamy and clayey floodplain soil with naturally high groundwater.

The site is not located in a Groundwater Source Protection Zone (SPZ).

There are no statutory main rivers within the SFRA boundary, however the Chestle Pill ordinary watercourse flows through the region adjacent to some of the sites.

The area's Rhine network is managed by the Lower Severn Internal Drainage Board and benefits all of the sites. The Rhines in the study area are in the form of drainage ditches or ordinary watercourse and provide land drainage, however, they are susceptible to tide locking, in which high tide levels prevent the Rhines from draining out to sea.

3 Policy and Strategy for Flood Risk Management

3.1 National Planning Policy Framework and Guidance

The NPPF was introduced by the Department for Communities and Local Government in March 2012 and was most recently revised in December 2024. The revised NPPF considers flood risk to developments using a sequential characterisation of all sources of flood risk, based on planning zones and the EA Flood Map. The revised NPPF is supported by the PPG, originally published in March 2014 and most recently updated in August 2022, which gives additional information on the assessment of flood risk. The main study requirement is to identify the flood zones and vulnerability classification relevant to the proposed development, based on an assessment of current and future conditions.

3.1.1 Defining flood risk

Section 3 (subsection 1) of the Flood and Water Management Act 2010 (FWMA) (gov.uk) defines the risk of a potentially harmful event (such as flooding) as 'a risk in respect of an occurrence is assessed and expressed (as for insurance and scientific purposes) as a combination of the probability of the occurrence with its potential consequences.'

3.1.2 Flood zones

Fluvial and tidal flood risk across the study area is assessed based on Flood Zones. The definition of the Flood Zones is provided below. The Flood Zones do not consider defences, except when considering the functional floodplain. This is important for planning long term developments as long-term policy and funding for maintaining flood defences over the lifetime of a development may change over time.

For this SFRA, the flood zones have been taken from the South Gloucestershire Level 1 SFRA for consistency with the Local Plan evidence base. It is important to note that as a Level 2 SFRA 'actual' risk, including consideration of defences is considered when assessing suitability of sites and that the sequential test has already been applied.

Table 3-1: Flood Zone classifications

Flood Zone	Definition
Zone 1: Low Probability	Land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1% AEP).
Zone 2: Medium Probability	Land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1% AEP) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1% AEP) in any year.
Zone 3a: High Probability	Land assessed as having a 1 in 100 or greater probability of river flooding (>1% AEP) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5% AEP) in any year.
Zone 3b: Functional Floodplain	This zone comprises land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Functional floodplain will normally comprise: • land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or • land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding). Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency.

3.1.3 The Sequential Test

The NPPF requires that the Sequential and Exception Tests be applied when choosing the location of new development and the layout of the development site. The Sequential Test aims to promote development in low flood risk areas considering all sources of flooding. The Exception Test is used where no suitable development areas can be found in low-risk zones.

The Sequential Test should be applied to identify suitable sites which are at low risk from all sources of flooding, avoiding medium and high-risk areas where possible. If no suitable areas can be identified in low-risk areas, then sites with the lowest flood risk should be considered next. If development is necessary within a medium or high-risk zone, an exception test may be required to demonstrate the need for the development in that location and plans to mitigate the flood risk. The requirement for the application of the Exception Test is outlined in Section 3.1.4 below.

The NPSG has prepared a Sequential Test with a methodology agreed in consultation with South Gloucestershire Council and the EA. Whilst SGCs flood zones were

extensive, with the majority of the area falling Flood Zone 3a/ 2, it is important to note that these are based off undefended modelling. As a result, an approach based on flood depths was utilised for undertaking the Sequential Test.

3.1.4 The Exception Test

It will not always be possible for all new development to be located on land that is not at risk from flooding. To further inform whether land should be allocated, or planning permission granted, a greater understanding of the scale and nature of the flood risks is required. In these instances, the exception test will be required. Diagram 3 of the PPG (gov.uk) (Paragraph: 033 Reference ID: 7-033-20220825) summarises the exception test (Figure 3-1).

Table 2 of the PPG (gov.uk) sets out the requirements for the exception test but does not reflect the need to avoid flood risk from sources other than rivers and the sea. There is no guidance on how to consider other sources of flood risk. The exception test should only be applied, following the application of the sequential test, in the following instances:

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

While the exception test is not explicitly required for sites at risk from other sources of flooding, the LPA should follow a similar principle where sites are proposed that are at risk from other sources of flooding, carefully weighing up the wider benefits of development against the risk, ensuring that site users can be kept safe through the lifetime of the development and ensuring residual risk can be safely managed.

For sites proposed for allocation within the Local Plan, the LPA should use the information in this SFRA to inform the exception test. At the planning application stage, the developer must design the site such that it is appropriately flood resistant and resilient in line with the recommendations in national and local planning policy and supporting guidance and those set out in this SFRA. This should demonstrate that the site will still pass the flood risk element of the exception test based on the detailed site level analysis.

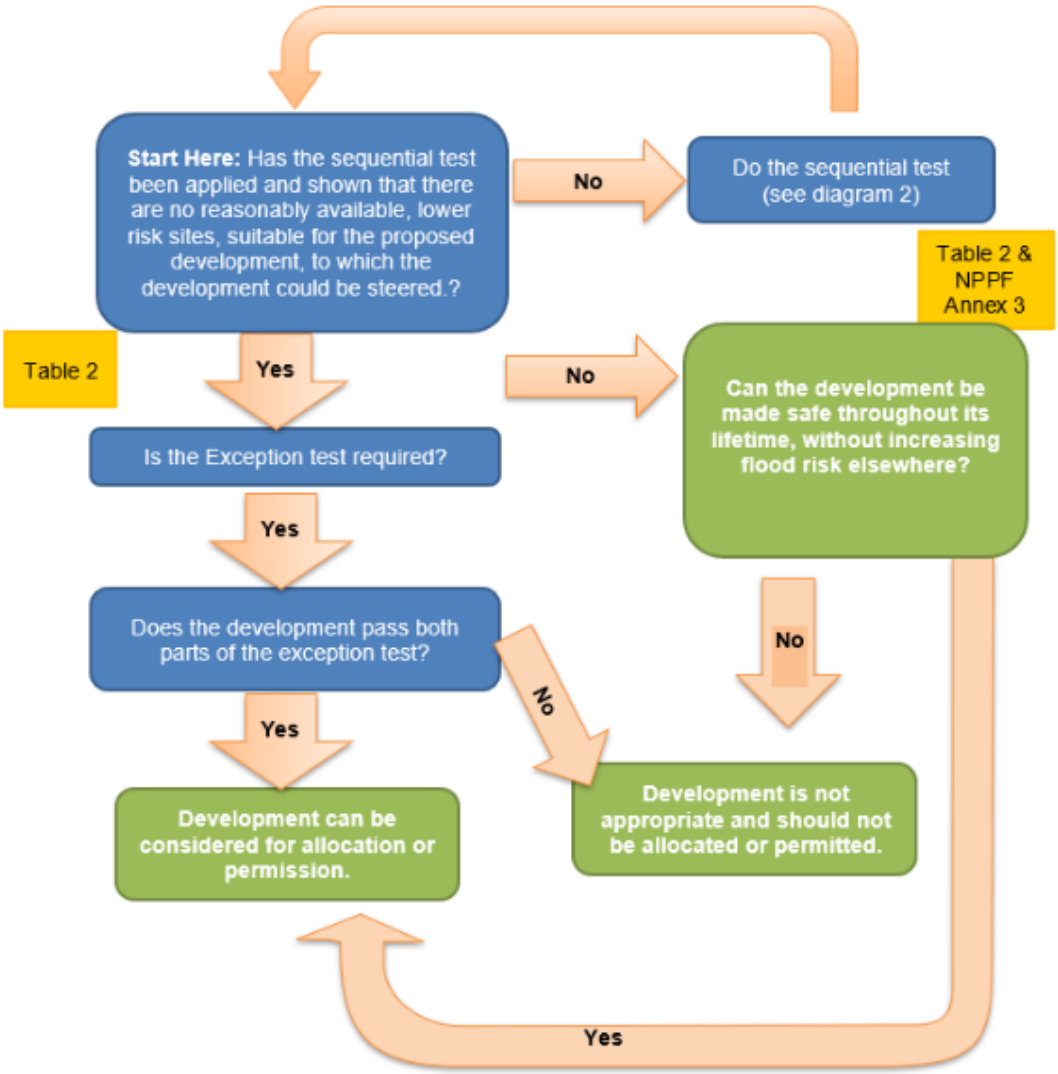

Diagram 3 of PPG: Flood Risk and Coastal Change (paragraph 033, Reference ID 7-033-20220825) Revised August 2022.

Figure 3-1: Application of the exception test to plan preparation.

There are two parts to demonstrating a development passes the exception test that should be considered by the LPA when allocating development sites, and developers when required (see Section 3.1.5 for exception test requirements for individual planning applications).

Part A: Demonstrating that the development would provide wider sustainability benefits to the community that outweigh the flood risk.

The LPA will need to set out the criteria used to assess the exception test and provide clear advice to enable applicants to provide evidence to demonstrate that it has been passed. If the application fails to prove this, the LPA should consider whether the use of planning conditions and/or planning obligations could allow it to pass the exception test. If this is not possible, this part of the exception test has failed, and planning permission should be refused.

Wider sustainability objectives should be considered, such as those set out in Local Plan Sustainability Appraisals. These generally consider matters such as biodiversity, green infrastructure, housing, historic environment, climate change adaptation, flood risk, green energy, pollution, health, transport etc.

The sustainability issues the development will address and how far doing so will outweigh the flood risk concerns for the site should also be considered, e.g., by facilitating wider regeneration of an area, providing community facilities, infrastructure that benefits the wider area etc.

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

In circumstances where the potential effects of proposed development are material a Level 2 SFRA is likely to be needed to inform the exception test for strategic allocations to provide evidence that the principle of development can be supported. At the planning application stage, a site-specific FRA will be needed. Both will need to consider the actual and residual risk and how this will be managed over the lifetime of the development.

Development proposals which substantially accord with the provisions of the Neighbourhood Development Plan will be considered by South Gloucestershire Council to provide Wider Sustainability Benefits and this, subject to an assumption of compliance with the recommendations of this Strategic Flood Risk Assessment, will demonstrate, in principle, that the first limb of Exception Test is satisfied. A site-specific Flood Risk Assessment will be expected to confirm compliance with the second part.

3.1.5 Applying the exception test

Where a development proposal is in accordance with an allocation made in a Local Plan following the application of the sequential and exception tests, the exception test will only be required to be repeated if:

- Elements of the development that were key to it satisfying the exception test at the plan-making stage (such as wider sustainability benefits to the community or measures to reduce flood risk overall) have changed or are not included in the proposed development; or
- The understanding of current or future flood risk has changed significantly.

For developments that have not been allocated in the Local Plan or where the sequential test was not applied at the development plan stage and new information becomes available that identifies a flood risk, developers must undertake the sequential and exception tests and present this information to the LPA for approval. The Level 1 SFRA can be used to scope the flooding issues that a site-specific FRA should investigate in more detail to inform the exception test for windfall sites.

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

3.2 Flood Risk Policy

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

The strategy sets out the long-term delivery objectives that the nation should take over the next 10 to 30 years, and shorter term practical measures that risk management authorities (RMAs) should take working with partners and communities. The management strategy has 3 long-term ambitions:

- 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

The NFCERM is available at:
https://assets.publishing.service.gov.uk/media/5f6b6da6e90e076c182d508d/023_15482_Environment_agency_digitalAW_Strategy.pdf

3.2.2 South Gloucestershire Local Flood Risk Management Strategy

The South Gloucestershire Council Local Flood Risk Management Strategy (LFRMS) (2022-2027) has been aligned with the latest guidance and legislation in the NFCERMS, and its aims fall under the categories of evidence, resilience/ awareness, adaptation, collaboration, sustainability and opportunities. It identifies six key themes which it deems important for this cycle of the LFRMS: sustainable development, sustainable drainage systems (SuDS), community involvement, climate change, biodiversity and natural flood management.

Concerning the SFRA study area, the LFRMS identifies the Chestle Pill catchment area as a prioritised catchment, meaning actions should be focused there as an area of high risk. Severn Beach is named as a key location for tidal flooding and adds that tidal flood risk can occur in combination with fluvial and surface water sources which can exacerbate flood risk by reducing the capacity of rhines discharging to the Severn estuary. Pilning is identified as a key location for risk from both surface water and flooding from rhines (drainage channels).

Available at:
https://beta.southglos.gov.uk/static/753db7f8bc408fcb1f954272f6cab01d/Local-Flood-Risk-Management-Strategy.pdf

3.2.3 South Gloucestershire Level 1 Strategic Flood Risk Assessment

The Level 1 Strategic Flood Risk Assessment identified potential development sites across South Gloucestershire and has provided an assessment of cumulative impacts. Its recommendations section lists many suggestions for developments in future with a focus on long term sustainability:

- Planning applications for phased developments should be accompanied by a Drainage Strategy, which takes a strategic approach to drainage provision across the entire site and incorporates adequate provision for SuDS within each phase.
- Space should be provided for the inclusion of SuDS on all allocated sites and outline proposals
- Natural drainage features should be maintained and enhanced.
- Planning applications for phased developments should be accompanied by a Drainage Strategy, which takes a strategic approach to drainage provision across the entire site and incorporates adequate provision for SuDS within each phase.
- SuDS should be considered and implemented as part of all new development, in line with South Gloucestershire Council's Supplementary Planning Document on SuDS document

- Ensure development is ‘safe’, dry pedestrian egress from the floodplain and emergency vehicular access should be possible for all residential development. If at risk, then an assessment should be made to detail the flood duration, depth, velocity and flood hazard rating in the 1% AEP plus climate change fluvial flood event and the 0.5% AEP plus climate change tidal event, in line with FD2320.
- Where there is a residual risk of flooding (from any source) to properties within a development, residential and commercial finished floor levels should be raised above whichever is higher of either 300mm above the 1% AEP plus climate change fluvial flood level, 300mm above the 0.5% AEP plus climate change coastal flood level or 300mm above the general ground level of the site. Finished floor levels for sleeping accommodation should be raised above whichever is higher of either 600mm above the 1% AEP plus climate change fluvial flood level, 600m above the 0.5% AEP plus climate change coastal flood level or 300mm above the general ground level of the site.
- Safeguard functional floodplain (Flood Zone 3b in Appendix A) from future development.

Available at:
https://beta.southglos.gov.uk/static/777cfdc6b8907d8ab9e1e4f97e59474e/Main-Report-Level_1_SFRA-2021-1.pdf

3.2.4 Pilning and Severn Beach Neighbourhood Area Design Codes and Guidelines

The neighbourhood area design codes and guidelines published in February 2023 include guidelines linked to flood resilience. ‘Design Code 04 – Architecture and Details’ states the following requirements.

Consideration must be given to the adoption of flood resilient arrangements that locate habitable rooms, such as bedrooms, above ground floor. While this is an area-wide design principle, it is emphasised for the Severn Beach area. Otherwise, ground floor levels should be designed above modelled flood levels and dwellings should be designed with solid garden walls where practicable, providing the option of control gates. Specification and detailing should include flood control threshold gates, non-return valves to drains, electrical and mechanical components set above EA predicted flood levels, and consideration should be given to interior finishes such as cement-based wall treatments, flood resilient kitchen units and non-absorbent flooring.

Available at:
https://www.psbpc.co.uk/_files/ugd/61816a_5bc869d6cc18402d8f315e40ccd41e9e.pdf

3.2.5 Shoreline Management Plan

The shoreline management plan review (SMP2) contains draft policies proposing how the shoreline around the Severn Estuary should be managed over the next 100 years. The shoreline within the SFRA study area is the New Passage to SevernsideWorks BRIS2 unit, and has been given a 'hold the line' management approach for the full 100 year timeframe. The plan is to retain a defence along approximately the current alignment where protection is currently provided by coastal defence structures or managed beaches, replacing and modifying defences when needed. This implies that the defence status of the Severn beach shoreline is unlikely to change over the next 100 years.

Available at: https://environment.data.gov.uk/shoreline-planning/unit/SMP19/BRIS2

3.2.6 South Gloucestershire SuDS Guidance

The SuDS guidance outlines the Council's policies and standards on SuDS for use by developers. SuDS should be designed so that:

- In a 1 in 30 year rainfall event there will be no flooding on site.
- In a 1 in 100 year rainfall event (plus allowance for climate change) there will be no flooding of any building on the site or any off site flooding.
- For any rainfall event above 100 year, the drainage design should demonstrate how exceedance flows generated within the site will be managed including overland flow routes, protection of buildings to prevent entry of water and protection of access routes.
- An allowance for climate change needs to be incorporated as part of SuDS design, which means adding an extra amount to peak rainfall (20% for commercial development and 40% for residential as per current industry requirements, which may be subject to change in the future).
- SuDS features are expected to be designed in accordance with CIRIA C753 the SuDS Manual and CIRIA C698 Site handbook for the construction of SuDS.
- Swales, infiltration basins, retention and detention basins and ponds must be designed with side slopes with a gradient of 1:3 or less. Basins and ponds must also be designed to incorporate a minimum freeboard of 300mm between the top water level and the top of bank.
- Suitable management arrangements must be put in place for all the SuDS features constructed in South Gloucestershire covering future operation and maintenance. In addition, adequate access must be provided to all SuDS features to allow for the required maintenance and operational activities to be carried out unimpeded.

Available at:
https://beta.southglos.gov.uk/static/d09c040fe226dad7f6871f573caf6b77/2660-Sustainable-Drainage-SPD.pdf

3.2.7 Lower Severn IDB Byelaws

The Lower Severn Internal Drainage Board (IDB) website outlines 33 byelaws that it states are considered necessary for securing the efficient working of the drainage system in the district. Byelaws 3 and 10 have been identified due to their relevance to change of land use and construction of properties.

3. Control of Introduction of Water and Increase in Flow or Volume of Water

No person shall, without the previous consent of the Board, for any purpose, by means of any channel, siphon, pipeline or sluice or by any other means whatsoever, introduce any water into the District or, whether directly or indirectly, increase the flow or volume of water in any watercourse in the District.

10. No Obstructions within 8 Metres of the Edge of the Watercourse

No person without the previous consent of the Board shall erect any building or structure, whether temporary or permanent, or plant any tree, shrub, willow or other similar growth within 8 metres of the landward toe of the bank where there is an embankment or wall or within 8 metres of the top of the batter where there is no embankment or wall, or where the watercourse is enclosed within 8 metres of the enclosing structure

Available at: https://www.lowersevernidb.org.uk/about/operations/land-drainage-byelaws

3.2.8 Documents Provided by the NPSG

A Level 2 SFRA specification was provided the Neighbourhood Plan Steering group, outlining the purpose and requirements of the L2 SFRA. The sequential test undertaken for the sites was also provided, demonstrating that development cannot be contained within Flood Zones 1 and 2 and that development in Flood Zone 3 must be considered in order to meet the objectives of the Neighbourhood Plan.

4 Flood Risk

4.1 Understanding flood risk

Section 3 (subsection 1) of the Flood and Water Management Act 2010 (FWMA) (gov.uk) defines the risk of a potentially harmful event (such as flooding) as 'a risk in respect of an occurrence is assessed and expressed (as for insurance and scientific purposes) as a combination of the probability of the occurrence with its potential consequences.' Figure 4-1 sets out this definition of risk.

Figure 4-1: Conceptual model depicting how risk can be defined.

4.1.1 Probability

The probability of flooding is expressed as a percentage based on the average frequency measured or extrapolated from records over many years. A 1% AEP indicates the flood level that is expected to be reached on average once in a hundred years, i.e., it has a 1% chance of occurring in any one year, not that it will occur at least once every hundred years.

4.1.2 Consequences

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

4.1.3 Source-Pathway-Receptor model

Flood risk can be assessed using the Source-Pathway-Receptor model (Figure 4-2) where:

- The source is the origin of the floodwater, principally rainfall.
- A pathway is a route or means by which a receptor can be affected by flooding, which includes rivers, drains, sewers, and overland flow.

- A receptor is something that can be adversely affected by flooding, which includes people, their property, and the environment.

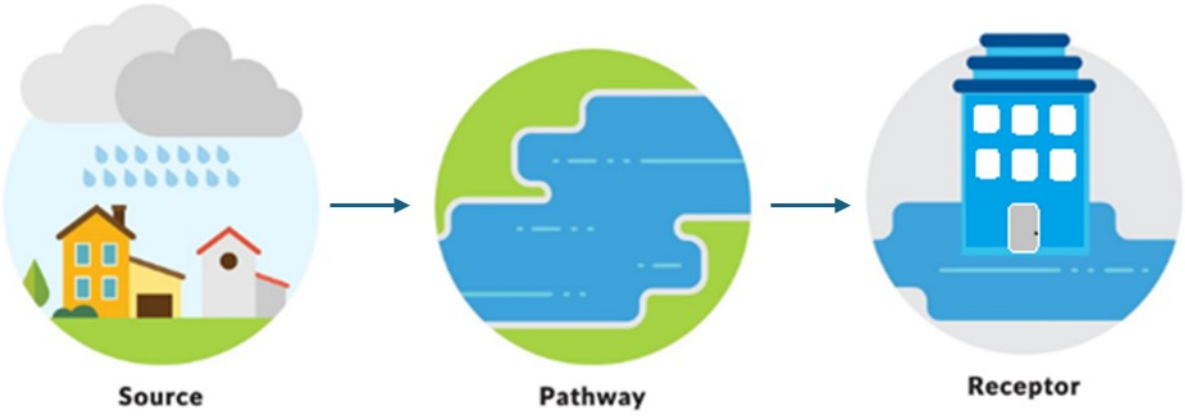

Figure 4-2: Source-Pathway-Receptor model.

This is a standard environmental risk model common to many hazards and should be the starting point of any assessment of flood risk. All these elements must be present for flood risk to arise. Having applied the Source-Pathway-Receptor model it is possible to mitigate the flood risk by addressing the source (often very difficult), blocking, or altering the pathway, or removing the receptor, e.g., steer development away.

The planning process is primarily concerned with the location of receptors, taking appropriate account of potential sources and pathways that might put those receptors at risk. It is therefore important to define the components of flood risk to apply this guidance in a consistent manner.

4.2 Historic flooding

Historic flood extents made available by the EA include a large area of land north of the M4 and New Passage Road, land along the waterfront north of the M4, residential land in North Severn Beach, land southeast of Green Lane, small patches of residential area around Severn Beach Station, and several patches of land in Marsh Common. Information provided in the Recorded Flood Outlines dataset indicates that none of the sites, however, are located within historic flood extents. The flood extents Norh of the M4 represents the 1981 tidal event mentioned in the South Gloucestershire LFRMS, which prompted the construction of tidal defences. Furthermore, none of the flood extents occurred after 2000, so given that tidal defences are in the processed of being improved as part of the ASEA Flood Defence

Project, historic flood extents are not necessarily an indication that the site is prone to flooding in the present day.

It is important to note that the absence of historic flood records does not mean than an area has never flooded, only that records are not held. For previously undeveloped sites, it is likely that any historic flooding incidents may have gone unreported due to a lack of site use or interest. In addition, it is also possible that flooding mechanisms have changed since the date of a recorded flooding incident, making it more or less likely for flooding to occur on site.

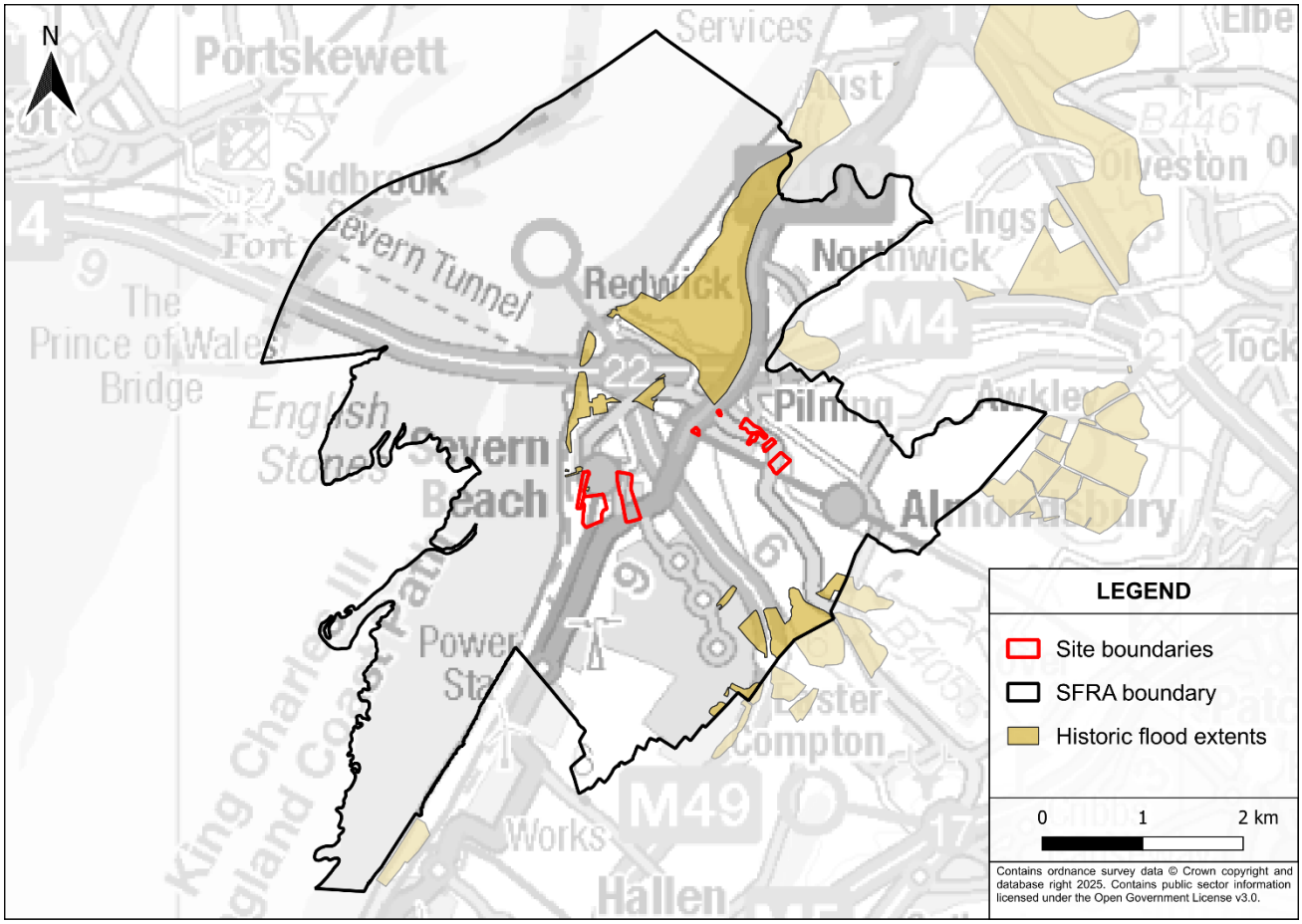

Figure 4-3: LiDAR Digital Terrain Model

4.3 Fluvial and tidal flood risk

4.3.1 Flood Zones

Fluvial and tidal flood risk across the area is assessed based on Flood Zones. The definition of the Flood Zones is provided below. The Flood Zones do not consider defences, except when considering the functional floodplain. This is important for planning long term developments as long-term policy and funding for maintaining flood defences over the lifetime of a development may change over time.

The Flood Zones are:

- Flood Zone 1: Low risk: less than a 0.1% chance of tidal flooding in any given year.
- Flood Zone 2: Medium risk: between a 0.5% and 0.1% chance of tidal flooding in any given year.
- Flood Zone 3a: High risk: between a 3.3% and 0.5% chance of tidal flooding in any given year.
- Flood Zone 3b: Functional Floodplain: land where water has to flow or be stored in times of flood (greater than a 3.3% chance of tidal flooding in any given year). Only water compatible and essential infrastructure are permitted in this zone and should be designed to remain operational in times of flood, resulting in no loss of floodplain or blocking of water flow routes. Annex 3 of the NPPF (gov.uk) provides information on flood risk vulnerability.

Flood Zones 1, 2 and 3 have been taken from the Environment Agency's 'Flood Map for Planning' and do not take into account flood defences. The Flood Map for Planning is based on generalised modelling where detailed modelling is not available. Whilst the generalised modelling is typically suitable for use on a large scale, they are not provided for specific sites or for land where the catchment of the watercourse is less than 3km^2.

For watercourses with smaller catchments, the Risk of Flooding from Surface Water (RoFSW) map provides an indication of the floodplain of small watercourses and ditches. It is more accurate in upper to mid river valley locations. This is because it does not represent the floodplain for small watercourses as well in topographically flat areas where the flow routes are not as well defined.

The Flood Map for Planning Flood Zones only detail flood extents. They do not provide data relating to the depth, velocity or hazard rating of flooding which is required to make an informed assessment of flood risk.

In addition, the Flood Map for Planning does not fully consider other sources for example, sewer or groundwater flooding or the impacts of canal or reservoir failure or climate change. Hence there could still be a risk of flooding from other sources and the level of flood risk will change during the lifetime of a development.

For these reasons, the Flood Map for Planning should not be used as application evidence to provide the details of possible flooding for individual properties or sites and for any sites with watercourses on, or adjacent to, the site. Accordingly, for site-specific assessments it will be necessary to perform more detailed studies in circumstances where flood risk is an issue.

The Environment Agency will prepare an updated and improved Flood Map for Planning in the course of updating the National Flood Risk Assessment 2 (NaFRA2). This mapping was released in January and March 2025 with more data expected to be released in the future. As the study area is in a defended area which is well defined

through an EA approved detailed hydraulic model prepared for the Avonmouth and Severnside Enterprise Area (ASEA) scheme; this is considered the 'best available data' for understanding tidal flood risk in the study area.

4.3.2 ASEA modelling

Outputs from the 1D-2D tidal inundation model prepared for the ASEA scheme were used to assess tidal flood risk to the study area. The model has undergone updates to represent the as-built flood defences and improve other modelling parameters; the 2024 version of the model was used for this SFRA.

As tidal flood risk throughout the study area is represented by the ASEA detailed modelling, there is sufficient certainty in the understanding of flood risk. As a result, the use of proxies is not required for a suitable approach to understanding tidal flood risk in this SFRA.

4.4 Surface water flood risk

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

The EA's Risk of Flooding from Surface Water mapping (RoFSW) (gov.uk) has been used to assess surface water risk within this SFRA. These maps are intended to provide a consistent standard of assessment for surface water flood risk across England and Wales in order to help LLFAs, the EA, and any potential developers to focus their management of surface water flood risk.

The RoFSW is derived primarily from identifying topographical flow paths of existing watercourses or dry valleys that contain some isolated ponding locations in low lying areas. They provide a map which displays different levels of surface water flood risk depending on the annual probability of the land in question being inundated by surface water. The RoFSW should not be used to understand flood risk for individual properties but is suitable for high level assessments such as SFRAs for local authorities.

4.5 Groundwater flood risk

In general, less is known about groundwater flooding than other sources of flooding and availability of data is limited. Groundwater flooding can be caused by:

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

Groundwater flooding is different to other types of flooding. It can last for days, weeks, or even months and is much harder to predict and warn for. Monitoring does occur in certain areas, for example where there are major aquifers or when mining stops.

The JBA Groundwater Emergence map shows the likelihood of groundwater emergence posing a risk to both surface and subsurface assets, based on predicted groundwater levels during a 1% AEP event. This divides groundwater emergence into five categories (Table 4-5).

Table 4-1: JBA Groundwater Emergence Map category descriptions.

Category	Potential risk
Groundwater levels are either at or very near (within 0.025m of) the ground surface.	Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
Groundwater levels are between 0.025m and 0.5m below the ground surface.	Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
Groundwater levels are between 0.5m and 5m below the ground surface.	There is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.
Groundwater levels are at least 5m below the ground surface.	Flooding from groundwater is not likely.
Negligible risk.	This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.

All of the mainland area within the SFRA is classified by the JBA Groundwater Emergence Map as 'negligible risk', with only a small area in the estuary itself being classified as having groundwater 'at or very near the surface itself'. All of the sites are located on land classified as having no risk of groundwater emergence.

It should be noted that these datasets only identify areas likely to be at risk of groundwater emergence and do not allow prediction of the likelihood of groundwater flooding or quantification of the volumes of groundwater that might be expected to emerge in a given area.

4.6 Sewer flood risk

Sewer flooding occurs when intense rainfall/river flooding overloads sewer capacity (surface water, foul or combined), and/or when sewers cannot discharge to watercourses due to high water levels. Sewer flooding can also be caused by blockages, collapses, equipment failure or groundwater leaking into sewer pipes.

Since 1980, the Design and Construction Guidance (formerly Sewers for Adoption) guidelines mean that new surface water sewers have been designed to have capacity for a 3.3% AEP rainfall event, although until recently this did not apply to smaller private systems. This means that sewers can be overwhelmed in larger rainfall and flood events.

New developments should not cause additional pressures on existing sewers due to the requirements to maintain greenfield runoff rates. However, increases in rainfall as a result of climate change can lead to existing sewers becoming overloaded, although this can be reduced through the use of well-designed SuDS to reduce surface water runoff.

5 Flood Risk Management Infrastructure

5.1 Flood defences

For sites where existing flood defences provide a reduction in the flood risk to the site, it is important to understand the standard of protection these structures and measures provide. It is also necessary to understand how this level of protection changes over time, considering the implications of climate change.

If flood defences are required to protect a development site, evidence will be required to show that the new development does not adversely impact and increase flood risk to other areas, for example that there is no net loss in floodplain storage in circumstances where this is a material consideration. It will need to be established that these defences can be appropriately managed and maintained during the lifetime of the development. In some cases, it will be a requirement to demonstrate that there is an appropriate level of commitment to the maintenance of the standard of protection afforded by existing defences, where reliance is placed on the standard they provide.

Current flood defences have been taken from the Environment Agency's Asset Information Management System (AIMS) Spatial Defences dataset. Their current condition and standard of protection are based on those recorded in the tabulated shapefile data.

According to the EA's AIMS Spatial Flood Defences dataset, much of the Severn Beach coastline is behind tidal flood defences including stretches of concrete wall, wave return wall and embankment with revetement. These defences have been constructed as part of the ASEA flood mitigation project which in total protects 17km of coastline. Embankments also run along the northern end of Beach Road.

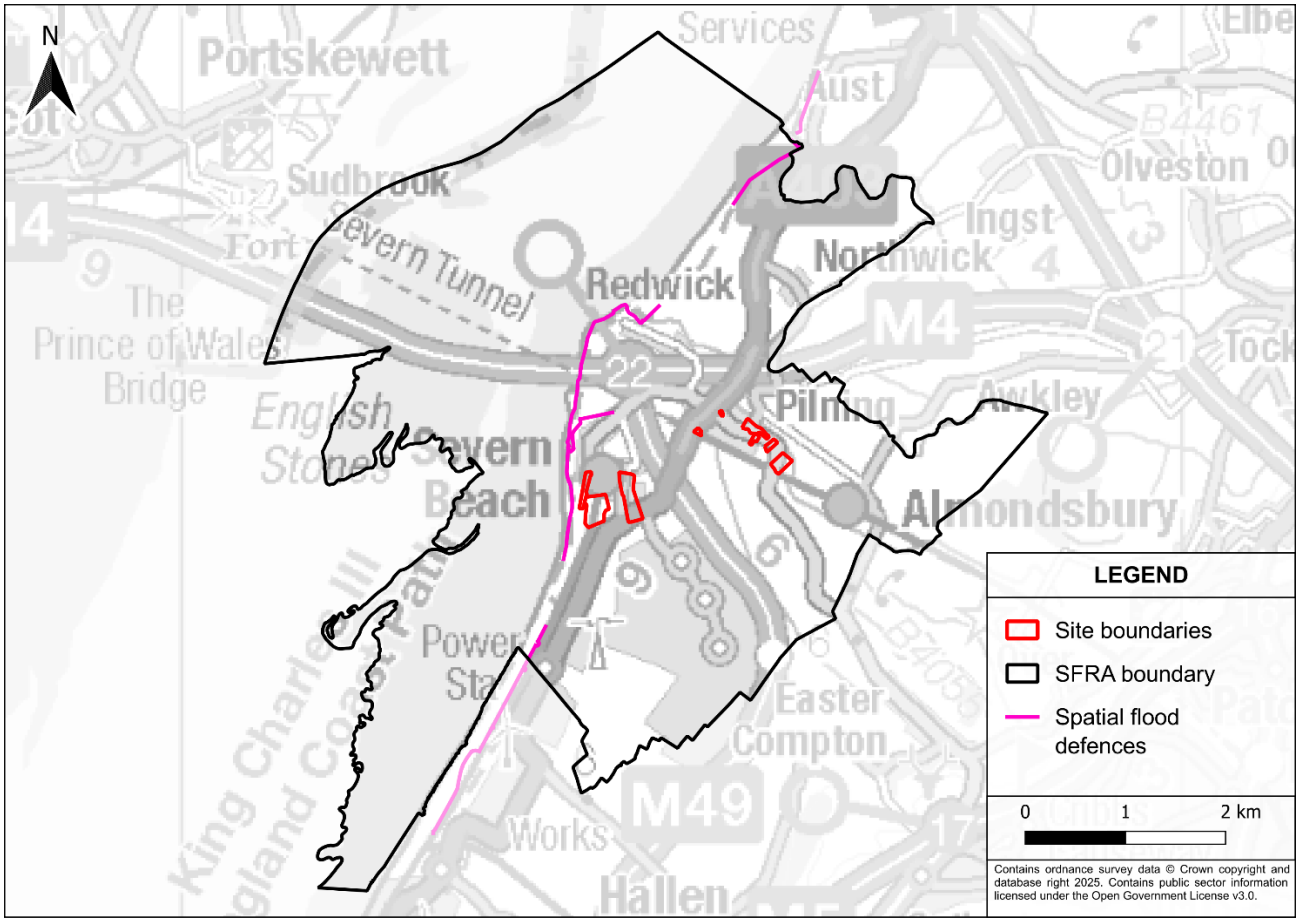

Figure 5-5-1: Spatial Flood Defences

5.1.1 ASEA Flood Defence Scheme

The ASEA (Avonmouth Severnside Enterprise Area) Ecology Mitigation and Flood Defence Scheme consists of 17km of improved flood defences, designed to protect communities up to a 1 in 200 year (0.5% AEP) standard of protection for at least 60 years. The project combines earth embankments, sheet pile walls, precast units, glass panels, outfalls and flood gates to reduce the risk to homes and businesses, with the Severn Beach and Pilning area being one of the project's particular focuses.

The ASEA website confirms that hard engineering works in the Severn Beach area have been completed, and landscaping works are projected to be complete in 2026. Figure 5.1.1 indicates that there are intervals in the tidal defences in Severn Beach and New Passage. Both intervals are, according to the ASEA website, the location at which flood embankments are being constructed, possibly not registered as complete. The ASEA website is available at: https://asea-flood-ecology.co.uk/.

5.2 Residual flood risk

Residual risk is the risk that remains after the impacts of flood risk infrastructure or site-specific mitigation measures have been considered. It is important that these risks are quantified to confirm that the consequences can be safely managed. The residual risk can be:

- The effects of a larger flood than defences were designed to alleviate (the 'design flood'). This can cause overtopping of flood banks, failure of flood gates to cope with the level of flow or failure of pumping systems to cope with the incoming amount of water.
- Failure of the defences or flood risk management measures, such as breaches in embankments or walls, failure of flood gates to open or close, failure of pumping stations, or blockages of culverts. This could result in the inundation of a site and may include the sudden release of water with little warning.

The failure of defences may result in flooding to areas which are not usually at risk. The hydraulic modelling for the ASEA scheme includes consideration of breach and overtopping and these impacts have been assessed in this SFRA.

5.2.1 Overtopping

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

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

5.2.2 Breach

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

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

6 Impacts of Climate Change

6.1 Climate Change allowances

6.1.1 Peak river flow allowances

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

The peak river flow allowances (gov.uk) provided in the guidance show the anticipated changes to peak flow for the management catchment within which the subject watercourse is located. The range of allowances are based on percentiles which describe the proportion of possible scenarios that fall below an allowance level:

- The central allowance is based on the 50th percentile (exceeded by 50% of the projections in the range).
- The higher central allowance is based on the 70th percentile (exceeded by 30% of the projections in the range).
- The upper end allowance is based on the 95th percentile (exceeded by 5% of the projections in the range).

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 2125).

The time period used in the assessment depends upon the expected lifetime of the proposed development. Residential development should be considered for a minimum of 100 years, whilst the lifetime of a non-residential development depends upon the characteristics of that development but a period of at least 75 years is likely to form a starting point for assessment. Further information on what is considered to be the lifetime of development is provided in the PPG (gov.uk).

Peak river flow climate change allowances developed by the Environment Agency are defined by Management Catchments. The SFRA study area falls within the Avon and Bristol Streams Management Catchment, as detailed in Table 6-1.

Table 6-1: Peak river flow allowances for the Avon and Bristol Streams Management Catchment.

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

6.1.2 Peak rainfall intensity allowances

Climate change is predicted to result in wetter winters and increased summer storm intensity in the future. This increased rainfall intensity will affect land and urban drainage systems, resulting in more frequent surface water flooding, due to the increased volume of water entering the systems.

The potential impacts of surface water plus climate change will need to be considered at site-specific assessment stage. In May 2022, the Environment Agency updated the surface water climate change projections, which are now based on Management Catchments. Table 6-2 shows the peak rainfall intensity allowances that apply in the SFRA study area when considering surface water flood risk.

The upper end allowance should be considered for both the 3.3% and 1% AEP events for the 2070s epoch to understand the range of impact.

Development should be designed so that for the upper end allowance in the 1% annual exceedance probability event:

- There is no increase in flood risk elsewhere
- The development will be safe from surface water flooding

Table 6-2: Peak rainfall intensity allowances for small and urban catchments for The Avon and Bristol Streams Management Catchment.

Allowance category	Total potential change (%) anticipated for '2050s' (2022 to 2060) 3.3% AEP	Total potential change (%) anticipated for '2050s' (2022 to 2060) 1% AEP	Total potential change (%) anticipated for '2070s' (2061 to 2125) 3.3% AEP	Total potential change (%) anticipated for '2070s' (2061 to 2125) 1% AEP
Upper end	35%	40%	40%	45%
Central	20%	25%	25%	25%

6.1.3 Sea level rise allowances

There are a range of allowances for each river basin district and epoch for sea level rise. They are based on percentiles. A percentile describes the proportion of possible scenarios that fall below an allowance level:

- higher central allowance is based on the 70th percentile
- upper end allowance is based on the 95th percentile

An allowance based on the 70th percentile is exceeded by 30% of the projections in the range. At the 95th percentile it is exceeded by 5% of the projections in the range.

The Severn river basin district falls in the South West area of England for consideration of sea level allowances, as set out in Table 6-3.

Table 6-3: Sea level allowances for the South West of England for each epoch in mm for each year – the total sea level rise for each epoch is in brackets.

Allowance category	2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative rise 2000 to 2125 (metres)
Upper end	7 (245)	11.4 (342)	16 (480)	18.4 (552)	1.62
Higher Central	5.8 (203)	8.8 (264)	11.7 (351)	13.1 (393)	1.21

7 Level 2 Assessment Methodology

7.1 Sites requiring a Level 2 assessment

Nine sites were identified by the NPSG as requiring a Level 2 assessment, some of which have been grouped together for assessment to form a total of 6 site summary tables. The sites were identified in the neighbourhood plan as being potential allocations. Due to the risk of flooding these sites require further information so that the NPSG can apply the Exception Test.

Table 7-1: List of sites requiring a level 2 assessment

Site ID	Site Name
CFS1	Land at Vicarage Road, Pilning
CFS13	Land at Pilning Forge, Pilning
CF9/10	21/23 Cross Hands Road, Pilning
SG033	Land at Church Road, Severn Beach
SG135	Land West of Ableton Lane, Severn Beach
SG136	Land West of School, Bank Road
SG778	Land at Station Road, Severn Beach
SG807	Land at Pilning Village Hall, Pilning
SG808	Land at Bank Road, Pilning

7.2 Site summary tables

Each site summary table is divided into the following sections: sources of flood risk, flood risk management infrastructure, emergency planning, climate change, requirements for drainage control and impact mitigation, NPPF and planning implications, and mapping information. These are provided in Appendix B.

7.3 Static mapping

Overview maps for the entire study area are provided in Appendix A. Mapping for individual site groupings has also been undertaken. Mapping was prepared using QGIS software for each individual site. These can be found in Appendix B.

8 Recommendations for Development

8.1 Development in Pilning and Severn Beach

It is important to note that the parish is in a defended area behind raised flood defences and currently the risk of tidal flooding is low. However, without commitments to maintain the standard of protection in the future the area will be at increased risk of flooding due to the impacts of climate change.

In the interests of making development safe in flood risk terms; in Pilning and Severn Beach, development must:

- Be supported by an NPPF compliant Flood Risk Assessment;
- Consider the existing Pilning and Severn Beach Neighbourhood Area Design Codes and Guidance;
- Demonstrate that safe access and egress or a suitable place of safety is incorporated into the design of new development for breach events, proportionate to the type and scale of development;
- Consider the future impacts of flood risk, including the potential need for developer contributions to maintain the design standard of protection of existing defences.

All development must adopt a sequential approach by situating the most vulnerable aspects of development in the lowest areas of risk, this means avoiding developing too close to or culverting existing watercourses. Areas at risk during future tidal flood events (non-breach) should also be avoided.

8.1.1 Area characteristics

Developments in Pilning and Severn Beach have different flood risk characteristics which will impact mitigation measures required. Developments in Severn Beach will need to:

- Avoid areas at risk of future tidal (non-breach) flood events, within existing surface water flow paths and watercourses.
- Avoid ground floor sleeping accommodation and incorporate a suitable place of safety.
- Emphasise the use of flood resistant and resilient design techniques.

Developments in Pilning are generally at a lower risk of flooding than those at Severn Beach and are generally at a reduced risk of flooding in the future. However managing residual risk is a key issue that must be addressed, consequently developments should not include ground floor sleeping accommodation.

8.1.2 Flood resilient design

The Pilning & Severn Beach Neighbourhood Area Design Codes and Guidance lays out both area wide design principles and area specific design codes. Area wide design principles should be considered for sites in both Severn Beach and in Pilning.

Sites located in Severn Beach have additional recommendations in the site tables, following area specific design codes. For sites located in Severn Beach, development should consider the following:

- No high priority living areas, such as bedrooms, on ground floor level;
- Solid garden walls with potential to install flood control gates;
- Electrical and mechanical components set above EA predicted flood levels;
- Non-return valves to drains;
- Non-absorbent flooring;
- Flood resistant kitchen units;
- Cement-based wall treatments.

It should be noted that not all flood resilient design options will apply to every site and should be appropriate to the nature and scale of the development.

8.1.3 Safe access and egress

The flood risk and coastal change section of the planning practice guidance (PPG) states that safe evacuation procedures and flood mitigation infrastructure must be demonstrated for sites where risks are unavoidable through location. Safe access and escape routes will need to be demonstrated during the design flood event (2123 0.5% AEP plus climate change).

The Pilning sites (CFS1, CFS13, CF9/10, SG136, SG807, and SG808) are accessible in all non-breach events and therefore the design flood event. The Severn Beach sites (SG033, SG135 and SG778) experience sufficient flood depths that in the design flood event access and egress may be impeded, dependant on where the sites' access and egress points are located. All sites may experience partially or entirely obstructed accessibility in any breach scenario.

Consideration must given to where access and egress points are located in each site, and to which roads they connect. It is recommended that where possible, developments should have multiple access and egress points to increase accessibility in the event that one may be obstructed by floodwater. Flood maps should be consulted in the layout design stage to ensure that the risk of obstruction of access and egress points is minimised.

It should be noted that the rate of onset for tidal flood events is much greater and there would be much longer to prepare for and if required evacuate in time if a flood warning were received.

8.1.4 Safe refuge

Development should be designed with a place of safe refuge 300mm above the maximum flood level during a breach event in the 0.5% AEP 2123. This place of safe refuge should:

- Be internally accessible to all residents/ occupants;
- Suitably sized relative to the proposed occupancy of the development;

Such places of refuge can also play an important role where, for whatever reason, evacuation in advance of flooding is not achieved.

8.1.5 Car parks

We understand there are a number of car parks proposed as part of the neighbourhood plan, both visitor car parks and transport car parks should be designed in a way that cars would not become a hazard during a flood. This includes incorporating sufficient fencing or barriers around a car park so cars do not become mobilised during a flood. This is particularly relevant for transport car parks where owners may not be nearby, and is more likely than visitor parking to still be in use at times of poor weather.

8.1.6 Sustainability targets

Developments must meet the sustainability targets identified in the Neighbourhood Development Plan and the NPSG Sequential Test. Therefore, prepared site-specific Flood Risk Assessments and exception tests must accord with those sustainability targets.

8.2 Flood warning and evacuation

8.2.1 Flood alert and warning

Where a development or its main route of access is located within a flood risk area, the NPPF recommends that Flood Warning Plans are put in place for managing the flood risk to the development and, if necessary, support the evacuation of the site. Given that all of the sites are in flood zone 3, residents must sign up to the EA's flood alert and warning services. The EA's flood warning and alert services are free services that are frequently updated and accessible for 24 hours of the day. To register for this service or find out if a flood warning or alert has been issued for the area of interest, the following telephone number and website should be used:

- 0345 988 1188
- https://www.gov.uk/sign-up-for-flood-warnings

If a flood event is forecast, alerts and warnings are issued using a set of four easily recognisable codes as shown in Table 8-1. Generic advice and examples of actions to be taken on receipt of the alert of warning are also shown in Table 8-1.

Table 8-1: EA Flood Alert and Warning codes

Flood Code	What it means	What to do
 Flood Alert	Flooding is possible, be prepared	Be prepared to act Prepare a flood kit of essential items Monitor local water levels and the flood forecast on the website
 Flood Warning	Flooding is expected, immediate action is required	Move family, pets and valuables to a safe place Turn off gas, electricity and water supplies if safe to do so Put flood protection equipment in place
 Severe flood warning	Severe flooding and danger to life	Stay in a safe place with a means of escape Be ready should you need to evacuate Co-operate with the emergency services Call 999 if you are in immediate danger
Warning no longer in force	Warning has been removed in the last 24 hours	Be careful. Flood water may still be around for several days and could be contaminated If you've been flooded, ring your insurance company as soon as possible

8.2.2 Community wide flood plan

Although the ASEA defences currently defend the area the standard of protection will diminish over time with the impacts of climate change. As the potential impacts of flood risk are widespread across the parish, a community flood plan could be developed for the area to help residents be prepared and coordinated in the event of a flood. The plan should establish the safest route of escape in the event of extreme flooding occurring. The plan could:

- Identify available flood warning systems and local triggers which will be used to active the flood response plan;
- Prepare procedures for the different levels of flood warning and local triggers available, including procedures for on and off-site evacuation; and
- Consider the depths, velocity and rate of onset of flooding.

8.3 Surface water drainage

Development sites will need to incorporate suitable surface water drainage proposals which should adhere to national and local guidance from South Gloucestershire Council as the LLFA. There are a number of local considerations that developers will need to consider:

- Much of the area is within the board district of the Lower Severn Internal Drainage Board, the requirements of the IDB including restrictions on flow rates or easements must be considered in surface water drainage design.
- The IDB rhine network has the potential for tide locking, where surface water drainage proposals introduce additional flows into the rhine network, the provision for additional emergency attenuation storage must be provided to mitigate the risk of drainage systems failing.
- Groundwater levels are likely to be very high with limited potential for infiltration, the risks posed by high groundwater levels must be factored into drainage design:
    - The potential for high groundwater levels to impact the hydraulic capacity and structural integrity of below ground drainage features and the impacts of floatation.
    - The potential for groundwater ingress into poorly sealed or designed surface water drainage systems.
    - In such cases the LLFA may request that additional groundwater monitoring is undertaken to support the feasibility of surface water drainage proposals.

9 Surface water management and SuDS

9.1 Sustainable Drainage Systems (SuDS)

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

It is essential that developers consider sustainable drainage at an early stage of the development process – ideally at the pre-application or master-planning stage. To further inform development proposals at the master-planning stage, pre-application submissions are accepted by the Council. This will assist with the delivery of well designed, appropriate, and effective SuDS. Applicants are also encouraged to engage with Severn Trent Water to discuss their surface water proposals, especially where adoption is proposed.

9.2 Sources of SuDS guidance

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

The Defra Non-Statutory Technical Standards for SuDS (gov.uk) provides non-statutory standards on the design and performance of SuDS. It outlines peak flow control, volume control, structural integrity, flood risk management and maintenance and construction considerations. The Local Authority SuDS Officer Organisation (LASOO) produced their Practice Guidance (susdrain.org) in 2016 to give further detail to the Non-Statutory technical guidance.

The Design and Construction Guidance (DCG) (water.org.uk), part of a new Codes for Adoption covering the adoption of new water and wastewater infrastructure by water companies, contains details of the water sector's approach to the adoption of SuDS.

9.3 Considerations for SuDS design

9.3.1 Four pillars of SuDS design

SuDS are designed to maximise the opportunities and benefits that can be secured from surface water management practices. SuDS design should consider the four pillars of SuDS (Figure 9-1): water quantity, water quality, amenity, and biodiversity.

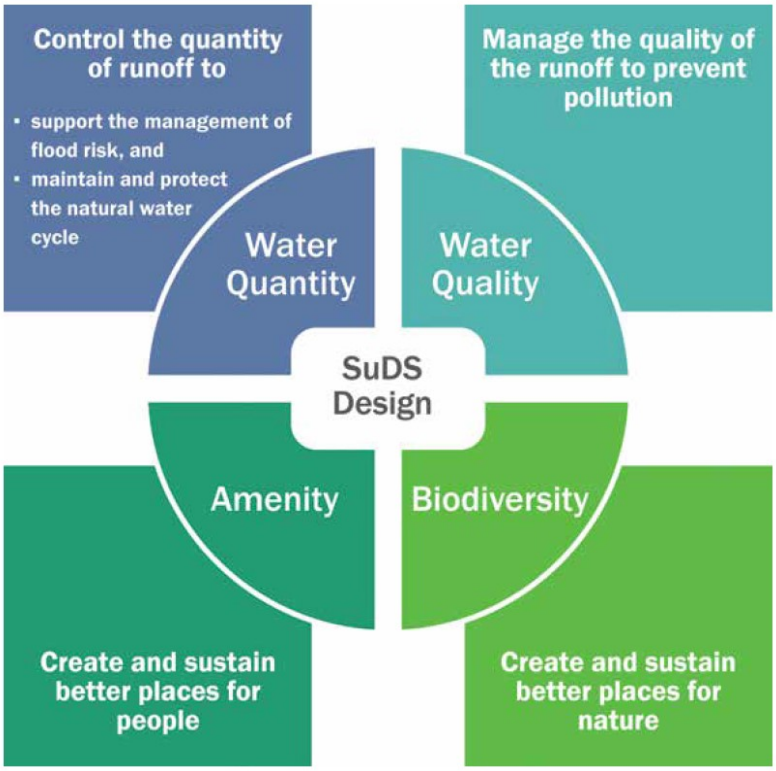

Figure 9-1: Four pillars of SuDS design (The SuDS Manual C753, 2015).

Given the flexible nature of SuDS, they can be used in most situations within new developments as well as being retrofitted into existing developments. SuDS can also be designed to fit into most spaces, for example, permeable paving could be used in parking spaces or rainwater gardens as part of traffic calming measures.

It is a requirement that *'applications which could affect drainage on or around the site should incorporate sustainable drainage systems to control flow rates and reduce volumes of runoff, and which are proportionate to the nature and scale of the proposal. These should provide multifunctional benefits wherever possible, through facilitating improvements in water quality and biodiversity, as well as benefits for amenity'* (NPPF Paragraph 182).

It is important that SuDS are maintained for the lifetime for the development so that features can function as designed. Consideration should be given to enhancing SuDS to achieve biodiversity net gain.

9.3.2 Types of SuDS System

There are many different SuDS techniques that can be implemented in attempts to mimic pre-development drainage. Techniques can include soakaways, infiltration trenches, permeable pavements, grassed swales, green roofs, ponds and wetlands. Many of which do not necessarily need to take up a lot of space. The suitability of the techniques will be dictated in part by the development proposal and site conditions. Advice on best practice is available from the EA and the Construction Industry

Research and Information Association (CIRIA) e.g. the CIRIA SuDS Manual C753 (2015).

9.3.3 SuDS management train

SuDS should not be used individually but as a series of features in an interconnected system designed to capture water at the source and convey it to a discharge location. Collectively this concept is described as a SuDS Management Train (see Figure 9-2).

The number of treatment stages required within the Management Train depends primarily on the source of the runoff and the sensitivity of the receiving waterbody or groundwater.

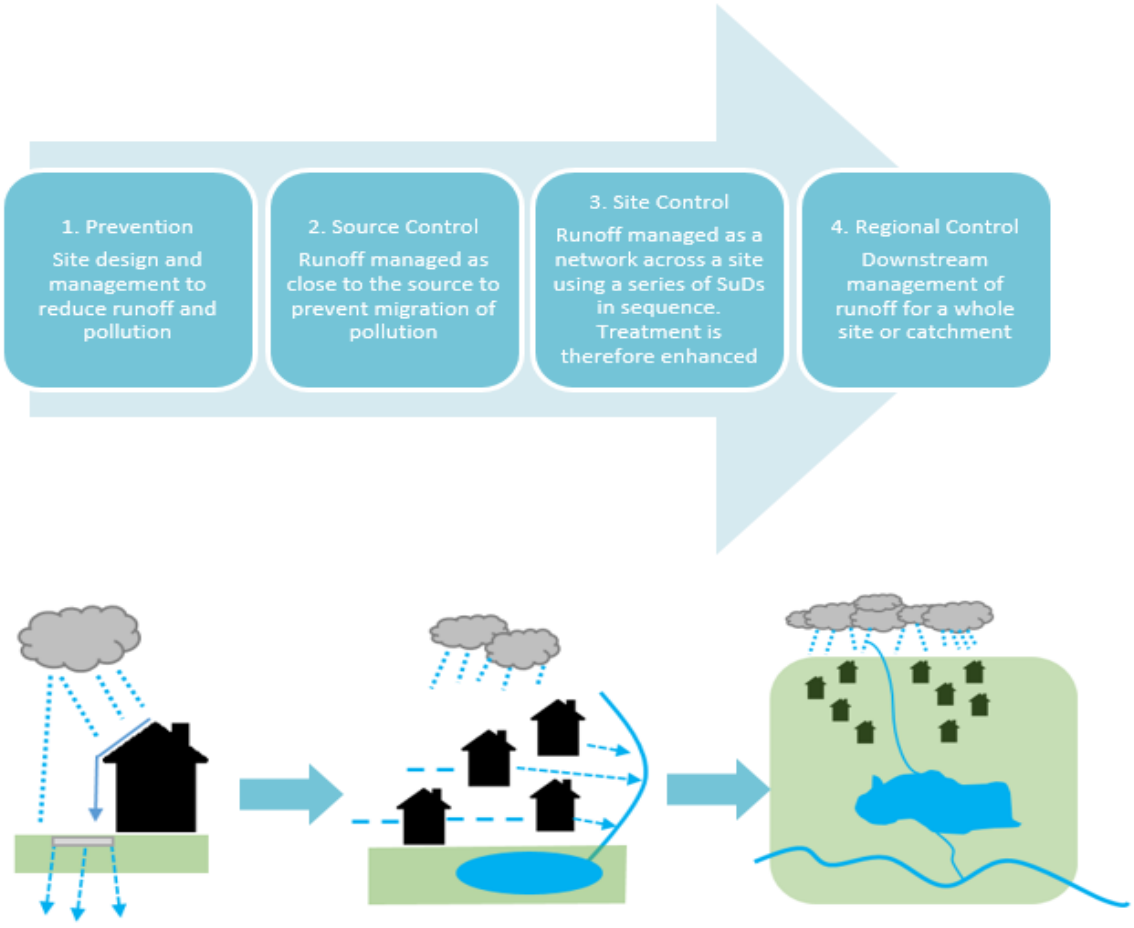

Figure 9-2: SuDS Management Train.

9.3.4 SuDS considerations

The design of a SuDS system will be influenced by a number of physical and policy constraints. These should be taken into account and reflected upon during the conceptual, outline and detailed stages of SuDS design. Table 9-1 details some possible constraints and how they may be overcome.

Drainage from new development sites or redeveloped sites should be designed in line with the drainage hierarchy (PPG: Flood Risk and Coastal Change Paragraph: 056 Reference ID: 7-056-20220825) which initially promotes the use of infiltration prior to considering alternative drainage. For SuDS techniques that are designed to encourage infiltration, it is imperative that the water table is low enough to receive surface run-off waters. Most types of SuDS will be suitable in areas with permeable bedrock including features such as soakaways and infiltration basins. In areas with more impermeable geology, off-site discharge in accordance with the drainage hierarchy may be required to discharge surface water runoff from the site. In some cases, above-ground features such as attenuation ponds may be practical with a managed outlet or discharge point. Infiltration should be considered with caution within areas of possible subsidence or sinkholes.

A site-specific infiltration test will need to be conducted early on as part of the design of the development in order to determine the impact of groundwater levels on the effectiveness of the drainage system. Groundwater monitoring is also encouraged and may be required in some locations.

Where sites lie within or close to Groundwater Source Protection Zones (SPZs) or aquifers, further restrictions may be applicable, and guidance should be sought from the LLFA and the EA.

Table 9-1: Example SuDS design constraints and possible solutions

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

10 Conclusion

10.1 Background

JBA Consulting has prepared a Level 2 SFRA to support the development of the Pilning and Severn Beach Neighborhood Plan on behalf of the Neighborhood Plan Steering Group (NPSG).

Nine sites were identified by the NPSG as requiring a Level 2 assessment following the application of the Sequential Test. These sites have been grouped together for assessment to form a total of 6 site summary tables. The sites were identified in the neighborhood plan as being potential allocations. Due to the risk of flooding these sites require further information so that the NPSG can apply the Exception Test.

10.1.1 Flood Risk

Historic flood extents made available by the EA indicates that there has been extensive flooding within the study area, however none of the proposed sites are situated within the flood extents.

The detailed ASEA modelling has been used to understand flood risk to the area, this highlights that although the area is in Flood Zone 3a and 2 it is situated behind existing sea defences affording a 1 in 200 year standard of protection. However, without a commitment to maintain the standard of protection into the future, areas of the study area will be at risk of tidal flooding in the future due to the impacts of climate change. The area is also at risk during a breach in both present day and climate change events.

Although surface water flood extents are minimal, the risks posed by tide-locking of the IDB rhine network should be considered where development proposes to discharge surface water runoff into the rhines. The area likely also features high groundwater levels. The risks posed by sewer and groundwater flooding are negligible.

10.2 Recommendations

In addition to site specific recommendations in the site summary tables, development should implement the following recommendations in the interests of safety for future users/ occupants:

- Be supported by an NPPF compliant Flood Risk Assessment;
- Consider the future impacts of flood risk, including the potential need for developer contributions to maintain the design standard of protection of existing defences.
- Incorporate flood resilient design principles in accordance with the existing Pilning and Severn Beach Neighbourhood Area Design Codes and Guidance.
- Consider access and egress arrangements in accordance with the ADEPT guidance due to the risk of tidal flooding in the future or during a breach event.
- Development should be designed with a place of safe refuge 300mm above the maximum flood level during a breach event in the 0.5% AEP 2123.
- We recommend both existing and future residents are signed up to the EA's Flood Warning Service.
- Consideration as to whether a community flood plan should be developed in the interests of safety for existing and future residents.
- Development sites will need to incorporate suitable surface water drainage proposals which should consider the potential impacts of tide-locking and high groundwater levels.

Development must meet the sustainability targets identified in the Neighbourhood Development Plan and the NPSG Sequential Test. Therefore, prepared site-specific Flood Risk Assessments and exception tests must accord with those sustainability targets.

A Overview Mapping

B Site summary tables

Offices at

Bristol
Coleshill
Doncaster
Dublin
Edinburgh
Exeter
Glasgow
Haywards Heath
Leeds
Limerick
Newcastle upon Tyne
Newport
Peterborough
Portsmouth
Saltaire
Skipton
Tadcaster
Thirsk
Wallingford
Warrington

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