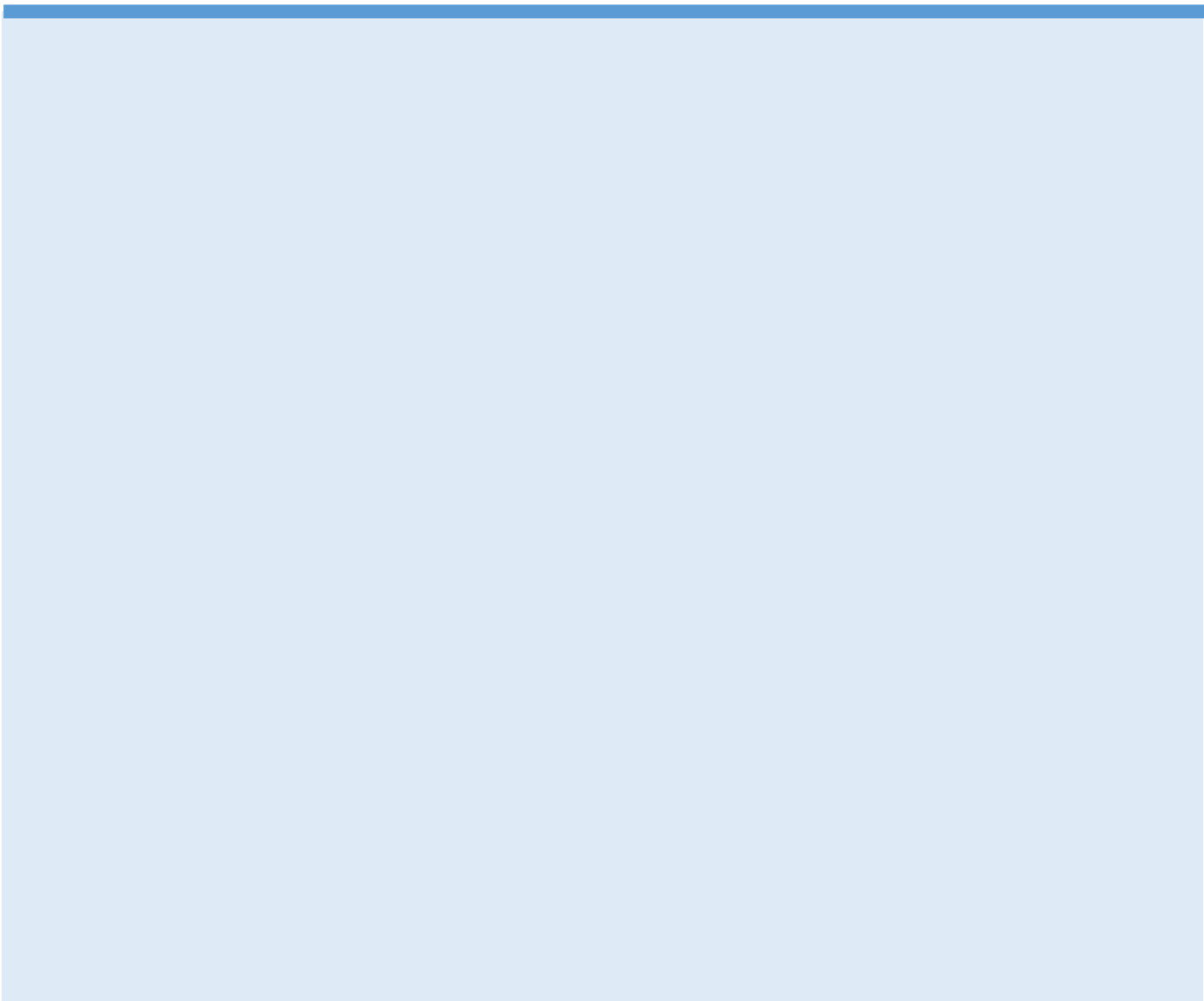


Southampton Level 2 Strategic Flood Risk Assessment

Version 1.2

May 2017



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Record of Amendments

Date of Publication	Record of Amendments
V1.1 January 2017	First publication
V1.2 May 2017	Flood records updated to include those to April 2017 – alterations to Appendix A and B

1. Introduction

Flood events can, more than many other emergencies, affect a wide number of homes and businesses, causing disruption, damage, and even loss of life. The time required to fully recover from a flood can be prolonged, leaving many temporarily, or even permanently displaced anywhere from a matter of days to a number of years.

Financially, the average cost of damage to a home as a result of flooding is somewhere in the region of between £20,000 and £50,000 (Association of British Insurers (ABI) January 2016 figures), however the financial impact on property can last years, negatively impacting property prices in an area affected by flooding. This highlights the need for both planners and developers to take flood risk into consideration when determining where development can take place, to reduce the risk for both people and property.

This document is the Southampton Level 2 Strategic Flood Risk Assessment hereafter referred to as the SFRA. It supersedes the Level 2 SFRA published in 2010. The SFRA provides a point of reference for both planners and developers when considering development at a site where flood risk exists, present day and/or in the future.

1.1 Background

It is emphasised within the National Planning Policy Framework (NPPF) that Local Planning Authorities (LPAs) should take an active role to ensure that flood risk is considered in strategic land use planning to reduce the impact of flooding on people and property. Paragraph 100 of the NPPF which states that *'inappropriate development in areas at risk of flooding should be avoided by directing development away from areas of highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere'*.

It is well documented in the NPPF that a SFRA is required to support the Local Plan, and encouraged by the accompanying Planning Practice Guidance (PPG) that LPAs undertake an SFRA to *'fully understand and assess the flood risk from all sources in the area both at present day and in the future (taking account of climate change), and to assess the impacts that changes to land use and development will have on flood risk'*.

This Level 2 SFRA has been prepared under the requirements of the NPPF and PPG, whilst following the guidance supplied by the Environment Agency. The results will be used to inform the development of the Local Plan and assist with the making of planning decisions.

1.2 Purpose of the SFRA

The purpose of this SFRA is to provide an overview of all sources of flood risk in Southampton, covering all areas within the Southampton City Council (SCC) administrative boundary (see Map 1). It aims to provide general guidance to planning officers, developers and other interested parties about areas where flooding is an issue, whilst forming an integral part of the Council's evidence base in terms of identifying locations for development and preparation of flood risk policies.

There are two different levels of the SFRA that reflect the likely risk of flooding from all sources and development pressures. They are:

- **Level 1 SFRA:** where flooding is not a major issue and where development pressures are low. It should be sufficiently detailed to allow application of the Sequential Test.
- **Level 2 SFRA:** where land outside flood risk areas cannot appropriately accommodate all the necessary development and the Exception Test needs to be applied. The assessment should consider the detailed nature of flood characteristics within a flood zone.

It is accepted that new development within Southampton cannot take place solely within Flood Zone 1 where there is a very low risk of flooding from the rivers and sea, therefore a Level 2 SFRA is required to provide the additional information needed to apply the Exception Test.

1.3 Objectives of the SFRA

The main objectives of the SFRA are to:

- a) Inform policies and plans to ensure future developments, where appropriate, have been subjected to the Sequential Test and Exception Test;
- b) Form part of the evidence base supporting the development allocations within the Local Plan to ensure they are in accordance with the NPPF;
- c) Identify strategies to limit flood risks and adapt to climate change;
- d) Ensure the safety of new development.

In order to achieve these objectives, PPG states that SFRAs are required to provide sufficient detail on all types of flood risk to enable the LPA to:

- Determine flood risk from all sources of flooding across the administrative area.
- Ensure that flood risk is fully taken into account when considering allocation options, and in the preparation of future plan and policies.
- Provide the basis from which to apply the Sequential Test and where necessary, the Exception Test.
- Identify the requirements for site-specific Flood Risk Assessments in particular locations.
- Determine the acceptability of flood risk in relation to emergency planning capability.
- Consider opportunities to reduce flood risk to existing communities and developments through better management of surface water, provision for conveyance and storage of water.

1.4 Outputs of the SFRA

The SFRA provides a number of outputs in order to assess the risk of flooding in Southampton and satisfy the objectives listed in section 1.3. The outputs will include:

Level one outputs:

- Maps showing the Local Planning Authority area, Main Rivers, ordinary watercourses and flood zones.

- An assessment of the implication of climate change on flood risk.
- Areas at risk from other sources of flooding, for example surface water or reservoirs.
- Flood risk management measures, including location and standard of flood defences, flood warning coverage and emergency plans.
- Recommendations about the identification of critical drainage areas and the potential need for surface water management plans.
- Advice on the likely applicability of sustainable drainage systems for managing surface water runoff at key development sites.
- Advice on the preparation of Flood Risk Assessments for development sites.

Level two outputs:

- An appraisal of the current condition of flood defence infrastructure.
- An appraisal of the probability and consequences of overtopping or failure of flood risk management infrastructure, including an appropriate allowance for climate change.
- Definition and mapping of the functional floodplain.
- Maps showing the distribution of flood risk across all flood zones from all sources of flooding taking climate change into account.
- Advice on appropriate policies for sites which could satisfy the first part of the Exception Test, and on the requirements that would be necessary for a site-specific Flood Risk Assessment supporting a planning application for an application to pass the second part of the Exception Test.
- Advice on the preparation of a site-specific Flood Risk Assessment for sites of varying risk across the flood zones, including information about the use of sustainable drainage techniques.
- Meaningful recommendations to inform policy, development control and technical issues.

1.5 Southampton

The City of Southampton is the largest settlement in South Hampshire, with an estimated population of 236,900 which is expected to grow to at least 252,600 by 2035 (2011 Census, Office of National Statistics). Southampton is a major employment centre providing the focus for commercial, retail and port-based industries. The city is divided into 16 ward areas (also used to record flood reports), and bordered by Test Valley District Council to the north-west, Eastleigh Borough Council to the north-east, and New Forest District Council to the south across Southampton Water. Map 1 provides an overview of the city.

The city covers a land area of approximately 50km², of which around 80% is currently developed. A large portion of the low-lying ground around the Southampton waterfront is land previously reclaimed from the sea in the early 20th Century. There is approximately 35km of tidal frontage in Southampton.

The 2011 Census recorded 98,300 residential dwellings in the city. Several areas of undeveloped open space exist to the north-west, north and south-east of the city, along with the main parks, greenways and other open spaces including

Southampton Common, Weston Shore, and Riverside Park. The city also has a number of internationally protected habitats, Sites of Special Scientific Interest and Ramsar Sites, many of which are located along the coastline of the tidal Itchen Estuary.

1.6 Using the SFRA

The SFRA provides SCC with the information required to assess the allocations of new development sites and apply the risk based Sequential Test. The SFRA also provides information for planners to make strategic decisions that identify the amount and type of development that may be appropriate, its deliverability, the infrastructure required to make the development 'safe' from flooding, and requirements for the management of run-off.

It is important to recognise that the Level 2 SFRA has been developed using the best information available at the time of writing. This relates to both the current risk of flooding, and the potential impacts of future climate change. It is the responsibility of the user to check for more up-to-date information prior to using the outputs of the SFRA for any purpose including, but not limited to, the support of strategy development, or development of a site-specific Flood Risk Assessment for a proposed development.

The Environment Agency regularly reviews and updates the flood risk mapping. It is important that they are approached to determine whether updated or more accurate information has become available prior to commencing a site-specific Flood Risk Assessment.

It is possible that, as a result of any future changes to legislation, data, policy, baseline flooding situations or revised Government guidance, the outputs of the SFRA may become invalid. This SFRA is intended to be a live document and effort will be made to update it as and when new information, data or guidance becomes available. Timescales for updates will depend on factors including the impact of the change and availability of staff resources.

2. Policy and Legislative Framework

The overarching aim of planning policy on development and flood risk is to ensure that people and property are kept safe from flooding by directing development away from areas of highest flood risk. This section outlines the planning framework and the responsibilities that planning officers and developers must adhere to when proposing development or approving applications. Since the publication of the first Level 2 SFRA in August 2010 there have been a number of changes to the planning system, policy, regulations, legislation and law, including the introduction of:

- National Planning Policy Framework (NPPF) (2012)
- Planning Practice Guidance (PPG) (March 2014)
- Flood Risk Regulations (2009)
- Flood and Water Management Act (2010)
- Localism Act (2011)

2.1 National Plans and Policies

2.1.1 National Planning Policy Framework

The NPPF was issued on 27 March 2012 during the Government's reforms to make the planning system less complex and easier to understand. The NPPF sets out the Government's planning policies for England, replacing Planning Policy Statements (PPS).

Paragraphs 99 to 108 of the NPPF relate specifically to flood risk and coastal change (replacing PPS 25: Development and Flood Risk) providing national planning guidance in relation to the assessment of flood risk when considering development in areas where a risk of flooding exists.

The NPPF provides guidance to Local Planning Authorities, helping them to prepare Local Plans whilst considering flood risk. In particular Paragraph 100 of the NPPF states '*Local Plans should be supported by Strategic Flood Risk Assessment and develop policies to manage flood risk from all sources, taking account of advice from the Environment Agency and other relevant flood risk management bodies, such as lead local flood authorities and internal drainage boards. Local Plans should apply a sequential, risk-based approach to the location of development to avoid where possible flood risk to people and property and manage any residual risk, taking account of the impacts of climate change*'.

The key message of the NPPF is to guide new development into areas with the lowest probability of flooding by applying the Sequential and Exception Tests as appropriate. Where it is not possible to locate development in areas with the lowest risk of flooding, all sources of flood risk must be carefully assessed and appropriate mitigation measures put in place to reduce the impact on people and property over the lifetime of the development.

2.1.2 Planning Practice Guidance

PPG was originally published in March 2014 to replace both the NPPF Technical Guidance (2012) and the Planning Policy Statement Practice Guidance (2009). PPG gives detailed guidance on how planning can take account the risks associated with flooding and coastal change in plan making and the application process.

In May 2015 the PPG was updated to reflect changes to the planning framework made by central Government regarding the requirement for Sustainable Drainage Systems to be incorporated into all major development.

The PPG should be applied alongside the NPPF, to all developments and planning applications.

2.1.3 Flood Risk Regulations

The Flood Risk Regulations (2009) transpose the EU Floods Directive into UK law, placing a responsibility on Lead Local Flood Authorities (LLFA) to manage local flood risk. This means that SCC, as a designated LLFA, has the responsibility for the management of flooding from groundwater, ordinary watercourses and surface water (local sources of flooding), while the Environment Agency remains responsible for the management of flooding from the sea, main rivers and reservoirs.

It is a requirement under the Flood Risk Regulations for all LLFAs to '*prepare a preliminary assessment report in relation to flooding in its area*' including information on past floods and the possible harmful consequences of future flooding.

2.1.3.1 Preliminary Flood Risk Assessment

SCC prepared a Preliminary Flood Risk Assessment (PFRA) for Southampton in accordance with the Flood Risk Regulations, publishing the main report in June 2011. The assessment considers the effects of past flooding and the potential consequences of future flooding from local flood sources, including surface water, groundwater and ordinary watercourses, in order to develop a clear understanding of local flood risk within the city. Nationally, the PFRA provides a high level summary of the areas at significant risk from local sources of flood risk (as per information available in 2011). PFRAs follow a 6 year cycle, with the next update due in 2017.

View the PFRA for Southampton online at: www.southampton.gov.uk/flooding

2.1.4 Flood and Water Management Act

The Flood and Water Management Act (FWMA) received royal assent in April 2010, aiming to create a simpler and more effective means of managing the risk of flood and coastal erosion. The FWMA incorporates and implements some of the recommendations from the Pitt Review (2008), following the severe flooding that affected a large area of the UK in 2007.

The FWMA also places a number of new duties and responsibilities on LLFAs regarding the management of local flood risk, including:

- Develop, maintain, apply and monitor a Local Flood Risk Management Strategy.
- Approve, adopt and maintain Sustainable Drainage Systems (SuDS) (yet to be implemented).

- Establish and maintain a flood risk Asset Register.
- Investigate incidents of flooding (where appropriate) and publish the findings in a report.
- Ensure delivery of effective and joined up management of flood risk.

Under the FWMA, LLFAs also have the power to:

- Designate any feature or structure which may have significant impact on flood risk.
- Consent and enforce certain activities associated with ordinary watercourses.
- Undertake works to manage flood risk.

2.1.4.1 Local Flood Risk Management Strategy

The FWMA places a statutory duty on all LLFAs to ‘*develop, maintain, implement and monitor a Local Flood Risk Management Strategy (LFRMS) to manage local flood risk in its area*’. In respect of this duty, SCC has produced a LFRMS which was formally adopted in November 2014.

The purpose, and overarching aim of the LFRMS is to help individuals, communities, businesses and other risk management authorities better understand and manage flood risk within the city. It lists a number of objectives which will help SCC achieve this aim. Chapter 6 of this SFRA describes the LFRMS in more detail.

The LFRMS is available on the SCC website at www.southampton.gov.uk/flooding

2.1.5 The Localism Act

The Localism Act was introduced in November 2011 with the aim of devolving more decision making powers from central Government back to local councils, communities and individuals. It covers a range of issues relating to local public services, community rights, neighbourhood planning and housing.

A duty to cooperate in relation to planning of sustainable development was placed on local authorities though Paragraph 110 of the Act. This duty to cooperate requires LAs to ‘*engage constructively, actively and on an ongoing basis in any process by means of which development plan documents are prepared so far as relating to a strategic matter*’.

2.1.6 Flood Risk Standing Advice

Produced by the Environment Agency, Flood Risk Standing Advice is a tool to assist LPAs with planning applications for development (including minor development and change of use) in areas at risk of flooding. It also helps LPAs assess some types of planning applications without the need to directly consult with the Environment Agency.

Flood Risk Standing Advice can be found here: <https://www.gov.uk/guidance/flood-risk-assessment-local-planning-authorities#check-if-you-need-to-consult>

2.1.7 Civil Contingencies Act

The Civil Contingencies Act 2004 is a piece of legislation that aims to provide a single framework for civil protection in the United Kingdom and sets out the actions that need to be taken in the event of a flood. The Act is separated into two substantive parts: local arrangements for civil protection (Part 1) and emergency powers (Part 2).

2.2 Local Plans and Policy

2.2.1 Southampton Local Plan

The City of Southampton Local Plan provides the framework for all development in the city to 2026. The Local Plan is a collection of adopted plans. These consist of the:

- Core Strategy (adopted 2010), including changes from the Core Strategy Partial Review (adopted 2015).
- City Centre Action Plan (adopted 2015).
- Local Plan Review – ‘saved’ policies (amended 2015).
- Minerals and Waste Plan (adopted 2013).

They guide new developments to appropriate locations whilst protecting and improving the environment and people’s quality of life. They will be used to decide planning applications and investment decisions across the city.

2.2.2 Southampton Core Strategy

The Core Strategy is one of the Plans that makes up the adopted Local Plan, outlining the future plans for the City of Southampton. It aims to promote the economic growth of the city and deliver the sustainable community strategy’s vision for Southampton. It explains how much and what type of development there will be in the city and where this will be located.

The Core Strategy is produced in accordance with the Planning and Compulsory Purchase Act 2004 and conforms to the (now abolished) Regional Spatial Strategy (RSS) as well as reflecting national policies. It is the strategic Development Plan Document (DPD) within the Local Development Framework. It is supported by a Sustainability Appraisal (SA) and Strategic Environmental Assessment (SEA) to ensure the strategy accords with the principles of sustainable development, and an Appropriate Assessment (AA) to demonstrate that the policies in this plan do not harm European designated sites for nature conservation.

The strategy sets out the long term spatial vision and the objectives for Southampton, the strategic policies and development principles. The strategy strives to implement spatial and transport policies based on development, housing and regeneration needs. Thus it sets out broad locations for delivering the housing and other strategic development (employment, retail, leisure, community, essential public services and transport development). The Core Strategy has a spatial vision to show what the city will look and feel like in 2026. The vision will be delivered through strategic objectives which are grouped together under three headings:

- A growing regional centre within a prosperous South Hampshire.

- Strong and distinctive neighbourhoods – a good place to live.
- An environmentally sustainable city.

The Core Strategy was initially adopted in January 2010 following a public examination. In March 2015 it was amended to incorporate changes following the adopted Core Strategy Partial Review. Changes included a reduction in development targets for new office and retail floor space, and the inclusion of a presumption in favour of sustainable development.

2.2.2.1 Flood Risk and the Core Strategy

Due to the importance of new city centre development in contributing to the region's economic growth and in regenerating parts of the city centre some sites within medium and high flood risk areas will need to be considered for development. Such proposals will need to demonstrate appropriate mitigation and adaptation measures such as land raising and providing safe means of escape on key housing sites and other vulnerable uses.

Responding to climate change and making Southampton more environmentally sustainable is a theme that runs throughout the Core Strategy. As a coastal city climate change is a major issue for Southampton and significant impacts are predicted on water resources, sea levels, the coastline and the natural environment.

The City of Southampton Strategy's vision states that:

'As the major city in central southern England, Southampton will be recognised as the region's economic, social and cultural driver, building on its role as an international seaport, centre for cutting edge research and leading retail centre. It will be a centre of learning, have a varied and exciting cultural landscape and be known for its innovative and creative businesses, leisure opportunities and fine parks and open spaces. Adapting into a sustainable waterfront city Southampton will have a world-wide profile, attracting visitors, new citizens and businesses by being the UK's premier cruise liner home port, a major European container port and the local city for one of the UK's top airports. Southampton will be known as a city that is good to grow up in and good to grow old in where people are proud to live and economic success is harnessed to social justice'.

To adequately inform the vision, twenty strategic objectives were identified in the Core Strategy. Flood risk is acknowledged in Strategic Objective 20, which states: *'Adopt an 'avoid, reduce and mitigate' approach to flooding to achieve an appropriate degree of safety, so adapting positively to sea level rise'.*

Flood risk is also recognised as a common issue through many of the Core Strategy policies. Core Strategy Policy CS20 (Tackling and Adapting to Climate Change) states *'Sustainable Drainage Systems (SUDS) and measures to reduce or avoid water contamination and safeguard groundwater supply should be incorporated into all development, unless it can be demonstrated that this is not appropriate in a specific location'.*

Core Strategy Policy CS 23 (Flood Risk) states: *'The Council will work with the Environment Agency and other key stakeholders to manage flood risk in the city, particularly in relation to new development in the flood risk zones within the city centre and Northam... Development will achieve an appropriate degree of safety taking into account standards of defence and sea level rise over the life of the development'.*

Core Strategy Policy CS 25 (Infrastructure and developer contributions) states that *'development will only be permitted if the necessary infrastructure services, facilities and amenities to meet the needs of the development are available or to be provided at the appropriate time. SCC will seek developer contributions towards measures required in association with the development, which may include flood defence infrastructure, to deliver sustainable development and be safe'*.

2.2.3 City Centre Action Plan

The City Centre Action Plan (CCAP), adopted in March 2015, updates the statutory planning framework for the city centre. It sets the framework for protecting the historic and natural environments, tackling climate change and creating an attractive and uplifting place to be, while promoting more offices, shops, homes and leisure facilities. It identifies the improvements in infrastructure required to support this growth to create a city centre we can be proud of. The vision in the City Centre Action Plan will be delivered through action across 6 cross-cutting themes.

The City Centre Action Plan is used by the council when deciding planning applications in the city centre. It replaces the city centre policies in the Local Plan Review.

2.2.3.1 Flood Risk and the City Centre Action Plan

The CCAP acknowledges that flood risk is an issue within Southampton. Policy AP 15 Flood Resilience states that:

The Council will work with the Government and Environment Agency, developers and landowners, to implement a strategic flood defence for the city, including the city centre. To help achieve this:

1. Strategic contributions will be received from developers towards a flood defence, through the Councils Community Infrastructure Levy (CIL) policy.
2. Where the flood defence search zone passes through a site, development will be designed to facilitate the delivery of an appropriate strategic flood defence, as follows:
 - a. All or part of the development site will be raised to form the defence; or
 - b. If it is clear that 'a' is not practical, viable or appropriate, development will:
 - i. When necessary, provide a robust 'front line' defence as an integral part of the development.
 - ii. If 'i' is not necessary, safeguard an area of land sufficient to provide a robust and appropriate 'front line' defence at a future date

Development proposals which are or will be within a flood risk zone:

1. Will be accompanied by a Flood Risk Assessment;
2. Will:
 - a. Provide a safe access and egress route away from the flood risk (i.e. to flood zone 1 or where flood risk is negligible) during a design flood event; and
 - b. Locate more vulnerable uses in the area of the proposal least at risk;

- c. Or provide a clear justification as to why these requirements are not practical, viable or appropriate in planning and design terms.
1. Will achieve an appropriate degree of safety over the lifetime of the development. The minimum safety standards are as follows:
 - a. For more vulnerable uses, the floor levels of habitable rooms will be above the design flood level.
 - b. For all uses the development will:
 - i. Remain structurally sound in an extreme flood event;
 - ii. Provide appropriate flood resistance / resilience measures to the extreme flood level;
 - iii. Not generate an increase in flood risk elsewhere;
 - iv. Provide a flood plan, which covers methods of warning and evacuation;
 - v. Provide an appropriate safe refuge above the extreme flood level if criterion 4a is not met.

Provision for a strategic flood defence and measures to make individual sites safe will integrate as far as practicable with the principles of good design for the site and wider cityscape, including public access to and along the waterfront.

2.2.4 Local Plan Review (2006)

The Local Plan Review is one of the current Local Plan Documents for the city. It is part of the statutory land-use plan and is used to make planning decisions. This means that it sets out the authority's policies on which land across the city should be developed and used, and against which applications for planning permission will be determined. This includes allocating areas and sites as suitable for uses such as housing, industry and shopping.

The Local Plan Review was first adopted in March 2006 after a public inquiry into the objections to the Plan. Parts of the Local Plan Review were replaced or changed by policies in the adopted Core Strategy, and a revised version was produced in 2010 to show the updated policies, including a list of 'saved' policies that remain operational. The Local Plan Review was last revised in March 2015 following the adoption of the City Centre Action Plan and Core Strategy Partial Review.

2.2.4.1 Flood Risk and the Local Plan

The Local Plan has an important role to play in resisting development where it would threaten the quality of water supplies or increase flood risk or be at direct risk from flooding itself. The initial policy SDP 20 Flood Risk and Coastal Protection was replaced by Core Strategy Policy CS 23 in the March 2015 partial review.

3. How Flood Risk is Assessed

The terms ‘flood’ and ‘flood risk’ are used many times throughout this SFRA. The standard definitions are set by the Flood and Water Management Act 2010 (FWMA) and used by all flood risk management authorities.

A “flood”, as defined by the FWMA includes ‘any case where land not normally covered by water becomes covered by water’.

It ‘does not matter for the purpose of subsection (1) whether a flood is caused by –

- (a) Heavy rainfall,
- (b) A river overflowing or its banks being breached
- (c) A dam overflowing or being breached
- (d) Tidal waters
- (e) Groundwater, or
- (f) Anything else (including any combination of factors)

A “flood” does not include –

- (a) A flood from any part of a sewerage system, unless wholly or partially caused by an increase in the volume of rainwater entering or otherwise affecting the system, or
- (b) A flood caused by a burst water main

“Flood risk” is defined by Section 3 (subsection 1) of the FWMA as ‘a risk in respect of an occurrence assessed and expressed (as for insurance and scientific purposes) as a combination of the probability of the occurrence with its potential consequences’. For simplicity, flood risk can be defined as:

Flood Risk = Probability (*chance*) of a flood **X** potential consequences (*impacts*) of a flood.

For the purposes of applying the NPPF, flood risk is defined as a combination of the probability and the potential consequences of flooding from all sources – including rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals, lakes and other artificial sources.

3.1 Flood Zones

Flood Zones describe the land that would be at risk of flooding from rivers and the sea, if there were no defences present, depending upon the magnitude of a flood event. Table 1, reproduced from the PPG describes each Flood Zone, based upon the criteria set by the Environment Agency. It is these criteria, and data from the Environment Agency that has been used to prepare the mapping that accompanies this SFRA.

When allocating land for development, it is preferred that (wherever possible), all new development is placed within in Flood Zone 1 where there is a low probability of flooding. Map 8 shows the areas of Southampton that are within each of the defined Flood Zones. Figure 1 gives a visual of the Flood Zones in relation to a river.

Table 1: Environment Agency Flood Zones Definitions

Flood Zone	Definition
Zone 1 (low probability)	Land having a less than 1 in 1,000 annual probability (0.1% chance) of river or sea flooding.
Zone 2 (medium probability)	Land having between a 1 in 100 and 1 in 1,000 annual probability (1% - 0.5% chance) of river flooding; <u>or</u> between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.
Zone 3a (high probability)	Land having a 1 in 100 or greater annual probability of river flooding; <u>or</u> a 1 in 200 or greater annual probability of sea flooding.
Zone 3b (functional floodplain)	This zone comprises land where water has to flow or be stored in times of a flood.

Note: Flood Zones are shown on the Environment Agency flood maps for planning. It is important to be aware that these flood maps do not take account of the possible impacts of climate change or future probability of flooding.

It should be noted that the Flood Zones set by the Environment Agency only consider flooding from the sea and rivers.

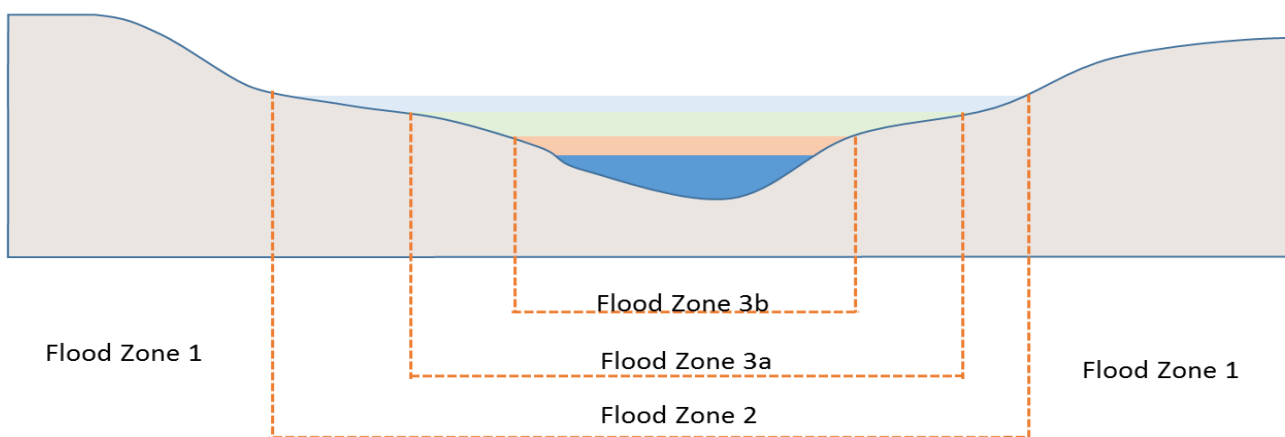


Figure 1: Visual outline of Flood Zones

Flooding from sources such as surface water, groundwater and sewers can occur anywhere, regardless of the Flood Zones.

3.2 Actual Flood Risk

Actual flood risk takes into account the presence of flood defences, providing a description of the safety of existing and proposed development. The following issues should be considered when assessing actual flood risk

- The level of protection afforded by existing defences might be less than appropriate and may need to be improved.

- The flood risk management policy for the defences will provide information on the level of future commitment to maintain existing standards of protection.
- The standard of safety must be maintained for the intended lifetime of the development (assumed to be 100 years for residential, and 60 years for non-residential). This means that over time, with the effect of climate change, maintenance and/or upgrade of the defence may be necessary to maintain present day standard of protection.

The assessment of actual risk can include consideration of the magnitude of the hazard posed by flooding, but does not allow for residual breach risk. By understanding the depth, velocity, speed of onset and rate of rise of floodwater it is possible to assess the level of hazard posed by flood events from the respective sources. This assessment will be needed in circumstances where consideration is given to the mitigation of the consequences of flooding or where it is proposed to place lower vulnerability development in areas that are at risk from inundation.

3.3 Residual Flood Risk

Residual risk refers to the risk that remains after all risk avoidance, reduction and mitigation measures (e.g. flood defences) have been taken to alleviate flooding. Whilst flood risk management infrastructure, including flood defences and flood storage areas, offer significant benefits to people and property by reducing the frequency and likelihood of flooding, the flooding hazard is not removed completely.

Examples of residual risk can include:

- The breach or failure of flood defences or flood risk management infrastructure including the failure of flood gates, flood embankments and/or pumping stations to operate in their intended manner.
- Failure of a reservoir, or;
- The effect of a flood of a higher magnitude than a defence/management measure was designed for, such as a flood that overtops a raised flood defence, or an intense rainfall event which the drainage system has not been designed to manage.

It is important that these risks are quantified to confirm that the consequences can be safely managed. When assessing the residual risk, thought should be given to the vulnerability of the receptors and the mitigation required to manage the resultant flood.

4. Understanding Flood Risk in Southampton

PPG requires that the Level 2 SFRA assesses flood risk from the six sources of flooding, as each are likely to present a range of different risks. The sources identified are:

- The sea (tidal).
- Rivers (fluvial).
- Surface water (pluvial).
- Groundwater.
- Sewers (foul, surface water and combined systems).
- Artificial sources (e.g. reservoirs).

This chapter provides an overview of the flood risk in Southampton from each of the above sources, providing the relevant information to apply the Sequential Test, and for sites where it is a requirement to prepare a site specific Flood Risk Assessment. Please see Chapter 5 for further information on the Sequential Approach, and Chapter 7 for guidance on the development of site specific Flood Risk Assessments.

4.1 Topography, Hydrology, Geology and Soils

Various factors including topography, hydrology, geology and soils can all have an influence on flooding. Local and site-specific conditions can also influence the suitability of flood management techniques such as Sustainable Drainage Systems (SuDS). The following sections give a brief overview of the Southampton environment.

4.1.1 Topography

A Digital Terrain Model (DTM) has been generated using LiDAR data (see Map 2). LiDAR is remotely sensed topographic data, with quoted vertical accuracies in the region of +/- 150mm in Southampton.

The DTM shows Southampton generally sloping downwards from the outer edges of the administrative boundary towards the River Test, River Itchen and coastal frontage. The highest areas of the city are to the north, along the boundaries with Test Valley and Eastleigh, where land heights are typically 50-60 metres above ordnance datum (mAOD). In contrast, the lowest areas are along the coastal frontage, including the docks where much of the land has been reclaimed. Here ground elevations average 3mAOD, with some areas as low as 0.5mAOD.

4.1.2 Hydrology

Southampton receives, on average, 779.4mm of rainfall per year making it one of the drier areas of the south. For comparison, the average for south England for the same period was 793.9mm per year (based on Met Office data averages for 1918-2010).

Southampton is within two large catchment areas, split between the River Test to the west, and the River Itchen to the east, the outlines of which are shown in Map 3. Both the Test and the Itchen are fed by groundwater from the underlying chalk aquifer close to the source, which is outside of the SCC administrative boundary. This helps to regulate the flows throughout the year, maintaining a relatively slow response to rainfall.

The lower reaches of both the River Test and River Itchen are tidal estuaries. This tidal effect extends throughout much of the city's administrative boundary, following a unique tidal regime, with a twice daily double high water and a young

flood stand. Tide locking can occur on the River Itchen where the fluvial Itchen meets the tidal estuary at Woodmill, increasing flood risk at times when high river flows occur at the same time as high tide.

There are several other smaller rivers and watercourses within the Southampton administrative boundaries including:

- Tanners Brook
- Monks Brook
- Holly Brook
- Blighmont Crescent Stream
- Rolles Brook
- Jurds Lake

Map 4 provides information on the detailed river network including other unnamed/unclassified ordinary watercourses and Main Rivers in the city and their catchment areas.

4.1.3 Geology and Soils

The geology of a catchment, and variations in the permeability of the strata can be an important influencing factor in the response it has to rainfall, while also influencing the suitability of some types of SuDS in new and existing developments, in particular those which require infiltration.

Typically Southampton is underlain by moderately permeable bedrock formations with the exception of bands of low permeability bedrock in the north of the city and along the waterfront (see Map 5). With a moderate permeability, the percentage runoff is likely to be high.

The geology of the River Test and River Itchen catchments are typically dominated by chalk in the north, and clay in the south. The southern catchment through Southampton, which includes the tributaries (Monks Brook, Tanners Brook and Holly Brook), therefore tends to be more responsive to rainfall due to the presence of clay, creating a more flashy hydrograph.

To the north of the city, the underlying bedrock geology consists primarily of London Clay, with pockets of Whitecliff Sand Member, Portsmouth Sand Member and Nursling Sand Member also present. Central to the city is a band of Wittering Formation which has a much more sandy texture, and is more permeable than the London Clay. Following this to the south and along the coastal areas is a narrow band consisting of Earnley Sand Formation and Marsh Farm Formation.

Superficial geology in the lower areas adjacent to the River Test and River Itchen consists of Tidal Flat deposits. The higher areas of ground away from the rivers are predominantly River Terrace deposits, with Alluvium present in some of the smaller watercourses in the catchment. Superficial deposits are displayed in Map 6.

Much of Southampton's soil is un-surveyed due to the largely urban environment of the city. However, site-specific surveys show that in some areas the soil is generally slowly permeable, and particularly along the coast, can become seasonally waterlogged.

4.2 Overview of Flood Defences, Assets and Structures

It is important to recognise that Southampton does not currently benefit from any formal raised defences to provide protection against flooding from rivers or the sea. There are however some isolated areas of raised erosion structures which are in private ownership, therefore the condition and standard of protection offered is highly variable.

The Environment Agency Spatial Flood Defence data (July 2016) (Map 7) shows the locations and types of known defence structures in the city. Since not all defences are owned or maintained by the Environment Agency, the condition and standard of protection that the defence currently provides is not included.

The most recent defence condition survey was carried out in October 2010 as part of the Southampton Coastal Erosion and Flood Risk Management Strategy in order to inform the decision making process. The visual survey of defences on the west bank of the Itchen Estuary and River Test showed a significant variation in defence type, condition, standard of protection and residual life. Many of the defences along the study frontage are in fair or good condition, with some poorer sections and other areas with no formal defences, summarised below:

- Upper Itchen – complex mix of informal private defences and formal defences mainly to prevent erosion, in moderate to good condition.
- Northam, St Marys and Town Depot - mix of mainly industrial and commercial land uses including marinas, operational wharves and quays with structures mainly in fair to good condition, however there are sections in poorer condition.
- Lower Itchen frontage - comprised of a mix of mass concrete quay walls and steel sheet pile erosion defences mainly in fair to good condition. However there is a localised area in poor condition with some loose/missing blocks and spalling.
- Eastern Docks of the Port of Southampton from Ocean Village to Town Quay - comprised of mass concrete quay walls and steel sheet pile walls in fair to good condition.
- Western Docks to the Test frontage – quay walls in generally fair to good condition. However there are two sections of mass concrete sea wall on the lower Test frontage that are also identified as having some poor areas with significant cracking and spalling.
- Redbridge to lower Test Valley - comprised of natural reed beds, saltmarshes and a tidal floodplain backed by a railway embankment, railway line and road, with no formal defences.

4.3 Tidal Flood Risk

Flooding from the sea and tidal estuaries occurs when water levels rise higher than coastal ground levels or defence structures, spilling onto the adjacent land (the floodplain). The main reason that sea levels can rise above land height is the result of a storm surge, which can develop during times of low pressure, coinciding with high tide, or wave overtopping. Tidal flooding can depend upon:

- The height of the tide
- Weather/storm systems, including wind and water conditions,

- Local topography
- The condition of defences (where they exist), and
- Local drainage

Tidal flooding can produce conditions that are a significant risk to life and property, with deep, fast flowing water in coastal areas; however the risk of hazardous conditions can also extend significant distances inland depending on topography.

4.3.1 Assessment of Tidal Flood Risk

Southampton has approximately 35km of tidal frontage, including the River Test and River Itchen estuaries, with the tidal influence of these rivers extending through much of the city's administrative boundary. Approximately 13% of the city is identified as currently at high or medium risk of flooding from tidal sources, as indicated by Map 8 which shows the present day Flood Zones.

The assessment of actual risk of tidal flooding in Southampton has been made based on the Southampton Water modelling produced by the Environment Agency completed in 2016, which provides information on areas at risk of tidal flooding, the expected flood duration and the tidal hazard at present day and in the future. The corresponding outputs are shown in the following maps:

- Overview of tidal flooding - Maps 9 – 9.4,
- Present day tidal flood hazard - Maps 10 - 10.4
- Future tidal flood hazard (2115) - Maps 11 – 11.5.

Erosion protection structures along the River Itchen and River Test, as well as some areas of the coastal frontage, provide a varying level of protection from flooding. Where those structures do exist, flooding can still occur if they are overtopped or breached.

At present there are no formal raised flood defences in Southampton therefore there is little risk from defence breach. Breach of erosion defence structures which at this time help to reduce flooding is possible, therefore future flood risk management and new development should consider this risk and include appropriate residual risk management measures where necessary. If raised flood defences are constructed in future to provide protection to lower lying ground, there is the potential for defences to breach or fail resulting in fast flowing water and deep flooding with little warning.

The outputs from the Southampton Water Modelling also provide the flood levels for a more frequent 1 in 20 year Average Recurrence Interval (ARI) flood (a flood with a 5% chance of occurring in any given year). At Dock Head the 1 in 20 year level is 2.95m Above Ordnance Datum (mAOD). Under this flood event, the outputs indicate overtopping occurs at a number of locations (Table 2), however general flood extents and depths are relatively limited.

Table 2: Areas Experiencing Overtopping from a Present Day 1 in 20 Year Return Period Flood Event (2015)

Location	Grid Reference	Approximate Flood Depth (m)
Endle St/Crosshouse Road (Town Depot)	SU 44302 11129	0.15 - 0.6
Itchen frontage east of Marine Parade	SU 44301 11168	0.3 - 0.45
Itchen frontage at Shamrock Quay and William Street, Millbank	SU 44338 11232	0.15 - 0.3
Itchen frontage on the Meridian and Drivers Wharf sites either side of the Northam Bridge	SU 44314 11287	0.15
Properties and gardens on Priory Road	SU 43184 13668	0.3 - 0.45
Back gardens on Oliver Road and over Woodmill Lane	SU 44377 11524	0.4 - 0.9 (back gardens) 0.15 (Woodmill Lane)

4.3.2 Future Extreme Water Levels

As a result of potential future sea level rise, extreme water levels are predicted to increase. The projected changes in relative mean sea level, as well as the projected changes in the storm surge component have been added to the present day extreme water levels to predict future extreme water levels.

The risk of overtopping of the coastline by a flood event with a 1 in 200 year ARI (a flood with a 0.5% annual chance of occurring in any given year) has been considered up to 2115. It has been identified that extreme water levels vary along the tidal frontage as a result of the hydraulic slope that exists on the River Test and River Itchen estuaries. Table 3 outlines the extreme water levels modelled for Dock Head only. Site specific levels coastline are available from the Environment Agency.

Table 3 Future Extreme Tidal Flood Levels 1 in 200 year data (Dock Head, Southampton)

Average Recurrence Interval (ARI)	Extreme Water Level
1 in 200 year (2015)	3.1 mAOD
1 in 200 year (2070)	3.6 mAOD
1 in 200 year (2115)	4.3 mAOD

Source: *Environment Agency Southampton Water Model (2016)*

The extreme levels nearest to the development location should be used to determine tidal flood risk in site specific FRAs for planning applications, therefore developers should contact the Environment Agency to obtain the levels nearest to the development site prior to identifying appropriate mitigation measures to ensure the development remains safe from flooding for its lifetime.

4.3.3 Historic Flood Risk - Tidal

A number of tidal flood events have been recorded by SCC and the Environment Agency. In most cases these are the result of a combination of high tides, storm surges and heavy rainfall being unable to drain. All tidal flood incidents recorded have been compiled and are listed in Table 1 of Appendix B, arranged by road name. Flood records are also illustrated in Map 12.

4.3.4 Assessment Results

Flood hazard can vary greatly throughout catchments and even across floodplain areas. The hazard posed by floodwater is proportional to the depth of exposure, the velocity of flow and the speed of onset of flooding. Hazardous flood flows can pose a significant risk to exposed people, property and infrastructure.

Whilst low hazard flows are less of a risk to life (shallow, tranquil water), they can still disrupt communities, require significant post-flood clean-up and can cause costly and possible structural damage to property.

Table 4 provides a summary of tidal flood risk in Southampton over the next 100 years.

Table 4: Summary of Tidal Flood Risk in Southampton (1 in 200 year return period event)

<p>Present Day (2016)</p>	<p>The main areas at risk are located on the lower ground either side of the River Itchen, notably north of the Itchen Bridge, along Marine Parade (Chapel) and in the suburb of Northam. This area is generally characterised by industrial and commercial uses that in many instances utilise the river for the transport of goods.</p> <p>Further upstream on the River Itchen, flooding is predominantly limited to gardens of private property, however this may reach buildings and properties, in particular along Priory Road (St Denys) and Oliver Road (Woodmill) on the west bank of the Itchen. Resistance and resilience measures to reduce the impact of flooding to 27 properties in Priory Road were installed in 2015, with similar measures being installed to a further 30 properties in 2017. Whilst the area remains at high risk of flooding, the potential damage to property has been reduced.</p> <p>On the River Test, there is limited overtopping of existing ground levels during the 1 in 200 year ARI flood event, however the combined effect of fluvial and tidal flooding means some areas in Millbrook are at risk of flooding. Some areas of Redbridge, along the River Test are also at risk of flooding.</p>
<p>2055</p>	<p>A projected increase of 300mm in tidal levels over the next 50 years results in an increase in flood extent in Northam, St Marys and Chapel, as well as in the industrial and commercial areas on both sides of the river including Spitfire Quay and Bevois Valley. The sewage treatment works at Portswood is also at high risk of flooding, raising the risk of pollution.</p> <p>On the River Test, Mayflower Park and the surrounding area including the ferry terminal is at risk from flooding, whilst the risk to the Millbrook area also increases.</p> <p>Northam Road, a key transport route connecting the eastern side of the city to the city centre, becomes at risk of inundation on both sides of Northam Bridge.</p>

2070-2085	<p>A further projected increase of 200mm compared to the 2055 scenario tidal levels means that Northam, St Marys and Chapel areas would be almost entirely inundated during the 1 in 200 year ARI event. Many of the properties along Priory Road (St Denys) on the west bank of the Itchen Estuary, up to Oliver Road at Woodmill are likely to be at risk, including the Portswood sewage treatment works and several on the eastern bank of the Itchen.</p> <p>Overtopping on the River Test is likely to extend onto Town Quay and West Quay Road, at relatively shallow depths. Further to the west, tidal flooding to the docks is likely to become more extensive.</p> <p>Overtopping of the mainline railway at St Denys is also predicted to occur, causing major disruption to the rail network across the south.</p>
2115	<p>Between 2085 and 2115 there is the potential for a significant increase in flood risk to Southampton, based upon the projected future increase in sea level. Much of the city centre will be inundated during a 1 in 200 ARI flood event, including the Port, with areas of Northam, St Marys and Chapel exposed to a significant flood hazard with the potential for very deep water in parts.</p> <p>On the River Itchen the mainline railway would be overtopped, flooding low lying areas of Bevois Valley (significant hazard), and many of the properties within 100-200m of the western bank would be at risk.</p> <p>Major transport routes including the A33, Southampton Central Station and many sections of the mainline railway near to the coast would be at risk.</p>

4.4 Fluvial Flood Risk (Rivers)

Flooding from rivers occurs when water levels rise higher than the level of the banks or breach raised banks or defences, causing water to flow out and across adjacent land (the floodplain). The main reasons for a rise in water levels in rivers are:

- Intense or prolonged rainfall causing increased runoff rates and flow to rivers, exceeding the capacity of the channel. This can be exacerbated by prolonged wet conditions and significant contributions of groundwater.
- Constrictions in the river channel causing flood water to back-up.
- Blockage of structures (i.e. culverts/trash screens) or the river channel increasing hydraulic roughness resulting in slower flows and causing flood water to back-up.
- High water levels and/or locked flood gates preventing discharge at the outlet of the river.

The consequence of river flooding depends on how hazardous the flood waters are and the potential receptors. The hazard of river flood water is related to the depths and velocity, which depends on:

- The magnitude of flood flows,
- Size, shape, slope and roughness of the river channel,
- Width, topography and roughness of the floodplain, and
- Types of structures that cross the channel.

4.4.1 Assessment of Fluvial Flood Risk

The assessment of actual flood risk has been undertaken using the fluvial Flood Zones (ignoring the presence of defences) on the basis that:

- The Flood Zones are based upon the most up-to-date detailed hydraulic modelling for fluvial flood risk;
- There are no areas within Southampton benefiting from fluvial flood defences;
- There is no major development proposed in or adjacent to fluvial watercourses in Southampton.

Map 8 identifies the Flood Zones which indicate the areas with a 'high' or 'medium' probability of fluvial flooding based on the present day. It is highly likely that as a result of climate change, some areas that are presently within Flood Zone 2, will become Flood Zone 3 in future, putting more properties at risk from fluvial flooding.

As no consistent modelled climate change data is available for both the Tanner Brook/Holly Brook catchment and the Monks Brook catchment, the following assumptions have been made in this SFRA regarding climate change:

- Over the next 100 years Flood Zone 3b (functional floodplain) will be equivalent to the existing Flood Zone 3 (1 in 100 year ARI event);
- Over the next 100 years Flood Zone 3 (1 in 100 year ARI event) will be equivalent to the existing Flood Zone 2 (1 in 1000 year ARI event);
- The future Flood Zone 2 has not been mapped to date.

More detailed hydraulic modelling for Tanner Brook and Holly Brook may have been developed by the Environment Agency. Developers should contact the Environment Agency directly to determine whether a proposed site is at risk of fluvial flooding from these rivers, and if so, to what extent, to ensure that appropriate mitigation measures are identified and in line with the Environment Agency Standing Advice.

4.4.2 Assessment Results

Flood hazard can vary greatly throughout catchments and even across floodplain areas. The hazard posed by floodwater is proportional to the depth of exposure, the velocity of flow and the speed of onset of flooding. Hazardous floodplain flows can pose a significant risk to exposed people, property and infrastructure.

Whilst low hazard flows are less of a risk to life (shallow, tranquil water), they can still disrupt communities, require significant post flood clean-up and cause costly and possible structural damage to property and infrastructure.

At present flooding on Tanners Brook and Holly Brook is predicted to be predominantly limited to the open space either side of the watercourses, however there is the potential for over 100 properties to be at risk where Holly Brook is constricted near Dale Valley Road. This number is likely to increase with climate change.

Flooding on the fluvial River Itchen and Monks Brook is also predominantly limited to the open space surrounding the watercourse, however flooding has occurred to the A27 Mansbridge Road and the bridge at Woodmill Lane. There are a number of businesses at risk of flooding at Mansbridge Road/Woodmill Lane, which have been impacted on several occasions, most notably by deep water in the flooding experienced over the winter of 2013/14.

Climate change is likely to result in increased rainfall intensity and increased peak flood flows in watercourses (UK Climate Change Predictions 2009), which has the potential to significantly increase flooding from watercourses.

Table 5 provides a summary of the additional areas identified as being potentially at high risk of fluvial flooding, within the future flood zone 3.

Table 5: Additional future high probability fluvial flooding locations

Location	Grid Ref	Source and Pathway	Properties at risk in future
Turnstone Gardens and Goldcrest Gardens	439470, 116194	Out of bank flooding on the Tanners Brook.	40-60
Longleat Gardens	439735, 115945	Out of bank flooding on the Tanners Brook.	10-20
Springford Road	439807, 115478	Out of bank flooding on the Tanners Brook.	20-35
Coxford Road	439343, 115173	Surcharging of culverts and/or overtopping of headwalls.	1 - 5
Warren Avenue	439669, 114371	Surcharging of culverts and/or overtopping of culverts.	1
Dale Road, Dale Valley Road and Dale Valley Close	440391, 115219	Surcharging of culverts and/or out of bank flooding on Holly Brook.	60-100
Romsey Road, Winchester Road	439320, 114271	Out of bank flooding on the Tanners Brook.	1+
Percy Road	439196, 113958	Out of bank flooding on the Tanners Brook.	10-25
King Georges Avenue	438973, 113466	Out of bank flooding on the Tanners Brook.	10-20
Elmes Drive, Creighton Road and Westbury Road	438806, 112935	Likely combined fluvial/tidal flooding where Tanners Brook discharges into the River Test.	60-80
Brookside Way, Monks Way and Wessex Lane	444064, 115785	Out of bank flooding on the Monks Brook	50-60
Lawrence Grove	444863, 110804	Out of bank flooding on Jurds Lake	5-10

4.4.3 Historic Flood Risk - Fluvial

There have been several incidents of fluvial flooding across the city. Table 2 of Appendix B lists all known fluvial flood incidents by road name reported to the Environment Agency or directly to SCC from 1999 to 01 April 2017. Flood records are also illustrated on Map 12.

4.4.4 Uncertainties in Flood Risk Assessment

The assessment of fluvial flood risk in Southampton has been based on Flood Zone Mapping provided by the Environment Agency, which in turn has been informed by detailed hydraulic modelling, where available. As with any hydraulic modelling, this has been based on a number of assumptions which may introduce uncertainties into the assessment of risk. The following key assumptions should be noted such that informed decisions can be made when using flood mapping:

- Flood Zone 2 is assumed as future Flood Zone 3 therefore there is currently uncertainty regarding the effects of climate change on the Tanner's Brook and Holly Brook in Southampton. However on the basis that key development sites in Southampton are located away from Flood Zone 2 and 3 this approach is considered appropriate for this SFRA. Detailed FRAs for development located in Flood Zone 2 or 3 on the fluvial watercourses in Southampton should seek the latest detailed modelling data from the Environment Agency, and where this is not available consider undertaking further analysis where necessary.
- The flood extents shown in this SFRA do not show localised flooding resulting from intense rainfall and where surface flow might exceed the capacity of the drainage system.
- The risk of blockage in structures throughout the river network may affect flood levels and extents, as demonstrated by previous records of flooding on the Tanner's Brook.
- Flood Zone or hazard mapping is not currently available for some of the smaller watercourses in Southampton, such as the Rolles Brook, however this does not mean there is no flood risk from these watercourses. New development proposed in close proximity to watercourses in Southampton should consider flood risk from these sources.
- All hydraulic models have limitations relating to factors such as input data, model hydrology and modular assumptions. It is therefore important to consider whether the model and its outputs are appropriate for the purpose for which they are being used. For example, a hydraulic model for a watercourse may not contain detailed information on ground levels at a development site and the results may therefore not be significantly accurate for assessing flood risk at the site. Further analysis may be required.

Taking these uncertainties and constraints into consideration, the estimation of flood risk of flooding from rivers presented in this report is considered robust based on the objectives and level of assessment required in the SFRA.

It is recommended that those proposing development in or adjacent to fluvial Flood Zones request the most up to date data from the Environment Agency to inform the detailed assessment of flood risk at the site level.

4.5 Surface Water Flood Risk

Flooding from land (surface water flooding), occurs when intense, often short duration rainfall is unable to soak into the ground or enter the local drainage system. It is made worse when soils are saturated so that they cannot accept any more water. The excess water then ponds in low lying points, overflows or concentrates in minor drainage lines that are usually dry. This type of flooding is usually short lived, localised and associated with heavy downpours of rain, and often has very little warning before it occurs.

Surface runoff is directly related to the size and shape of the drainage catchment. There are a number of sub-catchments in Southampton where water is collected and discharged via underground drainage or small drainage channels directly in the River Test and River Itchen. It is often only when the drainage network is exceeded that the original drainage (overland flow) routes become apparent.

The amount of runoff is also a function of geology, slope, climate, rainfall, saturation, soil type, urbanisation and vegetation. Geological considerations include rock, soil types and characteristics, and the degree of weathering. The geology in Southampton is generally relatively impermeable therefore has a limited capacity to absorb surface water runoff, unlike porous material (sand, gravel and soluble rock), and will therefore have a higher runoff potential which is more likely to result in flooding. The highly urbanised nature of Southampton, and the underlying geological characteristics mean there is a potential to generate large volumes of surface water runoff.

Developments which are close to artificial drainage systems, or located at the bottom of a hillslope, in valley bottoms and hollows, may be more prone to flooding. In Southampton this includes low lying land adjacent to the River Test and River Itchen, or where overland flow routes are blocked by buildings and infrastructure.

4.5.1 Assessment of Surface Water Flood Risk

Surface water flooding can happen anywhere within the city following a period of rainfall. The Environment Agency has produced detailed mapping to show the extent of land that could be affected by a flood of a given chance (1 in 30, 1 in 100 or 1 in 1000). This information is provided in Maps 13 – 13.4.

The Environment Agency surface water data only presents a current day scenario, and does not show flooding that occurs from overflowing watercourses, drainage systems or public sewers, river flow or ground water. It also does not include the presence or effect of pumping stations, or make any allowance for tide locking or high fluvial levels where sewers cannot discharge.

The areas at risk of surface water flooding are related to the major flow paths based on the overall topography of the area rather than purely urbanisation. The interaction between the increased flows in watercourses together with the expansion of the city, have led to the progressive culverting and channelling of downstream sections, which can in some cases increase the risk of surface water flooding.

The flow characteristics of watercourses and drainage systems are impacted by urbanisation, as storm waters flow faster within pipes due to reduced friction. Natural attenuation areas have also been removed, increasing the risk of surface water flooding. Flooding is further exacerbated through the flow restrictions at outfalls, especially within the Millbrook and Portswood catchments to the west of the city, as many outlets are below the high tide level and are affected by tide locking. Flood risk is at its highest when high tide and extreme rainfall occur simultaneously.

4.5.2 Historic Flooding – Surface Water

Distinguishing between flooding from land and flooding from groundwater can be complicated, and it is likely that errors have been made in the past recording of flood incidents. There are a number of records of groundwater flooding in Southampton, however it is likely that a majority of these were a result of surface water, rather than the water table. The flood records for surface water are listed in Table 3 of Appendix B. Flood records are also illustrated on Map 12.

4.5.3 Assessment Results

Results from the Environment Agency surface water flood risk areas and historic flooding records were overlain to identify areas where surface water flooding may occur. In addition to the rivers forming flow routes for surface water, the topography of Southampton has dictated a number of undefined, but important, flow routes through the urban environment.

During extreme rainfall events it is likely that water will either not be able to enter the drainage system, or sewers may surcharge due to exceedance of capacity. The broad scale surface water modelling depicted in Maps 13 - 13.4 are useful in identifying the areas that are more vulnerable to extreme rainfall events.

4.5.4 Uncertainties in Flood Risk Assessment

The causes of flooding from surface water are generally understood. However it is difficult to predict the actual location, timing and extent of flooding, which are dependent upon the characteristics of the site specific land use, local variations in topography, geology soils and the hydrological conditions.

There is a lack of reliable measured datasets on flood frequency and extent, and the estimation of flood events and is therefore difficult to verify. Strategic studies tend to present the incidents of flooding from surface water, rather than undertake frequency analyses.

The impact of climate change on this type of flooding is uncertain and likely to be very site specific, but more intense, short duration rainfall and increased more prolonged winter rainfall are likely to exacerbate flooding in the future, with guidance on climate change also stating that an increase in peak rainfall intensity is expected. In Southampton the highly urbanised nature of the area increases the potential for significant increases in runoff.

The mapping of areas at risk of surface water flooding provides an indication of where surface water flooding may occur however, as already identified, it is not a reliable for determining the actual risk of surface water flooding. With reliance on a largely aging positive drainage network in the city it is often difficult to disaggregate between surface water flooding and sewer flooding.

4.6 Flood Risk from Sewers

Flooding from sewers occurs when rainfall exceeds the capacity of the drainage network or where there is an infrastructure failure. The impact of sewer flooding is usually confined to relatively small localised areas, however when flooding is associated with a blockage or failure of the sewer network, flooding can be rapid and unpredictable. The main causes of sewer flooding are:

- Lack of capacity in sewer drainage networks due to original under-design;
- Lack of capacity in sewer drainage networks due to an increase in demand (such as climate change and/or new developments);
- Lack of capacity in sewer drainage due to events larger than the system designed event;

- Lack of capacity in sewer drainage networks when a watercourse is fully culverted (lost watercourse), thus removing capacity;
- Tide locking of drainage systems during periods of high tide, resulting in water ‘backing up’ in the drainage system;
- Lack of maintenance of sewer networks which leads to infrastructure failure, a reduction in capacity and can sometimes lead to total sewer blockage or pump failure.
- Groundwater infiltration into poorly maintained or damaged pipe networks.
- Restricted outflow from the sewer systems due to high water levels in the receiving watercourse.

4.6.1 Assessment of Flood Risk from Sewers

Southampton benefits from an extensive network of surface water, foul and combined sewers. The foul and combined sewer networks collect water for treatment at the local sewage treatment works (located at Millbrook, Portswood and Woolston), whilst the surface water sewers discharge into the River Test and River Itchen either directly or via the local watercourse network.

Two large areas of the city, including parts of the city centre and parts of Freemantle, Millbrook and Shirley to the west, rely on pumping stations to aid the discharge of surface water. These pumping stations, operated and maintained by Associated British Ports (ABP), are located within the Port estate at the King George V Dock and adjacent to Mayflower Park.

These surface water pumping stations are critical infrastructure for managing flooding from sewers in Southampton, particularly when the system cannot drain by gravity due to the tide level. The reliance on pumping means there is potentially a significant residual risk in the event of pump station failure, which is difficult to quantify without detailed modelling.

The surface water sewer network is further complicated by the interaction of the tide with surface water outfalls that discharge directly into the Itchen Estuary or tidal reaches of the River Test. In many cases, non-return valves or ‘flap valves’ are fitted to outfalls to protect the drainage system from tidal ingress, however these valves can at the same time reduce the ability for surface water to discharge. This is known as ‘tide locking’ and can result in water backing up in the drainage system, potentially leading to flooding inland from surcharging sewers, whilst also restricting outflow from the network into local watercourses (both main rivers and ordinary watercourses) due to high water levels, all of which can increase the risk of flooding. There is also a risk of flooding from the failure of flap valves, in particular if they get stuck open or damaged, allowing water ingress into the sewer system.

4.6.2 Historic Flooding – Sewers (Foul, Surface Water and/or Combined)

Data requested from Southern Water, the sewage undertaker for Southampton, shows a number of incidents relating to flooding from surface water, foul and combined sewer systems that have occurred within the SCC administrative boundary. These have been added to any reports made directly to SCC and are listed in Table 4 of Appendix B. Flood records are also illustrated on Map 12.

4.6.3 Assessment Results

Southampton has a combination of drainage networks, some that rely on gravity assisted branched systems, which convey water in trunk sewers located at the lower end of the catchment, as well as areas dependent upon pumped outfalls. Failure of either the trunk sewers or pumping stations can have serious consequences, which are often exacerbated by topography, as water from surcharged manholes will flow into low-lying areas. The effects of sewer flooding tend to be relatively localised, but often occur with very little warning.

Whilst an area affected by sewer flooding is often localised, the quality of water can be poor. Flooding of combined sewers can lead to contaminated water entering properties and watercourses. This form of flooding has adverse health implications for the local population, with potential for the spread of illness and disease if it happens on a regular basis.

Flooding from sewers is likely to have a high concentration of solid, soluble and insoluble contaminants, which can lead to a reduction in the environmental quality of receiving watercourses. Flooding of contaminated land (such as landfill, motorways and petrol station forecourts) will transport containments such as organics and metals to vulnerable receptors if the respective drainage systems are not designed to treat the water. The highly urbanised nature of Southampton heightens the impact that sewer flooding may have on surrounding land, properties and people.

The modification of watercourses in Southampton into either culverted or piped structures can also result in a reduced capacity in the overall drainage network in the city. Excess water may be sent along unexpected routes as its original channel is no longer present, and the new system cannot manage receiving flows, with the risk increasing from the pressures of new developments.

4.6.4 Uncertainties in Flood Risk Assessment

Assessing the risk of sewer flooding over a wide area is limited by a lack of data and the quality of the data that is available. Furthermore, flood events may be a combination of surface water, groundwater and sewer flooding.

Use of historic data to estimate the probability of sewer flooding is the most practical approach given the limited availability of modelled data, however it does not take account of possible future changes due to climate or future development. The incidents of flooding which are from sewers recorded throughout Southampton should be viewed with caution as the sewer network is constantly being maintained, upgraded and improved, thus flooding issues may be relatively short lived or 'shift' to a different location.

4.7 Flood Risk from Groundwater

Groundwater flooding is caused by the emergence of water originating from sub-surface permeable strata. A groundwater flood event results from a rise in groundwater level sufficient for the water table to intersect the ground surface and inundate low lying land or properties. Groundwater floods may emerge from either point or diffuse locations developing over weeks or months and prevailing for days or sometimes weeks.

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

- Direct contribution to channel flow.

- Springs erupting at the surface.
- Inundation of drainage infrastructure.
- Inundation of low-lying property (i.e. basements).

Groundwater levels rise and fall in response to rainfall patterns and distribution. The significance of this rise and fall for flooding depends largely on the type of geology and soils it occurs in, i.e. how permeable to water the geology or soil is, and whether the water level comes close to or meets the ground surface.

The primary controls on the distribution and timing of groundwater flooding include:

- Spatial and temporal distribution of rainfall.
- Spatial distribution of aquifer properties.
- Recharge mechanisms.
- Spatial distribution of geological structures.
- Efficiency of the surface drainage network.

The likelihood of an area experiencing groundwater flooding can largely be determined on a broad scale through an analysis of the previous meteorological conditions and geological knowledge. This can be helped by the analysis of groundwater boreholes and historic information, some of which is available from the British Geological Survey (www.bgs.ac.uk).

The main impacts of groundwater flooding are:

- Flooding of basements or buildings below ground level. In the mildest case this may involve seepage of small volumes through walls and temporary loss of service, but in the more extreme cases larger volumes may lead to the catastrophic loss of stored items and failure of structural integrity.
- Infiltration 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, which can lead to disruption of supply of services, particularly if inundation is prolonged.
- Inundation of roads, commercial, residential and amenity areas. Inundation of grassed areas can be inconvenient, however the inundation of hard-standing areas can lead to structural damage and the disruption of commercial activity and transportation.
- Flooding of ground floors of buildings above ground level which can be significantly disruptive, and may result in structural damage.
- Additionally groundwater flooding can cause a change in the structural properties of clay overlying chalk aquifers. This may cause costly damage to structures in the ground and the buildings that they support.

Groundwater flooding has always occurred. It generally occurs more slowly than river flooding and in specific locations. The rarity of groundwater flooding combined with the mobility of the population means that people often do not know that there is a groundwater flood risk.

4.7.1 Assessment of Groundwater Flood Risk

Southampton is mainly split into areas of low and medium permeability of bedrock areas, as shown by Map 5, and the city is at risk of groundwater flooding. Map 14 gives an indication of the susceptibility of groundwater flooding across the city, based upon 1km grid squares where geological and hydro-geological conditions show that groundwater may emerge. Each 1km grid square gives the proportion of each square (land area) that may be susceptible to groundwater, and does not show actual groundwater flood risk. Consideration should be given to these areas in development plans, and in the consideration of SuDS features.

In the lower lying areas of the city, groundwater tends to be influenced by the tidal levels of the River Test and River Itchen. With sea level rise, the number of areas at risk of groundwater flooding is also likely to increase.

The majority of the city is shown to be moderately permeable and therefore assessed as at medium risk of groundwater flooding, indicating a potential risk of groundwater emerging due to geology, soils and elevation. There are however a few areas within Southampton where the risk of groundwater flooding is assessed as high, namely Tanners Brook, Holly Brook and adjacent to the River Itchen in Portswood, predominantly as a result of the underlying geology. Most at risk will be deep foundations, basements and underground infrastructure.

It should be noted that this assessment is broad scale and does not provide a detailed analysis of groundwater. It only aims to provide an indication of where more detailed consideration of the risks may be required. This assessment was undertaken at a local authority scale using the information available from the Environment Agency. Historic records of groundwater flooding do not tend to show any distinct pattern, however in recent years following the very wet winter of 2013/14, reports of groundwater flooding show that areas of the city that appear to be susceptible include Bassett Green, Daisy Dip and Townhill Park.

In general terms groundwater flooding rarely poses a risk to life, however groundwater flooding can be associated with significant damage to property. Groundwater flooding is dependent on local variations in topography, geology and soils. It is difficult to predict the actual location, timing and extent of groundwater flooding without comprehensive datasets.

The sparse frequency of groundwater flood events can contribute to poor decision-making, with newer developments more likely to be at risk because little consideration has been given to groundwater as a source of flooding during the planning process. It is important that groundwater flood risk to any future development is considered and appropriate mitigation measures put in place to reduce any significant risk identified.

4.7.2 Historic Flooding - Groundwater

SCC records show over 60 records of flooding attributed to groundwater. Details provided in a majority of these records indicates that flooding lasted approximately 2 hours and was caused by heavy rainfall. It is likely that these flooding incidents were a result of saturated ground, including the flow of water through soil, rather than a result of the water table and high groundwater levels. However, these records do illustrate the difficulty in accurately determining the source of flooding. Records suspected to be surface water rather than groundwater are listed within Table 3 of

Appendix A with groundwater flood records listed in Table 5 of Appendix B. Flood records are also illustrated on Map 12.

In recent years, particularly during the very wet winter of 2013/14, groundwater flooding has become more prominent with several springs developing across the city.

4.7.3 Assessment Results

In general terms groundwater flooding is more likely to occur after an above average rainfall event which causes groundwater levels to rise, and in areas where there is insufficient surface drainage. The areas that appear to be more susceptible to groundwater, based upon geology, are shown in Map 14.

Consideration should be given to the potential for groundwater flooding in all site specific Flood Risk Assessments in Southampton (see further guidance in Chapter 7). A more detailed assessment of the risk from groundwater flooding should be made in areas identified by this SFRA as being at higher risk of groundwater flooding.

There is currently no research specifically considering the impact of climate change on groundwater flooding. The mechanisms of flooding from aquifers are unlikely to be affected by climate change, however if winter rainfall becomes more frequent and heavier, groundwater levels may increase. Higher winter recharge may however be counteracted by a lower recharge rate during the predicted hotter and drier summers.

In low-lying areas of Southampton, the groundwater level is linked to the tidal levels of the River Itchen and River Test. As mean sea levels are predicted to rise by approximately 1m over the next 100 years, it is likely that local groundwater levels, where influenced by the tide, will also rise.

With increased rainfall as a result of climate change, it is likely that there will be increased groundwater levels occurring across the city, in particular in those areas with impermeable bedrock, which could lead to an increase in groundwater flooding. This combined with the effects of rising mean sea level on the local water table in lower lying areas is also likely to increase the risk of groundwater flooding.

4.7.4 Uncertainties in Flood Risk Assessment

The spatial analysis undertaken in the SFRA is highly qualitative. The maps do not indicate specific areas that will flood, but instead indicate areas where the risk of emergence may be relatively higher and therefore further analysis is recommended. Local factors that cannot be assessed without more reliable quantitative data can affect groundwater and the potential for emergence.

The causes of groundwater flooding are generally understood. However groundwater flooding is dependent on local variations in topography, geology, soils and the tides. It is difficult to predict the actual location, timing and extent of groundwater flooding without comprehensive datasets.

There is a lack of reliable measured datasets to undertake flood frequency analysis and even with datasets this analysis is complicated due to the non-independence of groundwater level data. Studies therefore tend to analyse historic flooding which means that it is difficult to assign a level of certainty.

4.8 Flood Risk from Artificial Sources

Flooding from artificial sources is defined as flooding arising from the failure of man-made infrastructure or human intervention that causes flooding. This includes failure of canals or reservoir embankments, as well as activities such as ground water pumping. To understand flooding from artificial sources the whole hydrological and drainage system must be considered, along with the potential for interaction with other sources of flooding.

The spatial and temporal extent of flooding from artificial sources is highly variable. For example, the likelihood of a new reservoir failing is very low compared to that of a canal embankment that is more than one hundred years old. However the consequences of a reservoir failing is potentially catastrophic in comparison to a local canal embankment breaching. Failure of a structure can result in rapid, deep and fast flowing water, which poses a serious hazard, threatening life and potentially causing major damage to property.

Increased urbanisation, aging infrastructure and the impacts of climate change all result in the requirement for consideration of flooding from artificial sources within the development process.

4.8.1 Assessment of Flood Risk from Artificial Sources

Very few substantial artificial waterbodies exist within Southampton. There are four covered (one disused), water service reservoirs that store potable water for supply, owned and maintained by Southern Water. These are located at:

- South Hill, Glen Eyre Road, Bassett.
- Southampton Common.
- Dean Road, Bitterne.
- Mansbridge Road, Mansbridge (disused).

There are also two further water service reservoirs that are within the Eastleigh Borough Council administrative area but adjacent to the SCC boundary. They are:

- Moorhill (near Telegraph Woods), and
- West End (near to the River Itchen).

Reservoir Inundation Mapping has been completed by, and is available from the Environment Agency for the site at Glen Eyre Road, since this was identified as potentially resulting in the highest hazard.

Within Southampton Common there are also number of man-made lakes that include retaining embankments. These lakes are supplied by, and discharged into minor watercourses that merge with Rolles Brook which passes through the city centre, eventually discharging into the River Test. The most significant are:

- Model Yachting Lake (Boating Lake) (constructed 1831)
- Cemetery Lake (constructed 1881 by filling in a former gravel pit)
- Ornamental Lake (constructed 1888)

The Model Yachting Lake is retained by an embankment that is approximately 2m above the surrounding ground, with the other two including raised ground to assist in the retaining of water. The probability of flooding from these lakes is considered low due to the ongoing maintenance; however there is a residual risk of flooding in the event of an embankment failure.

Although the lakes are not in close proximity to property, flooding is likely to affect the park and potentially the surrounding road network, presenting a significant hazard to anyone using the park at the time. Depending on the location of the failure, the majority of water is likely to be captured within the drainage network of the park, discharging into Rolles Brook.

Historical maps indicate that a canal used to exist within Southampton, however this was filled in at some point during the 1840's. The route was thought to have followed the main railway line from Northam in the east, to Redbridge in the west, with a branch beginning at the River Test near Gods House Tower running north and connecting to the main route close to the main railway tunnel near Central Station. There are no known traces of the canal existing in Southampton today.

4.8.2 Historic Flooding from Artificial Sources

There are no records of flooding resulting from the failure of artificial sources in Southampton.

4.8.3 Assessment Results

The risk of flooding from artificial sources is considered to be very low in Southampton, as there are very few artificial structures or manmade lakes within the city that have the potential to affect people or property.

A large reservoir is classified by the Environment Agency as one that holds over 25,000 cubic metres of water, and only one exists within SCC's administrative boundary at South Hill, Glen Eyre Road. Reservoir flooding is extremely unlikely to happen and there has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers. The Environment Agency is the enforcement authority for the Reservoirs Act 1975 (as amended by the FWMA) in England, who ensure that reservoirs are inspected regularly and essential safety work is carried out.

However, in the unlikely event that a reservoir dam failed, a large volume of water would escape at once and flooding could happen with little or no warning, and could impact those living and working in the area.

4.9 Interaction between Flood Sources

In Southampton the interaction between different types of flooding can result in more severe flooding incidents so it is not possible to address each type in isolation. The following interactions are particularly evident within the city:

- Tidal/surface water - High tide conditions coinciding with heavy downpours can result in 'tide locking' of surface water sewers which discharge directly into the River Test and River Itchen, causing back up through the surface water sewer network.

- Sewer/surface water/river - High flows within rivers and ordinary watercourses coinciding with heavy downpours can prevent surface water sewers discharging into the channel, causing back up through the surface water sewer network. Additionally surface water can inundate the sewer network reducing its capacity.
- Surface water/sewer - Exceedance of the sewer capacity or failure of the infrastructure during heavy downpours can result in accumulation of surface water runoff from impermeable areas as it can't enter the drainage network.
- Tidal/river - High tide conditions can prevent discharge of water from rivers and ordinary watercourses into the River Test and River Itchen. Tidal inundation upstream within the river channel can also occur.
- Tidal/groundwater - Groundwater levels within the low lying areas of the tidal frontage are believed to be influenced by the state of the tide, fluctuating in response to the tidal ebb and flow.

4.10 Impact of Climate Change on Flood Risk in Southampton

The projected impact of climate change and sea level rise over the coming century will inevitably increase the risk of all forms of flooding within Southampton. There is clear scientific evidence that global climate change is happening now so it cannot be ignored. At a national level flood risk has been identified as one of the greatest climate change challenges facing the UK (Climate Change Risk Assessment, 2012).

Over the past century around the UK, sea level rise has been experienced along with more winter rain falling as intense wet spells. Seasonal rainfall is highly variable. It seems to have decreased in summer and increased in winter, although winter amounts have changed little in the last 50 years. Some of the changes might reflect natural variation; however the broad trends are in line with the climate change projections (UKCP09).

Past emissions of greenhouse gases mean some climate change is inevitable in the next 20-30 years. Lower emissions could reduce the amount of climate change further into the future, but changes are still projected at least as far ahead as the 2080s (UKCP09)

We have enough confidence in large scale climate models to say that we must plan for change. There is more uncertainty at a local scale but model results can still help us plan to adapt. For example we understand rain storms may become more intense, even if we can't be sure about exactly where or when. By the 2080s, the latest UK climate projections (UKCP09) are that there could be around three times as many days in winter with heavy rainfall (defined as more than 25mm in a day). It is plausible that the amount of rain in extreme storms (with a 1 in 5 annual chance, or rarer) could increase locally by 40%.

4.10.1 Key Climate Change Projections for the South East

If emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past are:

- Winter precipitation increases of around 18% (very likely to be between 2 and 39%)
- Precipitation on the wettest day in winter up by around 16% (very unlikely to be more than 34%)
- Relative sea level at Portsmouth very likely to be up between 10 and 40cm from 1990 levels (not including extra potential rises from polar ice sheet loss)

- Peak river flows in a typical catchment likely to increase between 11 and 24%
- Increases in rain are projected to be greater at the coast and in the west of the South East regions.

In February 2016, the Environment Agency released its updated guidance on climate change allowances for Flood Risk Assessment and planning. These are based on UKCP09 UK Climate Projections for peak river flow, peak rainfall intensity, sea level rise, offshore wind speed and extreme wave height. Whilst the exact future climate of Southampton cannot be accurately predicted, the projections in the guidance give an indication of how the climate is likely to change over the next hundred years. The allowances indicate that an increase in peak river flow, peak rainfall intensity, sea level, offshore wind speed and extreme wave height is likely.

These projections are discussed in more detail in the sections below.

4.10.2 Sea Level Rise

As a consequence of climatic changes and continued warming of the global oceans, sea levels are expected to increase over the coming century. The sea level rise allowances are listed in Table 6.

Table 6: Sea level allowances for each epoch in millimeters (mm) per year with cumulative sea level rise for each epoch in brackets (use 1990 baseline)

Area	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115	Cumulative Rise 1990 to 2115 / metres (m)
South East England	+4.0 (140mm)	+8.5 (255mm)	+12.0 (360mm)	+15.0 (450mm)	1.21m

Source: Environment Agency Guidance - Flood Risk Assessment: Climate Change Allowances, April 2016.

4.10.3 Peak River Flow Allowances

Table 7 shows the peak river flow allowances which identify the anticipated changes to peak flow by river basin district.

Table 7: Peak river flow allowances (use 1961 to 1990 baseline)

Area	Allowance Category	Total Change Anticipated '2020s' (2015-2039)	Total Change Anticipated '2050s' (2040-2069)	Total Change Anticipated '2080s' (2070-2115)
South East	Upper End	25%	50%	105%
	Higher Central	15%	30%	45%
	Central	10%	20%	35%

Source: Environment Agency Guidance - Flood Risk Assessment: Climate Change Allowances, April 2016

Developers will need to ensure that a site will be safe from flooding in future years, and advice should be sought, where required, from the Environment Agency.

The Environment Agency guidance states that, any development proposals will need to consider the Flood Zone and relevant flood risk vulnerability classification in order to understand the range of impacts and select appropriate values from the allowances in Table 7.

Flood Zone 2:

- Essential infrastructure – use the higher central and upper end to assess a range of allowances
- Highly vulnerable – use the higher central and upper end to assess a range of allowances
- More vulnerable – use the central and higher central to assess a range of allowances
- Less vulnerable – use the central allowance
- Water compatible – use none of the allowances

Flood Zone 3a

- Essential infrastructure – use the upper end allowance
- Highly vulnerable – development should not be permitted
- More vulnerable – use the higher central and upper end to assess a range of allowances
- Less vulnerable – use the central and higher central to assess a range of allowances
- Water compatible – use the central allowance

Flood Zone 3b

- Essential infrastructure – use the upper end allowance
- Highly vulnerable – development should not be permitted
- More vulnerable – development should not be permitted
- Less vulnerable – development should not be permitted
- Water compatible – use the central allowance

4.10.4 Rainfall

Rainfall is likely to become more frequent and more intense, which will have an impact on river levels and surface water, particularly in urban environments such as Southampton.

Table 8 shows the anticipated changes in extreme rainfall intensity in small and urban catchments. For site-specific Flood Risk Assessments, both the central and upper end allowances should be assessed to understand the range of impact.

Table 8: Peak rainfall intensity allowance in small and urban catchments (1961 to 1990 baseline)

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

Source: Environment Agency Guidance - Flood Risk Assessment: Climate Change Allowances, April 2016

4.10.5 Implications for Flood Risk

Climate change can affect flood risk in several ways, although impacts will depend on local conditions and vulnerability. It is anticipated that climate change will increase the likelihood of flooding, and that the severity and consequences will also increase. It is well documented through the NPPF that developers should take climate change into account to ensure that development remains safe for its lifetime. The effects of climate change and flood risk to the site should be determined as part of a site specific Flood Risk Assessment.

Wetter winters with more rain falling in persistent wet spells may increase river flooding. More intense rainfall increases surface runoff which will increase localised flooding. In turn, this will put more pressure on drains, sewers and water quality. Storm intensity in summer could increase, even in generally drier summers.

Rising sea or river levels will inevitably increase river and tidal flooding but this will have a knock on effect increasing other sources of flood risk because of the interactions with sewers and groundwater.

With more intense rainfall, the sewer networks are likely to experience exceedance of capacity more often and this will increase the pressure on ageing infrastructure which in combination is likely to increase the frequency of sewer flooding in the future. An increase in peak river flows is likely to increase the risk of fluvial flooding. Increased storminess and rainfall also increases the possibility of blockages or obstructions to watercourse channels, trash screens and other structures from debris washed into the watercourse or into highway drains.

Groundwater levels in coastal areas are projected to rise in response to the rising sea levels, which is likely to increase the risk of groundwater flooding. In addition, the interaction between the various sources of flooding, which are all anticipated to become more frequent in the future, will mean even more extreme flood events are likely to occur in the future, and the number of overall flooding incidents is expected to increase.

It is unlikely that climate change will significantly increase flood risk from artificial sources in Southampton. However, there may be a requirement to adapt the management regime to accommodate the potential increases in rainfall and storm intensity, particularly for water bodies that receive drainage from these sources, either formally or informally.

5. Planning and Flood Risk: The Sequential Approach

Both the Southampton Core Strategy (CS) and City Centre Action Plan (CCAP) have demonstrated that the target for development in the city cannot be entirely met using land outside of the flood zones. It is therefore recognised that development will be required in flood zones 2 and 3 to meet both the development target and to promote regeneration. This is recognised in the CS (paragraph 5.4.25) and the CCAP (paragraph 4.136).

The NPPF sets out requirements for developments (in particular the Sequential Test and Exception Test) to protect people and property from flooding, which all Local Planning Authorities are expected to follow. Where these tests are not passed, national policy is clear that new development must not be permitted. The PPG that accompanies the NPPF supports and describes a risk based Sequential Approach that planners should follow when allocating land for development.

The Sequential Approach is a risk-based approach to the location of development designed to ensure that areas at little or no risk of flooding from any source are developed in preference to areas at high risk. The aim is to avoid development in medium and high flood risk areas (Flood Zones 2 and 3) and areas affected by other sources of flooding, where possible.

This chapter explains the process of how to perform the Sequential Test and, where required, the Exception Test, which are required in order to provide evidence that a site will be safe from flooding.

5.1 When Should the Sequential Approach be followed?

In Southampton, there are some circumstance when a developer does not need to follow the Sequential Test as it is assumed that it has already been passed. This is the case for sites that have been allocated in the CCAP, or sites in the city centre and identified in the Council's Strategic Housing Land Availability Assessment 2013 (SHLAA – available online <http://www.southampton.gov.uk/planning/planning-policy/research-evidence-base/shlaa.aspx>). In these cases, the developer should still apply the Sequential Approach within the site to locate uses with higher vulnerability in areas at lowest risk.

For windfall sites (areas not specifically identified as being available) in the city centre and Northam where there are regeneration/sustainability benefits which outweigh flood risk, the Sequential Test will be deemed to have been passed, providing the developer is able to demonstrate that the benefits of the proposal outweigh the flood risk. This position was agreed with the Environment Agency and is reflected in paragraph 4.136 of the CCAP.

For all other sites, including those listed on the SHLAA that are not within the city centre, the applicant/developer should apply the Sequential Approach, beginning with the Sequential Test.

5.2 The Sequential Test

The Sequential Test aims to ensure that the Sequential Approach is followed to steer development into areas with the lowest probability of flooding. In most circumstances the Sequential Test must be applied to planning applications, with the outcome considered alongside other planning objectives, however there are some circumstances where the passing of the Sequential Test is not required to be demonstrated (as described in 5.1).

5.2.1 Applying the Sequential Test

It is accepted that development cannot be delivered entirely in flood zone 1, therefore the Sequential Test should be applied to individual planning application proposals, using information from this SFRA. Flood risk should be considered alongside other spatial planning issues such as transport, housing, economic growth and natural resources to help determine which alternative locations are considered reasonable. Figure 2 provides guidance on the application of the Sequential Test.

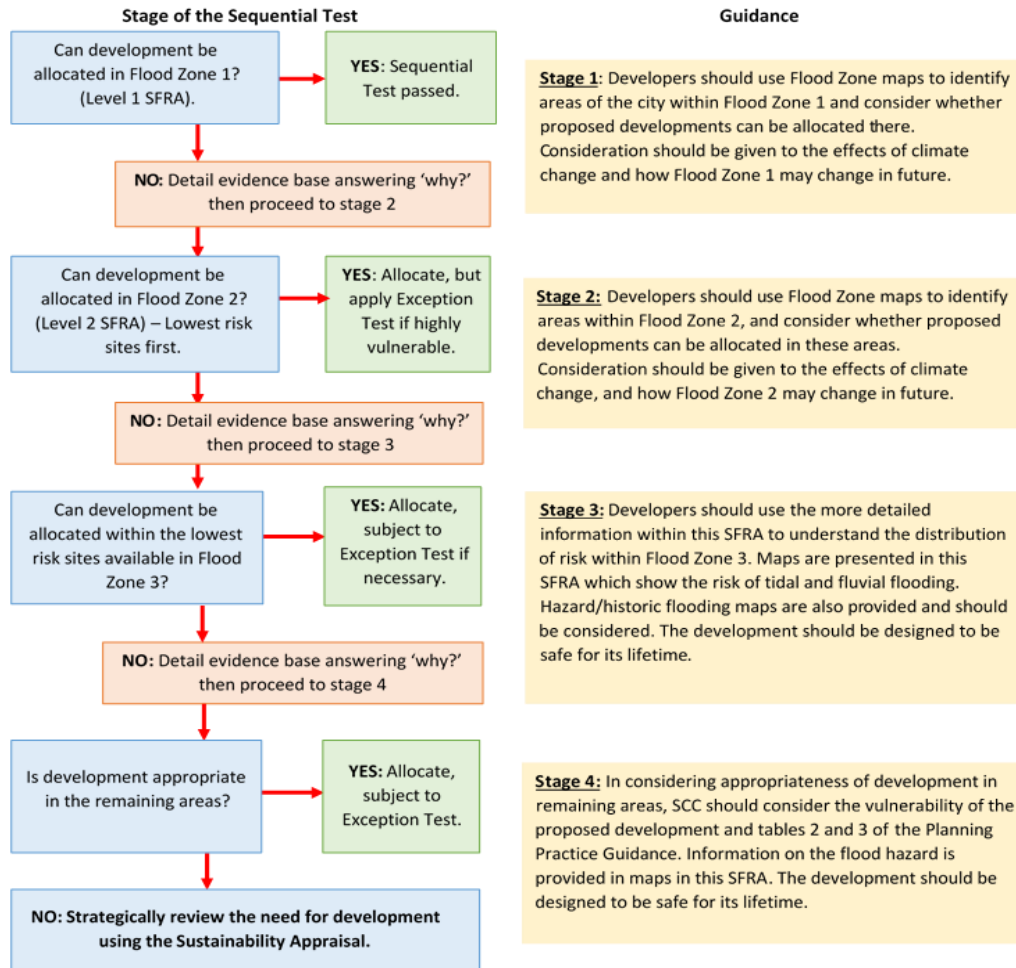


Figure 2: Guidance on the Application of the Sequential Test

In order to apply the Sequential Test it needs to be clear which flood zone a site falls within, and whether there are any reasonably available alternatives suitable for the purpose of the development. Flood zones are defined by the Environment Agency and refer to the probability of flooding from rivers or the sea, ignoring the presence of flood defences. Table 1 (page 14) of this SFRA defines the Flood Zones, while Map 8 shows the location of the present day Flood Zones within Southampton.

Following identification of the flood zone(s) and application of the Sequential Test, the vulnerability classification should then be used to determine whether a particular development type is appropriate. The vulnerability of a development varies according to the type and purpose of the development, shown in Table 9.

Table 9: Flood vulnerability classification, as defined by Planning Practice Guidance

Development classification	Type / Purpose of development
Essential infrastructure	<ul style="list-style-type: none"> • Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flooding. • Wind turbines
Highly vulnerable	<ul style="list-style-type: none"> • Police and ambulance stations, fire stations and command centres; telecommunications installations required to be operational during flooding • Emergency dispersal points • Basement dwellings • Caravans, mobile homes and park homes intended for permanent residential use • Installations requiring hazardous substances consent (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as ‘Essential Infrastructure’).
More vulnerable	<ul style="list-style-type: none"> • Hospitals • Residential institutions such as residential care homes, children’s homes, social services homes, prisons and hostels. • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. • Non-residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less vulnerable	<ul style="list-style-type: none"> • Police, ambulance and fire stations which are not required to be operational during a flood. • Buildings used as shops, financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the ‘More Vulnerable’ class; and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill (as defined in Schedule 10 to Environmental Permitting (England and Wales) Regulations 2010) and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Waste treatment works which do not need to remain operational during times of flood. • Sewage treatment works, if adequate measures to control pollution and manage sewage during flood events are in place

Water compatible	<ul style="list-style-type: none"> • Flood control infrastructure • Water transmission infrastructure and pumping stations • Sewage transmission infrastructure and pumping stations • Sand and gravel working • Docks, marinas and wharves. • Navigation facilities • Ministry of Defence (MoD) defence installations • Ship building, repairing and dismantling, dockside fish processing and refrigeration, and compatible activities requiring a waterside location • Water-based recreation (excluding sleeping accommodation) • Lifeguard and coastguard stations • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.
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Source: PPG - Table 2: Flood Risk Vulnerability Classification

5.1.2 Evidence of the Sequential Test

Evidence of the application of the Sequential Test should be provided through the provision of a Site Specific Flood Risk Assessment (FRA). When applying the Test, it should be demonstrated that:

- A transparent process has been formulated and followed,
- The process has sought to steer new development to areas with the lowest probability of flooding wherever possible, and;
- Full consideration has been given to reasonably available alternatives on land with a lower probability of flooding.

Where other sustainability criteria outweigh flood risk issues, the decision making process should be transparent with reasoned justifications for any decisions to allocate land in areas at high flood risk in the sustainability appraisal report.

The Sequential Test evidence base should be recorded, and it is suggested that this is included as an appendix to the Sustainability Appraisal. The required evidence base to show the passing of the Sequential Test is described in Table 10.

Table 10: Sequential Test Evidence Base

Required evidence	Guidance
Flood risk on the site	Refer to the map sets in Appendix A of this SFRA, or undertake more detailed analysis
The availability of 'reasonably available' sites in areas of lower flood risk, including allocated sites where appropriate.	Refer to the Southampton Local Development Framework SHLAA (2013) for guidance on defining 'reasonably available'
The vulnerability classification of the development	Refer to PPG or Table 09 (page 40) of this SFRA
The wider sustainability benefits of the site (if the Exception Test will need to be applied).	Assess the site against the aims and objectives of the Sustainability Appraisal of the LDD policies.

5.2 The Exception Test

The Exception Test is a method to demonstrate and help ensure that flood risk to people and property will be managed to a satisfactory level, while allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available.

If, following the application of the Sequential Test, it is not possible, consistent with wider sustainability objectives, for the development to be located within zones of lower probability of flooding, the Exception Test can be applied, if appropriate (as per paragraph 102 of the NPPF). The aim of the Exception Test is to ensure that more vulnerable development, such as residential development, are not located in areas at high risk of flooding.

5.2.1 Applying the Exception Test

The Exception Test only needs to be applied as set out in Table 11, following the application of the Sequential Test. Table 11 should be used in conjunction with the vulnerability of the development, which is described in Table 9.

Table 11: Compatibility of development type and Flood Zones (subject to passing of Sequential Test) (From PPG)

		Flood Risk Vulnerability Classification				
		Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zones*	1	✓	✓	✓	✓	✓
	2	✓	Exception Test Required	✓	✓	✓
	3a	Exception Test Required	✗	Exception Test Required	✓	✓
	3b	Exception Test Required	✗	✗	✗	✓
✓ Development is appropriate (subject to passing Sequential Test) ✗ Development should not be permitted * See table 1 (page 13) of this SFRA for Flood Zone Definition						

Once it has been established that the development type is compatible, the Exception Test should be applied (where required). Figure 3 provides a flow chart to guide the application of the Exception Test.

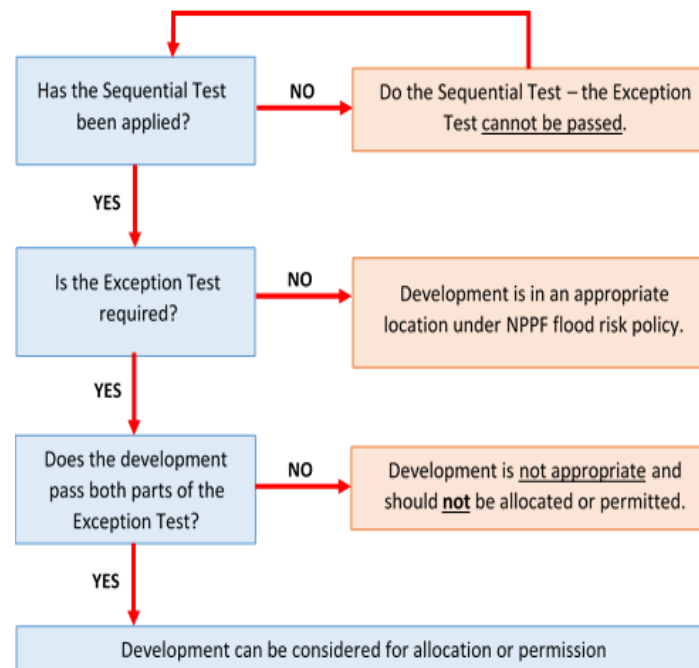


Figure 3: Application of the Exception Test (from PPG)

There are two parts to the Exception Test, and for development to be allocated or permitted, both the following elements have to be passed:

1. It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk.
2. A site-specific FRA must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible will reduce flood risk overall.

The first part of the test refers to the wider sustainability benefits to the community, evidence of which should be provided through the site specific FRA. If the proposed site allocation fails to score positively against the objectives of the sustainability appraisal, or is not otherwise capable of demonstrating sustainability benefits, the Local Planning Authority should consider whether the use of planning conditions or obligations could make it do so. Where this is not possible, the Exception Test will not be satisfied and the development should not be allocated or permitted.

The second part of the test relates to the safety of the development site. The developer must show that the proposed development would be safe for its lifetime (see box 1), and that any residual flood risk can be mitigated to the satisfaction of the Local Planning Authority. This should be demonstrated by the developer within the site-specific Flood Risk Assessment, which should be submitted alongside the planning application.

Consideration should be given to the safe access and egress arrangements that can be implemented so that during flood events the appropriate level of safety can be maintained. Further information on making a development safe, including safe access and egress arrangements, can be found in Chapter 7.

Box 1: Development Lifetime***Residential***

Residential development should be considered for a minimum of 100 years, unless there is a specific justification for considering a shorter period, which must be demonstrated to the LPA.

Non-residential

The lifetime of non-residential development depends on the characteristics of the development, and planners should use their experience within the locality to assess how long they anticipate the development to be present. For the purpose of flood risk, SCC will assume a 60 year life for non-residential developments.

Developers are expected to justify why they have adopted the given lifetime for the proposed development if it differs from the above.

5.2.2 Evidence of the Exception Test

In order for developments to be allocated or permitted, both elements of the Exception Test will have to be passed with suitable evidence of how each element is satisfied. For a successful application it is important that the arguments presented for justification through the Exception Test are in line with policies set out in the Local Plan and the Local Development Framework.

Where the NPPF requires the Exception Test to be applied for site allocation, it should be ensured that the wider sustainability benefits of the development, and how these outweigh flood risk, are clearly documented with reference to the site specific FRA.

It is for the developer/applicant to provide evidence that a proposed development is safe, and that any residual flood risk can be mitigated to the satisfaction of the Local Authority, taking account of any advice from the Environment Agency. Evidence should be reported within a site-specific Flood Risk Assessment submitted alongside the planning application, demonstrating that people will not be exposed to hazardous flooding.

6. Flood Risk Management in Southampton

The aim of this chapter is to set out how flood risk is currently managed in Southampton. For further detail on how flood risk can be managed on individual development sites, please see Chapter 7.

6.1 Principles of Flood Risk Management

The NPPF and accompanying PPG requires a precautionary approach to be undertaken when making land use planning decisions regarding flood risk. This is partly due to the considerable uncertainty surrounding flooding mechanisms and how flood risk may be affected by climate change. It is also due to the potentially devastating consequences of flooding to the people and property affected.

Flood risk is the combination of the probability of flooding and the consequences of flooding. Hence ‘managing flood risk’ involves managing either the probability of flooding, the consequences of flooding, or both.

The standard framework for managing flood risk is to use the ‘source – pathway – receptor’ risk management model. The source being the source of flooding (e.g. rainfall, rivers and the sea), the receptor the entity which can be damaged by flooding (e.g. a town, people, buildings, roads, the economy and habitats), and the pathway the link which connects the source(s) with the receptor (e.g. rivers, land, streets and sea defences).

This model can be applied at different scales, for example:

- River catchment: the source is rainfall, the pathway is the soil and rivers and the receptor is the town.
- Town scale: the source is the river, the pathway is the land, streets and any flood defences, and the receptor is the community, buildings, roads and economy.
- Development site: the source can be floodwater in the street adjacent to the site, the pathway can be the building on the site, or the land on which it might be raised, and the receptor can be the people in the building or the economic use of the building.

Modern flood risk management involves identifying how the source, the pathway and the receptors can be managed to reduce flood risk. For example:

Surface water flooding – the source may be overloaded sewers which are surcharging. In which case consider increasing the sewerage capacity to remove the source of flooding.

NPPF requires flooding from all sources (tidal, fluvial, surface water, sewers, groundwater and artificial sources) to be considered. A subset of the source – pathway – receptor model is the spatial planning framework for regulating development in flood zones. This is shown in Figure 4.

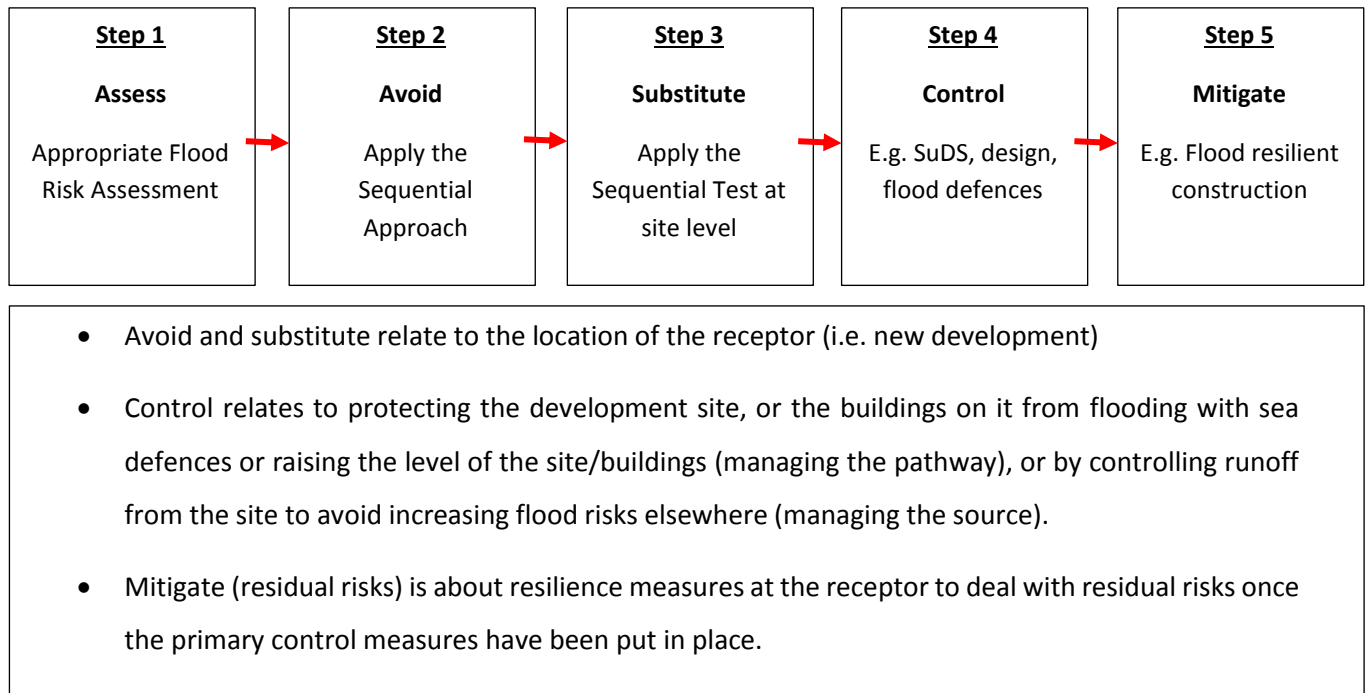


Figure 4: Source – Pathway – Receptor model

This hierarchy underpins the risk based approach and must be the basis for making all decisions involving development and flood risk. When using the hierarchy, account should be taken of:

- The nature of the flood (the source of the flooding)
- The spatial distribution of the flood (the pathways and areas affected by flooding)
- Climate change impacts, and
- The degree of vulnerability of different types of development (the receptors)

6.2 Local Flood Risk Management Strategy

As a unitary authority, SCC is designated a Lead Local Flood Authority (LLFA) under the Flood and Water Management Act 2010 (FWMA). The FWMA places a statutory duty on LLFAs to ‘develop, maintain, implement and monitor a Local Flood Risk Management Strategy (LFRMS) to manage local flood risk in its area’.

The purpose of the LFRMS is to help individuals, communities, businesses and authorities better understand and manage flood risk in Southampton. It considers flooding from surface water, groundwater and ordinary watercourses, however it was decided to also include other types of flooding (tidal and Main River), since it can sometimes be difficult to identify the source of flooding during an incident and flooding often can be from a combination of different sources. By including all sources of flood risk it provides a clear overview of flood risk within Southampton and the co-ordinated approach to managing these risks.

The aim of the Strategy is to better understand, communicate and manage the risk of flooding in Southampton through viable, sustainable and coordinated approaches, for the benefit of people, property, land and the environment, both now and in the future.

The objectives of the LFRMS are to:

1. Improve the knowledge and understanding of all sources of flood risk across the City.
2. Work in partnership with other authorities and stakeholders who have a role in flood risk management, including across administrative boundaries.
3. Identify ways to increase public awareness of flood risk across the City.
4. Identify ways of improving support for people at direct risk to promote appropriate individual and community level planning and action.
5. Ensure that planning decisions are properly informed by flooding issues so future development assists with reducing and mitigating flood risk.
6. Identify appropriate measures which reduce the likelihood of harm to people and damage to the economy and the environment and assign a lead organisation to facilitate delivery.
7. Maintain, and improve where necessary, affordable and sustainable flood risk management infrastructure and systems to reduce flood risk.
8. Identify all available funding mechanisms to enable delivery of flood risk management interventions

The Strategy identifies the actions to address flood risk in Southampton, which include:

- Investigate flooding incidents (where deemed appropriate).
- Maintain a register of flood risk assets.
- Maintenance/regulating activities on main rivers.
- Regulating works on ordinary watercourses through consenting and enforcement.
- Implement completed flood plans and strategies including the Coastal Strategy.
- Spatial/land use planning.
- Joint working/duty to co-operate through a co-ordinated approach.
- Improve our knowledge and understanding of flood risk, including groundwater and ordinary watercourses.
- Improve recording of flooding incidents.
- Raise awareness of flood risk in Southampton.
- Improve existing drainage infrastructure and rivers/watercourses with available resources.
- Designate features/structures which affect flood and coastal erosion.
- Retrofit SuDS.

The Southampton LFRMS has been developed to manage flood risk over the next 5 years; therefore a review of the Strategy will provide a good opportunity to also review any changes to the baseline data. Should a review of the Strategy be required sooner, the environmental baseline shall also be reviewed.

The LFRMS can be viewed online at www.southampton.gov.uk/flooding.

6.3 Managing Flooding from Tidal Sources

This SFRA has identified tidal flooding as a significant risk in Southampton as there are currently no formal defences to protect against flooding from the sea. The tidal frontages do include some protection, however these are predominantly erosion structures that provide an intrinsic (but varied) level of flood protection. Tidal flooding is generally a low probability but high consequence event, however over time both the probability and consequences will increase.

In addition to considering a strategic flood defence solution that aims to provide protection to Southampton, tidal flood risk can be managed through site specific measures such as flood resistant and resilient design, safe access and egress routes, evacuation and emergency planning and flood awareness. Land use planning and design of the site layout to avoid the areas with greatest flood hazard should also be considered. Further detail on these points, is available in Chapter 7 (Guidance for Developers).

6.3.1 Southampton Coastal Flood and Erosion Risk Management Strategy

The Southampton Coastal Flood and Erosion Risk Management Strategy (the Coastal Strategy) focuses on the long term management of a 22km stretch of frontage from Woodmill at the tidal extent of the River Itchen, to Redbridge on the River Test. The Strategy, completed in 2012, will influence future flood risk management options for key areas along this frontage.

The primary aim of the Strategy was to develop a sustainable and robust coastal management strategy to provide details on how the strategic Shoreline Management Plan policy of 'Hold the Line' could be implemented over the coming century.

The 22km stretch of coast was divided into sub-areas, Option Development Units (ODUs), which were used to assess the technical and practical feasibility of different defence options depending on the various constraints of each area (providing flexibility to develop appropriate management options for each area). Table 12 lists the preferred options for managing tidal flood risk in each ODU, and when implementation is likely to be required in order to reduce tidal flooding to people and property.

Table 12: Preferred options for tidal flood risk management from the Coastal Strategy 2012

Area	2015+	2030+	2060+	2110+
Unit 1 - Upper Itchen / St Denys	Community and property level protection to improve resistance and resilience of properties.		Concrete floodwall on or near the frontline.	
Unit 2 - Bevois Valley	Defended by existing structures.	Defend by steel sheet pile wall at the front line.		
Unit 3- Meridian Studios area	Raise vacant land at Meridian Studios prior to development. The remainder will require an intermediate height flood wall until raised land undertaken through		Raise land to achieve a continuous strip of raised land of at least 50m width and to a height of 4.25mODN. Land raised would need to tie into land previously raised at the	

	redevelopment supersedes the wall as the main defence by 2060.	Meridian Studios site in order to form a robust defence.
Unit 4 - Northam	Intermediate height floodwall forming the spine of the flood defence until raised land, preferably achieved through redevelopment supersedes the floodwall as the main defence by 2060.	Continuous strip of raised land.
Unit 5 – St Mary’s Wharves	Intermediate height floodwall forming the spine of the flood defence until raised land supersedes the floodwall as the main defence by 2060.	Defend by a continuous strip of raised land.
Unit 6 – Crosshouse / Town Depot	Defend by raising land through redevelopment.	
Unit 7 – Ocean Village	Maintain existing quay walls and defence structures.	Defend by raised quay walls with floodwall defences along perimeter of ABP land.
Unit 8 – Eastern Docks / Dock Gate 4	Do nothing. The area behind the Port is protected against flooding by the Strategy defences along the Itchen frontage to the north and the existing quay walls in the Port which is assumed will be maintained by ABP.	Defend by a floodwall around Ocean Village and along the boundary of the Port.
Unit 9 – Mayflower Park / Major Development Quarter	Land raising through development of the Royal Pier Site and the Major Development Quarter preferred. Implementation of a floodwall forming the spine of the defence by 2030 if a continuous strip of raised land not achieved by this time.	Defend by a floodwall or raised land.
Unit 10 – Western Docks	Do nothing. The area behind Port protected against flooding by the existing quay walls in the Port which it is assumed will be maintained by ABP.	Area behind the Port defended against flooding by a floodwall along the boundary of the Port with ramps or demountable defences on access points.
Unit 11 - Redbridge	Defended by current structures and existing land levels.	Community and property level protection to improve resistance and resilience to flooding.
		Defend by a floodwall constructed along the seaward side of the railway embankment.

It is important to note that whilst the Coastal Strategy identifies the preferred options for the management of tidal flooding, implementation is dependent on a number of factors including funding, so there is no guarantee they will be implemented, or to the timescales recommended. Therefore developers should always consider flood mitigation measures to protect people and property at a local, site level.

6.3.2 River Itchen Flood Alleviation Scheme

The River Itchen Flood Alleviation Scheme (River Itchen FAS) is a multi-million pound scheme developed from the recommendations of the 2012 Coastal Strategy. The Scheme focuses on reducing flood risk to hundreds of existing homes and businesses in Northam, St Marys, Chapel and parts of the city centre, through the implementation of a flood wall along on the west bank of the River Itchen from the Mount Pleasant Industrial Estate to the raised Southampton Water Activity Centre.

At present along this frontage there are over 500 residential properties, and 450 businesses are at risk from a 1 in 200 year tidal flood (a 0.5% chance of occurring in any year), as existing quay walls, structures and ground levels are not high enough to prevent more extreme high tides from inundating the west bank of the River Itchen. Flooding will become more frequent and severe if no action is taken to address tidal flood risk with the number of existing residential properties at risk increasing to approximately 1500 by 2115, with flood water reaching depths of up to 1.5 metres in several areas across Northam, St Marys and Chapel. In 2014, SCC began working with the Environment Agency and AECOM on a study to determine a feasible scheme, and scope out an appropriate route alignment for a floodwall. Two feasible options were put forward in a public consultation in August 2015, involving a frontline and a set-back route. A decision to progress with the frontline scheme was made by SCC in March 2016 (subject to future funding approval). This frontline route is illustrated in Figure 5.

Over the next 5 years, work will continue to develop the scheme, with progress updates being made available online at www.southampton.gov.uk/riveritchenfas.

Once construction is complete, the risk of flooding to the area will be dramatically reduced, however this does not reduce the responsibility for developers to ensure that sites benefiting from the scheme are safe from future flood risk, since there will still be a residual risk of flooding to the area in the form of breach or overtopping.



Figure 5: River Itchen FAS frontline route alignment

6.4 Managing Fluvial Flood Risk

The management of flood risk from Main Rivers is the responsibility of the Environment Agency, with smaller ordinary watercourses the responsibility of SCC. The most suitable type of flood management for a site depends on site specific conditions, the receptor of flooding and the type of flooding. Currently there are limited fluvial flood defences, however, the risk (and in particular the consequences) covers a relatively limited area when comparison is made to that of tidal flooding. Where developments are at risk of fluvial flooding, steps should be taken to minimise the risk, including appropriate site design to locate developments away from the highest risk, and use of measures to improve the resistance and resilience of the building (see Chapter 7, Guidance for Developers).

The precautionary approach adopted in this SFRA for assessing fluvial flood risk in Southampton should be adopted to secure river corridors, for flood risk management both now and in the future. This is supported by the Test and Itchen Catchment Flood Management Plan action to 'put in place policies within the Local Development Frameworks that work towards long-term protection and re-creation of river corridors through sustainable land use management'.

New development in fluvial Flood Zone 3b should be avoided. It is assumed that SCC will adopt fluvial Flood Zone 3 as the future Flood Zone 3b to assist in securing river corridors for appropriate 'water compatible' uses and, where necessary, 'essential infrastructure' only.

SCC will also adopt a presumption against further culverting, and seek opportunities to de-culvert, where site and ground conditions allow, in order to return watercourses to a more natural state, reducing the speed of water along the channel and increasing capacity through the drainage system, therefore helping to reduce flood risk.

6.4.1 Riparian Landownership

Any person who owns land or property next to a river, stream or ditch (a watercourse) is deemed to be a 'riparian landowner' and has a number of rights and responsibilities regarding the section of watercourse they own.

Riparian landowners play an important role in the reduction and management of flood risk, which is reflected in these rights and responsibilities. A riparian landowner must:

- Let water flow through their land without any obstruction pollution or diversion.
- Accept flood flow through their land, even if these are caused by inadequate capacity downstream.
- Keep the banks clear of anything that could cause an obstruction and increase flood risk, either on their land or downstream if it is washed away. This includes maintaining the bed and banks, any trees/shrubs growing on the banks, and removal of litter even if they did not originate from their land.
- Leave a development free edge on the banks next to a watercourse to allow for easy access for maintenance or inspection if required.

Full rights and responsibilities of a riparian landowner, as well as additional guidance is presented in the Environment Agency guide 'Living on the Edge' available on the Environment Agency's Website at: <https://www.gov.uk/government/publications/riverside-ownership-rights-and-responsibilities>.

6.4.2 Main River and Ordinary Watercourse Activities

Both the Environment Agency and SCC have different responsibilities for the management of activities on main rivers and ordinary watercourses.

The Environment Agency are responsible for the management and monitoring of activities that may affect flood risk from main rivers. Where the developer proposes to carry out works in, under, over or near a main river (including where the river is in a culvert), on or near a flood defence on a main river, in the floodplain of a main river or, on or near a sea defence, an Environmental Permit may be required. The developer should check with the Environment Agency prior to beginning any works, with further guidance on the types of activities requiring a permit available at <https://www.gov.uk/topic/environmental-management/environmental-permits>.

SCC, as a LLFA is responsible for the management of flood risk from ordinary watercourses, and under the FWMA 2010 has been given the powers of consenting and enforcement of certain works that may impact or alter the flow or structure of a watercourse.

The purpose of ordinary watercourse regulation is to control certain activities that might have an adverse flooding impact. An ordinary watercourse is defined as a watercourse that is not part of a main river, and includes rivers, streams, ditches, drains, cuts, culverts, dikes, sluices, sewers (other than public sewers) and passages through which water flows (although can be dry).

If proposals include the intention to carry out works (either permanent or temporary) which may place or alter a structure within an ordinary watercourse (i.e. affect the flow or storage of water), the developer will be required to apply to SCC for consent before any works begin. For further information see www.southampton.gov.uk/flooding

6.5 Managing Surface Water Flooding

Under the Flood and Water Management Act 2010, SCC as a Lead Local Flood Authority (LLFA), has a responsibility for the management of flooding from surface water which is set out within the LFRMS, available online at www.southampton.gov.uk/flooding.

Although the management of flooding from surface water is the responsibility of the LLFA, the Environment Agency has a Strategic Overview role assigned by the government following the recommendations of the Pitt Review released after the summer floods of 2007. A key part of this role is to provide local authorities with data, tools and guidance on risk management activities.

6.5.1 Surface Water Hotspot Study

The Southampton Surface Water Hotspots study is currently being developed to address the 'identification of priority surface water management schemes within hotspot catchments' action of the LFRMS through:

- Identification of potentially feasible options for managing surface water within hotspot catchments;
- Provision of evidence to support the exploration of funding options for priority surface water management schemes; and

- Provision of evidence to support the detailed design and implementation of priority surface water schemes.

A number of surface water hotspot areas have been identified within the city, based on a number of factors including flood history, and both short-term and long-term actions have been identified for each hotspot area. The short-term actions are generally investigative or maintenance works which are unlikely to require significant additional funding and which will help to provide evidence towards developing more long-term schemes. The long-term and strategic actions are likely to require additional resources. A number of city-wide actions have also been identified. It is envisaged that the identified hotspots and the action plan will be updated periodically to reflect any additional information collected or progress made on the actions.

This study is considered to have partially addressed the LFRMS actions detailed above, although it is recognised that further work will be required to fully meet these objectives. Identification of several potentially feasible options has been undertaken for each hotspot area, based on available data, but further work is required to collect additional information and to assess the feasibility of options. Evidence has been collected and presented in the hotspots action plan to support future detailed design and the exploration of funding options for further work. It is expected that funding will be the largest potential constraint on future work and the feasibility of schemes although a number of other potential constraints have also been identified. Hotspot areas have been ranked to determine which actions should be prioritised once funding becomes available.

When complete, the study will be available at www.southampton.gov.uk/flooding.

6.5.2 Sustainable Drainage Systems

Sustainable Drainage Systems (SuDS) are designed to control surface water runoff close to where it falls, mimicking natural drainage as closely as possible, and designed correctly are a good way of managing flooding from surface water.

The requirement for the provision of SuDS in all major development came into effect on the 6 April 2015, to ensure that runoff from a site is managed appropriately. The requirement for SuDS is well documented in the PPG that accompanies the NPPF, which states 'new development should only be considered appropriate in areas at risk of flooding if priority has been given to the use of sustainable drainage systems'.

The inclusion of SuDS in the master planning or development site planning stage can have a significant benefit on the viability and cost-effectiveness of SuDS integration, as all opportunities and constraints can be considered prior to construction. The location of SuDS features can also be used to inform the site layout as well as improving the amenity and visual appeal of the development.

For more detail on SuDS including advice on selection, please see chapter 7 (Guidance for Developers), or the SCC SuDS Guidance available at www.southampton.gov.uk/flooding.

6.6 Management of Groundwater Flooding

Under the Flood and Water Management Act 2010, SCC as a LLFA and are responsible for the management of groundwater flooding, which is set out in the LFRMS.

Groundwater flooding is often highly localised and complex. Groundwater flood risk should be investigated, identified, quantified and managed where possible by the Flood Risk Assessment process. Assessments of groundwater flooding must therefore always be included at all levels of future Flood Risk Assessment. Indicators that the site may be at risk from groundwater flooding include:

- If the development site is near to, or at, the junction between geological strata of differing permeability;
- If the development site is located at a similar level to nearby springs, or stream headwaters;
- If the development proposals include basements or excavations into the ground;
- If the vegetation on the site suggests periodic water logging due to high groundwater levels; and/or,
- If nearby recorded borehole water levels reach those of the site.

Management is highly dependent upon the characteristics of the specific situation. The costs associated with the management of groundwater flooding are highly variable. The implications of groundwater flooding should be considered and managed through development control and building design. Possible mitigation includes:

- Raising property ground or floor levels and avoiding the building of basements in areas considered to be at risk of groundwater flooding.
- Minimising excavation depths – for example; stipulating rafts in place of piles or trenches.
- Provide local protection for specific problem areas such as flood proofing properties i.e. tanking or sealing of basements.
- Replacement and renewal of leaking sewers, drains and water supply reservoirs. Water companies have a program to address leakage from infrastructure, so there is a clear ownership of the potential source.
- Major ground works (such as construction of new or enlarged watercourses) and improvements to the existing surface water drainage network to improve conveyance of floodwater from surface water or fluvial events through and away from areas prone to groundwater flooding.

The potential increase in groundwater levels due to sea level rise has the potential to result in flooding of low lying areas of Southampton. It is important to assess the impacts of managing groundwater with regard to water resources, and environmental designations. Likewise, placing a barrier to groundwater movement can shift groundwater flooding from one location to another.

The potential for higher groundwater levels should be considered where basements or underground structures are proposed in low-lying parts of Southampton. These types of structures should be discouraged in these areas, due to the potentially high probability of tidal flooding, however where they are necessary, development should assess the effect of climate change on local groundwater levels, and include appropriate mitigation into development proposals.

Development proposals will need to consider ground conditions and ground water levels over the lifetime of the development. In particular the design of any underground structures, services or foundations.

6.7 Management of Flooding from Sewers

Southern Water's main role is to provide and manage the public sewer system, which includes the foul, surface water and combined drainage system, as well as the provision of fresh water. The main roles of the water and sewerage company in managing flood risk include:

- Ensuring their systems have the appropriate level of resilience to flooding, and maintain essential services during emergencies.
- Maintain and manage their water supply and sewerage systems to manage the impact and reduce the risk of flooding and pollution to the environment.
- Provide advice to LLFAs on how water and sewerage company assets impact on local flood risk.
- Work with developers, landowners and LLFAs to understand and manage risks.
- Work with the Environment Agency, LLFAs and district councils to coordinate the management of water supply and sewerage systems with other flood risk management work. They also need to have regard to Flood and Coastal Erosion Risk Management (FCERM) plans in their own plans and work.

Adopted public sewers are owned and maintained by Southern Water, whereas un-adopted sewers are the responsibility of a third party. Private drains, those serving a single property are the responsibility of the property owner. As of 11 October 2011, property owners are only responsible for the sewer pipes that drain only their property, not those sections that are shared with others. Figure 6 explains the responsibilities for sewers, with sections of pipe coloured red owned and maintained by Southern Water, and those in yellow owned and maintained by the property owner. It is beneficial for property owners to maintain their privately owned sections of sewer in order to reduce the risk of flooding to their own property.

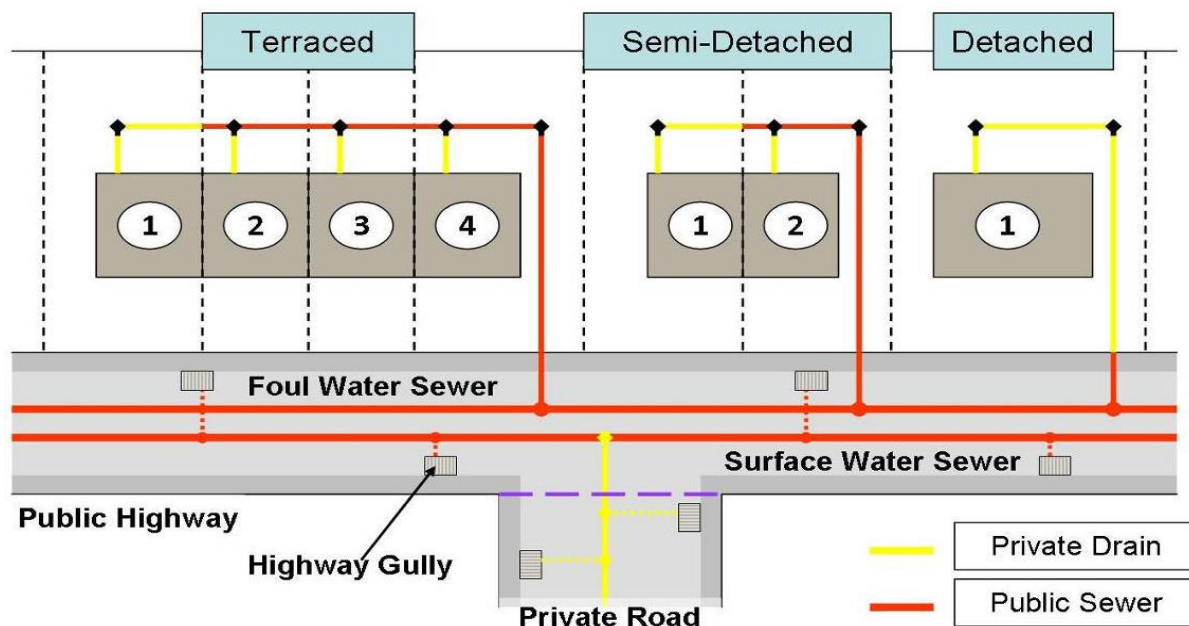


Figure 6: Overview of sewer ownership

Since 1980, with the introduction of Sewers for Adoption, Southern Water sewers are required to be designed in order to accommodate 1 in 30 year rainfall events. With this, flood risk from sewers is better managed, however many sewers in Southampton are pre-1980 and are likely to have a significantly lower capacity, which can in some areas lead to issues of flooding.

The sewerage system in Southampton is further complicated by the tidal nature of the sewer outfalls, and the reliance on pumping stations. In many instances 'non-return' valves are located on the outfalls. This protects the drainage system from the sea, but at the same time it will often prevent (or reduce) the ability of the system to discharge surface water – referred to as 'tide locking'. This can result in surface water backing up in the drainage system, potentially leading to flooding. The same effect can also be observed for outfalls into watercourses when water levels are elevated due to prolonged or intensive rainfall.

Southampton's surface water pumping stations are critical infrastructure for managing flooding from sewers. The reliance on the pumping stations means there is potentially a significant 'residual risk' in the event of pumping station failure, which is difficult to quantify without detailed modelling.

During the early stages of planning for a development, the developer should contact Southern Water to check the capacity available within the sewer system (more information is online at www.southernwater.co.uk). In areas where there is limited or insufficient capacity, the developer should seek to improve the drainage infrastructure to reduce flood risk on site, whilst not increasing flood risk elsewhere. There should be no increase in peak flow or volume of runoff from the development compared to the existing rate, but they should be reduced to as close as possible to Greenfield rate. In line with the changes to the PPG made in March 2015, major developments should seek to incorporate SuDS to reduce the risk of flooding from both surface water and sewers. It is also good practice and a requirement in local planning policy that all developments try to incorporate the use of SuDS to manage surface water runoff.

Any new development should not build over a public sewer. It is a requirement that a minimum distance of three metres must be maintained between any building and the public sewer to ensure that the building does not damage the sewer and that access is available at all times.

6.8 Emergency Planning

Emergency Planning for extreme events is a key consideration for new developments which have passed both the Sequential and Exception Tests, but must be located in areas identified at risk of flooding.

6.8.1 Civil Contingencies Act 2004: Duty of the Local Authority

The Civil Contingencies Act 2004 draws up the structure and procedures for civil protection. The Act formalises the duties of Category 1 responders (Local Authorities, Government Agencies, Emergency Services and NHS bodies) by requiring risk assessment and contingency planning to deal with emergencies, and the provision of advice and information to the public about actual or likely emergencies.

Under the Act, risk assessment and planning is arranged through Local and Regional Resilience Forums. The Forums, seek to co-ordinate with all those bodies which may be exposed to risk or be required to respond to events (including

flooding). This includes the production of a Multi-Agency Flood Plan, which may then be incorporated into a local emergency plan or major incident plan as appropriate.

The Civil Contingencies Act also places a legal duty on Category 1 responders (which includes Local Authorities) to produce a community risk register. Community risk registers are a compilation of risk assessments for hazards, including flood risk which is identified as one of the key risks to Southampton. It is expected that the outputs of this SFRA are used to support SCC in the maintenance of the Community Risk Register and mapping such that the risks can be evaluated with greater precision.

SCC has a legal duty to prepare and update emergency plans for major and local civil emergencies including flooding. As part of the requirements, SCC is expected to:

- Assist other relevant services and agencies, including the emergency services and the Environment Agency, with regards to alerting or warning the public if local flooding is either imminent or likely;
- Assist the emergency services with the evacuation of residents from areas that are likely to be, or have already been flooded;
- Identify and staff public reception centres for evacuees to offer information, refreshments and if necessary shelter overnight;
- Assist the Fire Service in dealing with floodwater and mitigating damage, by providing flood control measures such as sandbags;
- Assist the emergency services to control access to the scene by undertaking road closures or erecting road barriers etc.

It is expected that the mapping within this SFRA will support SCC in identifying evacuation areas, reception centre locations and critical infrastructure that lie within Flood Zones 2 and 3 and also assist in identification of future resourcing requirements for an emergency response. The information within this SFRA is likely to assist those preparing and updating emergency plans, by improving the understanding of the risk. It also enables those attending flood emergencies to prepare in advance and reduce the chance of unforeseen exposure to hazards during a flood emergency.

6.8.2 Hampshire and Isle of Wight Multi Agency Flood Plan

The Hampshire and Isle of Wight Multi Agency Flood Plan (Response & Recovery) (MAFP) is a specific hazard plan updated in 2016. It outlines both SCC's and the multi-agency response to flood events and is supported by Hampshire and the Isle of Wight Local Resilience Forum (HIOW LRF).

There are three parts to the MAFP:

- Part One: Response and Recovery.
- Part Two: Summarises the risks to each of the four Top Tier Local Authority areas (Hampshire, Isle of Wight, Southampton and Portsmouth Council areas).
- Part Three: Provides specific detail on Southampton's flood risk areas and the supporting mapping.

The plan describes the multi-agency management and response arrangements in preparation for, and in response to, a flood event in Hampshire and the Isle of Wight. The aim of the MAFP is to minimise the impacts of significant flood events in Hampshire and the Isle of Wight.

Each part of the MAFP has a number of objectives:

- Provide background information including relevant legislation, terminology definitions and supporting risk assessment.
- Describe the mechanisms for flood and severe weather warnings.
- Define plan activation triggers.
- Outline recovery arrangements specific to flooding.
- Describe the multi-agency emergency response structures that would be established.
- Provide flood response information for use by these response structures.
- Describe the roles and responsibilities of agencies responding to flooding.
- Outline considerations for media and public information.
- Provide information to support the warning and informing of the public before, during and after a flood event.
- Provide a flood risk profile for Hampshire, Isle of Wight, Portsmouth and Southampton.
- Provide a site specific flood response plan for areas at risk of flooding.

6.8.3 Critical Infrastructure

To assist in informing the Emergency Planning Team, this section gives an overview of the critical infrastructure in the city. Map 17 provides a visual of sites of critical infrastructure in relation to Flood Zone 2.

6.8.3.1 Emergency Service Infrastructure

There are four hospitals in Southampton, all of which are presently located in, and will remain in Flood Zone 1, over the next 100 years. They are:

- Southampton General Hospital (Tremona Road) – Flood Zone 1
- Princess Ann Hospital (Coxford Road) – Flood Zone 1
- Spire Hospital (formerly Chalybeate Hospital) (Chalybeate Close) – Flood Zone 1
- Royal South Hants Hospital (Brinton's Terrace) – Flood Zone 1

There are four police stations across the city, three of which are located will remain in Flood Zone 1 over the next 100 years, with the other being in present day Flood Zone 3. They are:

Southampton City Centre (Mountbatten Way) – Flood Zone 3

- Shirley (Shirley Road) – Flood Zone 1

- Bitterne (Bursledon Road) – Flood Zone 1
- Portswood (St Denys Road) – Flood Zone 1

There are three fire stations located across the city, all of which are presently located, and will remain in Flood Zone 1 over the next 100 years. They are:

- Hightown (Bursledon Road) – Flood Zone 1
- Redbridge (Redbridge Hill) – Flood Zone 1
- St Marys (St Mary's Road) – Flood Zone 1

6.8.3.2 Transport Infrastructure

There are a number of major transport routes within Southampton including national rail lines and road routes. Southampton Central Rail Station connects Southampton with London and the north, as well as the urban centres to the east (Brighton) and west (Weymouth) along the coast. There are 7 district stations within Southampton which include St Denys, Bitterne, Woolston and Sholing to the east, Millbrook and Redbridge to the west and Swaythling to the north, as well as connections to the docks for freight and container distribution.

Large sections of the rail route to the west of Central Station are within areas of high flood risk, particularly from tidal flood events. The effects of climate change over the next 100 years are predicted to include areas within the city centre and could lead to flooding of St Denys, Redbridge and Millbrook rail stations. Notably, Southampton Central Rail Station was flooded in May 2008, believed to have resulted from heavy rainfall.

Certain elements of Southampton's road infrastructure are critical to providing an integrated and effective response to major flooding. Most importantly access routes such as roads and pedestrian routes are vital to provide access for the emergency services to affected areas. Pedestrian and vehicular routes along with elements of public transport will also be important in providing a means of evacuation of the public should this be necessary. As there is much land within Southampton that could potentially be affected by surface water and tidal flooding, several key access routes may also be vulnerable to flooding.

Although outside SCC's administrative boundary, Southampton Airport is a regionally important infrastructure. The airport lies adjacent to Flood Zones 2 and 3, and is partially protected by flood defences on the River Itchen. The risk to the airport is expected to increase in the future as a result of climate change.

6.8.3.3 Service Infrastructure

Maintaining and protecting essential services such as water, electricity, gas and sanitation, or if this is not possible, ensuring their swift restoration is vital to securing a rapid return to normality following a flood. The Council will liaise with, and require assistance from, statutory undertakers during and after a flood event.

ABP maintain and operate two pumping stations to aid the discharge of surface water from the drainage system and prevent tide locking. These two pumping stations are critical to the operation of the surface water network in Southampton as they serve considerable drainage catchments including key transport links such as the A3024 and A33. These pumping stations are located adjacent to Mayflower Park and near King George V Dock at Millbrook.

Due to operational requirements, Southern Water's sewage treatment works at Kent Road, Millbrook Point and Victoria Road are all located in Flood Zone 3. Southern Water are planning to review the resilience of key water infrastructure sites in Southampton during their 2015 plan period.

The impacts of infrastructure which may cause danger to people during flood events needs to be assessed. Infrastructure such as foul sewers, electrical installations, nuclear installations such as Z-Berth (refer to the SotonSafe Plan) and areas where hazardous chemicals and fuels are stored. The responders will need to be aware of these hazards and the appropriate responses to them should they arise.

7. Guidance for Developers

This chapter provides information and advice to developers and planners on the methods that can be used to help manage flood risk to a development site, improve the safety of future occupants, and meet the requirements of planning policy relating to flood risk.

7.1 Site Specific Flood Risk Assessment

In accordance with paragraph 103 of the NPPF which states ‘Local Planning Authorities should ensure flood risk is not increased elsewhere and only consider development appropriate in areas at risk of flooding where, informed by a site-specific Flood Risk Assessment following the Sequential Test, and if required the Exception Test’. A site specific FRA must ‘demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall’.

Although this SFRA has been undertaken for Southampton, it does not negate the need for site specific FRAs to be undertaken at the planning application stage. Instead, this SFRA provides advice on the scope of the additional information required within a site specific FRA. Developers and applicants should be referred to this SFRA at the start of any pre-application discussions with SCC.

Flooding should be managed through the Flood Risk Assessment process. Further collection of relevant data is required, such as land use, runoff rates, existing drainage systems, past flood events and consultation with relevant bodies. Specific factors that should be considered when undertaking a FRA included:

- Areas liable to flooding (based on site and catchment characteristics).
- The extent, standard capacity and effectiveness of existing drainage systems,
- Existing runoff rates, with any probable increases,
- The likely impacts to other areas (such as increases in surface water runoff rates),
- The likely extent, depth and velocity of flooding,
- The effect of climate change, and
- The suitability of various sustainable urban drainage system options.

The site-specific FRA, which should be submitted alongside the planning application in accordance with NPPF, is required to demonstrate how flood risk will be managed now and in the future over the development’s lifetime. It is the responsibility of the developer/applicant to undertake a site specific FRA to fully assess the flood risk to and from the site, propose appropriate measures to mitigate the risk and demonstrate that any residual risks can be managed safely.

7.1.1 Aim and Objectives of the Site Specific Flood Risk Assessment

The aim of the site specific FRA is to assess all sources of flood risk and to demonstrate that the development is safe from flooding, including allowances for climate change. This includes assessment of mitigation measures required to safely manage flood risk.

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 the development will increase flood risk elsewhere;
- Appropriate mitigation measures;
- The evidence for the Local Planning Authority to apply the Sequential Test if it is required; and
- Whether the development will be safe and pass the Exception Test, if applicable.

7.1.2 Requirements for a Site Specific Flood Risk Assessment

A site specific FRA is required for:

- All site proposals greater than 1 hectare,
- All site proposals for new development (including minor development and change of use) in Flood Zone 2 and 3,
- A site within an area in Flood Zone 1 which has critical drainage problems, and/or,
- Where proposed development or change of use to a more vulnerable class (see Table 9, page 44) may be subject to other sources of flooding.

Figure 7 provides a flow chart to show when a site specific FRA is required or whether further consultation from the Environment Agency is required.

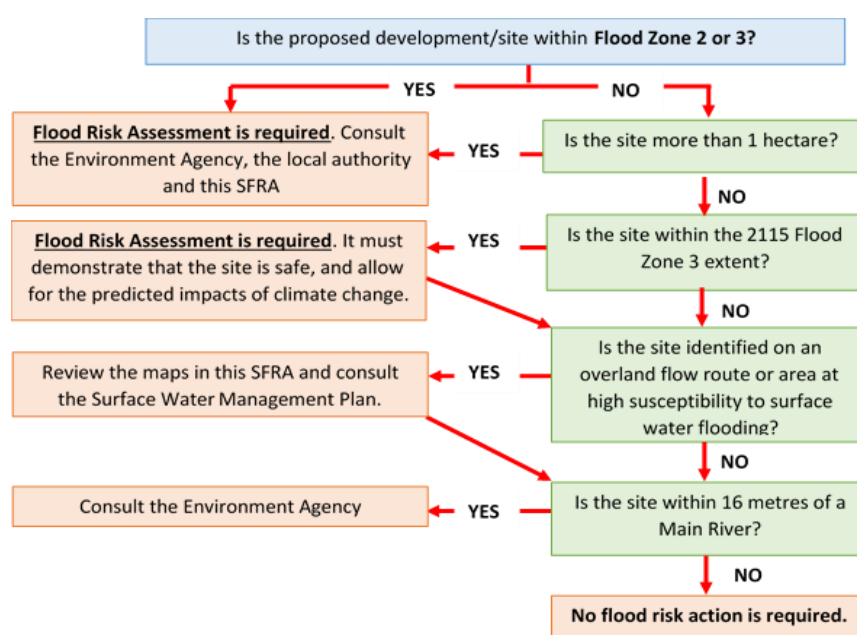


Figure 7: Guidance on when a site specific Flood Risk Assessment is required

Development proposals requiring a Site Specific FRA should:

- Apply the Sequential Test, and where necessary, the Exception Test.
- Not increase flood risk either upstream, downstream or to the site, including allowances for climate change.
- Not increase surface water volumes or peak flows in any circumstances.
- Use opportunities provided by new development to, where practicable, reduce flood risk within the site and elsewhere.
- Ensure that where development is necessary in areas of flood risk (after Sequential and Exception Tests applied), it is made safe from flooding for the lifetime of the development, taking into account the impact of climate change.
- Assess all sources of flood risk, including fluvial, surface water and groundwater.

7.1.3 Information to Include in a Site Specific Flood Risk Assessment

The information provided in a site specific FRA should be credible and fit for purpose, whilst remaining proportionate to the degree of flood risk, and appropriate to the scale, nature and location of the development. It should be demonstrated that the flood risk management hierarchy of ‘assess – avoid – substitute – control – mitigate’ has been applied.

The site specific FRA should:

- Consider the flood risk to the development site, as well as the risk that may arise as a result of the development, taking climate change into account.
- Consider the different types of flooding and identify any flood risk reduction measures.
- Consider the effects of a range of flooding events including extreme events on people, and property.
- Include an assessment of residual risk after flood risk measures have been taken into account, demonstrating that it is acceptable for the particular development or land use.

The site specific FRA should be undertaken as early as possible in the planning process to identify whether the site is suitable for particular development types, to avoid wasting time later in the planning process. It should be fully supported by appropriate data and information, including historical information on previous flood events. Table 13 provides a checklist of the minimum required content of a site specific FRA.

Table 13: Model Checklist for a Site Specific Flood Risk Assessment

1. Development site and location - This section should describe the site of the proposed development.
a) Where is the development site located? (e.g. postal address or national grid reference and a map)
b) What is the current use of the site (e.g. undeveloped land, housing, shops, offices etc.)
c) Which Flood Zone is the site within? (i.e. Flood Zone 1, 2 or 3 – use the Environment Agency flood map to determine)
2. Development proposals – this section should provide a general summary of the development proposals, and where possible make reference to/include plans or drawings.

<p>a) What are the development proposal(s) for this site? Will this involve a change of use of the site and, if so, what will that change be?</p> <p>b) In terms of vulnerability to flooding, what is the vulnerability classification of the proposed development?</p> <p>c) What is the expected or estimated lifetime of the proposed development likely to be?</p>
<p>3. Sequential Test – required for developments in Flood Zones 2 or 3 only.</p>
<p>a) What other locations with a lower risk of flooding have you considered for the proposed development?</p> <p>b) If you have not considered any other locations, what are the reasons for this?</p> <p>c) Explain why you consider the development cannot reasonably be located within an area with the lowest probability of flooding (flood zone 1); and, if your chosen site is within flood zone 3, explain why you consider the development cannot reasonably be located in flood zone 2.</p> <p>d) As well as flood risk from rivers or the sea, have you taken account of the risk from any other sources of flooding in selecting the location for the development?</p>
<p>4. Climate change</p>
<p>a) How is flood risk at the site likely to be affected by climate change? See section 4 of this SFRA and the Environment Agency Climate Change Allowances for further guidance.</p>
<p>5. Site specific flood risk – describe the risk of flooding to and from the proposed development over its expected lifetime, including allowances for climate change.</p>
<p>a) What is/are the main source(s) of flood risk to the site? (E.g. tidal/sea, fluvial or rivers, surface water, groundwater, other?). Consider information from the Environment Agency maps, this SFRA and historic flood records.</p> <p>b) What is the probability of the site flooding, taking account of the maps of flood risk available from the Environment Agency, this SFRA and any further flood risk information?</p> <p>c) Are you aware of any other sources of flooding that may affect the site?</p> <p>d) What is the expected depth and level for the design flood? Flood levels should be presented in metres above Ordnance Datum.</p> <p>e) Are properties expected to flood internally in the design flood and to what depth? Internal flood depths should be provided in metres.</p> <p>f) How will the development be made safe from flooding and the impacts of climate change, for its lifetime? See Section 7 of this SFRA for guidance.</p> <p>g) How will you ensure that the development and any measures to protect the site from flooding will not cause any increase in flood risk off-site and elsewhere? Consideration should be given to the impacts of climate change over the lifetime of the development.</p> <p>h) Are there any opportunities offered by the development to reduce the causes and impacts of flooding?</p>
<p>6. Surface water management – this section can be used to describe the existing and proposed surface water management arrangements at the site using SuDS wherever appropriate, to ensure there is no increase in flood risk to others off site.</p>
<p>a) What are the existing surface water drainage arrangements for the site?</p> <p>b) If known, what (approximately) are the existing rates and volumes of surface water run-off generated by the site?</p> <p>c) What are the proposals for managing and discharging surface water from the site, including any measures for restricting discharge rates? For major developments (e.g. of ten or more homes or major commercial</p>

<p>developments), and for all developments in areas at risk of flooding, sustainable drainage systems should be used, unless demonstrated to be inappropriate.</p> <p>d) How will you prevent run-off from the completed development causing an impact elsewhere?</p> <p>e) Where applicable, what are the plans for the ongoing operation and/or maintenance of the surface water drainage systems?</p>
<p>7. Occupants and users of the development – this section should provide a summary of the numbers of future occupants and users of the new development; the likely future pattern of occupancy and use; and proposed measures for protecting more vulnerable people from flooding.</p>
<p>a) Will the development proposals increase the overall number of occupants and/or people using the building or land, compared with the current use? If this is the case, by approximately how many will the number(s) increase?</p> <p>b) Will the proposals change the nature or times of occupation or use, such that it may affect the degree of flood risk to these people? If this is the case, describe the extent of the change.</p> <p>c) Where appropriate, are you able to demonstrate how the occupants and users that may be more vulnerable to the impact of flooding (e.g., residents who will sleep in the building; people with health or mobility issues; etc.,) will be located primarily in the parts of the building and site that are at lowest risk of flooding? If not, are there any overriding reasons why this approach is not being followed?</p>
<p>8. Exception Test – this section should provide evidence to support certain development proposals in Flood Zones 2 and 3 if, following the Sequential Test, it is appropriate to apply the Exception Test.</p>
<p>a) Would the proposed development provide wider sustainability benefits to the community? If so, could these benefits be considered to outweigh the flood risk to and from the proposed development?</p> <p>b) How can it be demonstrated that the proposed development will remain safe over its lifetime without increasing flood risk elsewhere?</p> <p>c) Will it be possible to for the development to reduce flood risk overall (e.g. through the provision of improved drainage)?</p>
<p>9. Residual risk</p>
<p>a) What flood related risks will remain after the flood risk management and mitigation measures have been implemented?</p> <p>b) How, and by whom, will these risks be managed over the lifetime of the development? (E.g., putting in place flood warning and evacuation plans).</p>
<p>10. Flood risk assessment credentials</p>
<p>a) Who has undertaken the flood risk assessment?</p> <p>b) When was the flood risk assessment completed?</p>

FRAs for proposed development within the SCC administrative boundary should follow the approach recommended by the NPPF and accompanying PPG, as well as guidance provided by the Environment Agency. To assist developers in the preparation of a suitable site specific FRA, SCC has produced a FRA template which is available on the SCC website www.southampton.gov.uk/flooding.

7.1.4 Reviewing the Site Specific Flood Risk Assessment

Once a planning application, together with an appropriate FRA, is submitted by the developer/applicant, it will be assessed to ensure that the applicant has considered flood risk from all sources and demonstrated how flood risk will be managed (flood mitigation measures etc.) taking climate change into account.

It is the responsibility of the applicant to provide sufficient detail to demonstrate compliance with NPPF and with local SCC policies, in particular that proposals will remain 'safe' for the lifetime of the development, which is typically 100 years for residential development, and 60 years for commercial, whilst making allowances for climate change.

7.2 Flood Risk Mitigation

The minimum acceptable standard of protection against flooding for new property within flood risk areas is 1% (1 in 100 year) annual probability for fluvial flooding and surface water drainage, and 0.5% (1 in 200 year) annual probability tidal event, with allowance for climate change over the lifetime of the development. The measures chosen to help manage and reduce flood risk will depend on different factors including the nature and source of the flood risk, and the site specific conditions.

7.2.1 Site Layout and Design

The Sequential Approach should be applied within the development site to locate the most vulnerable elements of the development in the areas with the lowest risk. Residential developments should be restricted to areas of lowest hazard, whereas parking, open space or proposed landscaped areas may be located within the areas of the site where a higher probability of flooding may exist.

Where structures such as bicycle shelters, park benches and refuse bins (and their associated storage areas) are located in areas with a high risk of flooding, they should be designed to be flood resilient and also firmly anchored to the ground to secure them should a flood event occur.

7.2.2 Raised Defences

Raised defences are a common method of flood risk mitigation, however can be expensive as they need to be specially designed and engineered to withstand the force of water, and require ongoing maintenance. Raised defences should be designed to achieve at least a 1 in 100 year standard of protection for fluvial flood risk and 1 in 200 year standard of protection for tidal flood risk until the end of the design life, adopting relevant climate change allowances for flood risk assessments (Environment Agency April 2016), whilst also including a 300mm freeboard to allow for uncertainty, settlement and small waves.

Whilst construction of a raised floodwall or embankment can help reduce the risk to a development, it is not the preferred option for flood risk management. This is because the residual risk will remain since water collecting on the landward side of a raised defence cannot discharge to a watercourse or the sea while levels remain high, and so will be trapped for the duration of the flood. Where raised defences are built on fluvial areas, compensatory storage must be provided as floodplain storage is used, and it must be demonstrated that the proposed structures do not increase flood risk elsewhere.

Areas behind flood defences are at particular risk from rapid onset of fast-flowing deep water flooding, with little or no warning if defences are breached or overtopped. Land raising is the preferred option over the use of raised defences, however it is acknowledged this is not always a viable option.

Temporary or demountable defences are not acceptable forms of flood protection for new development, unless the flood risk is residual only.

7.2.3 Ground Level Modification (Land Raising)

The most robust form of flood defence is raising land to create high ground. This method is particularly effective for reducing tidal flood risk, and also has the advantage of minimal defence maintenance or repair costs (depending on the design), and also minimises the need for additional resistance and resilience measures.

Such an option would be most appropriately and effectively carried out during the re-development of sites, as demolition of existing buildings may otherwise be required. However, if opportunities to redevelop do not arise, and sufficient time is available until the defence is required, with careful co-ordination and planning, such an option could be achieved through joining up incrementally raised areas overtime, aligned with renovation or building replacements therefore allowing existing land uses to remain.

This option should ensure safe movement of people in or out of the area, i.e. an island effect with surrounding areas inundated by floodwater is not acceptable, since access to the site for emergency services will not be possible.

In areas at risk of fluvial flooding, raising land above the floodplain is likely to reduce conveyance and flood storage, which may in turn have an adverse impact on flood risk further downstream. If land raising is proposed where fluvial flooding occurs then compensatory flood storage must be provided on land that is adjacent to the floodplain, but does not currently flood, and should be on a volume for volume, level for level basis.

Raising ground levels can also deflect flood flows. Analyses should therefore be performed to demonstrate that there are no adverse effects on third party land. It can also create areas where surface water may pond during significant rainfall events. Any proposals to raise ground levels should be assessed to ensure that it would not cause increased ponding or build-up of surface runoff on third party land.

7.2.4 Developer Contributions

Flood risk management authorities can apply for Flood Defence Grant in Aid (FDGiA) from Defra to help pay for the provision of flood defence schemes that reduce the risk of flooding and coastal erosion for existing communities, however eligibility is dependent on criteria including the benefits the scheme will provide. This means that some schemes may only be part funded and any shortfall in funding will need to be found from other sources including local levy funding or contributions from other parties that benefit from the scheme.

Following the application of the Sequential Test, it may therefore be necessary, in some cases, for the developer to make a contribution to the improvement of flood defences that would benefit both the development and the local community. Contributions from developers can also be made towards the maintenance and provision of flood risk management assets and the reduction of surface water flooding, for example SuDS.

The Community Infrastructure Levy (CIL) (which is levied on extensions and buildings) allows Local Planning Authorities to raise funds from new development. The charges are set by the local council, based on the size and type of the new development. These rates are set out in the Local Charging Schedule.

The money raised from CIL can be used to fund a variety of infrastructure requirements as set out in Section 216 (2) of the Planning Act 2008. This includes strategic transport schemes, flood defences and open spaces.

Further information on CIL, and the requirements of developer contributions can be found on SCC's website at: <http://www.southampton.gov.uk/planning/community-infrastructure-levy/>

7.2.5 Building Design: Finished Floor Levels

Where development in flood risk areas is unavoidable (following satisfaction of the Sequential and Exception Test), the most common method of flood risk mitigation to people and property, particularly with 'more vulnerable' land uses, is to ensure that habitable floor areas are raised above the flood zone. Internal areas of these types of development (including change of use) should be designed to be dry during the design flood (1 in 100 ARI for fluvial and 1 in 200 ARI for tidal), for the lifetime of the development.

At a minimum, finished floor levels should be raised above the extreme flood level. In addition, the Environment Agency requires a 300mm freeboard (the difference between finished floor levels of habitable rooms and the design flood level) to be achieved to allow for small waves.

In certain situations, such as proposed extensions to buildings with lower floor levels, it may prove impractical to raise the internal ground floor levels sufficiently in order to meet the general requirements. In these cases, the Environment Agency should be approached to discuss the options for a reduction in the minimum internal ground levels, providing appropriate flood mitigation and proofing measures (resistance and resilience measures) are implemented up to an agreed level. The Environment Agency Standing Advice (available at <https://www.gov.uk/guidance/flood-risk-assessment-standing-advice>) should be followed when considering development in areas of flood risk.

In some cases it may be possible to introduce flood resilient design in lieu of the freeboard level or to allocate less vulnerable development to the ground floor, for example commercial premises with residential above. Where this is the case, attention must be given to safe access and egress routes and the safety of people should not be jeopardised by creating an island development in times of flooding. A Site Flood Plan should be developed to ensure all future occupants are aware of the risks and how to evacuate safely when required.

The use of basement accommodation should be restricted to areas which are not susceptible to flooding, including groundwater flooding. Should basement development be required in areas designated by the Environment Agency as susceptible to groundwater flooding, it is advised that more consideration should be given to this source of flooding as part of a site specific FRA following a geological investigation being undertaken. SCC will not usually allow new residential development of basements in flood risk areas.

7.2.6 Resistance and Resilience Measures

There may be some instances where flood risk to a development remains. Examples include where the building use is water compatible (see Table 9 Flood Vulnerability Classification, page 45), residual risk remains behind a flood defence,

where an existing building is modified or where the floor levels have been raised but there is still a risk at the 0.1% annual probability. In these cases (and for existing development in the floodplain), additional measures can be put in place to reduce damage and aid recovery following a flood. These mitigation measures are often referred to as resistance and resilience measures.

Flood-resilient buildings are designed to reduce the consequences of flooding and facilitate the quick recovery should water enter a building. Resilience can be achieved:

- Through the use of water-resistant materials for floors, walls and fixtures e.g. lime based plaster on walls, tiles instead of carpets and plastic/stainless steel kitchen units rather than wood.
- By raising electrical sockets, cables and appliances above the flood level, and running electrical cables down from ceilings rather than up from floors.
- Installing solid concrete floors in place of suspended floors.

In considering appropriate resilience measures, it will be necessary to have a clear understanding of the mechanisms that lead to flooding and the nature of the flood risk by undertaking a Flood Risk Assessment.

Flood-resistant construction can prevent entry of water, or minimise the amount of water that may enter a building, where there is short duration flooding expected. Flood resistance measures can include:

- Flood barriers for doors and windows, or passive flood doors.
- Automatic airbricks which close on rising water and open when water recedes.
- Air vent covers.
- Non-return valves to waste water outlets and the foul sewer chamber to prevent flooding from sinks, toilets and other appliances.
- Sumps and pumps to control water levels under buildings with suspended floors reducing the likelihood of water entering via the floor.
- Application of a breathable waterproof brick sealant to at least 600mm above ground level.

Flood resistant construction should be used with caution, used in conjunction with resilience measures (in case of failure) and maintained regularly to ensure all components, such as rubber seals, are in good working condition. Resistance measures are not suitable where flood depths exceed 0.6m as the pressure exerted on the building by the outside may cause structural damage. In cases where depths of 0.6m is likely to be exceeded it is advised to allow water into the building, and rely on resilience measures to aid clean up.

In accordance with the Sequential Approach, flood resilience and resistance measures in new buildings should only be used as a means to manage relatively 'low' hazard or 'residual' flood risk, and should only be used as a last resort to address flood risk issues. Flood resistance and resilience measures should not be used to justify development in

inappropriate areas, and consideration should first be given to minimising risk by planning sequentially across a site. Once risk has been minimised, only then should mitigation measures be considered.

Figure 8 is taken from the Environment Agency guidance to support NPPF, to offer advice on the considerations for flood avoidance, resistance and resilience measures.

	1. Avoidance	2. Resistance / Resilience **		
Design Water Depth*		Water depth up to 0.3m	Water depth from 0.3m to 0.6m	Water depth above 0.6m
Approach	Remove building / development from the flood hazard.	Attempt to keep water out.	Attempt to keep water out, in full or in part, depending on structural assessment. If there are concerns, follow the approach for water above 0.6m.	Attempt to keep water out for low depths of flooding (below 0.6m). Allow water above 0.6m to pass through the property to avoid risk of structural damage.
Mitigation Measures	Land raising. Landscaping. Raised thresholds.	Materials and constructions with low permeability.	Materials and constructions with low permeability. Flood resilient materials and design. Access to all spaces to permit drying and cleaning.	Materials and constructions with low permeability. Accept water passage through building at higher depths Design to drain water away after flooding Access to all space to permit drying and cleaning.
Notes: * Design water depth should be based on assessment of all flood types that can impact the building ** Resistance/resilience measures can be used in conjunction with avoidance measures to minimise overall flood risk. *** In all cases the 'water exclusion strategy' can be followed for flood water depths up to 0.3m				

Figure 8: Considerations for Flood Avoidance, Resistance and Resilience Measures (EA Advice 2013)

7.2.7 Safe Access and Egress

Access and egress is required to enable the safe evacuation of people from the development during times of flooding, while also allowing the emergency services and other support with vehicular access to perform any necessary duties.

Wherever possible, safe access routes should be located above design flood levels and avoid flood flow paths. Where this is not possible, limited depths of flooding may be acceptable, provided that the proposed access is designed with appropriate signage etc. to make it safe. The acceptable flood depth for safe access will vary depending on flood velocities and the risk of debris within the flood water. Even low levels of flooding can pose a risk to people in situ

(because of, for example, the presence of unseen hazards and contaminants in floodwater, or the risk that people remaining may require medical attention).

The site specific FRA should provide information on flood hazard, duration and speed of onset along access/egress routes during the extreme flood event so that the LPA can make a judgement as to whether this is acceptable in light of the timeframe over which people might be trapped, the quality of the temporary refuge provided (and/or the length of time over which people might be displaced if prior evacuation has occurred), the capability of emergency services to effect a rescue and the advice of the particular authorities, operators, utilities and regulators as appropriate.

Where the site specific FRA shows that flood risk is an issue, access and egress should be discussed with SCC and the Environment Agency as early as possible in the planning stages, since it can affect the overall design of the development.

Where an acceptable standard of safe access/egress cannot be met, it will be necessary for users of the development to avoid flood hazards through the use of a Site Flood Plan which will detail how risk will be managed through the following methods:

- Evacuation procedure prior to a flood
- Reliance on temporary refuge during a flood

The FRA must provide clear evidence i.e. options appraisal which demonstrate why safe access and egress cannot be achieved before alternative methods will be considered by the Council.

7.2.8 Flood Warning and Evacuation

All development must be designed so that it is safe from flooding, including the consideration of residual risks, over its lifetime. Where a site would still be exposed to a flood hazard, because it has been demonstrated that safe access and egress is not feasible, then it may be considered appropriate to rely on flood warning and evacuation procedures, supported through the development of a Site Flood Plan.

The considerations for determining whether reliance on flood warning and evacuation procedures are appropriate include:

- The potential flood hazard to the site from a design flood event at the end of the anticipated lifetime of the development and the potential frequency and extent of any flooding at the site.
- Any well-developed proposals for future strategic flood defence schemes that could benefit the site.

Where the development proposal for more vulnerable uses (as defined by PPG) is considered appropriate from a flood risk perspective, with the habitable areas remaining dry under the design flood (for the lifetime), a Site Flood Plan complete with an appropriate evacuation procedure will be also be requested to inform all future occupants of the flood hazards and how to avoid them. For other developments, such as commercial, leisure or industrial premises, the requirement for a Site Flood Plan will be considered on a case-by-case basis depending upon factors including:

- The potential vulnerability and number of site users i.e. whether elderly or disabled persons or young children will be present at the site and may require additional support to evacuate safely.

- The proposed design of the development, including flood resistance and resilience measures.
- The potential flood hazard on the site over the lifetime of the development.

For any less vulnerable and water compatible developments where a Site Flood Plan has not been requested through a planning condition or planning obligation but a flood hazard exists at the site, it would be advised that the responsible owner/operator of the premises/operation develops a suitable flood evacuation procedure applicable to the future activities on the site which is communicated to staff and users so they are able to avoid being exposed to future flood hazards on the site. Further information on preparing a Site Flood Plan can be found online at www.southampton.gov.uk/flooding.

7.2.8.1 Flood Warnings Direct

The Environment Agency has the lead role for managing the issue of flood warnings and alerts, for coastal and fluvial (main river) flooding, and aims to give timely and effective warnings to people and property at risk in those situations where flooding is possible.

The Environment Agency uses the latest technology to monitor rainfall, river levels and sea conditions 24 hours a day. It uses this information to forecast the possibility of flooding from most major rivers and the sea, sending out warning and alert messages to the public via the Flood Warning Direct service. This service provides free warning messages directly to homes and businesses who are signed up and within areas at risk of flooding from Main Rivers or the sea, covering areas highlighted in Map 15 for flood alerts and Map 16 when a flood warning is issued.

The flood warning system is based on geographical flood warning areas and indicates the level of predicted risk, and any actions that should be taken. Three flood codes are used to indicate the level of predicted risk: flood alert, flood warning and severe flood warning, each explained in Figure 9. When the flood threat has receded, a “Warning No Longer in Force” message will be issued. In addition to this, the Environment Agency can issue Operational Messages that advise specific groups about the operation of certain assets or advise third parties to operate assets and/or install property level protection.




Alert state	What it means	When it is used	Actions
 Flood Alert	Flooding is possible. Be prepared	Two hours to two days in advance of flooding.	<ul style="list-style-type: none"> • Be prepared to act on your flood plan. • Prepare a flood kit of essential items. • Monitor local water levels and the flood forecast.
 Flood Warning	Flooding is expected. Immediate action required.	Half hour to one day in advance of flooding.	<ul style="list-style-type: none"> • 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. Danger to life.	When flooding poses a significant threat to life.	<ul style="list-style-type: none"> • Stay in a safe place with a means of escape. • Be ready should you need to evacuate from your home. • Co-operate with the emergency services. • Call 999 if in immediate danger.
Warning no longer in force	No further flooding is currently expected.	When sea or river levels are beginning to return to normal.	<ul style="list-style-type: none"> • Be careful as flood water may still be around for a several days. • If you have been flood, contact your insurance company as soon as possible.

Figure 9: Environment Agency Flood Warnings

Members of the public can also call the Environment Agency's dedicated 24 hour Floodline on 0345 988 1188 to access updates and advice on the current alert/warning situation. Quick-dial codes can be used to get to relevant information on a specific area quickly. The quick-dial codes for the flood warning areas within Southampton are listed in Box 2 The relevant code, together with how to use it, should be made available in required Site Flood Plans issued to occupants of new developments (including change of use) that are within a flood zone.

Box 2: Environment Agency Quick Dial Codes

To use a quick-dial code, call Floodline on 0345 988 1188, select option 1 then enter the code for the relevant warning area. The codes are:

Southampton Water: 012 21 21

Monks Brook: 012 22 38

Itchen Estuary: 012 21 24

Southampton Docks and Ocean Village: 012 21 23

Lower Test: 012 22 18

Hythe, Marchwood, Eling and Redbridge: 012 21 22

Lower Itchen: 012 22 36

Mansbridge to Woodmill (River Itchen): 012 22 37

Tanners Brook: 012 22 24

Developers are strongly advised to encourage those owning or occupying developments (including future occupants) within flood warning areas to sign up to the Flood Warnings Service, either by calling Floodline (0345 988 1188) or via the Environment Agency website (<https://www.gov.uk/sign-up-for-flood-warnings>). This applies even if the development is defended to a high standard and will remain dry internally under flood conditions since the occupant may be required to evacuate under extreme flood conditions.

7.3 Reducing Tidal Flood Risk

Table 14 provides further information on how new development can be made 'safe' in accordance with NPPF and the PPG. It has been prepared with consideration of local circumstances in Southampton (i.e. tidal flooding being the dominant source of flood risk) however particular local circumstances may dictate that an alternative approach is suitable. It is therefore particularly important that pre-application discussions are conducted with SCC, the Environment Agency and Southern Water (as a minimum), to avoid lengthy consultation following submission, or potential planning objections.

The information has been prepared on the basis of two broad flood risk management measures – a future strategic solution in Southampton that provides the required standard of protection, as well as 'site specific' solutions where a strategic approach is not available, or not appropriate.

Table 14: Safety Matrix – Making New Development Safe from Flooding

Development Vulnerability	Strategic Flood Risk Management		Site Specific Flood Risk Management		Residual Flood Risk Management	
	Flooding within Design Flood Event					
	Site Design Requirements	Safe Access Requirements	Site Design Requirements	Safe Access Requirements	Site Design Requirements	Emergency Response Requirements
Essential Infrastructure	Where development benefits from strategic flood risk management the developer should contribute to funding through Council contributions policy (CIL).	Development is afforded 'dry access' by virtue of the defence, however where possible opportunities should be sought to increase access levels above breach flood levels – unless hydraulic modelling results (accepted by the Council and EA) indicate that the depths are lower than indicated in the SFRA.	The site should remain operational and safe for use. The safety will be dependent upon the particular function of the essential infrastructure and should be agreed with the Environment Agency.	Prepare a site flood plan , in consultation with SCC emergency planners, local resilience forum, and with reference to the Multi Agency Flood Plan. Emergency services must be afforded access in extreme flood events. As a guide, flood depths to provide emergency access should not exceed 0.9m where velocities remain low, however the emergency services should be consulted in preparing development proposals.	The site should remain operational and safe for use. The safety will be dependent upon the particular function of the essential infrastructure and should be agreed with the Environment Agency.	Prepare a site flood plan , in consultation with SCC emergency planners, local resilience forum, and with reference to the Multi Agency Flood Plan. Emergency services must be afforded access in extreme flood events. As a guide, flood depths to provide emergency access should not exceed 0.9m where velocities remain low, however the emergency services should be consulted in preparing development proposals.
Highly Vulnerable	This type of development should not be permitted in this area, based on Flood Zone compatibility.				Finished floor levels/entrance levels of permanent buildings should be set to a minimum of 300mm above design flood level . Mobile homes or caravans intended for permanent occupancy must be located on ground a minimum of 300mm above design flood level	Prepare a site flood plan , in consultation with SCC emergency planners, local resilience forum, and with reference to the Multi Agency Flood Plan. Emergency services must be afforded access in extreme flood events. As a guide, flood depths to provide emergency access should not exceed 0.9m where velocities remain low, however the emergency services should be consulted in preparing development proposals.
More Vulnerable	Where development benefits from strategic flood risk management the developer should contribute to funding through Council contributions policy (CIL).	Development is afforded 'dry access' by virtue of the defence, however where possible opportunities should be sought to access levels above breach flood levels – unless hydraulic modelling results (approved by the Council and EA) indicate that the depths are lower than indicated in the SFRA. All site users to be placed on Environment Agency Flood Warning Register (Flood Warning Direct). All site users to receive a Site Flood Plan from developers identifying, as a minimum, the risk of flooding, how this is being managed on site, actions site users should take in the event of a flood and appropriate emergency contact details.	Finished floor levels of single storey buildings must be a minimum of 300mm above design flood event level. Internal services capable of operation during design flood event. Multi-storey buildings to have habitable rooms a minimum of 300mm above design flood event level. Where ground floor of multi storey buildings flood, flood hazard should be classified as 'low' and resilience and resistance techniques should be adopted in design. All site users to be placed on Environment Agency Flood Warning Register (Flood Warning Direct). All site users to receive a Site Flood Plan from developers identifying, as a minimum, the risk of flooding, how this is being managed on site, actions site users should take in the event of a flood and appropriate emergency contact details.	Unaided safe access and egress through the site and out of the floodplain must be available. Where 'dry' access is not available, flood hazard on access routes out of the floodplain should remain 'low' (e.g. flood depth should not exceed 250mm where velocities are low. Where necessary, access routes should be signposted , and all site users made aware of 'safe access' routes. A suitable Site Flood Plan should be developed prior to occupation.	Finished floor levels/entrance levels of single storey buildings can be subject to 'low' hazard from extreme flood events, if 'safe' access is available out of the floodplain during an extreme event. Where development includes ground floor habitable rooms, finished floor levels/entrance levels must be set a minimum of 300mm above design flood levels to prevent water ingress. Where possible, multi-storey buildings should locate habitable rooms a minimum of 300mm above design flood levels. Where this is not possible, they should be classified as single storey buildings.	Where ground floor of multi-storey buildings flood, access must be available to upper storeys (safe refuge), including for those with restricted mobility. Emergency services must be afforded access in extreme flood events . As a guide, flood depths to provide emergency access should not exceed 0.9m where velocities remain low, however the emergency services should be consulted in preparing development proposals. A suitable Site Flood Plan should be developed prior to occupation.

Development Vulnerability	Strategic Flood Risk Management		Site Specific Flood Risk Management		Residual Flood Risk Management	
	Flooding within Design Flood Event					
	Site Design Requirements	Safe Access Requirements	Site Design Requirements	Safe Access Requirements	Site Design Requirements	Emergency Response Requirements
Less Vulnerable	<p>Where development benefits from strategic flood risk management the developer should contribute to funding through Council contributions policy (CL).</p>	<p>Development is afforded 'dry access' by virtue of the defence, however where possible opportunities should be sought to access levels above breach flood levels – unless hydraulic modelling results (approved by the Council and EA) indicate that the depths are lower than indicated in the SFRA.</p> <p>All site users to be placed on Environment Agency Flood Warning Register (Flood Warning Direct).</p> <p>All site users to receive a Site Flood Plan from developers identifying, as a minimum, the risk of flooding, how this is being managed on site, actions site users should take in the event of a flood and appropriate emergency contact details.</p>	<p>Finished floor levels should be 'safe' and subject to only 'low' flood hazard during design flood event and resilience and resistance measures should be adopted in design.</p> <p>Internal services capable of operation during design flood event.</p> <p>All site users to be placed on EA Flood Warning Register (Flood Warning Direct).</p> <p>All site users to receive a Site Flood Plan from developers identifying, as a minimum, the risk of flooding, how this is being managed on site, actions site users should take in the event of a flood and appropriate emergency contact details.</p>	<p>Unaided safe access and egress through the site and out of the floodplain should be available.</p> <p>Where it can be demonstrated that development is not 'deliverable' and not compliant with other policy requirements by adopting unaided safe access and egress - 'safe refuge' must be available to all site users a minimum of 300mm above design flood levels, <u>and</u> include evacuation procedures in the site flood plan.</p> <p>A suitable Site Flood Plan should be developed prior to occupation.</p>	<p>Flood resilience and resistance measures should be adopted in design where appropriate.</p> <p>Buildings must be designed to withstand hydrostatic pressure from an extreme flood event, where necessary.</p> <p>All site users to be placed on EA Flood Warning Register (Flood Warning Direct).</p> <p>All site users to receive an 'information pack' from developers identifying, as a minimum, the risk of flooding, how this is being managed on site, actions site users should take in the event of a flood and appropriate emergency contact details.</p>	<p>A suitable Site Flood Plan should be developed prior to occupation.</p> <p>Emergency services must be afforded access in extreme flood events. As a guide, flood depths to provide emergency access should not exceed 0.9m where velocities remain low, however the emergency services should be consulted in preparing development proposals.</p>
Water Compatible	<p>Where water compatible development benefits from strategic flood risk management, the developer contribute to funding through Council contributions policy (CL). however in some instances development may be on the sea-ward of the defence line.</p>	<p>Where ancillary sleeping or residential accommodation in this vulnerability classification flood, flood hazard should be classified as 'low'.</p> <p>Flood resistance and resilience measures should be adopted in the design where appropriate.</p> <p>Buildings must be designed to withstand hydrostatic pressure, where necessary.</p> <p>All site users to be placed on EA Flood Warning Register (Flood Warning Direct).</p> <p>All site users to receive a Site Flood Plan from developers identifying, as a minimum, the risk of flooding, how this is being managed on site, actions site users should take in the event of a flood and appropriate emergency contact details.</p>	<p>A suitable Site Flood Plan should be developed prior to occupation.</p>	<p>Flood resistance and resilience measures should be adopted in the design where appropriate.</p> <p>Buildings must be designed to withstand hydrostatic pressure, where necessary.</p> <p>All site users to be placed on EA Flood Warning Register (Flood Warning Direct).</p> <p>All site users to receive a Site Flood Plan from developers identifying, as a minimum, the risk of flooding, how this is being managed on site, actions site users should take in the event of a flood and appropriate emergency contact details.</p>	<p>A suitable Site Flood Plan should be developed prior to occupation.</p>	
Development on Critical Drainage Routes	<p>Development layout and form should be designed so that critical drainage routes are retained and do not increase risk to others. Opportunities should be sought to reduce the risk of surface water flooding through the application of SuDS.</p> <p>Finished floor levels in proximity to critical drainage routes/areas should be raised 300mm above flood levels, as determined through hydraulic modelling.</p> <p>Opportunities to 'open up' critical drainage routes including deculverting should be sought.</p>					

7.4 Reducing Flood Risk from Sewers

Developers should check the capacity of the local public sewer network with Southern Water at the earliest possible stage in the planning process to ensure that there is sufficient capacity. All new developments should seek to improve the drainage infrastructure and reduce the risk of flooding, without increasing the risk of flooding elsewhere. There should be no increase in peak flow or volume of runoff from developments, and runoff rates should be reduced to as close as possible to Greenfield rate and volume. In line with PPG and SCC Local Plan policy, major developments should seek to incorporate SuDS to reduce the risk of flooding from both surface water and sewers.

Simple measures including non-return valves fitted to foul chambers and waste water outlets can help protect individual properties from both surface water and sewer flooding by preventing water entering the property via the drains and sewers. These can be easily incorporated into both new and existing developments.

7.5 Reducing Flooding from Groundwater

Many flood defences and methods of mitigation are not suitable for reducing flooding from groundwater. New development that includes basements is not deemed acceptable in areas where groundwater flooding is likely to be an issue, unless suitable mitigation is proposed. When redeveloping existing buildings it may be acceptable to use pumps, or tanking, as an option for resilience, however this is dependent on the proposed use of the basement.

7.6 Reducing flood risk from watercourses

The policy aim for Flood Zone 3 is to 'make space for water' by restoring the functional flood plain wherever possible. This is clearly set out within NPPF and the accompanying PPG.

Any developments in close proximity to rivers or watercourses should consider the opportunity to improve and enhance the river environment, including (where possible) river restoration, channel enhancement, de-culverting and removal of structures. Such measures can have benefits including reducing flood risk, improving water quality, increasing biodiversity and improving access to the river for maintenance or recreation.

7.6.1 Buffer Strips

Buffer strips refer to the vegetated riparian zone between a watercourse and adjacent land. All development bordering watercourses in Southampton should seek opportunities to set back development in accordance with the principles of 'Making Space for Water'. This should consider opportunities for restoring the river corridor, provision of flood storage and conveyance and future adaptation of flood defences where appropriate.

Individual planning applications should seek to adopt the Environment Agency requirements for an 8 metre wide buffer strips on Main Rivers, and 16 metre wide buffer strips from tidal defences, wherever possible.

7.6.2 Additional Consents

Where a planning application includes works to a watercourse that falls within the remit of the Water Resources Act 1991 or the Land Drainage Act 1991, additional approval may be required from SCC or the Environment Agency, prior

to any works being undertaken. More information on Ordinary Watercourse Consent can be found at www.southampton.gov.uk/flooding.

Developers may also be required to obtain an Environmental Permit from the Environment Agency if works are proposed on, over, under or adjacent to a Main River, flood or sea defence, or to make changes to any structure that helps to control flooding. Further information can be obtained from the Environment Agency at <https://www.gov.uk/flood-defence-consent-england-wales>.

Both Ordinary Watercourse Consent and an Environmental Permit must be obtained prior to any works being carried out. Failure to obtain the relevant consent prior to carrying out works may be a criminal offence and any person acting in contravention may be liable, on conviction, of a fine.

For further information refer to Section 6.4.2 (Main River and Ordinary Watercourse Activities)

7.7 Reducing Risk from Surface Water

Developers should seek to reduce surface water runoff to as close to Greenfield rates and volumes as possible. This can be achieved by the incorporation of Sustainable Drainage Systems (SuDS) into the site.

7.7.1 Sustainable Drainage Systems

For many years developers have dealt with surface water through the use of piped systems that collect and convey water away from the site as quickly as possible, discharging it directly into the nearest watercourse or sewer. Although this method may work in the reduction of surface water at the site, it can result in the increase of flood risk downstream, as well as pollution of watercourses from oil, silt and other pollutants carried directly from a development.

In order to help reduce the risk of surface water flooding to development sites across the city, developers should look for opportunities to move away from traditional piped drainage towards softer engineering solutions which seek to mimic the natural drainage regime. This can be achieved through the use of SuDS, which aim to control surface water runoff as close to its origin as possible, before it is discharged to a watercourse or sewer.

Incorporating SuDS into a development provides opportunities to:

- Reduce the causes and impacts of flooding
- Improve water quality by removing pollutants from urban runoff at source
- Combine water management with green space to provide benefits for amenity, recreation and wildlife
- Protect the natural flow regime of watercourses
- Encourage natural groundwater recharge

The replication of natural drainage is referred to as the SuDS philosophy, which can be achieved through three objectives:

- Water quality management: SuDS can help prevent and treat pollution in surface water, contributing to the objectives of the Water Framework Directive.
- Amenity and biodiversity: SuDS provide opportunities to create visually attractive green spaces and blue (water) corridors in developments, connecting people to water whilst providing the opportunity to improve existing, and create new habitats for wildlife.
- Flood risk management: SuDS help reduce the quantity and flow rate of surface water runoff, lowering the risk of flooding at, and downstream of the development.

Each of the three objectives should be considered equally, however delivery will vary according to the constraints and opportunities presented on a site by site basis.

7.7.1.2 SuDS: The Planning Context

Following consultation by Defra on the use of the planning system to secure SuDS, the Department for Communities and Local Government released written statement HCWS161 which came into effect on 06 April 2015. This states that local planning policies and decisions on planning applications should ensure that SuDS are put in place for major development, unless demonstrated to be inappropriate. Local Planning Authorities (LPAs) should consult the relevant LLFA on the management of surface water for major developments.

SCC's Adopted Core Strategy (amended 2015) requires SuDS measures to be incorporated into all development unless they can be demonstrated to be inappropriate at a specific location. For minor developments, there is currently no requirement for the LPA to consult the LLFA on surface water drainage, however the incorporation of SuDS is always recommended.

7.7.1.3 Types of SuDS

There are many different SuDS features that can be incorporated into a development to help reduce flood risk and provide additional benefits to the site. SuDS features can be broadly split into three types:

1. Source control - those that aim to control runoff at, or close to, the source e.g. green roofs and rainwater harvesting.
2. Site control - the management of runoff from several areas in the local area e.g. routing water to detention basins.
3. Regional control – involves the management of runoff from a site or number of sites, typically draining to a balance pond or wetland.

Figure 10 summarises each SuDS feature, showing how each of the SuDS philosophy objectives can be met.

Control		SuDS technique	Description	Flood risk reduction	Water quality treatment	Landscape, wildlife & amenity
Prevention	Source control	Green roof	Layer of vegetation covering a roof that intercepts/retains water.	✓	✓	✓
		Rainwater harvesting	The capture and reuse of rainwater from roofs and hard surfaces.	✓	/	/
		Permeable paving	Allows water to infiltrate through the surface and into the underlying layers for storage and infiltration.	✓	✓	/
Site control		Filter drains	Drain filled with permeable material with a perforated pipe base.	✓	✓	✗
		Infiltration trenches	Similar to a filter drain but infiltration from the sides and base is allowed.	✓	✓	✗
		Soakaway	Geo-cellular underground structure filled with rubble for storage and infiltration.	✓	✓	✗
		Bio-retention areas	Shallow vegetated areas used for treating runoff prior to discharge into a watercourse or infiltration.	✓	✓	✓
		Swales	Grassed depression providing temporary storage, conveyance, treatment and infiltration.	✓	✓	/
		Sand filters	Treatment provided by filtering runoff through sand.	✓	✓	✗
Regional control	Basins	Grassed depression that is usually dry. Provides temporary attenuation, treatment and possibly infiltration.	✓	✓	/	
	Ponds	Provides attenuation, treatment and enhances biodiversity and amenity.	✓	✓	✓	
	Wetlands	Similar to a pond, but designed to provide continuous flow through vegetation.	✓	✓	✓	
✓ = suitable/meets objective / = suitable/may meet objective but dependent on site conditions ✗ = not suitable/does not meet objective						

Figure 10: Example SuDS techniques and the SuDS philosophy objectives they meet

7.7.1.4 SuDS Design and Suitability

SuDS should be designed in accordance with the National Non-Statutory Technical Standards (Defra, 2015), which set out the requirements for design, construction, operation and maintenance of SuDS. The Standards are available to view at <https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards>. The principles of SuDS design that should be incorporated, include:

- Considering drainage at the earliest stages of site design

- SuDS can be multifunctional spaces
- SuDS should follow the management train
- Rainwater should be managed as close to its source as possible
- Connection to foul sewer is not permitted, unless it can be demonstrated that all other discharge methods are unfeasible.

The suitability of SuDS techniques within a single site should be assessed on a site-by-site basis, as selection will be dictated in part by site conditions and potential constraints including, (but not limited to):

- Topography
- Geology and permeability of soil
- Groundwater levels and protection status
- Proposed site use e.g. industrial increases contamination risk
- Previous site uses, and possibility of contamination

SCC has also developed a Local SuDS Design Guidance document to assist developers in identifying the local requirements and design principles/criteria that should be followed. Along with this guidance, developers should consult the CIRIA SuDS Manual 2015 for specific detailed design guidance.

It is recommended that the developer/applicant considers the use of SuDS as early as possible in the development of a site, as doing so can have a significant impact on the cost-effectiveness since all opportunities and constraints can be considered prior to construction. The location of SuDS features can be used to inform the layout of buildings, roads and open spaces, contributing to the improvement of amenity and visual appeal of the development. SuDS features should be designed with the long-term maintenance requirements in mind to ensure they remain functional for the lifetime of the development.

It must be recognised that some of the typical approaches to SuDS are not appropriate in areas which suffer from high groundwater levels or seasonally waterlogged soils. This should be considered in Southampton when assessing drainage proposals as part of planning applications as some areas are particularly susceptible to this type of situation, both now and increasingly in the future.

When determining if infiltration is suitable, it is recommended that site-specific infiltration tests are undertaken. Based on the geology and soils of Southampton there are limited areas within the catchment with permeable soils that would be suitable to implement infiltration based SUDS techniques. Geology close to the main watercourses of the River Itchen and River Test along with pockets of sands and gravels are moderately permeable, which could allow infiltration, although development should, where possible, be located outside the Flood Zones. In other areas of the catchment where the geology is less permeable, swales and balancing ponds may be suitable where space is available but the potential for infiltration based drainage solutions will be limited.

Guidance should be sought from the Environment Agency where a site falls within, or close to, a groundwater protection zone or aquifer as further restrictions may apply to the type of SuDS or activities that may be undertaken at the site. In addition, the historical industrial land use in parts of Southampton has resulted in the presence of

contaminated land in the city. This is likely to further limit any increase in infiltration on development sites due to the potential to negatively impact on groundwater quality, and consequently surface watercourses.

Where non-infiltration based SuDS techniques are recommended, particular consideration should be given to the inclusion of additional on-site surface water attenuation where there is a reliance on pumping to discharge surface water (either on site or further downstream).

The suitability of particular SUDS techniques to a specific development should be assessed on a site-by-site basis. A matrix like the one shown at the end of this chapter (Tables 15 and 16) is a useful tool in assessing where SuDS could be implemented. The technique assesses the optimum SuDS solution for the area by ranking the local geology, groundwater and contamination risk, topography and land use cover. The matrix acts as a decision framework for choosing the most applicable SUDS option.

Table 16 provides a qualitative guide on the relative weighting of the different factors for particular SuDS Groups. For example, geology (5) and groundwater/contamination (4) are relatively more significant factors in the use of infiltration techniques than land cover (2) or site slope (1). Similarly, topography (4) and land use (5) are relatively more significant factors in using wetlands than geology (1) or groundwater (2). Geology and groundwater are factors to be considered in the use of a wetland, but issues can be 'engineered out' (e.g. through use of an impermeable liner) more easily than 'regrading' an entire site. Each relative weighting is out of 12.

A specific site can then be ranked on a score from 1-3 for each of the four factors – geology, topography, land use and groundwater/contamination. High values (3) indicate a SuDS solution is particularly well suited to a specific site. Table 16 provides a guide on how each factor could be scored. For example, in scoring 'land use' a densely developed site may be given a score of 1 out of 3, whereas a low density development may be scored 3 out of 3 – this would indicate SuDS solutions such as wetlands, or detention basins may be a suitable solution. Multiplying each factor against each weighting in each group of SuDS can provide a quick indication of the SuDS potential for a site.

This method is useful to carry out a broad scale assessment across Southampton, however does not remove the need to consider each site on its own specific conditions. This approach should not be used as a definitive justification for particular SuDS techniques and it is recommended that appropriately qualified drainage engineers are employed to make decisions on drainage on a site specific basis. In general terms the method looks at where SuDS techniques that rely on permeable material will be appropriate and where swales and balancing ponds may be more appropriate to store and manage the controlled discharge of water.

Based on the geology and soils of Southampton there are very few areas within the catchment with permeable soils that would be suitable to implement infiltration based SuDS techniques. The underlying bedrock in Southampton is predominantly Sand, Silt and Clay with a few areas overlain by the Wittering formation. Geology close to the main watercourses of the River Itchen and River Test along with pockets of sands and gravels are moderately permeable, which could allow infiltration, although development/redevelopment should, where possible, be located outside the floodplain. In other areas of the catchment where the geology is less permeable, swales and balancing ponds may be suitable where space is available but the potential for infiltration based drainage solutions will be limited.

It must be recognised that some of the typical approaches to SuDS will not work in areas which suffer from high groundwater levels or seasonally waterlogged soils. This should be considered in Southampton when assessing

drainage proposals as part of planning applications as some areas are particularly susceptible to this type of situation, both now and increasingly in the future.

In addition, the historical industrial land use in parts of Southampton has resulted in contaminated land. This is likely to further limit any increase in infiltration on development sites due to the potential to negatively impact groundwater quality, and consequential surface watercourses.

Figure 11 at the end of this section are examples of how the SuDS matrix can work to provide initial SuDS guidance for two conceptual sites. The matrix does not consider 'at source' SuDS techniques as these will be particular to the site proposals, however should be considered. Green (living) roofs are at the top of the sustainability hierarchy for SuDS techniques and are suitable in this area. As well as flood reduction benefits, green roofs also provide pollution control and landscape and wildlife benefits. The attenuation provided by green roofs on redeveloped Brownfield sites has been shown to provide a 40% reduction in surface water runoff. The use of green roofs can therefore play a significant role in this management of runoff. Permeable surfaces and filter drains are another non infiltration based SuDS technique that should be considered in all new development in Southampton.

Table 15: Sustainable Drainage Solution Analysis Data Set Weighting Criteria

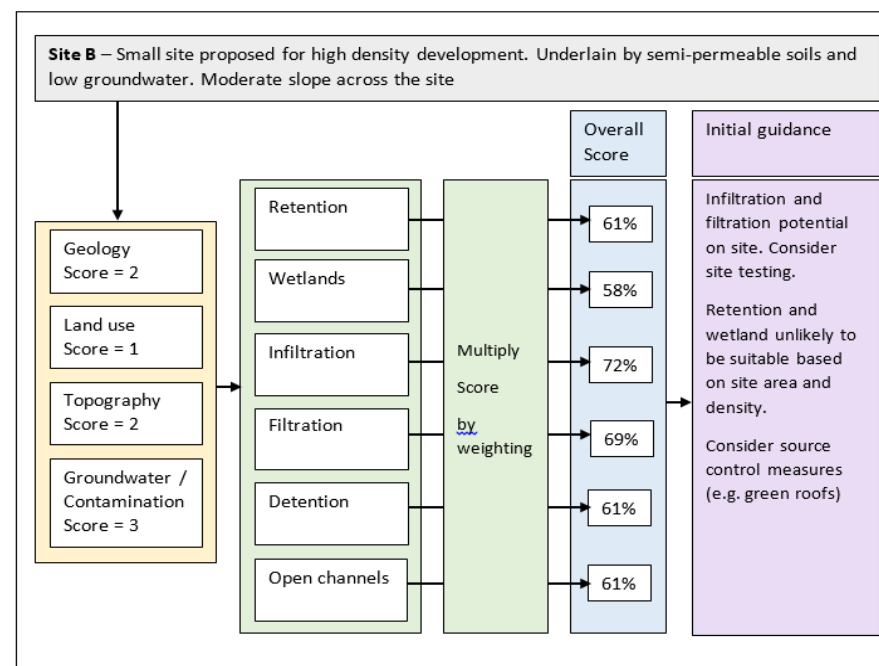
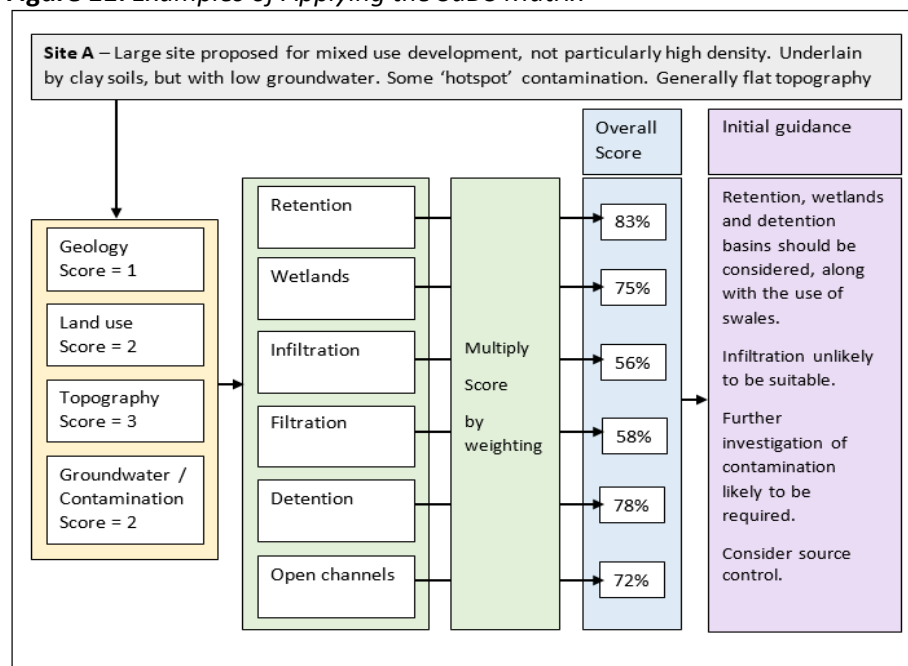
SuDS Solution		Data Set							
Group	Technique	Geology	Comment	Land Use / Cover	Comment	DTM / Slope	Comment	Groundwater / Contamination Risk	Comment
Retention	Retention Ponds and Subsurface Storage	1	In permeable geology a liner (or other impermeable material such as puddled clay) will be required to prevent the pond drying out.	3	Ponds should be located in, or adjacent to, non-intensively managed landscapes where natural sources of native species are likely to be good.	7	Ponds should not be located on steep slopes, or on unstable ground.	1	The soil below a wet pond should be sufficiently impermeable to maintain the water levels within the permanent pool at the required level, unless a continuous upstream base flow can be guaranteed.
Wetland	Shallow Wetland, Extended Detention Wetland, Pond/Wetland, Pocket Wetland, Submerged Gravel and Wetland Channel	1	In permeable geology a liner (or other impermeable material such as puddled clay) will be required to prevent the wetland drying out.	5	Usually requiring a high land take, the location of a wetland should take account the natural site features that might be used as additional temporary storage when wetland capacity is exceeded.	4	Wetland basins require a near-zero (almost horizontal) longitudinal slope, which can be provided using embankments.	2	The soil below a wetland should be sufficiently impermeable to maintain wet conditions, unless the wetland intersects with the water table.
Infiltration	Infiltration Trench/ Basin and Soakaways	5	Infiltration measures are generally appropriate for catchments with small impermeable areas.	2	Infiltration measures should be integrated into the site planning and should take account of the location and use of other site features.	1	Infiltration measures are usually restricted to sites without significant slopes, unless they can be placed parallel to contours.	4	The seasonally high groundwater table must be more than 1m below the base of the facility. Infiltration measures are designed for intermittent flow and should be allowed to drain between rainfall events.
Filtration	Surface Sand Filter, Sub-surface Filter, Perimeter sand Filter, Bioretention/ filter Strips and Filter Trench	5	Filtration measures should not be used to drain hotspot runoff if soils are permeable and groundwater may be put at risk.	2	Filtration measures should be sited next to and alongside its drainage area. They should be integrated with the overall site design and landscaping. However they are not suitable where pedestrian traffic is expected.	2	Site gradients should not exceed 1 in 20 to prevent erosion and channel flows across the filtration measures.	3	The maximum 'length' of impervious area draining to filtration measures should be controlled to reduce risk of 'sheet flows' changing to concentrated flows, although this is dependent on slope.
Detention	Detention Basin	1	Geology is not a significant issue in use of detention basins.	4	Detention basins should be integrated into the site planning process and take into account the location, use of other site features and undisturbed natural areas.	5	The basin floor should be as level as possible to minimise flow velocities, maximise pollution removal efficiencies and minimise risks of erosion.	2	Groundwater level records should be checked to ensure that during periods of high groundwater, storage capacity of the retention pond is maintained.
Open Channels	Swales	2	Swales are generally appropriate for catchments with small impermeable areas.	4	Swales should be integrated into the site planning and should take account of the location and use of other site features.	4	Swales are usually restricted to sites without significant slopes, though careful planning enable their use in steeper areas by considering the contours of the site.	2	The seasonally high groundwater table must be more than 1m below the base of the facility.

Table 16: Sustainable Drainage Solution Analysis – Data Set Significance Criteria

SuDS Solution		Data Set							
Group	Technique	Geology	Comment	Land Use / Cover	Comment	DTM / Slope	Comment	Groundwater / Contamination Risk	Comment
Retention	Subsurface storage	3	Impermeable Geology would assist retention	1	Low density development and/or green field development.	3	Relatively flat ground levels are advantageous for retention measures.	3	Low groundwater preferable.
		2	Mildly permeable Geology, which may require an impermeable membrane at various locations	2	Urban areas where landscaping/open space can be multifunctional.	2	Ground levels that are a mixture of steep and shallow should altered to flat gradient for retention measures.	2	Fluctuating groundwater levels or moderate contamination may mean additional remedial work is required.
		1	Permeable Geology, which would require an impermeable membrane.	3	High density urban or commercial/industrial environment.	1	Steep ground levels are not advisable for retention measures.	1	High groundwater and/or site contamination may mean impermeable membrane is Required.
Wetland	Ponds, Shallow Wetland, Extended Detention Wetland, Pond/Wetland, Pocket Wetland, Submerged Gravel and Wetland Channel	3	In permeable geology a liner (or other impermeable material such as puddled clay) will be required to prevent the wetland drying out.	1	High density urban or commercial/industrial environment.	3	Relatively flat ground levels are advantageous for wetland areas.		
		2		2	Urban areas where landscaping/open space can be multifunctional.	2	Ground levels that are a mixture of steep and shallow should altered to flat gradient for retention measures.		
		1		3	Low density development and/or green field development.	1	Steep ground levels are not advisable for wetland areas.		
Infiltration	Infiltration Trench/Basin and Soakaways	1	Low permeability (e.g. clay) means infiltration is unlikely to be suitable.	1	High density urban or commercial/industrial environment.	3	Relatively flat ground levels are advantageous	1	Permanently high ground water or significant contamination is inadvisable in locations with infiltration and likely to require significant remedial works
		2	Moderate permeability would mean infiltration may be possible in conjunction with other techniques.	3	Urban areas where landscaping/open space can be multifunctional.	2	Slopes should be kept to a minimum, although ground contours can be used in locations with significant gradients	2	Varying ground water or contamination 'hot spots' will require monitoring prior to decision on using infiltration.
		3	Permeable geology required for infiltration measures	3	Low density development and/or green field development.	2	Steep ground levels are not advisable for infiltration basins or trenches, but may be designed out in soakaways	3	Permanently low ground water is preferable in locations with infiltration.
Filtration	Surface Sand Filter, Subsurface Filter, or Perimeter sand Filter, Bioretention / filter Strips and Filter Trench	3	Impermeable Geology, which would assist filtration measures.	1	High density urban or commercial/industrial environment.	3	Relatively flat ground levels are advantageous for filtration measures and to keep sheet flow to a minimum.	3	High groundwater and/or site contamination may mean filtration will mobilise contaminants
		2	Mildly permeable Geology, which may require an Impermeable membrane at various locations	3	Urban areas where landscaping/open space can be multifunctional.	2	Slopes should be kept to a minimum, although ground contours can be used in locations with significant gradients.	2	Varying ground water or contamination 'hot spots' mean filtration locations will have to be carefully selected.
		1	Permeable Geology, which would require an impermeable membrane.	3	Low density development and/or green field development.	1	Steep ground levels are not advisable for retention measures and limited filtration will be possible on steep slopes.	1	High groundwater and/or site contamination may mean filtration will mobilise Contaminants.

Detention	Detention Basin	1	Geology is not considered a significant issue.	1	High density urban or commercial/industrial environment.	3	A virtually flat gradient is essential.	3	Low groundwater preferable.
				3	Urban areas where landscaping/open space can be multifunctional.	2	Ground levels that are a mixture of steep and shallow should be altered to flat gradient for detention measures.	2	Fluctuating groundwater levels or moderate contamination may mean additional remedial work is required.
				3	Low density development and/or green field development.	1	Steep ground levels are not advisable for detention measures.	1	High groundwater and/or site contamination may mean impermeable membrane is required
Open Channels	Swales	1	Large impermeable areas should be avoided.	2	High density urban or commercial/industrial environment.	3	Relatively flat ground levels are advantageous for swales.	3	Low groundwater preferable.
		2	A 50/50 split in geological permeability would be acceptable if this was the deciding factor.	3	Urban areas where landscaping/open space can be multifunctional	2	Slopes should be kept to a minimum, although ground contours can be used in locations with significant gradients.	2	Fluctuating groundwater levels or moderate contamination may mean additional remedial work is required.
		3	Large areas of permeable geology would be advantageous.	3	Low density development and/or green field development.	1	Steep ground levels should be avoided, however 'check dams' may be able to be used to slow flow.	1	High groundwater and/or site contamination may mean impermeable membrane is required.

Figure 11: Examples of Applying the SuDS Matrix



8. SFRA Management and Maintenance

This chapter provides an overview of the data collection, management procedures and maintenance that are required to ensure that this SFRA remains up-to-date and continues to make use of the best available information. Implementing a maintenance and management procedure for the SFRA will assist in the regular review of the technical data available and in commissioning updates where necessary.

8.1 Data Collection

The data sources used to inform this SFRA are listed in Table 17.

Table 17: Data used to inform the Level 2 SFRA

Data	Date of Data	Owner
LiDAR	June/July 2011	SCC
Detailed River Network	June 2013	Environment Agency
Environment Agency Classified Main Rivers	June 2015	Environment Agency
Bedrock Geology	August 2015	Environment Agency
Superficial Deposits and Bedrock Composition	August 2015	Environment Agency
Flood and Erosion Defence Overview	July 2016	SCC / Environment Agency
Flood Zones 2 and 3	July 2016	Environment Agency
Tidal Flood Risk	2016	Environment Agency
Recorded Flood Incidents	April 2017	SCC / Southern Water / Environment Agency
Surface Water Flood Risk (Complex)	May 2016	Environment Agency
Areas Susceptible to Groundwater Flooding	May 2011	Environment Agency
Flood Alert Areas	June 2016	Environment Agency
Flood Warning Areas	October 2016	Environment Agency
Critical Infrastructure	August 2015	SCC / SSE

No data processing was carried out; the datasets obtained for use in the SFRA have come from a number of sources under licence agreement. These datasets cannot be passed to external sources without permission from the owner and that those requiring the data ensure that they possess the appropriate copyrights and access.

It is recommended that information on all sources of flooding continues to be collected and that where required more resources are invested in determining the source and pathways of flooding. When more detailed or updated hydraulic modelling becomes available from the Environment Agency or other sources this should be incorporated into the SFRA. More detailed information may also be collected from site specific FRAs carried out by developers and land owners at the local site scale.

8.2 Monitoring of the SFRA

It is in the interest of SCC that this SFRA remains current and as up-to-date as possible.

The following tasks should be undertaken when including new datasets in the Southampton SFRA:

- Identify new dataset;
- Save new dataset/information;
- Record new information in a log so that the next update can review this information.

The following tasks should be undertaken when updating the Southampton SFRA:

- Undertake further analyses as required after SFRA review;
- Document all new technical analysis by rewriting and replacing relevant chapters;
- Amend and replace relevant SFRA;
- Re-issue to departments within SCC and other relevant stakeholders.

9. Glossary and Notations

Several terms and acronyms have been used throughout this SFRA. These are explained in Table 18 below.

Table 18: *Glossary and Notations*

Acronym or Term	Meaning
AA (Appropriate Assessment)	Also “Habitats Regulation Assessment” - a powerful tool in the control of environmental impacts. Often described as a decision making tool because it has the potential to stop a development,
ABI (Association of British Insurers)	Represents the collective interests of the UK insurance industry, speaking out on common interest, helps to inform and participate in debates on public policy issues, and also acts as an advocate for high standards of customer service in the insurance industry.
ABP (Associated British Ports)	Associated British Ports is the port owner and operator in Southampton.
Actual Risk	The risk that has been estimated based on a qualitative assessment of the performance capability of the existing flood defences.
AEP (Annual Exceedance Probability)	The chance or probability of a natural hazard event (usually a rainfall or flooding event) occurring annually and is usually expressed as a percentage.
ARI (Average Recurrence Interval)	The average time interval between occurrences of a hydrological event, such as a flood of a given or greater magnitude.
Astronomical tide	The ‘perigean’ spring tide, when both the sun and the moon are closest to the earth. Occurs approximately four times per year.
Breach or failure hazard	Hazards attributed to flooding caused by a breach or failure of flood defences or other infrastructure which is acting as a flood defence.
CCAP (City Centre Action Plan)	Sets the framework for protecting the historic and natural environments, tackling climate change and creating an attractive and uplifting place to be, while promoting more offices, shops, homes and leisure facilities. Adopted March 2015.
CFERMS (Coastal Flood and Erosion Risk Management Strategy)	A non-statutory document focusing on the long term management of a 22km stretch of Southampton’s coastline. Published by Southampton City Council in 2012.
CFMP (Catchment Flood Management Plan)	Consider all types of inland flooding, from rivers, groundwater, surface water and tidal flooding, helping to plan and agree the most effective way to manage flood risk in the future.
CIL (Community Infrastructure Levy)	Allows Local Planning Authorities to raise funds from new development. It is levied on extensions and buildings. The charges, set by the local council, based on the size and type of the new development, are used to fund a variety of infrastructure including transport, flood defences and open spaces.
Consequence	Impact that the flood event would cause if it occurred.
Critical Drainage Area	An area that has critical drainage problems and which has been notified to the Local Planning Authority as such by the Environment Agency.

CS (Core Strategy)	One of the plans that make up the Southampton's adopted Local Plan. It contains the vision, objectives and strategic planning policies for the city
Defra (Department for Environment, Food and Rural Affairs)	The UK Government department responsible for safeguarding the natural environment, supporting world-leading food and farming industry, and sustaining a thriving rural economy
Design flood event	The return period event for which flood risk management measures are design to provide protection.
DPD (Development Plan Document)	The planning policy documents which make up the Local Plan. They help to guide development within a Local Planning Authority area by setting out the detailed planning policies, which planning officers use to make their decisions on planning applications.
DTM (Digital Terrain Model)	A topographic model of the bare earth that can be manipulated by computer programmes.
Exception Test	A method to demonstrate and help ensure that flood risk to people and property will be managed satisfactorily, while allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available and there are wider sustainability benefits.
Extreme flood event	The return period event, or flood conditions, exceeding the standard of protection for which flood risk management measures have been designed.
FDGiA (Flood Defence Grant in Aid)	Capital funding from the Government, provided by Defra and administered and managed by the Environment Agency. Defined 'Outcome Measures' are used to determine which applications will receive funding, and how much.
Flood Defence	Natural or man-made infrastructure used to prevent flooding.
Flood Risk	Flood risk is a combination of two components: the chance (or probability) of a particular flood event and the impact (or consequence) that the event would cause if it occurred.
Flood Risk Management	Flood risk management can reduce the probability of occurrence through the management of land, river systems and flood defences, and reduce the impact through influencing development in flood risk areas, flood warning and emergency response
Flood Zones	The extent of flooding based on extensive modelling undertaken by the Environment Agency, ignoring the presence of flood defences, and as defined by the Planning Practice Guidance.
Floodplain	Area of land that borders a watercourse, an estuary or the sea, over which water flows in time of flood, or would flow but for the presence of flood defences where they exist.
Floods Directive	European Directive (Directive 2007/60/EC) is legislation in the European Parliament on the assessment and management of flood risks. Transposed into UK law by the Flood Risk Regulations 2009.
Flood Risk Regulations	Transposes the European Floods Directive into UK law. Under the Flood Risk Regulations 2009 the Environment Agency and LLFAs had to prepare preliminary Flood Risk Assessments.
FRA (Flood Risk Assessment)	A document required for all development located within Flood Zones 2 and 3, and for development larger than 1 hectare in size in Flood Zone 1, to assess the level of flood risk to a property or site

FWMA (Flood and Water Management Act 2010)	The Act to make provision about water, including provision about the management of risks in connection with flooding and coastal erosion.
IPCC	Intergovernmental Panel on Climate Change
LFRMS	Local Flood Risk Management Strategy – Southampton’s strategy for the management of local flood risk within the city, published in 2014.
LiDAR	Light Detection and Ranging – a remote sensing method that uses light in the form of a pulsed laser measure ranges (variable distances) to the Earth.
LLFA (Lead Local Flood Authority)	All unitary authorities, including SCC, are designated as LLFAs under the Flood and Water Management Act 2010, holding a number of duties, powers and responsibilities related to flood risk management.
Local Plan	Collection of adopted plans, consisting of the City Centre Action Plan, Core Strategy, saved policies from the Local Plan review and the Minerals and Waste Plan.
Localism Act	An Act of Parliament that changes the powers of local government in England. The aim of the act is to facilitate the devolution of decision-making powers from central government control to individuals and communities.
LPA (Local Planning Authority)	The local authority or council that is empowered by law to exercise statutory town planning functions for a particular area of the UK.
mAOD	Metres Above Ordnance Datum
NPPF (National Planning Policy Framework)	Sets out government's planning policies for England and how these are expected to be applied.
Ordinary Watercourse	A watercourse that does not form part of a main river and includes rivers, streams, ditches, drains, cuts, dikes, sluices, sewers (other than public sewers within the meaning of the Water Industry Act 1991) and passages, through which water flows.
PFRA (Preliminary Flood Risk Assessment)	A document summarising the flood risk from local sources, describing both the probability and harmful consequences of past and future flooding.
Pitt Review	An independent review of the 2007 floods, carried out by Sir Michael Pitt, outlining the lessons learnt and future recommendations.
PLP (Property Level Protection)	A method of flood protection on an individual property basis rather than a wider area. Usually consists of resistance and resilience measures.
PPG (Planning Practice Guidance)	Additional guidance that accompanies the National Planning Policy Framework.
Planning Policy Statements	Superseded by the Planning Practice Guidance in 2014
PUSH (Partnership for Urban South Hampshire)	PUSH Strategic Flood Risk Assessment - A critical part of the evidence base for the sub-region and enables the Local Planning Authorities within the PUSH sub-region to make informed decisions on the allocation of land for development in their Local Development Frameworks
Residual risk	Risk that remains after all risk avoidance, reduction and mitigation measures have been applied

River Itchen FAS	River Itchen Flood Alleviation Scheme – A scheme taken from the Coastal Strategy, looking into the construction of flood defences from Mount Pleasant Industrial Estate to the Itchen Bridge, protecting parts of Northam, St Marys and Chapel.
SA (Sustainability Appraisal)	An appraisal of the economic, environmental and social effects of a plan from the outset of the preparation process to allow decisions to be made that accord with sustainable development.
SCC	Southampton City Council
SEA (Strategic Environmental Assessment)	A systematic decision support process, aiming to ensure that environmental and possibly other sustainable aspects are considered effectively in policy, plan and programme making.
Sequential Test	A test set out in National Planning Policy Framework aiming to steer development towards areas with the lowest probability of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for that development in areas of lower probability of flood risk.
SFP (Site Flood Plan)	A document that provides a means by which those living or working in a development where flood risk exists shall be made aware of the flood hazard, and identify any procedures that will enable them to avoid being directly exposed to the hazard in any future flood event.
SFRA (Strategic Flood Risk Assessment)	A study carried out by one or more Local Planning Authorities to assess the risk to an area from flooding from all sources, now and in the future, taking account of climate change, and to assess the impact that land use changes and development in the area will have on flood risk.
SMP (Shoreline Management Plan)	A large scale assessment of the risks associated with coastal processes. Identifies the most sustainable approach to managing the flood and coastal erosion risks to the coastline in the short, medium and long term.
South East Plan	Adopted in May 2009, the South East Plan sets out the vision for the future of the south east region to 2026
Storm surge	A rise in sea level above normal levels. Mainly the result low pressure and stormy weather conditions.
SuDS (Sustainable Urban Drainage System)	Drainage designed to reduce the potential impact of surface water on new and existing development, by mimicking natural drainage.
Tide Locking	When tidal water enters the surface water network causing the system to 'back up' as water is unable to discharge.
Windfall Site	Development sites that have not specifically been identified as available for development in the Local Plan.