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Brighton and Hove City Council Level 1 and 2 Strategic Flood Risk Assessment

Final Report

October 2018

Brighton and Hove City Council

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Contract

This report describes work commissioned by the Project Centre, on behalf of Brighton and Hove City Council, by an email dated 9 October 2017. The Project Centre's representative for the contract was Geoff Waller. Jennifer Hill, Ffion Wilson and Anna Hastings of JBA Consulting carried out this work.

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Purpose

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- Brighton and Hove City Council
- The Environment Agency
- Southern Water
- Project Centre

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Executive Summary

Introduction

Brighton and Hove City Council have commissioned a Level 1 and 2 Strategic Flood Risk Assessment (SFRA) to provide a comprehensive evidence base to support the Brighton and Hove City Plan Part 2. This updated SFRA replaces the 2012 SFRA which provided the evidence base for the Brighton and Hove City Plan Part 1. The study area excludes the area covered by South Downs National Park Authority.

SFRA Objectives

The key objectives of the review performed during the preparation of the 2018 SFRA are:

1. To take into account the latest flood risk policy
2. Take into account the latest flood risk information and available data including more detailed groundwater vulnerability mapping and surface water flood mapping which takes climate change into account.
3. To provide individual flood risk analysis for sites identified in the emerging draft City Plan Part 2
4. To provide a comprehensive set of maps displaying flood risk information

An overarching aim, in meeting these objectives is to put flood risk management policy and practice in place to provide for a strategic approach to the management of surface water flood risk as this is a priority to address the needs of adaptation to climate change effects.

SFRA Outputs

There are two levels of SFRA, described as follows:

- Level 1 –performed where flooding is not a major issue and where development pressures are low.
- Level 2 –Where it is not possible to find enough land for Plan allocations at locations outside of flood risk and so more detailed information is required to understand how the safety of the allocations might be affected (the Exception Test).

This report fulfils Level 1 and 2 requirements. To meet the objectives, the following outputs have been prepared:

- Assessment of all potential sources of flooding
- Mapping of location and extent of functional coastal floodplain
- Assessment of standard of protection provided by existing flood risk management infrastructure
- Assessment of the potential impact of climate change on flood risk
- Assessment of locations where additional development may increase flood risk elsewhere
- Identification of Surface Water Flood Zones and provide recommendations on development in these areas.
- Recommendations of the criteria that should be used to assess future development proposals and the development of a Sequential Test and sequential approach to flood risk.
- Guidance for developers including requirements for site specific flood risk assessments and the process for flood map challenges.

Summary of Assessment

Appraisal of flood risk

- There have been several recorded flood incidents across the study area, from a combination of sources. The prominent sources of historic flooding in the City of Brighton and Hove are surface water and groundwater. Patcham, South Portslade, Central Hove, Brunswick and Adelaide and Regency are the wards with the most recorded flood incidents in Brighton and Hove.
- There are no main rivers or watercourses in the City of Brighton and Hove.

- Much of the coastline along Brighton and Hove is protected from coastal flooding by flood defences. There are only two main areas of tidal flood risk throughout Brighton and Hove, which are Portslade-by-Sea (including the eastern arm of Shoreham Harbour) and Brighton Marina. There is also the possibility that tidal flood defences can fail or be overtopped. The assessment of the 'residual' risk of defence failure should be considered on a site by site basis.
- The shingle beaches along the coastline protect from coastal erosion. Due to sea level rises in the future, new defences will be required as the shingle beaches are predicted to become narrower.
- There is a significant surface water flood risk across Brighton and Hove. London Road, Lewes Road, Marlborough Place, Gloucester Place and Old Steine are areas of concern and are located in the centre of Brighton providing access from North to South of the city. There are also significant areas in Hove which are at risk of surface water flooding. Surface water flood risk mapping showing the extents of the 1% AEP (Annual Exceedance Probability) event plus 30% and 40% uplift for climate change has been prepared as part of the SFRA.
- Surface Water Flood Zones have been introduced to the this SFRA with the intention to define areas potentially at risk from surface water flooding to provide more strategic consideration of surface water flood risk in the land allocation and planning process. Two zones have been defined, an Accumulation Zone (SWFZa) and a Conveyance Zone (SWFZb). The FRA requirements for development falling within SWFZa or SWFZb are different, in reflection of their risk profiles.
- Groundwater levels vary throughout Brighton and Hove. Groundwater levels are closest to the surface along small areas of the coast and in Aldrington, Patcham and Falmer.
- Historical incidents of flooding are detailed by Southern Water. This database records incidents of flooding relating to public foul, combined or surface water sewers and identifies which properties suffered flooding. A total of 84 recorded flood incidents have been identified in the study area.
- There are no reservoirs storing water above normal ground level in Brighton and Hove or reservoir flood risk within the study area.
- There are currently four Flood Alert Areas and four Flood Warning Areas in the study area.

Flood defences

A shingle beach offers protection from tidal flooding along the coastline of Brighton and Hove. Further tidal flood defences are also in place along the coastline. The residual risk of the flood defences failing or being overtopped should be considered as part of a detailed FRA. A number of Brighton and Hove City Council owned surface water flood assets have also been presented within this SFRA.

Development and flood risk

The Sequential Test was carried out as part of the City Plan Part 1 for five of the Level 2 SFRA sites. It is recommended that Brighton and Hove City Council revisit the Sequential Test, and Exception Test where applicable, and confirm that the conclusions are still valid based on the new evidence presented in this 2018 Level 1 and 2 SFRA document.

Five further sites have been taken forward to the Level 2 assessment and it is recommended that the Sequential Test, and Exception Test if necessary, are undertaken for these five sites based on the evidence provided in this document.

The Sequential and Exception Test procedures for site-specific FRAs have been documented, along with guidance for planners and developers. This includes guidance for development in Surface Water Flood Zones a and b.

This SFRA defines Surface Water Flood Zones to encourage sustainable development in Brighton and Hove. It is not recommended that Surface Water Flood Zones are used as part of the Sequential Test, but the site layout of a development considers a sequential approach and should include consideration of surface water flood risk and now it is managed.

Relevant studies

There are many relevant regional and local key studies which complement the SFRA and have been considered, such as the Shoreline Management Plans, the Surface Water Management Plan, the Catchment Flood Management Plan, River Basin Management Plan, the Preliminary Flood Risk Assessment, Flood Risk Management Plan and Local Flood Risk Management Strategies. The emerging SuDS SPD will also complement the evidence and policy included in the SFRA.

Policy recommendations

The following policy recommendations are to be considered by Brighton and Hove City Council.

Development and planning considerations

Sequential approach to development

It is recommended that the sequential approach is adopted for all future developments within the study area. New development and re-development of land should wherever possible seek opportunities to reduce overall level of flood risk at the site.

Sequential and Exception tests

The SFRA has identified that areas of the City of Brighton and Hove are at high risk of flooding from surface water, groundwater and tidal sources. Therefore, proposed development sites at such locations will be required to satisfy the Sequential and, where necessary, Exception Tests in accordance with the updated 2018 NPPF. The presence of extensive surface water risk zones introduces a requirement to demonstrate that proposed development is safe from surface water flood risk for over the intended life.

Site-specific Flood Risk Assessments

For all development or change of use in within a SWFZ an FRA should be prepared. The FRA requirements for development falling within SWFZa or SWFZb are different, in reflection of their risk profiles. The policy for each SWFZ is outlined below:

Surface Water Flood Zone a: Accumulation Zone

As surface water in this zone is expected to pond, the development of basement dwellings is not normally permitted in SWFZa.

For all other development, an FRA is required to demonstrate that the proposal will be safe from surface water flooding for its lifetime and does not increase flood risk elsewhere. FRA requirements include:

- Assessment of flood risk from all sources.
- Consideration of flow paths across the site and how the proposed development may alter these.
- Demonstration that ground floor levels should normally be a minimum of whichever is higher of:
 - 300 mm above the general ground level of the site
 - 600mm above the estimated surface water level in the 1% AEP event with drainage plus 30% uplift to account for climate change
- Consideration of other surface water flood resilience measures

As part of this assessment the 1% AEP event plus 30% uplift to account for climate change has been prepared. For detailed mapping to carry out any assessments, requests should be sent to sustainable Drainage@brighton-hove.gov.uk.

Surface Water Flood Zone b: Conveyance Zone

These areas are characterised by sloping ground so runoff from rainfall events here can be expected to flow over impermeable areas within SWFZb during events.

All types of development could be compatible in SWFZb, providing an FRA can demonstrate that the proposal will be safe from flooding for its lifetime and does not increase flood risk elsewhere. FRA requirements include:

- Assessment of flood risk from all sources.

- Consideration of flow paths across the site and how the proposed development may alter these. Overland flow modelling maybe required to demonstrate this. The aim is to demonstrate there is no detriment to third parties and the proposed development is safe.
- Consideration of surface water flood resilience measures.

The use of SuDS should be required on all new development. Reference should be made to the Brighton and Hove City Council's SuDS SPD.

It is recommended that the council require a flood risk assessment for all development or change of use, regardless of Flood Zone or size, where flood risk from groundwater is identified by the SFRA. The FRA should clearly state the degree of risk and how the risk to the development will be mitigated

The council normally requires that any subterranean development proposals provide evidence to demonstrate there is no risk from groundwater or other sources of flooding and should show that groundwater flow paths are preserved so as not to increase the flood risk elsewhere. The design of any new subterranean development should be supported by evidence to demonstrate that flood risk is not increased for existing adjacent subterranean developments by changes to groundwater flow paths.

In areas where there is a tidal flood risk, the impact of defence failure or wave overtopping will need to be considered. The condition of existing flood defences and whether they will be continued to be maintained and/or improved in the future will also need to be thoroughly explored.

Review of planning applications

Brighton and Hove City Council should consult the Environment Agency's '**Flood Risk Assessment: Local Planning Authorities**', last updated 28 February 2017, when reviewing planning applications for proposed developments at risk of flooding. The council will consult the relevant statutory consultees as part of the planning application assessment and they may, in some cases, also contact non-statutory consultees (e.g. Southern Water) that have an interest in the planning application.

Infrastructure and safe access and egress

Safe access and egress will need to be demonstrated at all development sites. Emergency vehicular access should be possible during times of flood. Where development is located behind, tidal defences, consideration should be given to the potential safety of the development, finished floor levels and for safe access and egress in the event of rapid inundation of water due to a defence breach with little warning. Resilience measures will be required if buildings are situated in the flood risk area.

Consultation with Southern Water should be undertaken prior to development commencing to confirm whether the sewer drainage network has enough capacity to accommodate the flows from all new development.

Residual risk

Residual risk is the risk that remains after mitigation measures are considered. The residual risk includes the consideration of flood events that exceed the design thresholds of the flood defences, including wave overtopping, or circumstances where there is a failure of the defences. Residual risks should be considered as part of site-specific Flood Risk Assessments.

Furthermore, any developments located within an area protected by flood risk management measures, should consider the condition of the defences and standard of protection they offer.

Use of Strategic Flood Risk Assessment data

SFRAs are high level strategic documents and, as such, do not go into detail on an individual site-specific basis. This SFRA has been developed using the best available information, supplied at the time of preparation. This relates both to the current risk of flooding from all sources and the potential impacts of future climate change. The Environment Agency regularly reviews its flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a site-specific FRA. Other datasets used to inform this SFRA may also be periodically updated and following the publication of this SFRA, new information on flood risk may be provided by Risk Management Authorities.

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Using this document

Hyperlinks

Hyperlinks have been provided where there are useful reference points. These are shown as **green text**.

Contents, list of figures, list of tables and references to other sections, figures and tables have also been hyperlinked to enable easy navigation around the report.

Abbreviations and Glossary of Terms

Term	Definition
AEP	Annual Exceedance Probability
AOD	Above Ordnance Datum
CFMP	Catchment Flood Management Plan
CIRIA	Company providing research and training in the construction industry
DEFRA	Department of the Environment, Food and Rural Affairs (formerly MAFF)
DTM	Digital Terrain Model
EA	Environment Agency
ESWSL	Extreme Still Water Sea Level
FCERM	Flood and Coastal Erosion Risk Management (R&D programme)
FCERMGiA	Flood and Coastal Erosion Risk Management Grant in Aid
FRA	Flood Risk Assessment
FRMP	Flood Risk Management Plan
FWA	Flood Warning Area
FWD	Flood Warnings Direct
FWS	Flood Warning Service
GIS	Geographical Information System
LiDAR	Light Detection and Ranging (ground level data)
LFRMS	Local Flood Risk Management Strategy
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
NFF	National Flood Forum
NPPF	National Planning Policy Framework
OS	Ordnance Survey
PFRA	Preliminary Flood Risk Assessment
PLP	Property Level Protection
PPG	Planning Practice Guidance
Ramsar	The intergovernmental Convention on Wetlands, signed in Ramsar, Iran, in 1971
RBMP	River Basin Management Plan
RMA	Risk Management Authorities
RoFSW	Risk of Flooding from Surface Water
SCAPE	The Shaping Climate Change Adaptive Places
SFRA	Strategic Flood Risk Assessment
SHLAA	Strategic Housing Land Availability Assessment
SMP	Shoreline Management Plan
SWMP	Surface Water Management Plan
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems
SuDS SPD	Sustainable Drainage Systems Supplementary Planning Documents
SPD	Supplementary Planning Documents
SWFZ	Surface Water Flood Zones
UKCP09	UK Climate Projections
WFD	Water Framework Directive

1 Introduction

1.1 Background to the study

National policy requires local authorities to include in their Local Plans strategic policies for the provision of flood risk and coastal change management. Local Plans shall take account of climate change over the longer term, including factors such as flood risk and coastal change.

The 2005 Brighton and Hove Local Plan has been replaced by the Brighton and Hove City Plan, with Part 1 having been completed in 2016. Brighton and Hove City Plan Part 2 is currently being prepared.

This version of the Brighton and Hove City Council Strategic Flood Risk Assessment (SFRA) replaces the previous document "Brighton & Hove Strategic Flood Risk Assessment, Final, January 2012".

The primary objective for updating the previous version of the SFRA was to prepare a document that was compliant with the latest guidance described in the 2018 update to the National Planning Policy Framework (NPPF) and to provide an evidence base for the Brighton and Hove City Plan Part 2.

A revised version of the NPPF was published on 24 July 2018 and sets out Government's planning policies for England and how these are expected to be applied. This revised Framework replaces the previous NPPF published in March 2012. The online searchable version of the revised NPPF is not available at the time of writing, however a pdf version can be downloaded via:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/728643/Revised_NPPF_2018.pdf

The key updates to the 2012 SFRA are:

- Changes to national and regional policies.
- The Risk of Flood from Surface Water (RoFSW) map also includes an allowance for climate change.
- The addition of Surface Water Flood Zones
- More detailed groundwater vulnerability mapping.
- Inclusion of recent flood events.

This SFRA reflects the changes in policy and includes recent flood events which will form an important part of the evidence base for the City Plan Part 2.

1.2 Study Area

The study area comprises the administration area of the City of Brighton and Hove, excluding the area covered by South Downs National Park. Brighton and Hove is located on the south coast of England and is neighboured by the districts of Horsham, Adur, Mid Sussex and Lewes. Brighton and Hove has the largest population in the South East England region and over 50% of the council's boundary is urban, with rural, open countryside only being found north of the A27 and to the east of Brighton. 40% of Brighton and Hove is within the South Downs National Park. The South Downs National Park Authority is responsible for all planning in the South Downs National Park and therefore this area has not been included in the SFRA. The study area and its neighbouring authorities is outlined in Figure 1-1.

There has been a wide range of flooding events within Brighton and Hove over the last 15 years, however there are no rivers in Brighton and Hove. Surface and groundwater flooding are the most notable sources of flooding. The autumn and winter event of 2000/2001 was the largest recorded event when extreme weather conditions caused flooding across the city. A severe storm in July 2014 was also noted to cause widespread flooding throughout Brighton and Hove. Figure 5-1 displays the reported incidents of flooding in Brighton and Hove.

1.2.1 Topography

The topography of the study area can be an important influencing factor on the way water runs over the ground surface. This is primarily due to steep slopes leading to rapid runoff and preventing infiltration of rain. The topography of Brighton and Hove can be seen Figure 1-2.

The elevation of the administrative area varies dramatically, due to its proximity to the Downs in the north and the coast in the south. Higher elevations are towards the north of the Brighton and Hove City Council boundary, the highest elevations reaching approximately 193m Above Ordinance Datum Newlyn (m AOD), located in the north east at Bullock Hill. Elevations decrease towards southerly towards the coast where elevations reach as low as -2.1 m AOD across the entirety of the southern section of Brighton and Hove City Council on the seafront.

This differential in elevations across the study area leads to steep slopes in Brighton and Hove.

1.2.2 Geology and soils

The geology of the study area can be an important influencing factor on the way water runs off the ground surface. This is primarily due to variations in the permeability of the surface material and bedrock stratigraphy. Figure 1-3 shows the bedrock formations within Brighton and Hove and Figure 1-4 shows the superficial deposits. Superficial deposits refer to geology which is less than 2.6 million years in age, anything older is referred to as Bedrock. Brighton and Hove are primarily underlain by the White Chalk Subgroup with pockets of the Lambeth Group in the south west.

The White Chalk Subgroup which underlies the majority of Brighton and Hove is covered by shallow and well drained topsoil's, allowing for rainfall to quickly seep into the chalk aquifers below. The pockets of the Lambeth Group consist of clay, silt and sand in the south west of Brighton and Hove.

The superficial deposits found within the study area are found to be Brickearth, Clay with flints and sand and gravel of uncertain age and origin. The deposits of clay with flints are found to be in two areas which are high in elevation in the centre, north west and east of Brighton and Hove. Deposits of Brickearth, which consists of silt, are found in on the western section of the sea front, alongside two deposits of sand and gravel of uncertain age and origin.

1.2.3 Watercourses

There are no designated main rivers or ordinary watercourses, within Brighton and Hove, although the city area shares approximately 14km of its boundary with the sea.

Figure 1-1: Study area and its neighbouring authorities

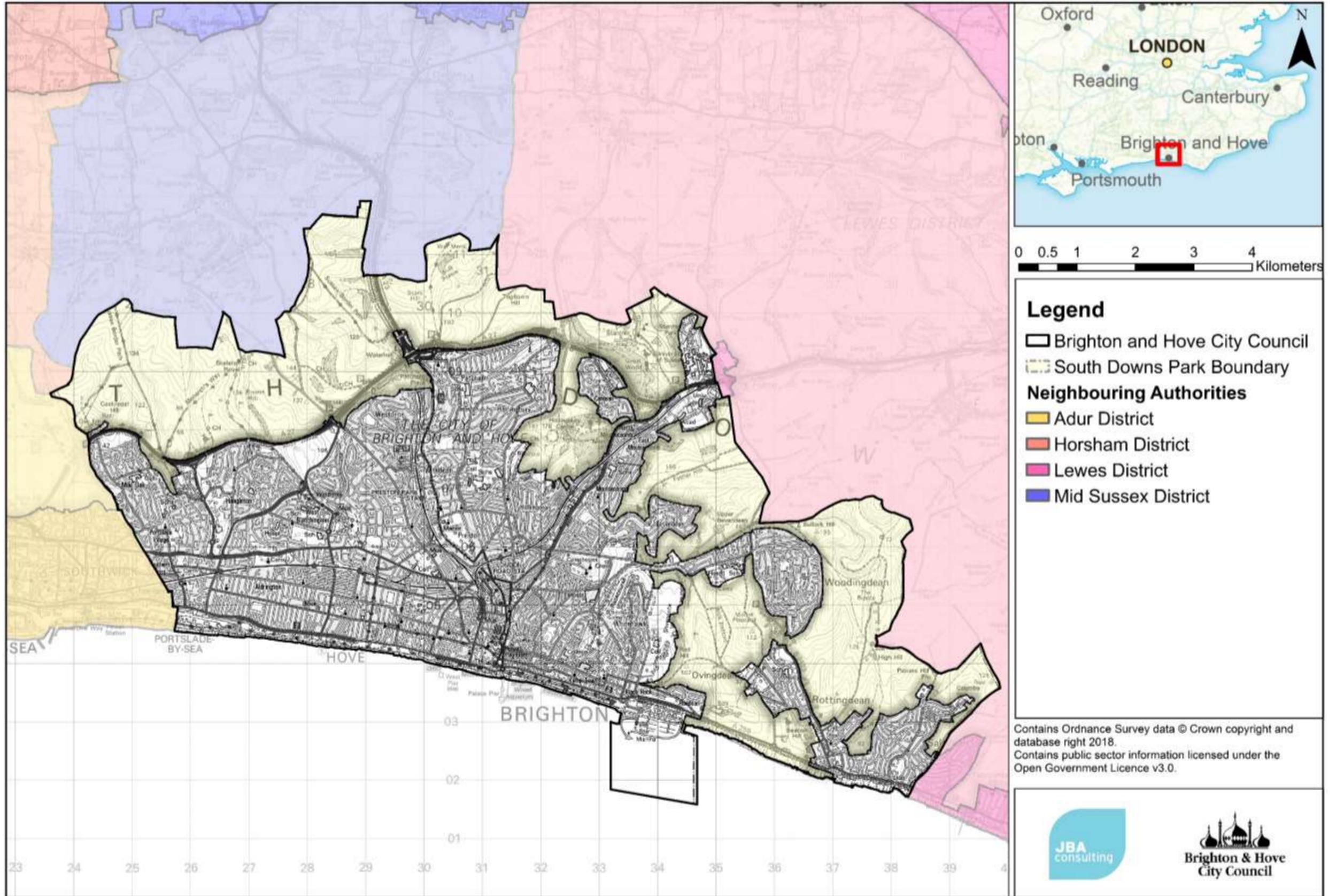


Figure 1-2: Topography across Brighton and Hove

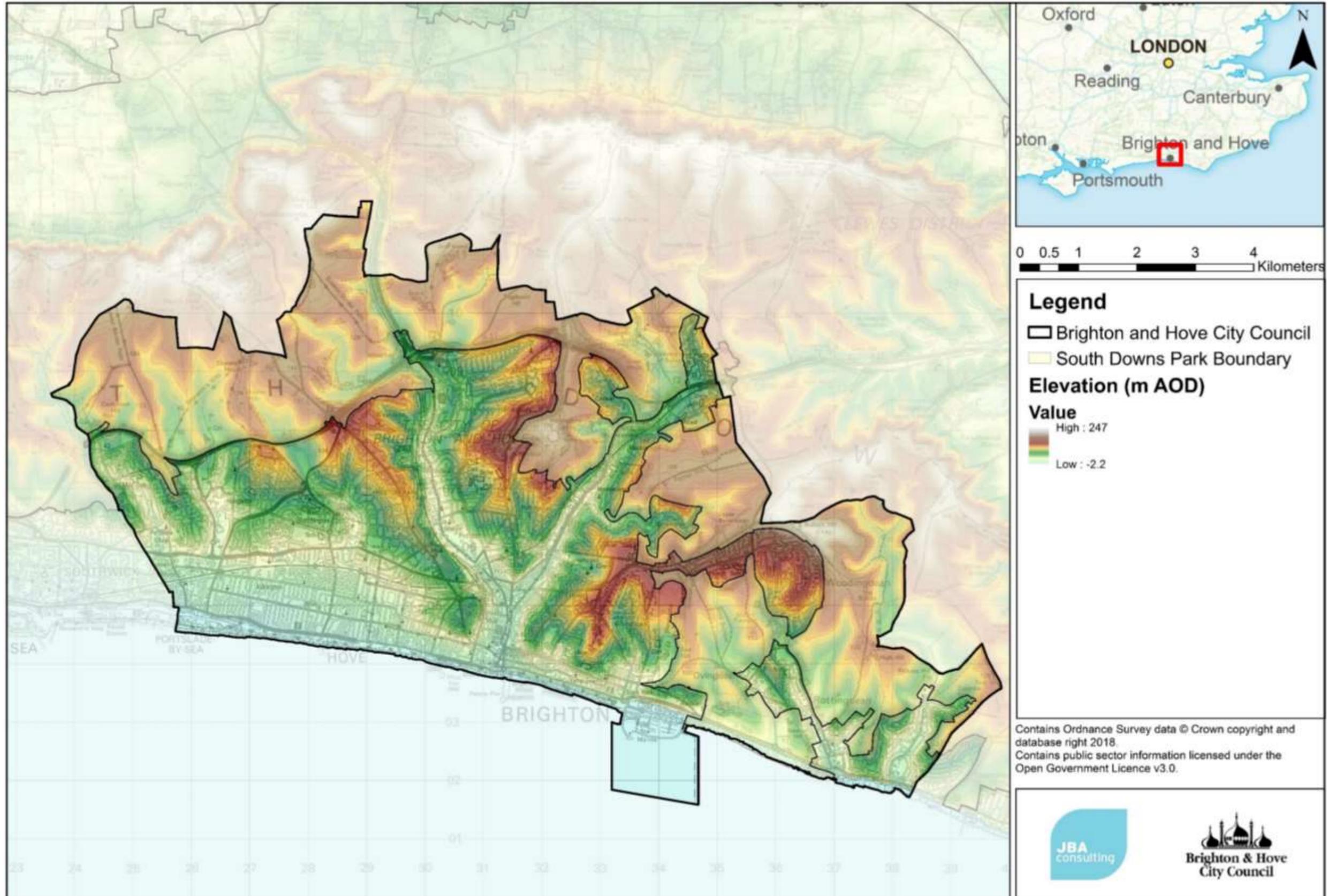


Figure 1-3: Bedrock geology in Brighton and Hove

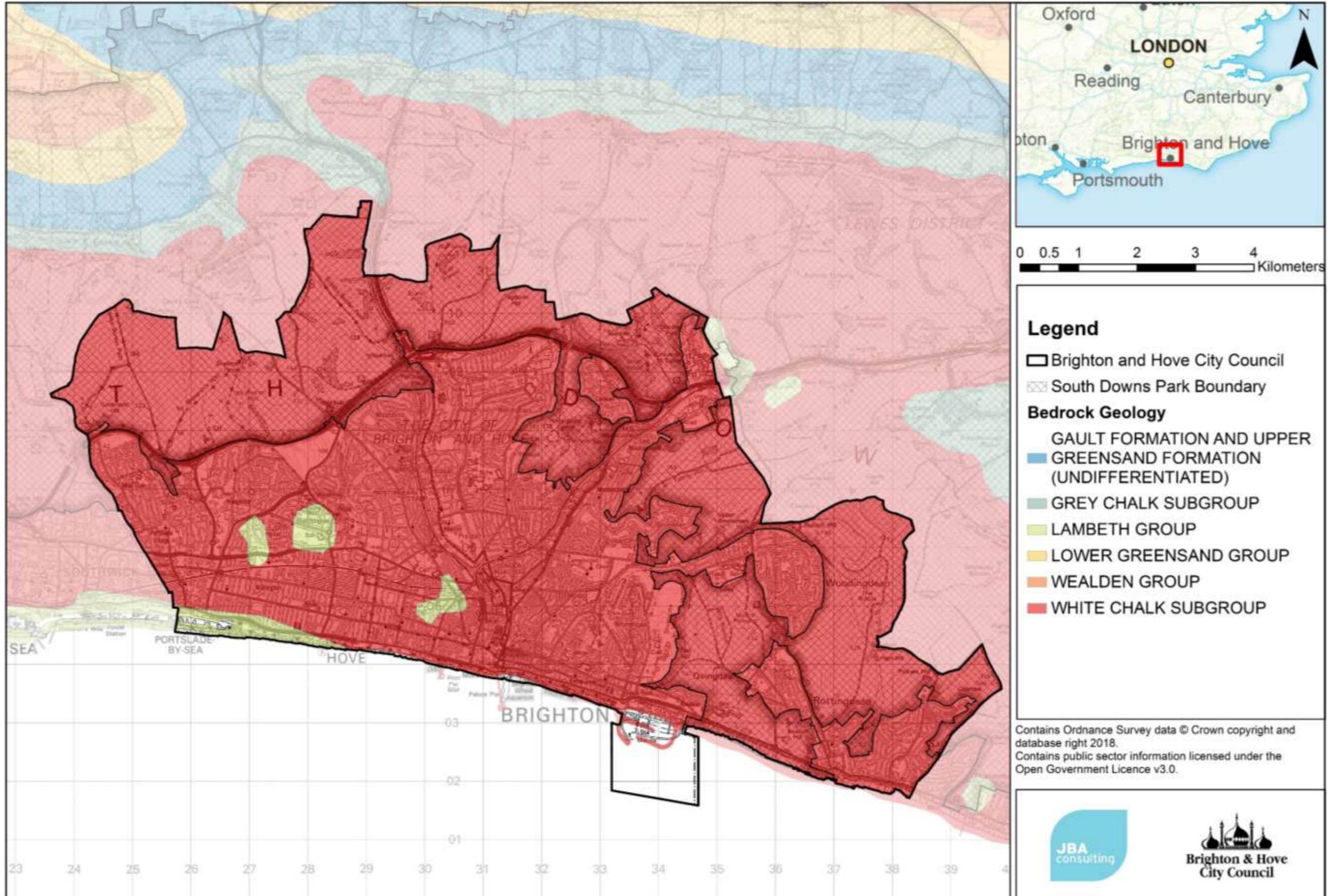
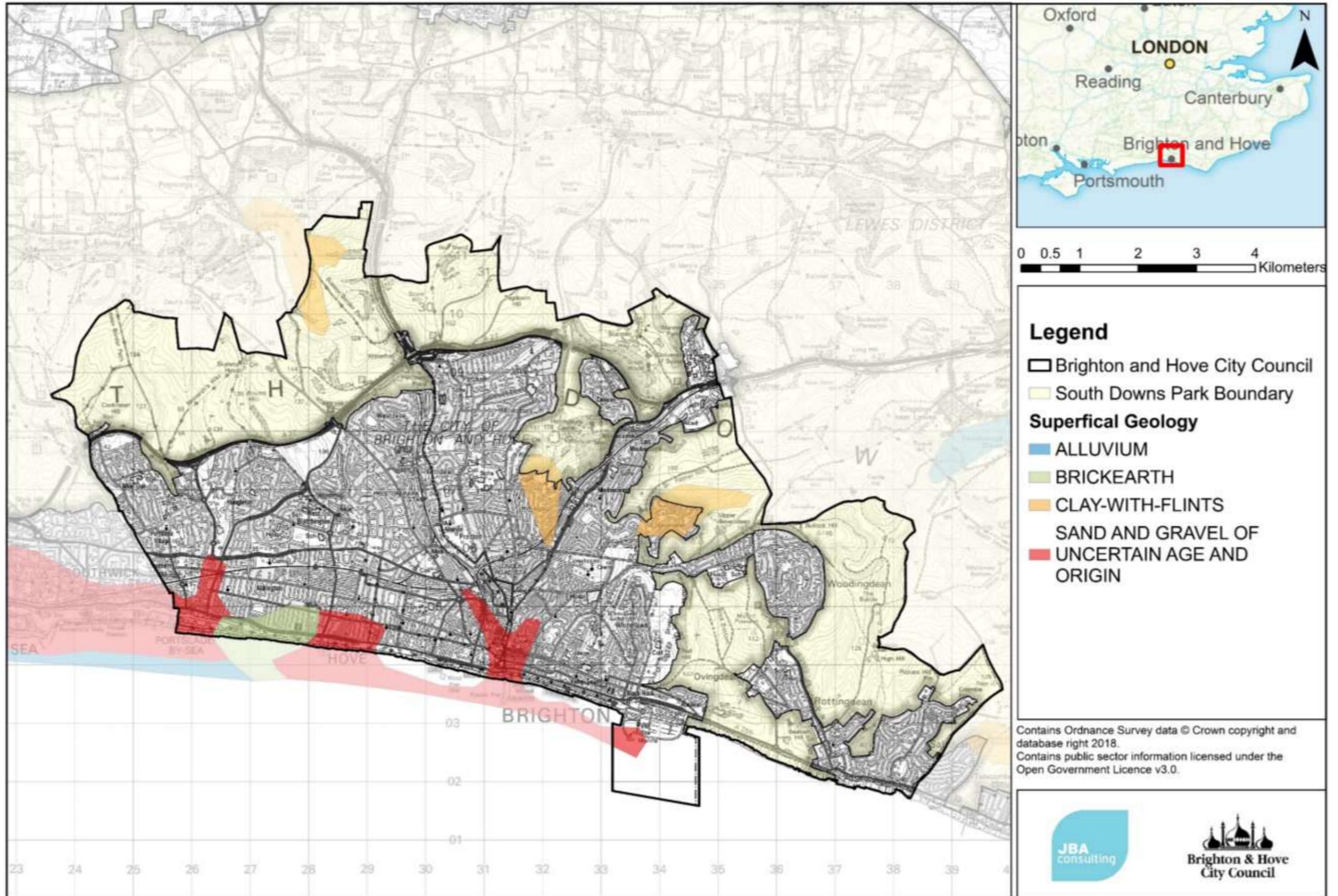


Figure 1-4: Superficial deposits in Brighton and Hove



1.3 Purpose of the Strategic Flood Risk Assessment

“Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards.”

(Revised National Planning Policy Framework, Section 14 paragraph 156)

This Strategic Flood Risk Assessment (SFRA) document replaces the Level 1 and 2 SFRA published by Brighton and Hove City Council in 2012. The SFRA study area is shown in Figure 1-1. This report provides a comprehensive evidence base to support the production of the City Plan Part being prepared for the administrative area of Brighton and Hove.

The updated SFRA (2018 SFRA) will be used to inform decisions on the location of future development and the preparation of sustainable policies for the long-term management of flood risk.

The key objectives of the review performed during the preparation of the 2018 SFRA are:

- To take into account the latest flood risk policy
- Take into account the latest flood risk information and available data including more detailed groundwater vulnerability mapping and surface water flood mapping which takes climate change into account.
- To provide individual flood risk analysis for sites identified in the emerging Draft City Plan Part 2
- To provide a comprehensive set of maps displaying flood risk information

An overarching aim, in meeting these objectives is to put flood risk management policy and practice in place to provide for a strategic approach to the management of surface water flood risk as this is a priority to address the needs of adaptation to climate change effects.

1.4 Levels of SFRA

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

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

This report fulfils Level One and Two SFRA requirements.

1.5 SFRA outputs

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

- Assessment of all potential sources of flooding
- Mapping of location and extent of functional coastal floodplain
- Assessment of standard of protection provided by existing flood risk management infrastructure
- Assessment of the potential impact of climate change on flood risk
- Assessment of locations where additional development may increase flood risk elsewhere
- Identification of Surface Water Flood Zones together with recommendations on development in these areas.

- Recommendations of the criteria that should be used to assess future development proposals and the development of a Sequential Test and sequential approach to flood risk.
- Guidance for developers including requirements for site specific flood risk assessments and the process for flood map challenges.

1.6 Consultation

The following parties have been consulted regarding the SFRA:

- Brighton and Hove City Council
- Southern Water
- Environment Agency
- West Sussex County Council
- East Sussex County Council
- South Downs National Park Authority
- Lewes District Council
- Mid Sussex District Council
- Horsham District Council
- Adur District Council

As shown in Figure 1-1, the South Downs National Park includes land with the Brighton and Hove City Council, and that for planning purposes the South Downs National Park Authority is the sole planning authority for the whole for the designated National Park area.

1.7 Use of SFRA data

It is important to recognise that SFRAs are high level strategic documents and, as such, do not go into detail on an individual site-specific basis. The SFRA has been developed using the best available information at the time of preparation. This relates both to the current risk of flooding from fluvial, tidal, surface water, groundwater, sewers and reservoirs as well as the potential impacts of future climate change.

SFRAs should be a 'living document', and as a result should be updated when new information on flood risk, new planning guidance or legislation becomes available. New information on flood risk may be provided by Brighton and Hove City Council, the Environment Agency and Southern Water which could be influential with respect to flood risk. Such information may be in the form of:

- New hydraulic modelling (flood risk) results
- Flood event information following a flood event
- Policy/ legislation updates
- Environment Agency flood map updates
- New flood defence schemes, works, dredging regimes etc.

The Environment Agency regularly reviews its flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a detailed Flood Risk Assessment.

2 The Planning Framework and Flood Risk Policy

2.1 Introduction

The overarching aim of development and flood risk planning policy in the UK is to ensure that the potential risk of flooding is considered at every stage of the planning process. This section of the SFRA provides an overview of the planning framework, flood risk policy and flood risk responsibilities.

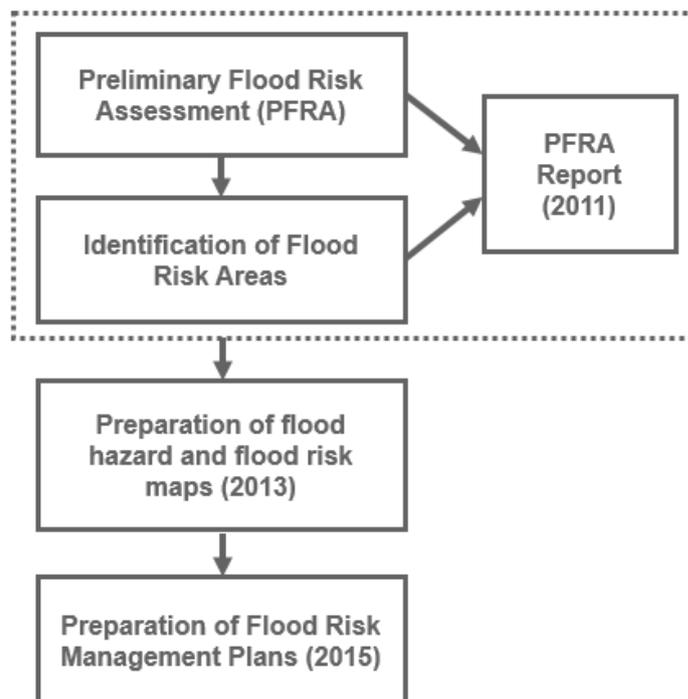
2.2 Flood Risk Regulations (2009) and Flood and Water Management Act (2010)

2.2.1 Flood Risk Regulations (2009)

The Flood Risk Regulations (2009) translated the current EU Floods Directive into UK law and placed responsibility upon the Environment Agency to manage flood risk from rivers, the sea and reservoirs. The Flood Risk Regulations established Lead Local Flood Authorities (LLFAs) and placed responsibility all other sources of flooding with LLFAs. In the instance of this SFRA, the LLFA is Brighton and Hove City Council. Details on the responsibilities of LLFAs are provided in section 2.11.1.

Figure 2-1 illustrates the steps that were initially taken to implement the requirements of the EU Directive in the UK in accordance with the Flood Risk Regulations. The Regulations established a process that is repeated on a 6-year cycle.

Figure 2-1: Flood Risk Regulation Requirements



2.2.2 Preliminary Flood Risk Assessments (PFRAs)

Under this action plan and in accordance with the Regulations, LLFAs initially had the task of preparing a Preliminary Flood Risk Assessment (PFRA) report. The document that covers the study area is the **Brighton and Hove PFRA (2011)**.

The aim of the PFRA was to identify Flood Risk Areas. Flood Risk Areas are defined as having more than 30,000 people at risk of flooding. At the time of the publication of the 2011 PFRA, 10 Flood Risk Areas had been identified throughout England with Brighton and Hove ranked as 8th with 36,412 people potentially at risk.

It should be noted that the Flood Risk Areas are currently being refined and due to be published in 2018. The indicative Flood Risk Areas provided to Lead Local Flood Authorities in 2017 showed Brighton will retain this designation. No indication of relative ranking of Flood Risk Areas has been published yet.

2.2.3 Flood Risk Management Plans (FRMPs)

Under the Regulations the Environment Agency exercised an 'Exception' and did not prepare a PFRA for risk from rivers, reservoirs and the sea. Instead they had to prepare and publish hazard and risk mapping and an FRMP.

The study area is covered by the **South East River Basin District Flood Risk Management Plan (FRMP) (2016)**. The FRMP covers the period of 2015-2021. The FRMP draws on policies and actions identified within Catchment Flood Management Plans (Section 2.6) as well as incorporating information from the Local Flood Risk Management Strategies (Section 2.2.5).

2.2.4 Flood and Water Management Act (FWMA) (2010)

Following the 2007 floods, Sir Michael Pitt was appointed to chair an independent review into the floods. The **final report** was published in June 2008. The Flood and Water Management Act (2010)¹ implements some of Sir Michael Pitt's recommendations and aims to create a simpler and more effective means of managing both flood risk and coastal erosion.

One of the main purposes of the Act was to set out new responsibilities for the management of local flood risks namely from surface water, groundwater and smaller watercourses. The Act gave LLFAs responsibility for the management of these risks and promoted partnership working and cooperation between all bodies with a role to play in the management of flood and coastal erosion risks. Brighton and Hove City Council is a Lead Local Flood Authority.

2.2.5 Local Flood Risk Management Strategies (LFRMS)

Brighton and Hove City Council are responsible for developing, maintaining, applying and monitoring a LFRM'S for Brighton and Hove. **The Brighton and Hove Local Flood Risk Management Strategy (2014)** is used to co-ordinate Flood Risk Management on a day to day basis. The Strategies also set measures to manage local flood risk i.e. flood risk from surface water and groundwater.

2.2.6 The National Flood and Coastal Erosion Risk Management Strategy for England (2011)

The **National Flood and Coastal Erosion Risk Management Strategy for England** provides the overarching framework for future action by all risk management authorities to tackle flooding and coastal erosion in England. It was prepared by the Environment Agency with input from Defra.

The Strategy builds on existing approaches to flood and coastal risk management and promotes the use of a wide range of measures to manage risk. It describes how risk should be managed in a coordinated way within catchments and along the coast and balance the needs of communities, the economy and the environment.

2.3 2018 National Planning Policy and Guidance

The **revised NPPF** was published in July 2018, replacing the previous version published in March 2012. The key changes in the revised NPPF compared to the 2012 NPPF include:

- Strategic policies should also now consider the 'cumulative impacts in, or affecting, local areas susceptible to flooding' (para 156), rather than just to or from individual development sites;
- Future risk from climate change- the 'sequential approach should be used in areas known to be at risk now or in the future from any form of flooding' (para 158);
- Natural Flood Management - 'Using opportunities provided by new development to reduce the causes and impacts of flooding (where appropriate through the use of natural flood management techniques)' (para 157c);
- 'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate' (Para 165); and
- Emergency planning. Emergency plans are required as part of an FRA that includes the inclusion of safe access and egress routes (para 163e).

¹ Flood and Water Management Act (2010):
http://www.legislation.gov.uk/ukpga/2010/29/pdfs/ukpga_20100029_en.pdf
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The NPPF sets out Government's planning policies for England and how these are expected to be applied. The Framework is based on core principles of sustainability and forms the national policy framework in England, also accompanied by a number of Planning Practice Guidance (PPG) notes. It must be taken into account in the preparation of local plans and is a material consideration in planning decisions.

The PPG documents will, where necessary, be updated in due course to reflect the changes in the revised NPPF.

A description of how flood risk should be taken into account in the preparation of Local Plans is outlined in (Figure 2-2).

Sequential Test

"The aim of the sequential test is to steer new development to areas with the lowest risk of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test. The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding.

If it is not possible for development to be located in zones with a lower risk of flooding (taking into account wider sustainable development objectives), the exception test may have to be applied. The need for the exception test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification set out in national planning guidance."

(Revised National Planning Policy Framework, Section 14 paragraph 158 and 159)

Exception Test

"The application of the exception test should be informed by a strategic or site specific flood risk assessment, depending on whether it is being applied during plan production or at the application stage. For the exception test to be passed it should be demonstrated that:

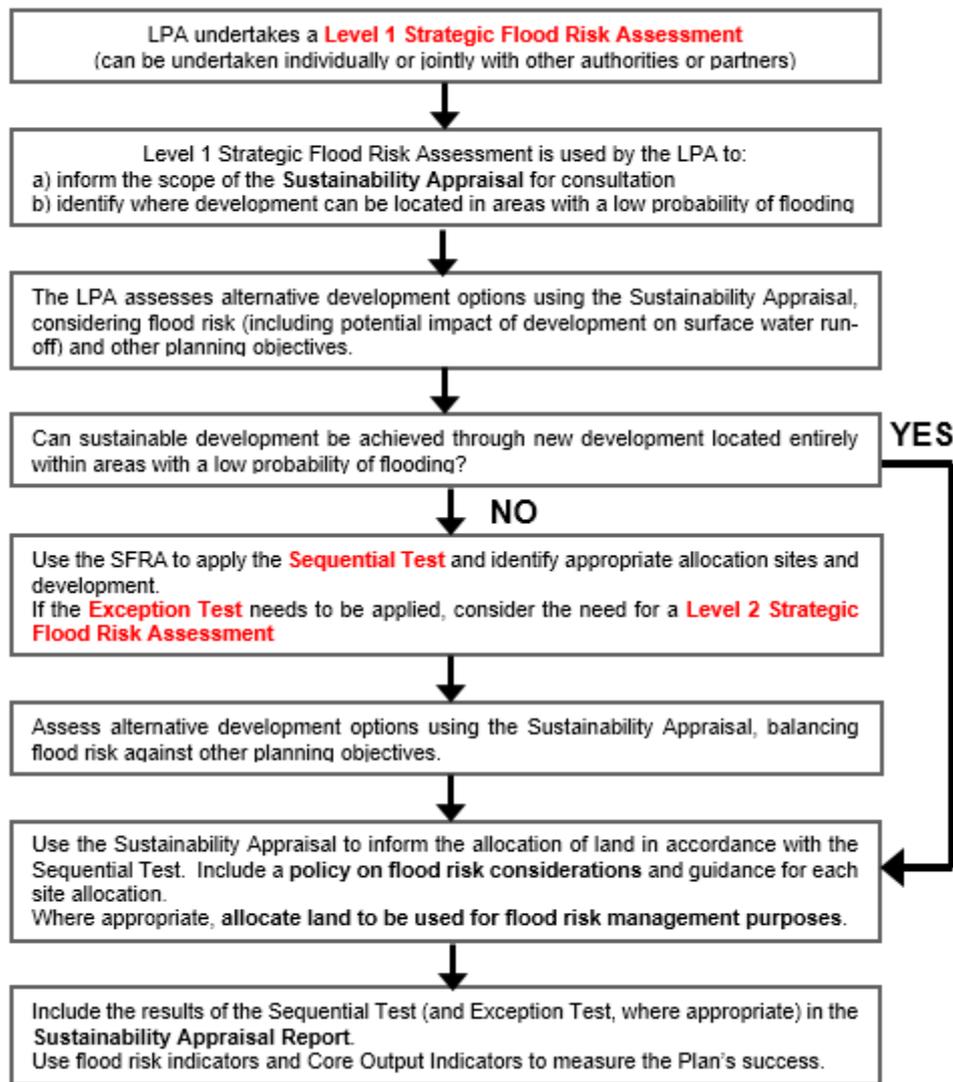
a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; and

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

Both elements of the exception test should be satisfied for development to be allocated or permitted."

(Revised National Planning Policy Framework, Section 14 paragraph 160 and 161)

Figure 2-2: Flood risk and the preparation of Local Plans



2.4 LLFAs, surface water and SuDS

On 18 December 2014 a **Written Ministerial Statement** laid by the Secretary of State for Communities and Local Government set out changes to the planning process that would apply for major development from 6 April 2015.

Major developments are defined as

- Residential development: 10 dwellings or more, or residential development with a site area of 0.5 hectares or more where the number of dwellings is not yet known; and
- Non-residential development: provision of a building or buildings where the total floor space to be created is 1,000 square meters or more or, where the floor area is not yet known, a site area of 1 hectare or more.

When considering planning applications, Local Planning Authorities should consult the LLFA on the management of surface water so that:

- The proposed minimum standards of operation are appropriate
- There are clear arrangements for on-going maintenance over the development's lifetime, using planning conditions or planning obligations.

Brighton and Hove City Council's guide for master planning sustainable drainage into development provides information on what is required by developers, designers and planners to provide to support planning applications for new developments. The emerging Brighton and Hove SuDS Supplementary Planning Document (SPD) will assist both the Council and developers deliver SuDS schemes.

2.4.1 Defra Non-Statutory Technical Standards for SuDS

On March 23 2015, the Department for Environment, Food and Rural Affairs (Defra) published the Non-Statutory Technical Standards for SuDS. The standards should be used in conjunction with the NPPF and NPPG. These standards cover the following

- Flood risk outside the development
- Peak flow control
- Volume control
- Flood risk within the development
- Structural integrity
- Designing for maintenance considerations
- Construction

2.4.2 C753 CIRIA SuDS Manual (2015)

The **C753 CIRIA SuDS Manual (2015)** replaces and updates the previous version (C697) providing up to date guidance on planning, design, construction and maintenance of SuDS. The document is designed to help the implementation of these features into new and existing developments, whilst maximising the key benefits regarding flood risk and water quality. The manual is divided into five sections ranging from a high-level overview of SuDS, progressing to more detailed guidance with progression through the document. It is recommended that developers and the LPA utilise the information within the manual to help design SuDS which are appropriate for a development.

2.5 Surface Water Management Plans

SWMPs outline surface water issues in each location, and the preferred options for managing the flood risk. SWMPs are undertaken, when required, by LLFAs in consultation with key local partners who are responsible for surface water management and drainage in their area. SWMPs establish a long-term action plan to manage surface water, and are intended to influence future capital investment, drainage maintenance, public engagement and understanding, land-use planning, emergency planning and future developments.

The **Brighton and Hove SWMP** was developed in 2014 by Peter Brett Associates LLP (PBA) on commission by Brighton and Hove County Council. Flooding hot spots were identified and were deemed to be of high risk and an action plan where preferred options, further work and next steps are discussed.

2.6 Catchment Flood Management Plans

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

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

2.6.1 River Adur CFMP (2009)

The policies for the study area within the **River Adur CFMP** are:

- **Policy 3 - Brighton and Hove.** Areas of low to moderate flood risk where we are generally managing existing flood risk effectively
- **Policy 6 - South Downs East.** Areas of low to moderate flood risk where we will take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits

2.6.2 River Ouse CFMP

The policies for the study area within the **River Ouse CFMP** are:

- **Policy 1 - South Downs (East & West) / Saltdean and Peacehaven.** Areas of little or no flood risk where we will continue to monitor and advise

The CFMPs provide specific 'actions' for flood risk management for each sub area.

2.7 Flood and Coastal Erosion Risk Management Strategy

Defra has responsibility for the formation of national policy on flood and coastal erosion risk management (FCERM) in England, and the Environment Agency (EA) in partnership with local risk management authorities (RMA) has responsibility for its implementation. Local implementation of national policy for FCERM involves the development of plans and strategies together with a business case for their implementation. This process identifies strategic objectives and options to manage the shoreline in line with FCERM Appraisal Guidance.

2.7.1 Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy Review (2014)

The **Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy Review (2014)** examines the coastline between Brighton Marina and the River Adur which lies within Brighton and Hove City Council and Adur District Council's areas. The Strategy divides the coast into 3 units: Unit 1 is the locked basin of Shoreham Port, Unit 2 is the coast between the River mouth and the Marina and Unit 3 is Brighton Marina. The preferred strategic approach outlined in the Strategy is for "Improve" to a 1 in 200-year standard (0.5% AEP) for Units 1 and 2, with "Sustain" the current standard of defence in Unit 3. These recommendations are in agreement with the preferred Hold the Line policy in the 2006 shoreline management plan.

2.8 Shoreline Management Plan

Shoreline Management Plans (SMP) form part of Defra's strategy for flood and coastal defence. They provide a high level assessment of risks associated with coastal evolution and present the policy framework to address those. The SMP policies defined by Defra are:

- Hold the line – maintain or change the standard of protection.
- Advance the line – build new defences on the seaward side of the existing defences
- Managed realignment – allowing the shoreline to move backwards or forwards, with management to control or limit the movement.
- No active intervention – no investment in coastal defences or operations.

SMPs cover a 100 year period divided up as follows: epoch 1 = 0 to year 20; epoch 2 = 20 to 50 years; epoch 3 = 50 to 100 years. Each epoch has an individual policy allotted to it.

2.8.1 Beachy Head to Selsey Bill Shoreline Management Plan (2006)

The **Beachy Head to Selsey Bill Shoreline Management Plan (2006)** covers the study area from Portslade-by Sea to Hove. The following policies are outlined for the study area:

- **Unit 10 - Saltdean to Rottingdean** - Hold Cliff Base is the Present and medium-term policy choice and for Long term policy monitor, manage and review.
- **Unit 11 - Rottingdean to Brighton Marina** - Present and medium-term preferred policy plan is to Hold Cliff Base. Long term policy plan on the other hand is to monitor, manage and review.
- **Unit 12 - Brighton Marina to Portslade-by Sea** - Present, medium and long-term policy is to hold the line.

2.9 River Basin Management Plans

River Basin Management Plans (RBMPs) are prepared under the Water Framework Directive (WFD) and assess the pressure facing the water environment in River Basin Districts. Brighton and Hove falls within the **South East River Basin RBMP**.

2.10 Water Cycle Studies

Water Cycle Studies assist Local Authorities to select and develop sustainable development allocations so that there is minimal impact on the environment, water quality, water resources, and infrastructure and flood risk. This can be achieved in areas where there may be conflict between any proposed development and the requirements of the environment through the recommendation of potential sustainable solutions.

A Water Cycle Study has been carried out by **South Downs National Park Authority** who commissioned AMEC to support long term decisions for housing growth within the area. Part of this study extends into the Brighton and Hove area.

2.11 Roles and responsibilities of Risk Management Authorities

The roles and responsibilities of Risk Management Authorities (RMAs) in the Brighton and Hove City Council area are summarised as follows.

2.11.1 Brighton and Hove City Council

Brighton and Hove City Council is the local authority for the city of Brighton and Hove and is a unitary authority. Brighton and Hove City Council is the local planning authority which assesses, consults and determines whether development proposals are acceptable so that flooding and other, similar, risks are effectively managed.

Brighton and Hove City Council will consult with relevant statutory consultees as part of planning application assessments and may, in some cases, also contact non-statutory consultees, such as Southern Water, that have an interest in the planning application.

As a unitary authority, Brighton and Hove City Council is also the Lead Local Flood Authority (LLFA). Brighton and Hove City Council LLFA duties include:

- Local Flood Risk Management Strategy (LFRMS): LLFAs must develop, maintain, apply and monitor a LFRMS to outline how they will manage flood risk, identify areas vulnerable to flooding and target resources where they are needed most.
- Flood Investigations: When appropriate and necessary LLFAs must investigate and report on flooding incidents (Section 19 investigations).
- Register of Flood Risk Features: LLFAs must establish and maintain a register of structures or features which, in their opinion, are likely to have a significant effect on flood risk in the LLFA area.
- Designation of Features: LLFAs may exercise powers to designate structures and features that affect flood risk, requiring the owner to seek consent from the authority to alter, remove or replace it.
- Preparing and issuing information to satisfy the requirements of the Flood Risk Regulations

Brighton and Hove City Council are also the Local Highway Authority and manage highway drainage, carrying out maintenance and improvement works on an on-going basis, as necessary, maintain existing standards of flood protection for highways, making appropriate allowances for climate change. It also has the responsibility to ensure road projects to no increase flood risk.

2.11.2 Environment Agency

The Environment Agency is responsible for protecting and enhancing the environment and contributing to the government's aim of achieving sustainable development in England and Wales. The Environment Agency has powers to carry out flood and coastal risk management work and to regulate the actions of other flood risk management authorities on the coast. These powers are permissive, which means they are not a duty.

The Environment Agency also has powers to work on Main Rivers to manage flood risk and to regulate and consent works to Main Rivers. However, there are no Main Rivers in Brighton and Hove.

The Environment Agency also has a strategic overview role across all types of flooding as well as other types of water management matters. Additionally, the Environment Agency prepares, and issues mapping and plans to meet the requirements of the Flood Risk Regulations.

2.11.3 Water and wastewater providers

Southern Water are the sewerage undertaker for the study area. They have the responsibility to maintain surface, foul and combined public sewers to ensure the area is effectively drained. When flows (foul or surface water) are proposed to enter public sewers, Southern Water will assess whether the public system has the capacity to accept these flows as part of their pre-application service. If there isn't available capacity, they will provide a solution that identifies the

necessary mitigation. Southern Water will also comment on the available capacity of foul and surface water sewers as part of the planning application process. Further information can be found on the respective Southern Water websites.

Southern Water also supply potable water to the study area. Consent, prior to commencing work, is required from Southern Water if installing water systems, or altering existing systems, is intended.

2.12 When to consult authorities

The new and emerging responsibilities under the Flood and Water Management Act 2010 and the Flood Risk Regulations 2009 are summarised in Table 2-1.

Table 2-1: Roles and responsibilities in Brighton and Hove

Key Authority	When to consult
Brighton and Hove City Council (Local Planning Authority)	Pre-application consultation is recommended to identify the range of issues that may affect the site and, following on from the Sequential and, if necessary, Exception Test, determine whether the site is suitable for its intended use. Should be consulted where an awarded watercourse runs within or adjacent to proposed development consultation. Consultation is recommended for development in Surface Water Flood Zones and sites located in areas where groundwater levels are between the ground surface and 0.5m according to the JBA Groundwater map (Figure 5-6).
Brighton and Hove City Council (LLFA)	Statutory consultee on surface water drainage and groundwater flood risk for major development.
Environment Agency	Should be consulted on development as defined in the Environment Agency's Flood Risk Standing Advice document within Flood Zone 2 or 3, or in Flood Zone 1 where critical drainage problems have been notified to the LPA. Consultation will also be required for any development projects within 20m of a flood defence.
Brighton and Hove City Council (Local Highway Authority)	Where the proposed development will either involve a new access to the local highway network or increase or change traffic movements
Highways England	When the quality and capacity of the Highways England (strategic) road network could be affected.
Historic England	Whilst Historic England are not a RMA, they should be consulted where proposals may affect heritage assets and their settings.
Natural England	Natural England has mapped 'risk zones' to help developers and LPAs determine whether consultation is required. This is likely where water bodies with special local or European designations (e.g. SSSI or Ramsar) exists
Southern Water	Where connection to a public sewerage system is required. Where new connections to the water supply network are required or if any alterations are made to existing connections Southern Water would wish to comment on major planning applications in the area where it proposed to connect to the public sewerage network.

3 The Sequential and Exception Tests

For certain developments in Brighton and Hove the Sequential and/or Exception Tests will need to be passed. This section outlines the requirements of the Sequential, Exception and Sustainability Tests.

3.1 The sequential, risk-based approach

This approach is designed to ensure areas with little or no risk of flooding (from any source) are developed in preference to areas at higher risk, with the aim of keeping development outside of medium and high flood risk areas (Flood Zones 2 and 3) and other sources of flooding, where possible. The sequential approach can be applied both between and within Flood Zones.

When drawing up a Local Plan, it is often the case that it is not possible for all new development to be allocated on land that is not at risk from flooding. In these circumstances, the Flood Zone maps (that show the extent of inundation assuming that there are no defences) do not contain enough information and a greater understanding of the scale and nature of the flood risks is required, as described in a Level 2 SFRA.

3.1.1 Coastal Flood Zones

Table 1 of NPPG Flood Risk and Coastal Change identifies the following Flood Zones. In Brighton and Hove, these apply to coastal flood risk. Flood risk vulnerability and Flood Zone compatibility is set out in **Table 3** of the NPPG. Table 3-1 summarises this information and also provides information on when an FRA would be required.

Table 3-1: Flood Zone descriptions for Brighton and Hove based on the NPPG

Zone	Probability	Description
Zone 1	Low	This zone comprises land assessed as having a less than 1 in 1000 annual probability of sea flooding in any year (<0.1%).
		All land uses are appropriate in this zone.
		For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a flood risk assessment.
Zone 2	Medium	This zone comprises land assessed as having between 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.1% – 0.5%) in any year.
		Essential infrastructure, water compatible infrastructure, less vulnerable and more vulnerable land uses (as set out by NPPF) are appropriate in this zone. Highly vulnerable land uses are allowed as long as they pass the Exception Test.
		All developments in this zone require an FRA.
Zone 3a	High	This zone comprises land assessed as having a greater than 1 in 200 annual probability of flooding from the sea (>0.5%) in any year. Developers and the local authorities should seek to reduce the overall level of flood risk, relocating development sequentially to areas of lower flood risk and attempting to restore the coastal floodplain and make open space available for flood storage.
		Water compatible and less vulnerable land uses are permitted in this zone. Highly vulnerable land uses are not permitted. More vulnerable and essential infrastructure are only permitted if they pass the Exception Test.
		All developments in this zone require an FRA.
Zone 3b	Functional coastal Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify, in their SFRA, areas of functional coastal floodplain, in agreement with the Environment Agency. The identification of functional coastal floodplain should take account of local circumstances.
		Only water compatible and essential infrastructure are permitted in this zone and should be designed to remain operational in times of flood, resulting in no loss of coastal floodplain or blocking of water flow routes. They must also be safe for users and not increase flood risk elsewhere. Essential Infrastructure will only be permitted if it passes the Exception Test.
		All developments in this zone require an FRA.

3.2 Further definition of Flood Zone 3b

Flood Zone 3b has been defined in this SFRA as land which has 5% annual probability of flooding, also referred to as a return period of 20 years or less, or an area that is designed to flood in an extreme event. Flood Zone 3b takes account of flood defences.

It should be noted that Flood Zones 2 and 3a do not take account the presence of flood defences.

3.3 Applying the Sequential Test and Exception Test and the City Plan Part 1 and 2

The City Plan Part 1 sets out Brighton and Hove City Council's spatial strategy for the city to 2030. The Plan directs future development to eight broad areas of the city where capacity exists to accommodate significant levels of development. These areas are identified as 'Development Areas', and the **2012 SFRA** update considered these broad areas. In addition, the City Plan Part 1 identified Strategic Allocations where development could be located and housing potential from the Strategic Housing Land Availability Assessment (SHLAA). This was set out in City Plan Part 1 Housing Delivery which included an allowance for windfall sites across the city.

A **Sequential Test and Exception Test** was carried out for the eight Development Areas in 2012. During the course of the examination, the Urban Fringe was reconsidered as a broad area of opportunity with an allowance of 1,200 homes and an **update to the Sequential and Exception Test** was undertaken. The 2014 update also included one Strategic Allocation site. An Exception Test was carried out for those sites found to be wholly or partly in Flood Zone 2 and 3a. The Sequential and Exception Test concluded that:

'All the proposed Development Area allocations have passed the Sequential Test.'

The approach was examined and found sound and the City Plan Part 1 was adopted in 2016. Many of these sites have since been developed or planning permission has been obtained. The remaining sites which were identified in City Plan Part 1 and satisfied the Sequential Test but have not yet been developed have been carried forward to the 2018 SFRA update.

This 2018 SFRA supports the City Plan Part 2. The role of the City Plan Part 2 is to support the implementation and delivery of the City Plan Part 1 through further site allocations (particularly housing sites) that follow the broad strategy and approach to accommodating the 13,200 housing target as set out in the adopted City Plan Part 1.

With respect to the 2018 Level 1 SFRA, in addition to the City Plan Part 1 sites, updated information on housing land availability (SHLAA) (list of potential housing sites) has been provided. This has informed the proposed housing site allocations in the City Plan Part 2 and new strategic site allocations that emerged through the call for sites at the scoping consultation on the draft City Plan Part Two (2016). It should be noted that four sites included in the Level 2 SFRA assessment are situated within a Development Area, and one is the Strategic Allocations site, where the Sequential and Exception Tests have been undertaken as part of the City Plan Part 1. These sites are:

- Combined Engineering Depot, New England Road
- Marina Development
- Sackville Trading Estate and Coal Yard
- King Alfred
- Telecom House 123-135, Preston Road

It is recommended that Brighton and Hove City Council confirm that the conclusions of the Sequential and Exception Tests are still valid based on the new evidence presented in this document.

Five sites have been taken forward to the Level 2 SFRA which have not previously been included in the Sequential and Exception Test as prepared for the City Plan Part 1. These are:

- 46-54 Old London Road, Patcham
- Brighton General Hospital
- EDF Portland Road Business Park, Portland Road

- Land at and adjoining Horsedean Recreation Ground
- Land at Lyon Close

It is recommended that Brighton and Hove City Council undertake a Sequential Test, and if necessary, Exception Test for these sites based on the evidence in this document.

3.3.1 Sequential and Exceptions Test and Surface Water Flood Zones

This SFRA defines Surface Water Flood Zones to encourage sustainable development in Brighton and Hove (this concept is explained fully in Section 5.8). It is not intended that Surface Water Flood Zones are used to perform a Sequential Test as applies to river or sea flood risk. This means that if a development site is located in a Surface Water Flood Zone it does not automatically cause the site to fail the Sequential Test or trigger the Exception Test.

Surface Water Flood Zones introduce an additional requirement to perform FRA's that will be submitted in support of planning applications and increase the emphasis that the site layout of a development adopts a sequential approach. PPG states that within each flood zone, surface water and other sources of flooding should be taken into account in applying the sequential approach to the location of development.

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

3.4.1 Sequential Test

Local circumstances must be used to define the area of application of the Sequential Test (within which it is appropriate to identify reasonably available alternatives). The criteria used to determine the appropriate search area relate to the catchment area for the type of development being proposed. For some sites this may be clear, in other cases it may be identified by other Local Plan policies. A pragmatic approach should be taken when applying the Sequential Test.

Brighton and Hove City Council with advice from the Environment Agency, are responsible for considering the extent to which Sequential Test considerations have been satisfied, and will need to be satisfied that the proposed development would be safe and not lead to increased flood risk elsewhere.

The Sequential Test does not need to be applied for individual developments under the following circumstances:

- The site has already been identified in development plans through the application of the Sequential Test.
- Applications for minor development or change of use (except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site).

It is normally reasonable to presume and state that individual sites that lie in Zone 1 satisfy the requirements of the Sequential Test; however, consideration should be given to risks from all sources, including surface water and groundwater flood risk.

3.4.2 Exception Test

If, following application of the Sequential Test, it is not possible for the development to be located in areas with a lower probability of flooding, the Exception Test must then be applied if deemed appropriate (see 2014 **NPPF Table 3: Flood risk vulnerability and Flood Zone 'compatibility'**). The aim of the Exception Test is to ensure that more vulnerable uses, such as residential development can be implemented safely and are not located in areas where the hazards and consequences of flooding are inappropriate. For the Test to be satisfied, the following two elements have to be accepted for development to be allocated or permitted:

1. It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared.

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

possible, this part of the Exception Test has not been passed and planning permission should be refused.

2. A site-specific Flood Risk Assessment must demonstrate that the development will be safe for its lifetime, taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

The site-specific Flood Risk Assessment should demonstrate that the site will be safe and the people will not be exposed to hazardous flooding from any source. The following should be considered:

- The design of any flood defence infrastructure.
- Access and egress.
- Operation and maintenance.
- Design of the development to manage and reduce flood risk wherever possible
- Resident awareness.
- Flood warning and evacuation procedures.
- Any funding arrangements required for implementing measures.

The 2014 **NPPG** provides detailed information on how the Test can be applied and a **table** that outlines when the Exception Test is required.

3.5 Actual flood risk

If it has not been possible for all future development to be situated in Zone 1 then a more detailed assessment is needed to understand the implications of locating proposed development in Zones 2 or 3. This is accomplished by considering information on the “actual risk” of flooding. The assessment of actual risk takes account of the presence of flood defences and provides a picture of the safety of existing and proposed development.

It should be understood that the standard of protection afforded by flood defences is not constant and it is presumed that the required minimum standards for new development in Brighton and Hove is that residential development should be protected against flooding with an annual probability of tidal (sea) flooding of 0.5% (1 in 200 chance of flooding) in any year. Standard of protection information was not provided for surface water and groundwater risk management assets and therefore has not been considered in areas where these structures are present.

The assessment of the actual risk should take the following issues into account:

- The level of protection afforded by existing defences might be less than the appropriate standards and hence may need to be improved if further growth is contemplated.
- The flood risk management policy for the defences will provide information on the level of future commitment to maintain existing standards of protection. If there is a conflict between the proposed level of commitment and the future needs to support growth, then it will be a priority for the Shoreline Management Plans and Flood and Coastal Erosion Risk Management Strategy to be reviewed.
- The standard of safety must be maintained for the intended lifetime of the development. Over time the effects of climate change may reduce the standard of protection afforded by defences, due to increased sea levels, and so commitment is needed to invest in the maintenance and upgrade of defences if the present-day levels of protection are to be maintained and where necessary land secured that is required for affordable future flood risk management measures.
- The assessment of actual risk can include consideration of the magnitude of the hazard posed by flooding. By understanding the depth, velocity, speed of onset, rate of rise and duration 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 a) the consequences of flooding need to be mitigated or b) where it is proposed to place lower vulnerability development in areas of flood risk.

3.6 Impact of additional development on flood risk

When allocating land for development, consideration must be given to the potential cumulative impact of development on flood risk. The increase in impermeable surfaces and resulting increase in runoff increases the chances of surface water flooding if suitable mitigation measures, such as SuDS, are not put in place.

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

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

The cumulative impact of development should be considered at the planning application and development design stages and the appropriate mitigation measures undertaken, within an appropriate FRA, to ensure flood risk is not exacerbated, and in many cases the development should be used to improve the flood risk. It is possible that it might be more appropriate to consider strategic measures, but additional studies would be required to provide evidence that the provisions supported the principle of development and were deliverable.

Maintenance and upkeep of SuDS have been neglected in the past as a result of lack of clarity over where responsibility rests. Therefore, it is important that maintenance and upkeep for mitigation measures, such as SuDS, has been set out as part of a drainage strategy and that management funding for the lifetime of the development is agreed.

3.7 Surface Water Flood Zones and Sequential and Exception Tests

Surface Water Flood Zones should not be considered as part of the Sequential or Exception Tests, as triggered by river and sea flooding. However, they do identify locations where there is a requirement to prepare a Flood Risk Assessment in support of the application to provide evidence that development is safe from surface water flood risk for its lifetime and does not have an adverse effect on others.

4 Climate Change

4.1 Climate change and the NPPF

The 2018 NPPF sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. NPPF and NPPG describe how FRAs should demonstrate how flood risk will be managed over the lifetime of the development, taking climate change into account.

4.2 Revised climate change guidance

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

4.3 Climate change allowances

By making an allowance for climate change it will help reduce the vulnerability of the development and provide resilience to flooding in the future. The 2016 climate change guidance covers sea level rise and water height. These allowances are based on climate change projections and difference scenarios of carbon dioxide emissions to the atmosphere. Due to the complexity of projecting climate change effects, there are uncertainties attributed to climate change allowances related to the confidence in the prediction. As a result, the guidance presents a range of possibilities to reflect the potential variation in climate change impacts over the three periods as a consequence of differing levels of confidence in the predictions.

The Environment Agency anticipate that there will be new climate change allowances released in November 2018. Any changes which impact on this SFRA will be added as an addendum after the release of the updated predictions.

4.4 The impact of climate change

Flood Risk Assessments (FRAs) are required to demonstrate future implications of climate change have been considered, and risks managed where possible, for the lifetime of the proposed development. This may include for instance:

- Consideration of the vulnerability of the proposed development types or land use allocations to flooding and directing the more vulnerable away from areas at higher risk due to climate change.
- Use of 'built in' resilience measures. For example, raised floor levels.
- Capacity or space in the development to include additional resilience measures in the future, using a 'managed adaptive' approach.

The last consideration acknowledges that there may be instances where some flood risk management measures are not necessarily needed now but may be in the future.

The latest guidance on climate change allowances for FRAs released by the Environment Agency² provides predictions of anticipated change. The allowances to be considered in FRAs for developments in Brighton and Hove City Council's authoritative area are:

- peak rainfall intensity;
- sea level rise; and
- offshore wind speed and extreme wave height.

The Environment Agency guidelines should be used for sea level rise, offshore wind speed and extreme wave height in FRAs for developments at risk of coastal flooding.

Although the Environment Agency provides peak rainfall intensity climate change allowances, Brighton and Hove City Council would require that larger increases in rainfall intensities are

² <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>
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considered for surface water flood risk in FRAs and drainage and surface water attenuation schemes associated with developments.

The guidelines which should be used in FRAs are outlined in the following sections.

4.5 Sea Level allowances

Climate change is predicted to cause sea level rise and increase the rate of coastal risk erosion. The table below shows anticipated sea level rise for each time-period (termed 'epoch'), with cumulative sea level rise in brackets. Guidance on how to calculate the sea level rise (i.e. the cumulative total sea level rise expected over the lifetime of a development), is provided on the government [website](#).

Table 4-1: Sea level allowance for each epoch in millimetres (mm) per year, with cumulative sea level rise for each epoch in brackets (use 1990 baseline)

Area of England	1990 to 2025	2026 to 2055	2056 to 2085	2086 to 2115	Cumulative rise 1990 to 2115 / metres (m)
South east	4 (140mm)	8.5 (255mm)	12 (360mm)	15 (450mm)	1.21m

4.6 Offshore wind speed and extreme wave height allowances

In addition to increase sea levels, wave heights may change due to increased water depths. The severity, duration and frequency of storms may also change. Allowances for wind speed and wave heights have also been [published](#), alongside the sensitivity allowances to be used.

4.7 Peak rainfall intensity allowance and surface water flood risk

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

Brighton and Hove City Council require that all FRAs for developments consider as a minimum a 30% increase in peak rainfall intensity, and ideally a 40% increase in peak rainfall intensity.

Drainage and surface water attenuation schemes associated with developments will also need to consider a 30% increase in peak rainfall intensities as a minimum, and ideally a 40% increase in peak rainfall intensities.

Surface water flood risk mapping showing the extents of the 30% and 40% increases in peak rainfall has been prepared as part of the Level 1 SFRA. The surface water climate change mapping can be found in Figure 5-4 and Appendix B.2. High detail surface water climate change flood mapping can be requested from Brighton and Hove City Council by emailing sustainable drainage@brighton-hove.gov.uk.

4.8 Groundwater

The effect of climate change on groundwater flooding problems is more uncertain. The updated climate change guidance released in February 2016 does not provide information on expected changes to groundwater flooding under future climate change. However, milder wetter winters may increase the frequency of groundwater flooding incidents in areas that are already susceptible, but warmer drier summers could counteract this effect by drawing down groundwater levels to a greater extent during the summer months. Where groundwater flooding is expected to influence a development site, it will be expected that consideration of groundwater flooding under a changing climate is assessed and measures taken to mitigate any change in risk.

4.9 The Impact of climate change in Brighton and Hove

4.9.1 UK Climate Projection 2009

The [UK Climate Projection 2009](#) (UKCP09) predicts the following climatic changes to the study area:

South East England

- Increased summer temperatures of 3.1°C by 2050
- Increased winter temperatures of 2.5°C by 2050
- Reduced summer rainfall of 19% by 2050 making summers much drier
- Increased winter rainfall of 19% by 2050.

UKCP18 is due to be completed in November 2018 which will provide more extensively evaluated projection data. UKCP18 will build upon the outcomes of UKCP09.

4.9.2 Brighton and Hove Climate Change Adaptations Scrutiny Panel Review (2010)

The **Brighton and Hove Climate Change Adaptations Scrutiny Panel Review (2010)** was a cross party scrutiny inquiry which looked into how the city will adapt to climate change. It identified that one of biggest risks that climate change poses to Brighton and Hove was increased likelihood of flooding (including surface water flooding). Other vulnerabilities noted by witnesses included coastal erosion, cliff protection, storm surges, snow and increased impact of extreme weather conditions, insufficient drainage, highway drainage sewerage capacity and sea water levels.

4.9.3 Adapting to climate change

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

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

Identifying no or low-cost responses to climate risks that also deliver other benefits, such as green infrastructure that improves adaptation, biodiversity and amenity, for example by leaving areas shown to be at risk of flooding as public open space.

The **Brighton and Hove Climate Change Adaptations Scrutiny Panel Review (2010)** provided details of how the city will adapt to climate change and presented 13 recommendations for the future. These included:

'The panel welcomes planning proposals to ensure that developments can adapt to future climate changes. This will be achieved by implementing planning policies which require that new developments in the city must demonstrate that they can adapt to climate change through addressing such issues as flooding, overheating, rain events, storm surges and other climate related impacts. Any new planning documents will be fully informed by relevant studies about climate impacts now and in the future.'

Brighton and Hove City Council have produced a **City Sustainability Action Plan (2015)**. This sets out actions and initiatives that will support sustainability. One action is for Brighton and Hove to be a Sustainable Water City. The aim is support reduced water demand, improve water quality and reduce flood risk. The plan sets out where the council would like to get to, where they are now, what they are going to do and medium and long term actions to adapt to climate change.

Between 2017 and 2020, Brighton and Hove City Council are developing ways to reduce flood risk in the Carden Avenue area, Patcham and Norton Road area, Hove. **The Shaping Climate Change Adaptive Places (SCAPE)** project works with the local communities, urban professionals and **INTERREG 2 Seas SCAPE partners**. These areas have been badly affected by surface water flooding in the past. The project aims to work with the local residents to increase the capacity of the existing drainage network in the two areas and to improve the quality of public space. The project aims to develop solutions for water management which

uses 'landscape led design' to enable coastal landscapes in the 2 Seas area to be better adapted and more resilient to climate change.

5 Understanding flood risk in Brighton and Hove

5.1 Historic flooding

Brighton and Hove have a history of documented flood events with the main sources being from coastal, groundwater, sewer and surface water sources. A number of different data sources have been used to understand the historic flood risk in Brighton and Hove which are outlined in this section.

5.1.1 Brighton and Hove Flood Incident Database

The Brighton and Hove Flood Incident Database holds all records of flooding known to the council since 1850. The information has been collected from a number of sources including historic maps, public records and reports from members of the public.

A total of 834 records of flooding have been identified and categorised per ward is shown in Figure 5-1. A summary of these events per ward identifying the sources of historical flooding is displayed in Table 5-2. The sources of flooding are recorded as follows:

- 4 records of tidal flooding
- 26 records of groundwater flooding
- 209 of highway flooding
- 324 records of sewer/drain flooding

The sources of the remaining flood incidents were undefined.

The main flood events highlighted in this dataset shown in Table 5-1 with additional information collected from an internet search.

Table 5-1: Key flood events in Brighton and Hove based on the council's Flood Incident Database and additional information

Date	Number of reports	Location of reports	Source of flooding
9 August 1992	66	Throughout Hove and the centre and west of Brighton	Heavy rain caused combined and surface water sewer flooding.
8 August 1999	11	Portslade, Hove, Queen Park, Whitehawk and Brighton	The source of the flooding was from foul / combined sewers.
4 July 2000	11	Portslade, Hove and Brighton	The source of the flooding was from foul / combined sewers. There were three reports of damage to living quarters.
12 October 2000	12	Portslade, Hove and Brighton	The source of the flooding has not been recorded in the Flood Incident Database. Online sources show that heavy rainfall hit the south of England ³ .
28 July 2014	140	Throughout Portslade, Hove and the west of Brighton.	Heavy storms ⁴ caused flooding internally and externally at multiple properties and water pooling on the roads and pavements. Drains were noted to have been blocked.
8 October 2014	12	Patcham, Preston Village, Portslade,	A heavy rainfall event with blocked gullies and insufficient road drainage was reported. Flooding was also reported

³ BBC News (12/10/2000) South hit by severe floods (Accessed 12/01/2018)

⁴ BBC News (28/07/2014) Torrential rain and flash flooding cause travel chaos (Accessed 12/01/2018)

Date	Number of reports	Location of reports	Source of flooding
		Hove	along the Westdene parade of shops ⁵ .
10 October 2014	10	Saltdean and Brighton	Following significant and localised rain fall in this area, surface runoff from a field partially owned by The Council led to a number of residential properties being affected by flooding and soil build up in gardens
13 August 2015	23	Brighton Seafront, Preston Village, Brighton, Patcham, Preston, Preston Park	Heavy rain caused flood water to cover the seafront promenade, with a few reports of flood water entering the property. Flooding was noted at Brighton train station and the Co-op along London Road was closed ⁶ .
19 July 2017	25	Preston Circus, Hangleton, Patcham, Hove, Mile Oak, Preston Park	A number of reports of the roads flooding, with flood waters also reported to have entered properties and basement flats.

5.1.2 Environment Agency Recorded Flood Outlines dataset

The Environment Agency Recorded Flood Outlines dataset, provides details of all recorded flood incidents by the Environment Agency from rivers, sea groundwater and surface water. The absence of coverage by the dataset does not mean the area has never flooded, only that the Environment Agency does not currently have records in the area.

The dataset provides details of two flood incidents which are shown in Figure 5-1 and are outlined below.

- **November 1976** - Mile Oak Road, Portslade by Sea - local drainage /surface water flooding
- **October 1987** - Falmer Road - flooding caused by the drainage

⁵ ITV News (08/10/2014) Fire crews called to deal with major flooding (Accessed 12/01/2018)

⁶ Evening Standard (13/08/2015) Severe floods hit Brighton and the south-east after torrential rain falls (Accessed 12/01/2018)

Figure 5-1: Brighton and Hove Flood Incident Database and the Environment Agency Recorded Flood Outlines

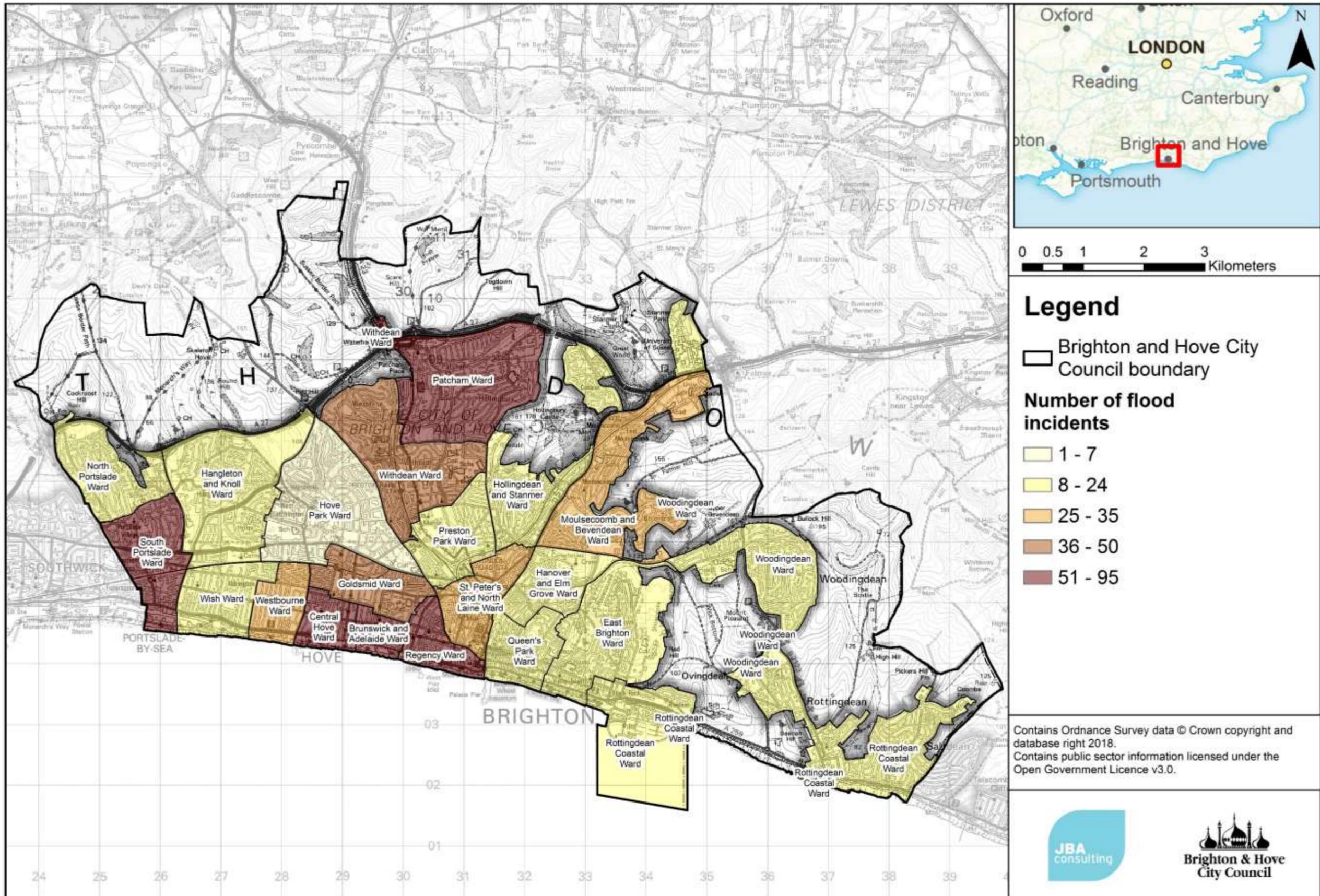


Table 5-2: Summary of historic flood incidents in Brighton and Hove within each ward from various sources of flooding

Wards	Total number of incidents	Groundwater flooding	Tidal flooding	Sewer/drain flooding	Highway flooding	Other sources of flooding
Rottingdean Coastal Ward	22	1	0	5	2	14
South Portslade Ward	114	6	0	52	43	13
Hove Park Ward	7	0	0	2	0	5
North Portslade Ward	19	2	0	0	3	14
Hangleton and Knoll Ward	23	0	0	18	5	0
Withdean Ward	66	5	0	37	11	13
Hollingdean and Stanmer Ward	15	0	0	7	1	7
Woodingdean Ward	20	0	0	18	0	2
Moulsecoomb and Bevendean Ward	29	2	0	13	2	12
Patcham Ward	83	10	0	26	19	28
Wish Ward	25	0	1	10	8	6
Goldsmid Ward	44	0	0	15	20	9
Queen's Park Ward	23	0	0	1	1	21
St. Peter's and North Laine Ward	30	0	0	9	3	18
Hanover and Elm Grove Ward	12	0	0	5	1	6
East Brighton Ward	21	0	1	5	0	15
Preston Park Ward	24	0	0	10	1	13
Westbourne Ward	35	0	1	16	12	6
Central Hove Ward	86	0	0	24	40	22
Brunswick and Adelaide Ward	70	0	0	32	21	17
Regency Ward	66	0	1	19	16	30
Total	834	26	4	324	209	271

5.1.3 Previous Brighton and Hove City Council SFRA

Surface water flooding

The SFRA (2008) reported the historical surface water flooding events recorded back to the 1960s, which were sometimes referred to as 'muddy floods'. It was thought that the increase in muddy floods in this area may be as a result of changes in the farming methods used.

Groundwater flooding

The most notable and largest events in recent years occurred in 2000/01. This resulted in extensive flooding of the A23, which was closed for several days.

5.1.4 Section 19 Investigations

Under Section 19 of the Flood and Warning Management Act, Brighton and Hove City Council in their role as LLFA, are expected to investigate flood events which are deemed necessary and to produce a Section 19 Flood Investigation Report.

In May 2014, Brighton and Hove City Council published a **Section 19 Flood Investigation Report** into the groundwater flooding which occurred throughout the city in during the winter of 2013 to 2014. Rising high groundwater levels followed extreme rainfall. The winter of 2013/2014 was described as one of the wettest on record.

Appendix A of the Section 19 Flood Investigation Report also provides details of further historic flood events in Brighton.

5.1.5 The Brighton and Hove PFRA

The **2011 Brighton and Hove PFRA** provides further details of flood events up until 2011.

5.1.6 Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy Review

According to the **Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy Review**, storm events in 2013/14 caused flood water to enter 45 arches along the lower promenade, including 30 commercial properties. The events caused a number of homes along Western Esplanade to lose their decking and other beach structures and caused damage to Hove Deep Sea Anglers' building. Wave heights during this period were considered to be a 2% AEP event, with other storms in the time period greater than a 100% AEP event.

In 2014, Brighton and Hove City Council received Flood and Coastal Erosion Risk Management Grant in Aid (FCERMGiA) for emergency repair works of the breaches in seawalls and rebuilding some groyne following storm damage in Shoreham Port.

Historic flood information can be used for:

- Model calibration. This involves checking the model results align with historic flood information.
- Informing the extent of Environment Agency Flood Zones. In certain locations, the Flood Zone extents are based on the Environment Agency's Historic Flood Map rather than hydraulic modelling data.
- A driver for preparing a site-specific Flood Risk Assessment for a site. If the site is known to be affected by historic flood events, a site-specific Flood Risk Assessment will be appropriate to investigate the risk further.

5.2 How flood risk is assessed

A flood is now formally defined in the Flood and Water Management Act (2010) as "any case where land not normally covered by water becomes covered by water". The act also states that a flood, as defined above, can be 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*
- f. anything else (including any combination of factors).*

In the context of the FWMA (2010) a flood does not include:

- a. A flood from any part of a sewerage system, unless wholly or partly caused by an increase in the volume of rainwater (including snow and other precipitation) entering or otherwise affecting the system.
- b. A flood caused by a burst water main (within the meaning given by section 219 of the Water Industry Act 1991).

The FWMA (2010) states that flood risk "means a risk in respect of flood", where risk is "assessed and expressed (as for insurance and scientific purposes) as a combination of the probability of the occurrence with its potential consequences".

Thus, it is possible to define and express flood risk as:



5.3 Fluvial flood risk

With no main rivers or ordinary watercourses within Brighton and Hove the SFRA does not include an assessment of fluvial flood risk.

The council's previous 2008 SFRA does make reference to a so-called 'lost river', the River Wellesbourne, which was reported to run below Preston Park, London Road and The Level, discharging to the sea in the vicinity of Palace Pier, but investigations found that this watercourse no longer exists, and it has therefore not been considered further in this updated SFRA.

5.4 Tidal flood risk

5.4.1 Introduction

This section assesses risk in Brighton and Hove from tidal flooding, now and in the future. It makes use of all the data and information described in Section 2. It defines the tidal Flood Zones 1, 2, 3a and 3b, providing enough information for the council to perform the Sequential Test for these areas.

Brighton and Hove's coastline extends from Shoreham Port in the west to Saltdean in the east. All of the Brighton and Hove coastline is at risk of erosion, and some of the coastline is at risk of flooding as a result so the overtopping or breach of coast protection measures. The spatial variation in the level of risk across the floodplain must be identified to enable a more refined approach to the Sequential Test within tidal Flood Zone 3.

5.4.2 Tidal flood risk

Tidal flood risk is assessed based on Extreme Still Water Sea Levels (ESWSL), plus an allowance for the interaction of wind and waves. An ESWSL is the level the sea is expected to reach during a storm event for a particular magnitude of flood event as a result of the combination of astronomical tides and meteorological surges. It is conventional to assess the magnitude of these events by referring to 'still' water, and then to make additional allowances for the effect of waves, wind and swell. The astronomical tide levels are primarily generated by the gravitational effects of the sun and the moon. Surge events are the result of meteorological conditions where low atmospheric pressure causes the sea level to be increased to a higher level than during more average or high atmospheric pressure conditions. The wave heights and swells are influenced by the strength, direction and persistence of the wind and the profile of the nearshore.

Tidal flooding is caused by extreme tide levels exceeding ground and/or defence levels. Tidal flooding often also occurs by wave overtopping of defences. Flood Zones 1, 2 and 3 delineate areas at low risk, medium risk and high risk respectively from both tidal and fluvial flooding. Flood Zones do not take into account the effects of flood defences, and as such provides a worst-case assessment of flood risk. Flood Zone 3 and 2 represent the area that would be flooded in the 0.5% AEP and 0.1% AEP tidal event in the absence of defences, respectively. Flood Zones 1, 2 and 3a shown in Figure 5-2 are based on the Environment Agency Flood Zones.

In general, there are only two main areas of tidal flood risk throughout Brighton and Hove:

- Portslade-by-Sea
- Brighton Marina.

There remains a residual risk that the defences could fail or be overtopped during a flood event. The spatial variation in the level of risk across the floodplain must be identified to enable a more detailed Sequential Test within tidal Flood Zone 3.

5.4.3 Tidal functional floodplain (Flood Zone 3b)

One of the aims of the SFRA is to define the tidal functional floodplain (Flood Zone 3b). Flood Zone 3b has been defined using the following approach.

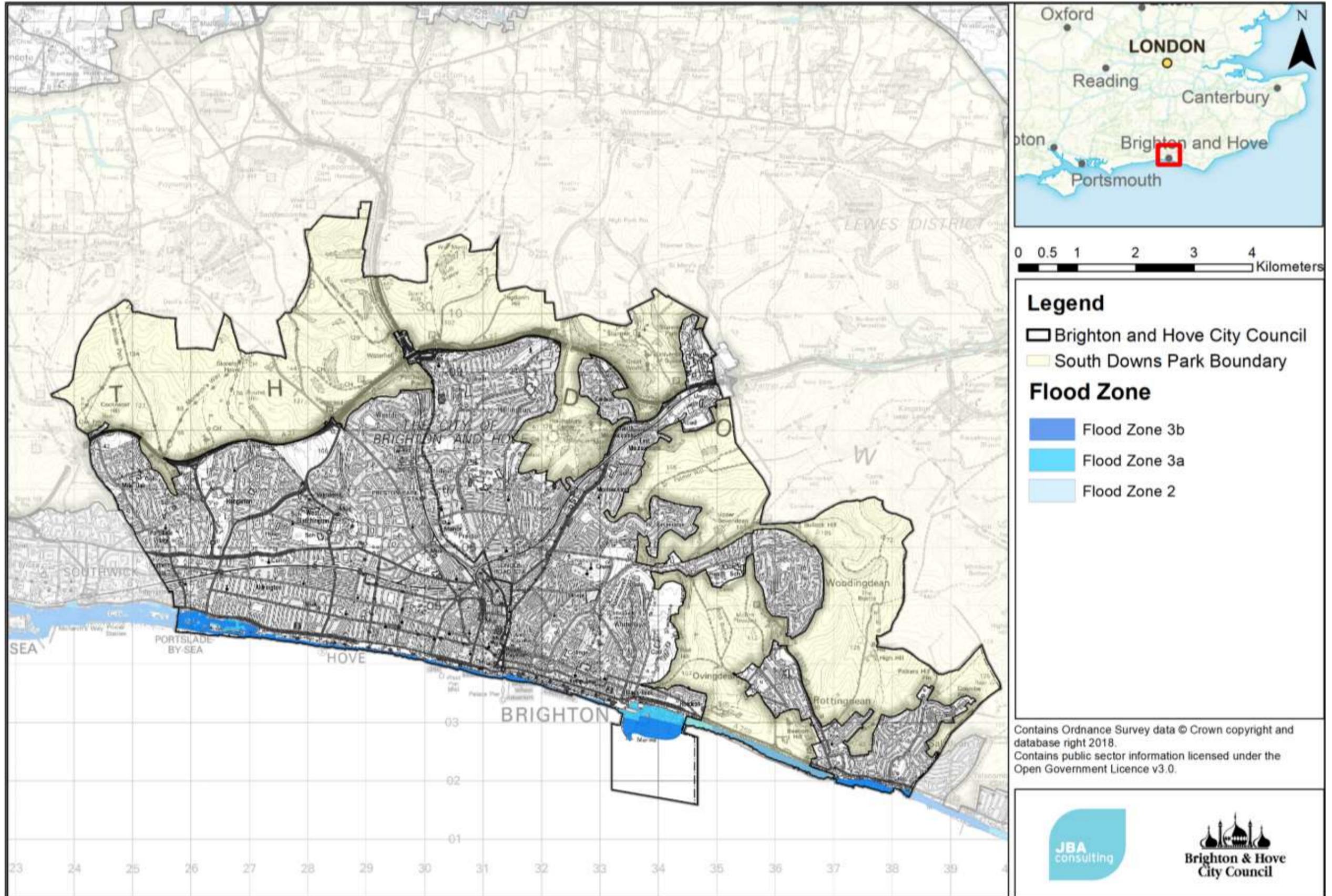
- **Brighton Marina:** Analysis was carried out using the tide level from JBA Extreme Sea Level Analysis (2004)⁷ and LIDAR as prepared for the 2008 SFRA.
- **Shoreham Port/ Aldrington Basin:** Arun to Adur section of the East Sussex Coastal model (2012). This has been updated since the 2012 SFRA.
- The Functional Floodplain for the rest of the area within Brighton and Hove has represented using Flood Zone 3a.

For the majority of Flood Zone 3b wave overtopping has been excluded. The exclusion of wave overtopping in the delineation of the Functional Floodplain is considered appropriate, when making land use planning decisions. However, it must be ensured that wave overtopping is managed effectively through the design of development. The effect of wave overtopping should therefore be investigated thoroughly in flood risk assessments accompanying development applications in these areas. Suitable mitigation measures should be incorporated to manage the effects of wave overtopping where this cannot be avoided.

Since 2012 SFRA, a small section around Shoreham Port/ Aldrington Basin has been remodelled as part of the Arun to Adur section of the East Sussex Coastal modelling (2012). Flood Zone 3b is defined in this area using the defended 5% AEP outline and includes wave overtopping.

Flood Zones 2, 3a and 3b are shown in Figure 5-2.

Figure 5-2: Flood Zones within Brighton and Hove



5.5 Coastal Flood Risk

If the coast is eroding, then the potential effect is that tidal flood defences near to the sea will be lost and flood risk will increase. To maintain an appropriate standard of safety from flooding it is sometimes necessary to implement works to slow down or stop the rate of coastal erosion and so maintain the integrity of the tidal defences. The **Beachy Head to Selsey Bill Shoreline Management Plan (2006)** and **Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy Review (2014)** covers the study area and describes the arrangements and strategy for managing coastal erosion.

The Beach Head to Selsey Bill SMP states that the coast west of Brighton Marina, is low lying with limited input and linkage along the frontage and is also susceptible to significant flood risk. East of Brighton Marina there are steep cliffs. The main defence west of Brighton Marina is shingle beach which if not maintained, will be susceptible to breaches, increase in frequency, leading to a loss of properties, historical assets and flood damage to many more. Thus, there is a justification economically to maintain defences and hold the line. However, to maintain this for the long term, significant lengths of new defences will be required where only a beach offers protection from flood damage and erosion loss. This is due to the nature of sea level rise where larger defence structures will be required associated with narrower beaches.

5.5.1 Coastal Flood Boundary study

Since the 2012 SFRA was completed a new Environment Agency project has been undertaken to determine extreme sea levels for the UK as "Extreme still water Levels for Planning: East Sussex". This information can be obtained from the Environment Agency.

5.6 Surface water flood risk

Flooding from surface water runoff (or 'pluvial' flooding) is usually caused by intense rainfall that may only last a few hours, occurring often where the natural (or artificial) drainage system is unable to cope with the volume of water. Surface water flooding problems are inextricably linked to issues of poor drainage, or drainage blockage by debris, and sewer flooding.

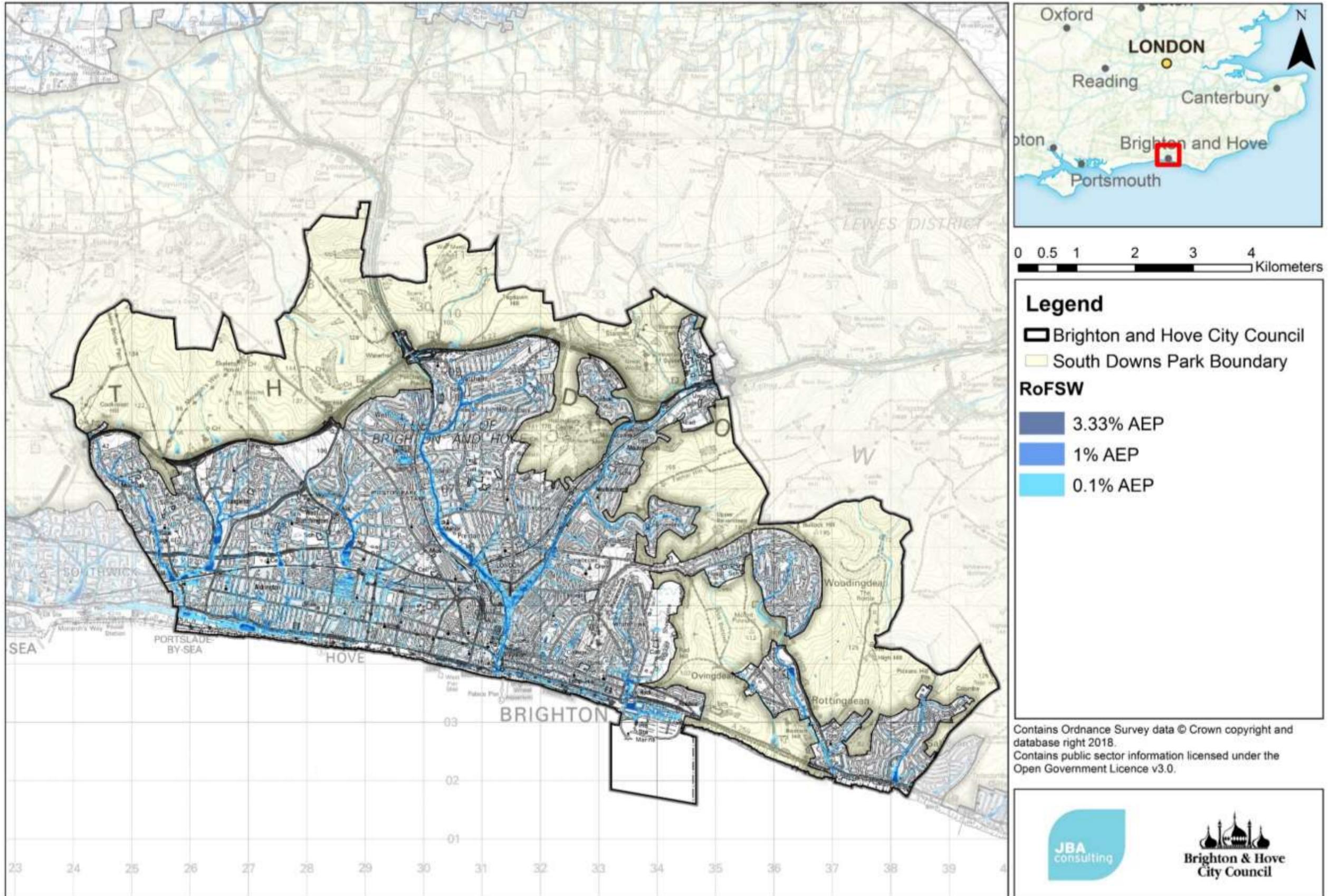
Mapping of surface water flood risk in Brighton and Hove has been taken from the updated the Risk of Flooding from Surface Water (RoFSW) published online by the Environment Agency. These maps are intended to provide a consistent standard of assessment for surface water flood risk across England and Wales in order to help LLFAs, the Environment Agency and any potential developers to focus their management of surface water flood risk.

The Risk of Flooding from Surface Water (RoFSW) dataset (Figure 5-3) shows that there is a significant risk of surface water flooding within Brighton and Hove, showing concern in urbanised areas where floods occur quickly in response to heavy rainfall events. Further detailed mapping of the surface water flood risk within Brighton and Hove is located within Appendix B.2.

Areas of concern are shown to be along main road routes through Brighton, such as London Road, Marlborough Place, Gloucester Place and Old Steine which are in the centre of Brighton providing access from North to South of the city. This area in conjunction with the rest of high risk from surface water flooding, are in areas of low elevation and act as a flow path of water travelling from high elevations in the north to low elevations in south towards the sea front. There are eight well defined flow routes within Brighton and Hove according to the RoFSW. The largest affected areas are along the A23 and A270 which form a 'y' shaped flow route in the centre of the city. There are significant areas in Hove, which are more susceptible to surface water flooding. The largest area of surface water ponding in Hove lies between the A270 to Kingsway.

In general, surface water flooding is the most frequent cause of flooding, although floodwaters are typically shallower and persist for shorter durations than other types of flooding.

Figure 5-3: Risk of flooding from Surface Water



5.7 Surface water and climate change

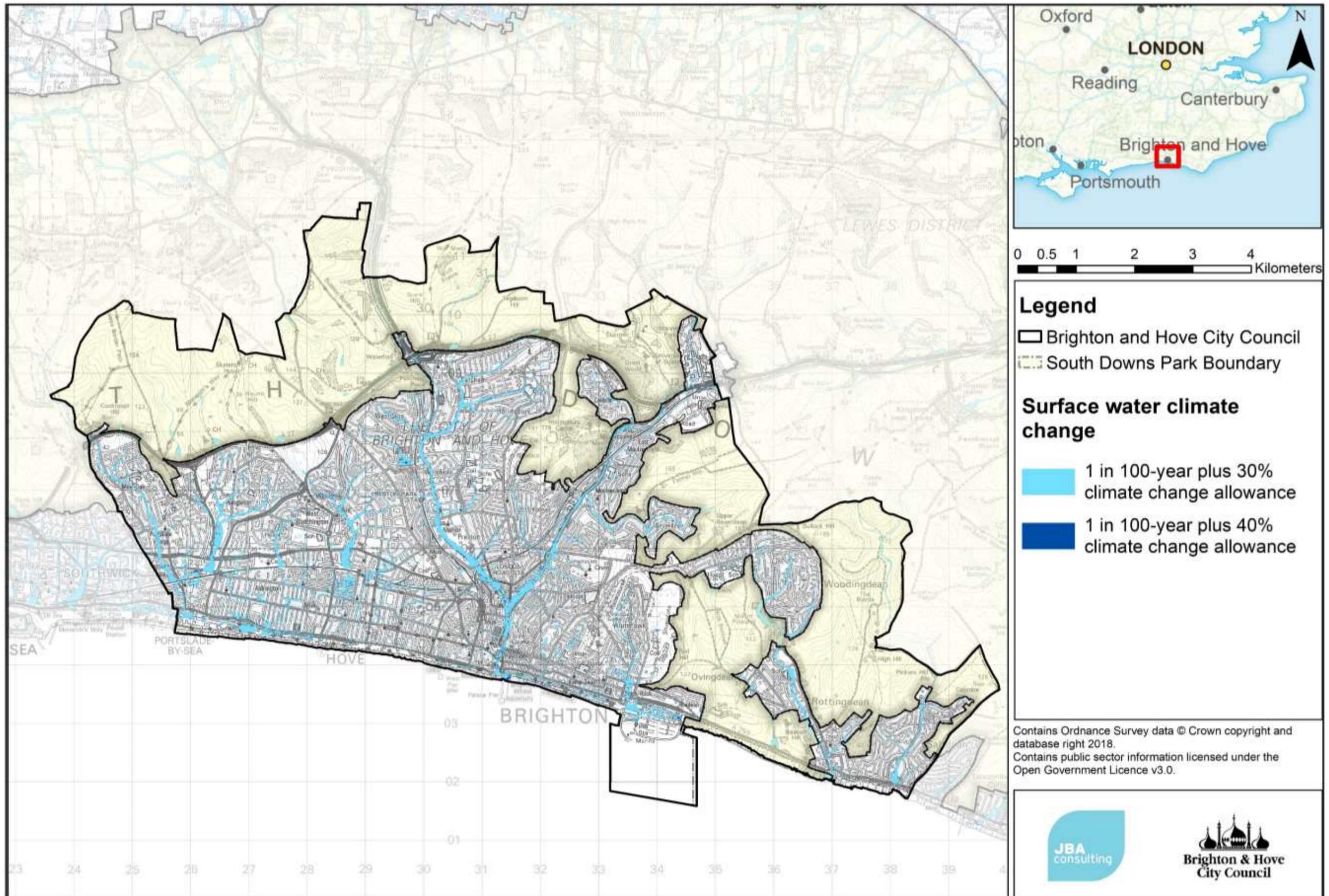
Brighton and Hove City Council require that all FRAs for developments consider as a minimum a 30% increase in peak rainfall intensity, and ideally a 40% increase in peak rainfall intensity.

Drainage and surface water attenuation schemes associated with developments will also need to consider a 30% increase in peak rainfall intensities as a minimum, and ideally a 40% increase in peak rainfall intensities.

Surface water flood risk mapping showing the extents of the 1% AEP plus 30% and 40% increases in peak rainfall has been prepared as part of the Level 1 SFRA. The surface water climate change mapping can be found in Figure 5-4. Further detailed maps can be found in Appendix B.2. High detail surface water climate change flood mapping can be requested from Brighton and Hove City Council for development sites using the following email address:

sustainable drainage@brighton-hove.gov.uk

Figure 5-4: Surface water climate change map



5.8 Surface Water Flood Zones

Surface Water Flood Zones have been introduced to the Brighton and Hove SFRA to define areas potentially at risk from surface water flooding. The aim of this is to provide for more strategic consideration of surface water flood risk in the land allocation and planning process and secure appropriate commitments that development will be safe for its intended lifetime and not have an adverse effect on third parties.

The urban land use, steep topography and lack of watercourses in Brighton and Hove make it particularly susceptible to surface water flooding. The Risk of Flooding from Surface Water (RoFSW) shows surface water risk is prevalent across Brighton and Hove, affecting 2.4 square kilometres of area during a 1% AEP event. Recorded incidents of actual surface water flooding show clusters of events in Preston Park, Patcham and Portslade.

For the purpose of establishing Surface Water Flood Zones the relative level of risk for high medium and low probability events is not easily defined primarily due to the fragmentation of responsibility for management, the differing standards used to design and maintain assets and the complexity of the mechanisms involved. It is a necessity to identify the areas that are potentially at risk and understand the parties responsible for management of the risk. Accordingly, a simpler approach has been taken based on the identification of surface water: 'Accumulation Areas' and 'Conveyance Areas' that describe the areas potentially at risk.

Surface Water Flood Zone a: Accumulation Zone

Surface Water Flood Zone a is defined as land affected by a high probability event (1% AEP). This event was selected to be representative of the flood risk areas in Brighton and Hove, have a reasonable chance of occurrence and to be consistent with the level of risk used for river Flood Zones.

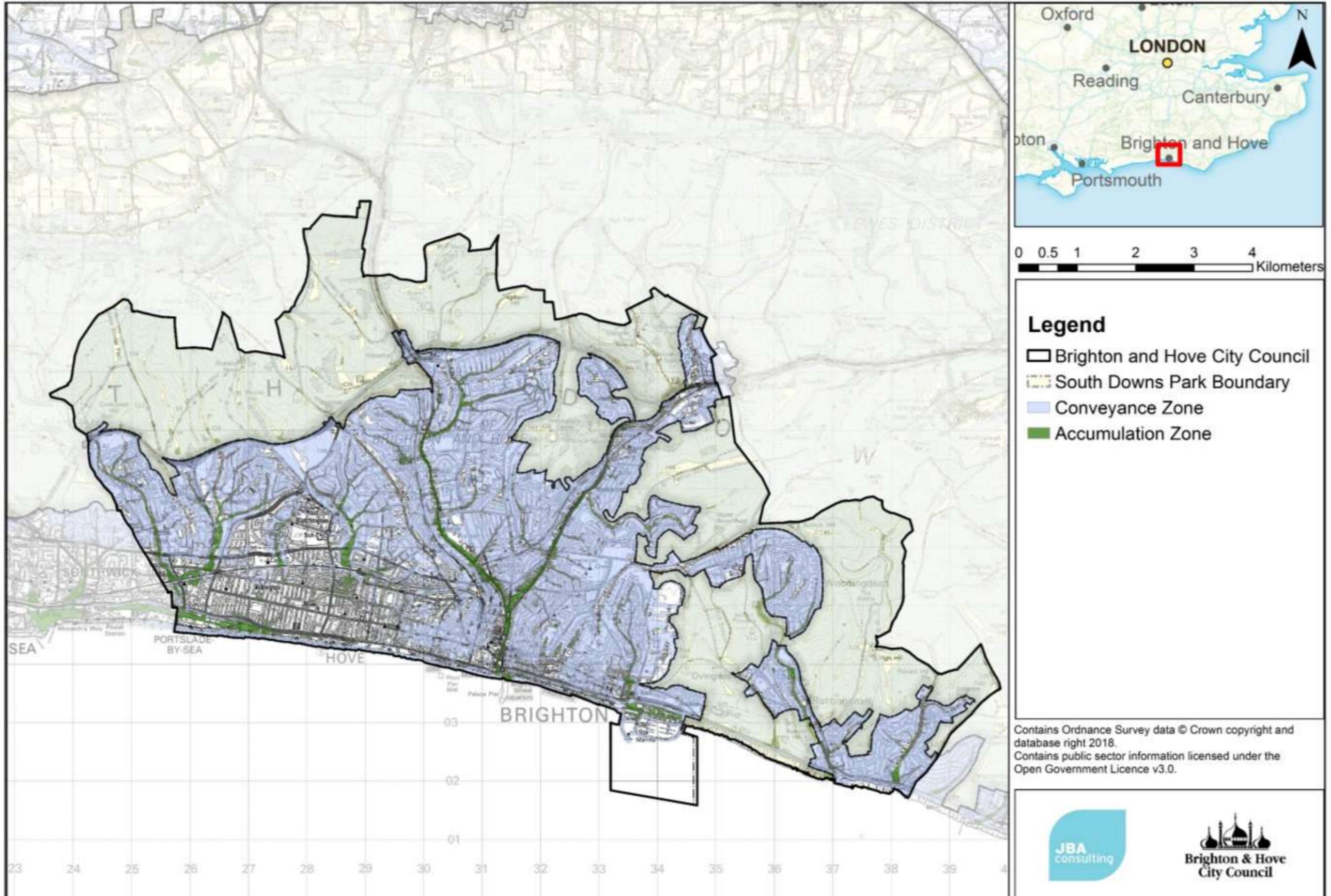
SWFZa is the risk extent not taking account of any existing measures to manage or control risk and as such defines the zone that could potentially be affected if no measures were in place. The extent of SWFZa in Brighton and Hove is shown in mapping in Figure 5-5.

Surface Water Flood Zone b: Conveyance Zone

The extent of SWFZb is based on the speed and depth with which surface water can flow over the ground surface and is to identify locations where the interruption or changing of flow direction could affect flood risk. It is defined by ground that has a gradient steeper than 1 in 20 (or gradient of 5%). The extent of SWFZb in Brighton and Hove is shown in mapping Figure 5-5.

The FRA requirements for development falling within SWFZa or SWFZb are different, in reflection of their risk profiles. Further details regarding SWFZs and FRA requirements can be found in Section 7.3.

Figure 5-5: Surface Water Flood Zones in Brighton and Hove



5.9 Groundwater flood risk

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

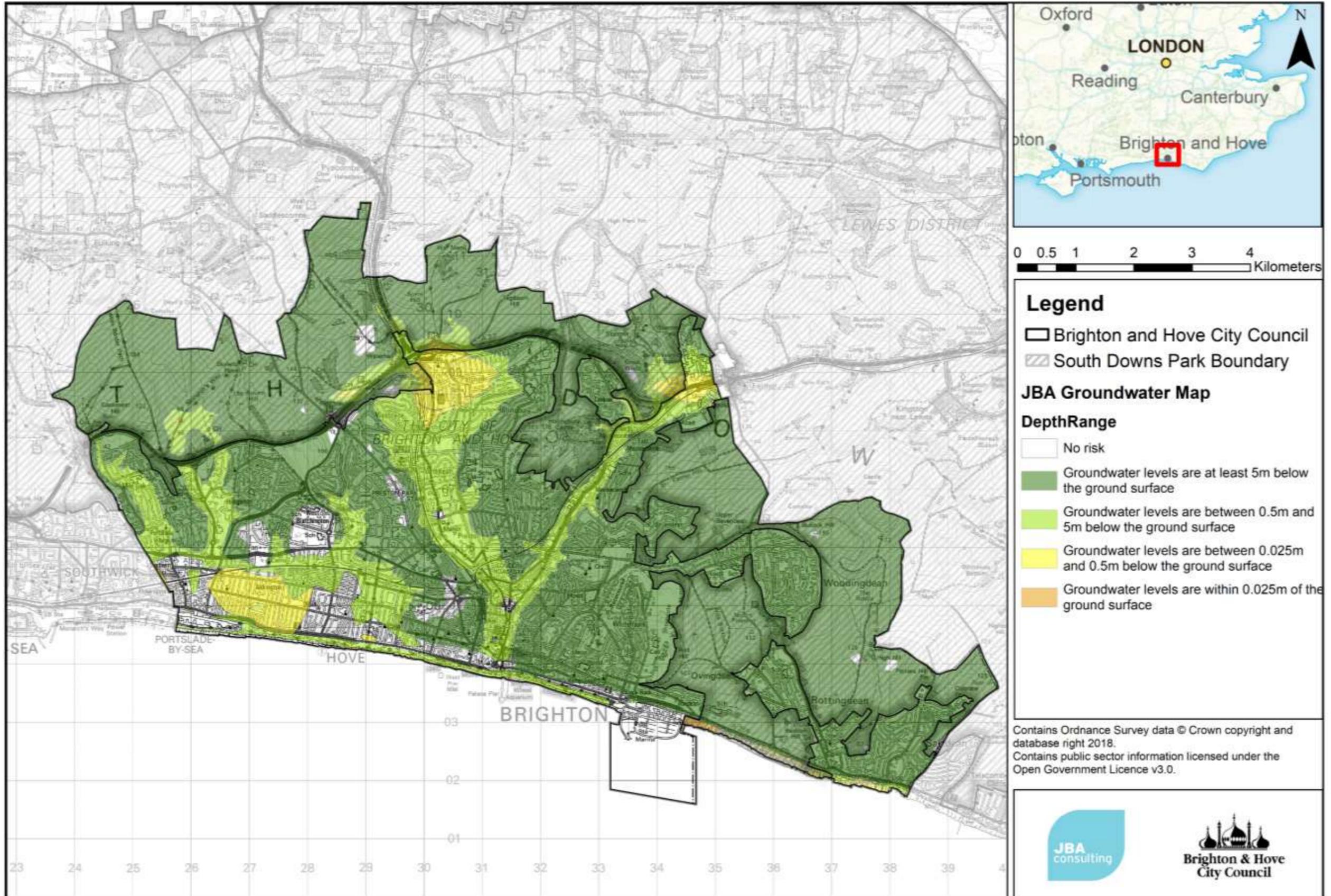
The geology within the administrative area of Brighton and Hove is very much dominated by chalk, with isolated pockets of clay, silt and sand lying in the south west of this area (Figure 1-3 and Figure 1-4). Due to the Brighton and Hove being situated on the south of the Chalk South Downs, there has been a history of groundwater flooding, the most notable and largest events occurring in 2000/01. This resulted in extensive flooding of the A23 which was closed for several days.

JBA has developed a range of Groundwater Flood Map products at national scale. The 5m resolution JBA Groundwater map can be found in Figure 5-6. The modelling involves simulating groundwater levels for a range of return periods (including 1.33% AEP, 1% AEP and 0.5% AEP). Groundwater levels are then compared to ground surface levels to determine the head difference in metres. The JBA Groundwater Map categorises the head difference (m) into five feature classes based on the 1% AEP model outputs. Detailed mapping of the groundwater flood risk within Brighton and Hove can be located within Appendix B.3.

It should be noted that the JBA Groundwater Flood Map is suitable for general broad-scale assessment of the groundwater flood hazard in an area, but is not explicitly designed for the assessment of flood hazard at the scale of a single property. In high risk areas a site-specific risk assessment for groundwater flooding is recommended to fully inform on the likelihood of flooding.

There are small areas along the coast in which groundwater levels are at very near (within 0.025m) of the ground surface. In areas of Aldrington, Patcham and Falmer, the groundwater levels are between 0.025m and 0.5m below the ground surface. London Road and Lewes Road form a Y-shape where the groundwater levels are between 0.5m and 5m below ground surface. Along much of the coastline and in areas of Portslade-by-Sea, Hangleton and Hove the groundwater levels are also between 0.5m and 5m below ground surface. The remainder of the authority area has groundwater levels which are at least 5m below ground surface or there is no risk.

Figure 5-6: JBA Groundwater Map



5.10 Sewer flood risk

Sewer flooding occurs when intense rainfall overloads the sewer system capacity (surface water, foul or combined), and/or when sewers cannot discharge properly to watercourses due to high water levels. Sewer flooding can also be caused when problems such as blockages, collapses or equipment failure occur in the sewerage system. Infiltration or entry of soil or groundwater into the sewer system via faults within the fabric of the sewerage system, is another cause of sewer flooding. Infiltration is often related to shallow groundwater, and may cause high flows for prolonged periods of time.

Since 1980, the Sewers for Adoption guidelines have meant that most new surface water sewers have been designed to have capacity for a 3.3% AEP rainfall event, although until recently this did not apply to smaller private systems. This means that, even where sewers are built to current specification, they are likely to be overwhelmed by larger events of the magnitude often considered when looking at river or surface water flooding. Existing sewers can also become overloaded as new development adds to the discharge to their catchment, or due to incremental increases in roofed and paved surfaces at the individual property scale (urban creep). Sewer flooding is therefore a problem that could occur in many locations across the study area.

In Brighton and Hove, storm water is generally drained by the sewer infrastructure, the system is at risk of becoming overloaded in storm conditions. The infrastructure is also at risk of becoming inundated with groundwater when groundwater levels rise.

Historical incidents of flooding are detailed by Southern Water in their Sewage Incident Report File (SIRF). This database records incidents of flooding relating to public foul, combined or surface water sewers and identifies which properties suffered flooding. For confidentiality reasons, this data has been supplied on a postcode basis. The information from the SIRF register is shown in Table 5-3.

The SIRF indicates a total of 84 recorded flood incidents in Brighton and Hove (excluding the South Downs National Park). The more frequently flooded postcodes are BN1 1 (10 incidents), BN1 8 (eight incidents), BN4 11 (eight incidents) and BN3 6 (seven incidents). It is important to recognise the SIRF does not contain information about properties and areas at risk of sewer flooding caused by operational issues such as blockages. Also, the SIRF represents a snap shot in time and will get outdated with properties being added to the register following rainfall events, whilst risk will be reduced in some locations by capital investment to increase the capacity of the network. As such the SIRF is not a comprehensive 'at risk register'.

Table 5-3: Southern Water SIRF data for Brighton and Hove (excluding the South Downs National Park)

Postcode	Recorded flood incidents	Postcode	Recorded flood incidents
BN1 1	10	BN2 6	4
BN1 2	1	BN3 1	1
BN1 5	5	BN3 2	6
BN1 6	3	BN3 3	1
BN1 7	1	BN3 4	5
BN1 8	8	BN3 5	5
BN2 0	1	BN3 6	7
BN2 1	1	BN3 7	3
BN2 3	1	BN3 8	1
BN2 4	5	BN4 11	8
BN2 5	1	BN4 12	6
Total: 84			
Note: Based on data supplied on 14/12/2017			

5.11 Reservoirs

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

There are no reservoirs storing water above normal ground level in Brighton and Hove or reservoir flood risk within the study area.

5.12 Canals and other artificial sources

There are no known canals or 'other' potential artificial sources of flooding in Brighton and Hove.

5.13 Summary of flood risk to each ward

A high-level review of the flood risk to each ward was undertaken. Table 5-4 summaries the flood risk to each ward in Brighton and Hove outside of the South Downs National Park authoritative area.

Table 5-4: Summary of flood risk to each ward in Brighton and Hove

Ward	Number of historic flood incidents	Tidal flood risk	Risk of Flooding from Surface Water (RoFfSW map)	Groundwater depths present within the ward (metres below ground surface)					Number of recorded sewer flood incidents on Southern Water's SIRF (outside South Downs National Park)
				No risk	>5m	0.5-5m	0.025-0.5m	>0.25	
Rottingdean Coastal Ward	22	Flood Zone mapping shows that the coastline is situated within Flood Zone 3b and the marina is situated in Flood Zone 2. The mainland is located in Flood Zone 1. Most of the ward is protected by a seawall at the foot of cliffs. A shingle beach offers protection to the mainland, however there remains a residual risk should the shingle beach be overtopped. This shingle beach mostly exists for amenity purposes.	Surface water mapping shows that the surface water flood risk is mostly confined to the main roads in Rottingdean Central Wards. Roads which are at particularly high risk are Saltdean Vale, Rottingdean High Street, Eley Drive, The Vale, Greenways, Marine Drive and Boundary Road. The Longhill High School/ Longhill Sport Centre grounds and roads located in the Brighton Marina are also shown to be at risk from surface water flooding.	✓	✓	✓	✓	✓	0
South Portslade Ward	114	Flood Zone mapping shows that areas in the far south of the ward are at risk of tidal flooding. These areas include the land surrounding Shoreham Harbour and Basin Road South. This area of land is located in Flood Zone 2, 3a and 3b. The buildings at risk of tidal flooding are used for industrial and commercial purposes. A number of defences lie along the coast including a beach ridge with concrete rubble armour and shingle, timber posts infilled with rough concrete, reinforced concrete walls, concrete apron, sheet piling and timber breastwork. A residual risk remains should these defences fail or be overtopped.	Surface water maps show that the surface water flood risk throughout South Portslade Ward is widespread. Surface water is likely to flow from Drove Road in the far north-west of the ward southwards through Windlesham Close and Shelldale Road towards the coast. The maps show that surface water pooling is likely to occur to the north of the railway line between Portslade and Fishersgate Stations and in the area of Links Road.	✓	✓	✓	✓		14
Hove Park Ward	7	Hove Park Ward is land locked and located in Flood Zone 1.	The area at greatest risk of surface water flooding is Hove Park itself which lies in a topographical low. Other roads at risk of surface water flooding include Goldstone Crescent, Woodland Drive, Tredcroft Road and Woodruff Avenue.	✓	✓	✓			5
North Portslade Ward	19	North Portslade Ward is land locked and located in Flood Zone 1.	Mapping shows that the main surface water flow path through North Portslade Ward is from the north of Mile Oak Road through Oakdene Gardens and Chalky Road and Southwards the Valley Road. Bush Farm Drive is also at risk of surface water flooding.	✓	✓	✓			0
Hangleton and Knoll Ward	23	Hangleton and Knoll Ward is land locked and located in Flood Zone 1.	Mapping shows that many of the roads throughout Hangleton and Knoll are at risk of surface water flooding. In particular, surface water flows along Hangleton Valley Drive and Dake View and pools in the south-west of the ward in the area of Hove Park School and Sainsburys.	✓	✓	✓	✓		4
Withdean Ward	66	Withdean Ward is land locked and located in Flood Zone 1.	Mapping shows that the main areas at risk of surface water flooding in Withdean Ward are Valley Drive and the commercial development along Tongdean Lane, Westdene Primary School, London Road and the railway track along Station Road.	✓	✓	✓	✓		7
Hollingdean and Stanmer Ward	15	Hollingdean and Stanmer Ward is land locked and located in Flood Zone 1.	Areas at risk of surface water flooding include Stamner Villas, Hollingdean Street and Upper Hollingdean Road, Coldean Lane, the railway track and areas of the University of Sussex campus.		✓	✓	✓		1

Ward	Number of historic flood incidents	Tidal flood risk	Risk of Flooding from Surface Water (RoFfSW map)	Groundwater depths present within the ward (metres below ground surface)					Number of recorded sewer flood incidents on Southern Water's SIRQ (outside South Downs National Park)
				No risk	>5m	0.5-5m	0.025-0.5m	>0.25	
Woodingdean Ward	20	Woodingdean Ward is land locked and located in Flood Zone 1	There are three major flow paths in Woodingdean Ward which all flow from the north-east of the ward to Falmer Road and into South Downs National Park. The northern most path is from Sandhurst Avenue through Falmer Gardens, the central path flows from Crescent Drive North through Lockwood Crescent. The southernmost flow path is from Truleigh Close through Ravenswood Drive.		✓				4
Moulsecoomb and Bevendean Ward	29	Moulsecoomb and Bevendean Ward is land locked and located in Flood Zone 1	The main surface water flow paths in Moulsecombe and Bevendean are along the Lewes Road and Heath Hill Avenue/Upper Bevendean Avenue.	✓	✓	✓	✓		5
Patcham Ward	83	Patcham Ward is land locked and located in Flood Zone 1	The surface water flood risk is widespread throughout the Patcham Ward. The areas which are at particularly high risk are Carden Avenue, Old London Road, areas of London Road and Mackie Avenue.		✓	✓	✓		8
Wish Ward	25	Flood Zone mapping shows that areas along the south of the ward are at risk of tidal flooding. Land along Shoreham Port, Wharf Road, Western Esplanade, Basin Road South and Western Lawns are located in Flood Zones 1, 2, 3a and 3b. The remainder of the ward is located in Flood Zone 1. A beach ridge within the Port consisting of concrete rubble armour with shingle, a rock revetment shingle beach and reinforced concrete wall offer protection. Outside the Port, shingle beach and seawall are the only line of defence. However, a residual risk remains should the defences overtop or breach.	The surface water flood risk throughout Wish Ward is very widespread. Most of the roads in the ward are either at low, medium or high risk of surface water flooding.	✓	✓	✓	✓		5
Goldsmid Ward	44	Goldsmid Ward is land locked and located in Flood Zone 1	The surface water flood risk throughout Goldsmid Ward is very widespread. Most of the roads and some buildings in the ward are either at low, medium or high risk of surface water flooding. Many of the roads and buildings in the Goldstone Street area are at a low to high risk of surface water flooding.	✓	✓	✓			2
Queen's Park Ward	23	Flood Zone mapping shows that the coastline is situated in Flood Zone 3b. The mainland is located in Flood Zone 1. A shingle beach and small concrete blockwork wall lie along the coastline and offer protection to the mainland. A residual risk remains should the defences be overtopped or fail.	Mapping shows that areas at particularly risk of surface water flooding in the ward are Marine Parade, Upper Bedford Street, Hendon Street Area, Stevenson Road, North Drive and Grand Parade.	✓	✓	✓		✓	2
St. Peter's and North Laine Ward	30	St. Peter's and North Laine Ward is land locked and located in Flood Zone 1.	The surface water flood risk is particularly high along London Road, Grande Parade and Lewes Road. Properties in the vicinity of these roads are also at risk of surface water flooding.	✓	✓	✓			3
Hanover and Elm	12	Hanover and Elm Grove Ward is land locked and	Lewes Road is at particularly high risk of surface water	✓	✓	✓			1

Ward	Number of historic flood incidents	Tidal flood risk	Risk of Flooding from Surface Water (RoFfSW map)	Groundwater depths present within the ward (metres below ground surface)					Number of recorded sewer flood incidents on Southern Water's SIRC (outside South Downs National Park)
				No risk	>5m	0.5-5m	0.025-0.5m	>0.25	
Grove Ward		therefore located in Flood Zone 1.	flooding, with surface water flow paths from Brighton Borough Cemetery, Harrington Road and Elm Grove.						
East Brighton Ward	21	Flood Zone mapping shows that the coastline is situated in Flood Zone 3b. The mainland is located in Flood Zone 1. A shingle beach offers protection to the mainland, however a residual risk remains should the shingle beach be overtopped.	The main areas at risk of surface water flooding in the ward are Whitehawk Road, Whitehawk Way and Marine Parade.	✓	✓	✓			2
Preston Park Ward	24	The ward is land locked and therefore located in Flood Zone 1	Mapping shows that Preston Park itself and London Road are at high risk of surface water flooding. Stanford Avenue also provides a flow path. The mapping shows that surface water pools in the Preston Circus area.	✓	✓	✓			1
Westbourne Ward	35	Flood Zone mapping shows that the coastline is situated in Flood Zone 3b. Part of Western Esplanade is located in Flood Zone 2. The remainder of Westbourne Ward is located in Flood Zone 1. A shingle beach and reinforces stepped seawall offer protection from tidal flooding, however a residual risk remains should these defences be overtopped or fail.	The surface water flood risk throughout Westbourne Ward is very widespread. Most of the roads in the ward are either at low, medium or high risk of surface water flooding. Areas at particularly high risk include the Kingsway, Langdale Gardens, Lawrence Road, Modena Road and Tamworth Road.	✓		✓	✓		3
Central Hove Ward	86	Flood Zone mapping shows that the coastline is situated in Flood Zone 3b. The mainland is located in Flood Zone 1. Mass concrete walls offer protection to the mainland; however a residual risk remains should the walls be overtopped or fail.	The surface water flood risk throughout Central Hove Ward is very widespread. Most of the roads in the ward are either at low, medium or high risk of surface water flooding. The risk of surface water flooding is particularly widespread in the Blatchington Road and Clarendon Villas area with many properties at risk.	✓		✓	✓	✓	9
Brunswick and Adelaide Ward	70	Flood Zone mapping shows that the coastline is situated in Flood Zone 3b. The mainland is located in Flood Zone 1. Mass concrete walls offer protection to the mainland; however a residual risk remains should the walls be overtopped or fail.	The surface water flood risk throughout Brunswick and Adelaide Ward is widespread. Most of the roads in the ward are at low or medium risk of surface water flooding	✓	✓	✓	✓	✓	1
Regency Ward	66	Flood Zone mapping shows that the coastline is situated in Flood Zone 3b. The mainland is located in Flood Zone 1. A shingle beach offers protection to the mainland. However, a residual risk remains should the defences be overtopped or fail.	The surface water flood risk throughout Regency Ward is fairly widespread. Many roads in the ward are at low risk of surface water flooding	✓	✓	✓	✓	✓	7

6 Coastal defences and surface water management

Preparation of the SFRA has included a high-level review of available information on flood defences and involved interrogation of existing evidence on defence condition and standards of protection. Details of the flood defence locations and condition were provided by Brighton and Hove City Council and the Environment Agency. The coastal and surface water defences and their locations are summarised in the sections below.

6.1 Coastal Defences in Brighton and Hove

Coastal defences along Brighton and Hove provide coastal protection and sea defence. Brighton and Hove seafront is protected by either cliffs or shingle beaches which run along the coastline and provide the main form of coastal defence.

The shingle beach is replenished twice a year and protects the coast from wave overtopping. Most of the shingle beaches are maintained by Brighton and Hove City Council, with a 160m stretch in the west maintained by the Shoreham Port Authority.

The **Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy Review** provides further details about the coastal defences in place westwards of Brighton Marina. The beaches to the west comprise shingle beaches which are controlled by a series of timber, masonry and concrete groynes. This area of coastline is constrained by seawalls and revetments.

Brighton Marina is protected by breakwaters which prevent open water waves propagating into the marina. The marina also benefits from an inner harbour wall and lock gates which prevent overflow. These flood defences are maintained by the Brighton Marina Company.

Brighton and Hove City Council have confirmed that the coastline to the east of the marina is protected by a near vertical reinforced concrete seawall. There are shingle beaches in places, which are used for amenity purposes only.

6.1.1 Defence condition and standard of protection

One of the principal aims of the SFRA is to outline the present risk of flooding Brighton and Hove including consideration of the effect of flood risk management. Both Environment Agency data and the Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy Review have been used to assess the flood defence condition and standard of protection.

Environment Agency

The Port Authority section of the shingle beach is given a rating based on a grading system for its condition. A summary of the grading system used by the Environment Agency for condition is provided in Table 6-1.

Table 6-1: Defence asset condition rating

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

Source: Condition Assessment Manual – Environment Agency 2006

The Port Authority section of the shingle beach is in fair condition, meaning that the shingle beach has defects which could reduce the performance.

The standard of protection of the defence should also be considered.

Standard of Protection

Flood defences are designed to give a specific standard of protection, reducing the risk of flooding to people and property in flood prone areas. For example, a flood defence with a 1% AEP (present day) standard of protection means that the flood risk in the defended area is reduced to a 1% chance of flooding in any given year.

Although flood defences are designed to a standard or protection it should be noted that, over time, the actual standard of protection provided by the defence may decrease, for example due to deterioration in condition or increases in flood risk due to climate change

The Environment Agency data indicates that this area of shingle beach has a standard of protection against a 1% AEP flood event.

[Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy Review](#)

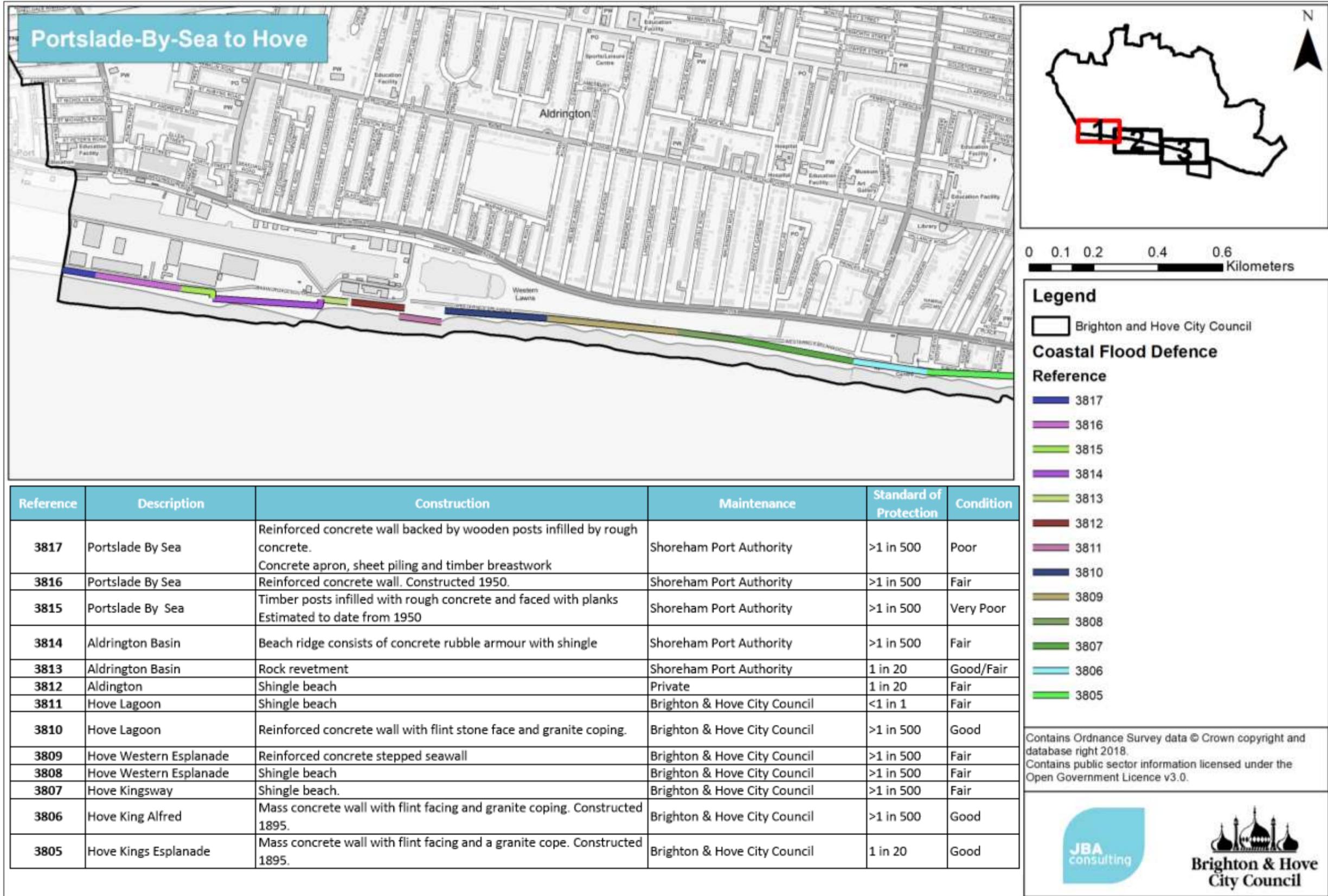
Figure 6-1, Figure 6-2, and Figure 6-3 provide a summary of the defence type, responsible authority for maintenance, standard of flood protection and condition along the coast to the west of the marina. Here the Brighton and Hove coastline has been subdivided into the three areas of:

- Portslade-By-Sea to Hove
- Hove to Brighton Pier
- Brighton Pier to Brighton Marina

The table is based on information provided by Appendix H of the 2014 Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy Review. This is the most up to date information available.

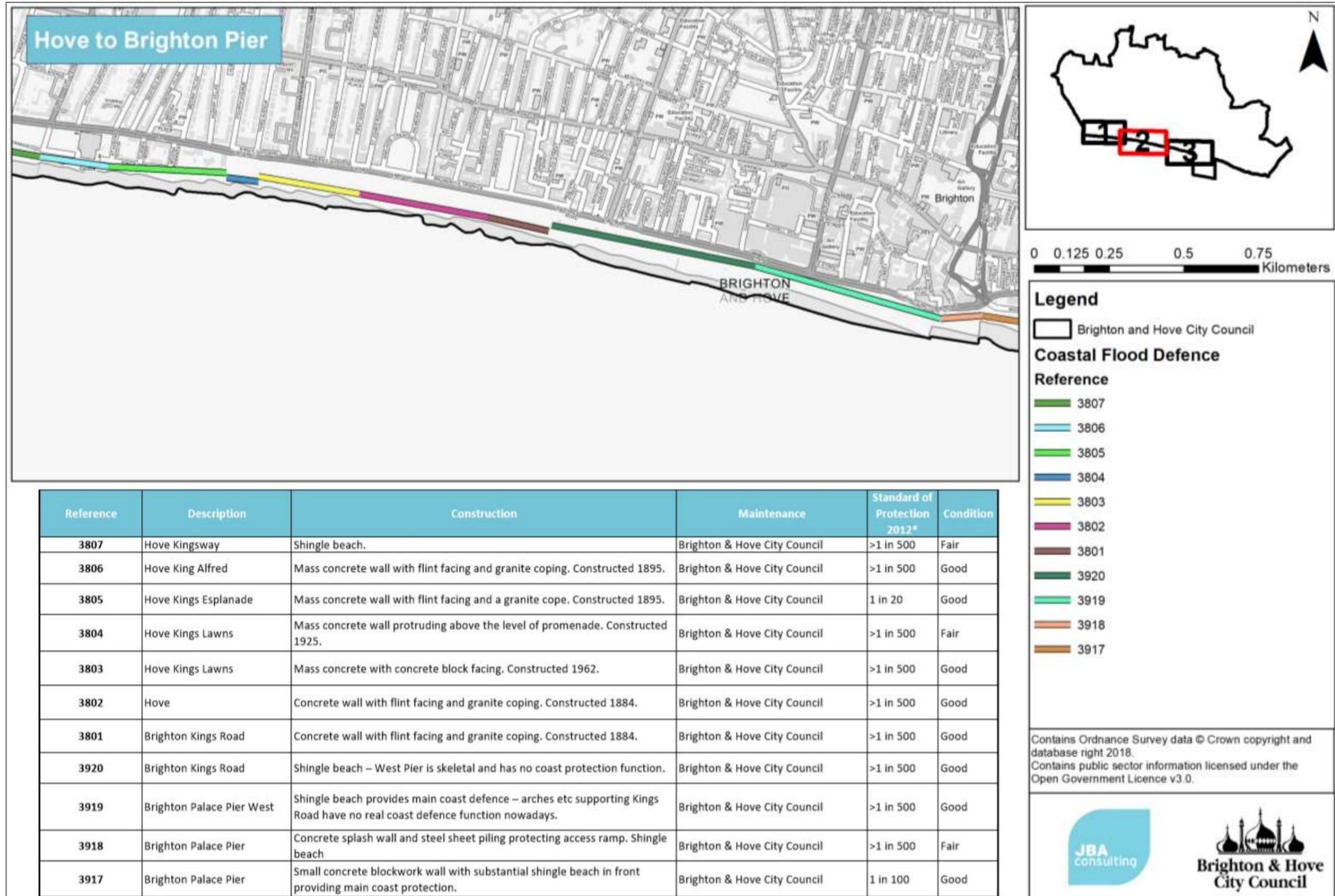
As the coastline eastwards of Brighton Marina is protected by cliffs, it is unlikely that tidal flooding will occur.

Figure 6-1: Summary of flood defence structures located along Hove to Portslade-By-Sea



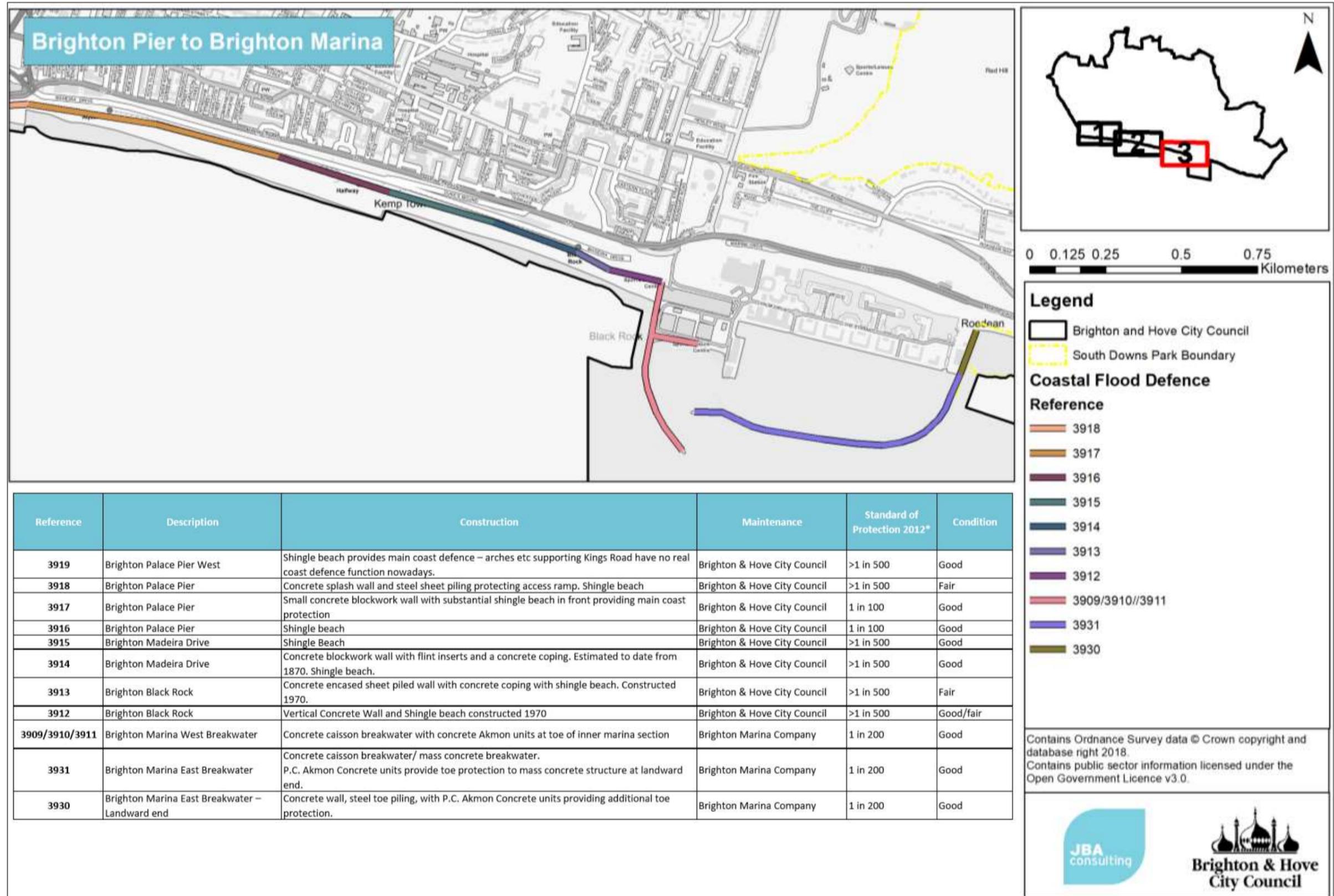
*The Standard of Defence has been calculated in accordance with methods set out in EurOtop: Wave Overtopping of Sea Defences and Related Structures: Assessment Manual (2007). The quoted Standard of Defence is based on the year 2012. It should be noted that this standard of defence will reduce during the life of the structure due to the effects of climate change

Figure 6-2: Summary of flood defence structures located along Brighton Pier to Hove



*The Standard of Defence has been calculated in accordance with methods set out in EurOtop: Wave Overtopping of Sea Defences and Related Structures: Assessment Manual (2007). The quoted Standard of Defence is based on the year 2012. It should be noted that this standard of defence will reduce during the life of the structure due to the effects of climate change

Figure 6-3: Summary of flood defence structures located along Brighton Marina to Brighton Pier



*The Standard of Defence has been calculated in accordance with methods set out in EurOtop: Wave Overtopping of Sea Defences and Related Structures: Assessment Manual (2007). The quoted Standard of Defence is based on the year 2012. It should be noted that this standard of defence will reduce during the life of the structure due to the effects of climate change.

6.1.2 Shoreham Port Lock Gates

Although located in the Adur District, consideration has been given to the standard of protection afforded by Shoreham Port Lock Gates. Within the analyses performed in the 2012 Arun to Adur East Sussex Coastal modelling study, it has been assumed that the Shoreham Port Lock Gates were closed for both the defended and undefended scenario as they were considered part of the infrastructure rather than defences. The gates were represented as a defence line with a crest of 3.63m AOD. The modelling results predict that the gates would be overtopped in the defended and undefended scenarios for the 5%, 0.5% and 0.1% AEP events.

6.1.3 Areas Benefiting from defences

The Environment Agency has a dataset called “Areas Benefiting from Defences”. This dataset for England shows those areas that benefit from the presence of defences in a 1% AEP chance of flooding each year from rivers; or 0.5 % AEP chance of flooding each year from the sea. No areas in Brighton and Hove are identified by the Environment Agency to benefit from flood defences. It is important to note that the Environment Agency “Areas Benefiting from Defences” does not show all areas that benefit from defences.

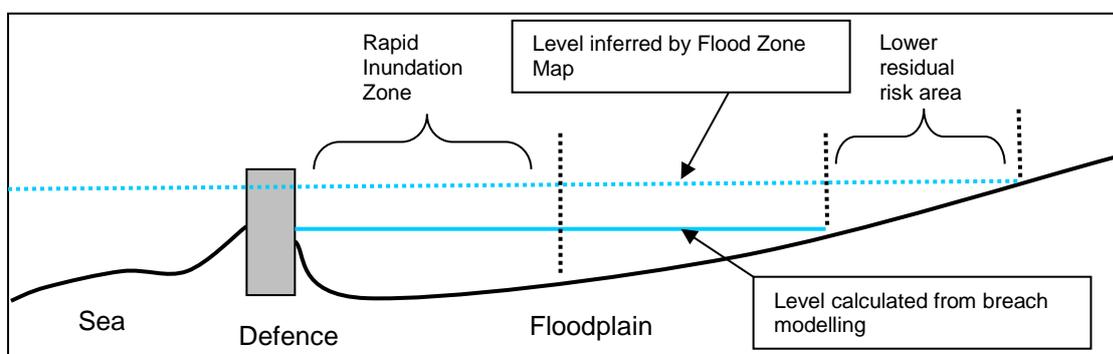
6.1.4 Tidal Residual risk

‘Residual risk’ is defined as the flood risk remaining with flood mitigation measures in place. The land behind the defences is only at risk of flooding through failure or overtopping of the defences.

6.1.5 Failure of flood defences

Flood Zones represent the undefended situation and therefore highlight whether there would be a residual risk from failure of a defence. Based on Flood Zone 3a, the areas shown to be at risk of a failure of the defences level are Brighton Marina and Portslade South.

Figure 6-4 Illustration of residual risk associated with defence failure

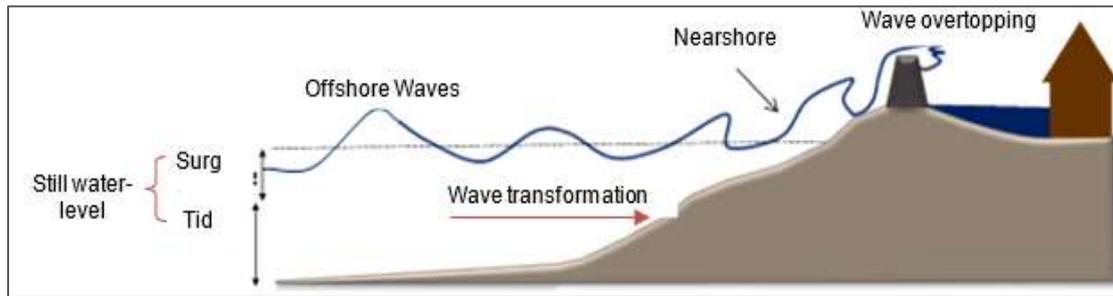


The impact of a failure in the defences has not been modelled as part of this SFRA. It is recommended that this be **fully assessed** as part of an FRA for any future development proposals.

6.1.6 Wave Overtopping

Tidal flooding along much of the south coast is characterised by the presence of risk associated with wave overtopping. In exposed locations along the coast, landward flooding is more likely to occur as a consequence of wave overtopping than inundation. Wave overtopping is a term, which encompasses a number of complex physical processes, which result in the transfer of water from the sea onto the coastal floodplain. The amount of wave overtopping that occurs during an extreme event is dependent on the local water depth, the properties of incoming waves and the geometry of local flood defences. Figure 6-5 outlines the process of wave overtopping in relation to the Extreme Still Water Sea-level.

Figure 6-5: Illustration of residual risk associated with wave overtopping



Wave overtopping is one of the principal mechanisms of flooding for the coastal frontage. The Shoreham Harbour and Adur to Arun studies undertook modelling to show the affect of wave-overtopping. The effect of wave overtopping has been included in the Flood Zone delineation. However, wave overtopping is of material concern to the coastal frontage of Brighton and Hove, therefore any **future development proposal should be accompanied by a flood risk assessment**, which appropriately considers the effects of wave overtopping.

6.1.7 Future coastal defence management

The condition of existing flood defences and whether they will continue to be maintained and/or improved in the future is an issue that needs to be considered as part of the risk based sequential approach and, in light of this, whether possible site options for development are appropriate and sustainable. The Beachy Head to Selsey Bill Shoreline Management Plan (2006) and Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy Review (2014) provide further details about the future of the coastline.

Beachy Head to Selsey Bill Shoreline Management Plan (2006)

The 2006 **Beachy Head to Selsey Bill Shoreline Management Plan** 'Hold the Line'

The following policies are outlined for the study area:

- **Unit 10 - Saltdean to Rottingdean** - Hold Cliff Base is the Present and medium-term policy choice and for Long term policy monitor, manage and review.
- **Unit 11 - Rottingdean to Brighton Marina** - Present and medium-term preferred policy plan is to Hold Cliff Base. Long term policy plan on the other hand is to monitor, manage and review.
- **Unit 12 - Brighton Marina to Portslade-by Sea** - Present, medium and long-term policy is to hold the line.

Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy Review (2014)

The 2014 **Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy Review** provides a implementation plan for the management of the coastline from Brighton Marina to the River Adur for the next 100 years.

The strategy divides the coastline into three zones:

- Unit 1 - Shoreham locked section (partially within the Brighton and Hove City Council authority area)
- Unit 2 - The open coast
- Unit 3 - Brighton Marina

Along the Brighton Marina to River Adur coastline, under a 'No Active Intervention' scenario, it has been predicted that 22 residential and 167 commercial properties would be lost to erosion within the first 20 years; increasing to 260 residential and 266 commercial properties by Year 100

Therefore, the preferred option is to improve the defences along Unit 1 and 2 and sustain Unit 3. These recommendations are in agreement with the preferred 'Hold the Line' policy outlined in the SMP.

The strategy states that in the short-term, capital schemes are required along the coast at Southwick Beach to Portslade, Western Esplanade, Hove Deep Sea Anglers' Buildings, Kings Esplanade and Lower Promenade to reduce the risk of erosion and flooding due to wave overtopping.

The strategy proposes that the standard of flood protection should be against a 0.5% AEP event in the future.

The Brighton Marina Company has undertaken a review on the impacts of climate change and has a maintenance programme to provide long term viability.

Flood Risk Assessment considerations

Flood Risk Assessments (FRAs) will need to thoroughly explore the condition of defences, especially where any defences are informal and demonstrate a wide variation of condition grades. It is important that all of these assets are maintained to a good condition and their function remains unimpaired.

6.2 Surface water management assets in Brighton and Hove

Details of the number of Brighton and Hove City Council owned surface water flood assets have been provided by the council with further details taken from the **2014 Brighton and Hove Surface Water Management Plan**. These are outlined below.

6.2.1 Bevendean Dams

Three adjoining dams lie to the north east of Bevendean which retain surface water. Each dam storage area has a soakaway and two ditches to the north of Bodiam Close flow into the lower dam. The outfall is into the highway drainage in Bodiam Close.

In 2000 heavy rainfall caused a large amount of flooding and damage in Bevendean. Therefore, in 2001, the existing dams were substantially enlarged and a new piped overflow system to regulate flows was installed.

The 2014 SWMP stated that flooding in this area could be further exacerbated by poor maintenance of the existing flood defence structures. The 2013 Flood Defence Asset Inspection highlighted that this structure was in need of maintenance.

In addition, there are number of soakaways in the area and several gullies on the roads to provide a flow path in the event of the dams overtopping.

This is one of three assets protecting Bevendean.

6.2.2 Kenilworth Ditch

An embankment and ditch lie in the field above and close to the north of Kenilworth Close. The ditch helps alleviate the flood risk to Bevendean. The 2014 SWMP states that the bank has been breached by a footpath in one location. In 2014 the vegetation was thinned and fly tipping was removed.

This is one of three assets protecting Bevendean.

6.2.3 Walmer Crescent

An open channel and embankment is located a behind properties 28 -34 Walmer Crescent. In 2014, vegetation was thinned and fly tipping was removed. In addition, a vacant plot between 32 and 34 Walmer Crescent may hold a soakaway.

This is one of three assets protecting Bevendean.

6.2.4 Bulstrode Farm

In 2000, it was reported that homes were affected by runoff from the council owned farm. The farmer subsequently built and improved a dam made from chalk to the east of Ovingdean Farm, to the north of Ovingdean Road.

The earth bund is constructed from chalk and is approximately 1.3m high and 50 metres long. In 2003 it was reported that the structure was in good condition but had damage in one location. The embankment was overgrown and needed maintenance.

6.2.5 Longhill School

A ditch runs along Falmer Road, Ovingdean with a total of 12-13 soakaways. A site visit in 2014 indicated that the ditch was overgrown and that clearance would be required.

6.2.6 Millcroft

Millcroft benefits from a dew pond which lies to the rear of properties 57-65 Millcroft and 103 Green Ridge. There is also a small bund (approximately 140m) running along the curtilage of these properties to assist in the storage of runoff. In 2014, vegetation clearance was carried out to the embankment.

6.2.7 Mile Oak

2014 SWMP states that the Mile Oak area relies upon soakaways to manage surface water with a number of large super gullies discharging to a combined sewer. The Highway Services department stated that soakaways in the area were repaired in April 2012.

Embankments lie to the north of Mile Oak Farm and clearance of the vegetation on the first two embankments took place in 2014.

6.2.8 New Barn Valley

A series of embankments lie along New Barn Valley, with a soakaway which is situated to the east of Falmer Road. Maintenance was carried out in December 2013 which involved the thinning of vegetation on the embankment. In 2014 the soakaway appeared to be in working order, with several burrows observed in several of the dams.

6.2.9 Wheatfield Way

A drainage ditch runs parallel and above Wheatfield Way in a field to the east which is approximately 205m in length. In 2014, vegetation was thinned and fly tipping was removed.

6.2.10 Wolseley Road

There were reports of surface water runoff from the hills causing ponding outside 73 & 74 Wolseley Road during the extreme rainfall events in February 2013.

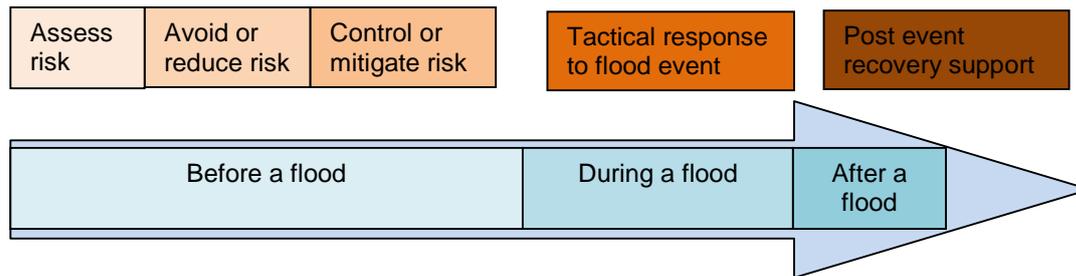
In 2014, site inspections showed that a small non-engineered embankment was located opposite No 73 to 80 Wolseley Road. In 2016 further works to the asset were carried out. The 2016 site inspection shows that an engineered flood defence clay bund was observed, with the inclusion of six soakaways. A spillway was also included in the mid-point of the crest which is represented with a concrete collar.

7 FRA requirements and flood risk management guidance

7.1 Using SFRA risk information

The SFRA contains information that can be used at strategic, operational and tactical levels as shown in Figure 7-1. The flood risk data contained within this SFRA should be updated following flood events.

Figure 7-1: Use of SFRA information



7.2 Over-arching flood risk assessment principles

This SFRA focuses on delivering a strategic assessment of flood risk within Brighton and Hove. Due to the strategic scope of the study, prior to any construction or development, site-specific assessments will need to be undertaken for individual development proposals (where required) so all forms of flood risk at a site are fully addressed. It is the responsibility of the developer to provide an FRA with an application.

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

7.3 Requirements for flood risk assessment

7.3.1 What are site specific FRAs?

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

7.3.2 When are site specific FRAs required?

The council should require that all development, including changes of use, have at least an initial assessment of flood risk using this SFRA. There should be a requirement for a detailed site-specific flood risk assessment to be submitted with planning applications for:

- Proposals of 1 hectare or greater in Flood Zone 1.
- Proposals for new development (including minor development and change of use) in Flood Zones 2 and 3.
- Proposals for new development (including minor development and change of use) in an area within Flood Zone 1 and located with Surface Water Flood Zone a or b (Figure 5-5).
- Where proposed development or a change of use, regardless of Flood Zone or size, where flood risk from other sources (surface water, sewer, groundwater) is identified by the SFRA.

An FRA may also be required for some specific situations:

- If the site may be at risk from the breach of a local defence (even if the site is actually in Flood Zone 1)

- Where the site is intended to discharge to the catchment or assets of a water management authority which requires a site-specific FRA
- Where evidence of historical or recent flood events have been passed to the LPA

7.3.3 Objectives

Flood risk assessments should identify and assess the risks of all forms of flooding to and from the development and demonstrate how these flood risks will be managed, taking climate change into account.

Generally an FRA should demonstrate:

- whether any proposed development is likely to be affected by current or future flooding from any source;
- that the development is safe and where possible reduces flood risk overall to the LPAs satisfaction;
- whether it will increase flood risk elsewhere; and
- the measures proposed to deal with these effects and risks. Any necessary flood risk management measures should be sufficiently funded to ensure that the site can be developed and occupied safely throughout its proposed lifetime.

FRAs for sites located in Brighton and Hove City Council's authoritative area should follow the approach recommended by the Environment Agency. Guidance and advice for developers on the preparation of the site specific FRAs include:

- **Standing Advice on Flood Risk (Environment Agency)**
- **Flood Risk Assessment for Planning Applications (Environment Agency)**
- **Site-specific Flood Risk Assessment: CHECKLIST (NPPG, Defra)**

7.4 For Brighton and Hove City Council

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

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

As discussed in Section 3.3, five of the 2018 Level 2 SFRA sites satisfied the Sequential Test, and the Exception Test, during the preparation of City Plan Part 1. It is recommended that Brighton and Hove City Council confirm that the conclusions of the Sequential and Exception Test are still valid based on the evidence in this document. Five of the 2018 Level 2 SFRA sites were not considered in City Plan Part 1 Sequential and Exception Test. It is recommended that a Sequential Test (and if necessary an Exception Test) are prepared for these sites.

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

7.4.1 Surface water runoff

The use of Sustainable Drainage Systems (SuDS) should be required on all new developments. It is understood that a detailed development management policy on SuDs will be included in the draft City Plan Part 2. Reference should be made to the Brighton and Hove City Council's emerging SuDS Supplementary Planning Document (SPD).

7.4.2 Surface water flooding

There is a history and recognised risk of surface water flooding in Brighton and Hove (Section 5.6)

Therefore, the council require a flood risk assessment for all development or change of use, within a Surface Water Flood Risk Zone. The FRA requirements for development falling within SWFZa or SWFZb are different, in reflection of their risk profiles. The guidance for developers for each SWFZ is outlined below:

Surface Water Flood Zone a: Accumulation Zone

This area is at risk of surface water flooding in a 1% AEP rainfall event and here runoff can be expected to pond. For this reason, the development of basement dwellings is not normally permitted in SWFZa.

For all other development, an FRA is required to demonstrate that the proposal will be safe from surface water flooding for its lifetime and does not increase flood risk elsewhere. FRA requirements include:

- Assessment of flood risk from all sources.
- Consideration of the 1% AEP plus 30% uplift for climate change flow paths across the site and how the proposed development may alter these. Overland flow modelling may be required to demonstrate this.
- Demonstration that ground floor levels should be a minimum of whichever is higher of:
 - 300 mm above the general ground level of the site
 - 600mm above the estimated surface water level in the 1% AEP event with drainage plus 30% uplift to account for climate change
- Consideration of other surface water flood resilience measures.

The 1% AEP plus 30% climate change flood level has been calculated as part of this SFRA. The information is mapped in the SFRA but may not provide sufficient information to inform the floor level assessment. It is recommended that the applicant contact Brighton and Hove City Council to request detailed flood levels specific to their site. Requests should be emailed to sustainable drainage@brighton-hove.gov.uk.

Surface Water Flood Zone b: Conveyance Zone

This area is steeply sloping, so in a rainfall event, runoff can be expected to flow over impermeable areas within SWFZb. In Brighton and Hove, even small changes to the topography can influence flow paths. This can result in changing surface flood risk on and off the site. Generally, in the conveyance zone flood depths are low. Therefore, all types of development could be compatible in SWFZb, providing the FRA can demonstrate that the proposal will be safe from flooding for its lifetime and does not increase flood risk elsewhere. FRA requirements include:

- Assessment of flood risk from all sources.
- Consideration of the 1% AEP plus 30% uplift for climate change flow paths across the site and how the proposed development may alter these. Overland flow modelling may be required to demonstrate this.
- Consideration of surface water flood resilience measures.

7.4.3 Groundwater flooding

Situated on the South Downs the underlying geology of Brighton and Hove is predominantly chalk. Consequently, there is a history and recognised risk of groundwater flooding (Section 5.95.7).

It is recommended that the council require a flood risk assessment for all development or change of use, regardless of Flood Zone or size, where flood risk from groundwater is identified by the SFRA. The FRA should clearly state the degree of risk and how the risk to the development will be mitigated.

The council should ensure that any subterranean development proposals prove there is no risk from groundwater or other sources of flooding and should prove that groundwater flow paths are preserved so as not to increase the flood risk elsewhere. The design of any new subterranean development should ensure that flood risk is not increased for existing adjacent subterranean developments by changes to groundwater flow paths.

7.4.4 Failure of defences

The Brighton and Hove seafront is heavily protected by a series of coastal defences. Although their standard of protection is high, there remains a residual risk in the incidence of failure.

Where flood risk exists from failure of defences, all development proposals should be required to demonstrate that:

- The council's emergency planners have been consulted on the proposals.
- The emergency services have been consulted on the proposals.
- A robust emergency/evacuation plan has been developed and communicated.
- The development would be structurally safe against the effects of breach flood waters.
- 'Safe' access including the ability to escape to higher levels without having to pass through flood waters has been appropriately allowed for.

7.4.5 Wave overtopping

Wave overtopping is a significant risk along the south coast. Wave overtopping is one of the principal mechanisms of flooding for the coastal frontage (Section 6.1.6). Wave overtopping will be considered in this SFRA update within the assessment of actual risk or residual risk, not within the Flood Zone delineation. This approach balances the predominance of redevelopment and regeneration in the coastal frontage of the study area with the need to consider flood risk from all sources. Allowing for wave-overtopping increases the extent of flooding. In some instances, this can mean the defended 0.5% AEP outline with the effect of wave overtopping would be larger than Flood Zone 3a. Therefore, any future development proposal along the coastal frontage should be required to thoroughly consider the effects of wave overtopping through detailed hydraulic modelling.

Where flood risk exists from wave overtopping, all development proposals should be required to demonstrate that:

- The council's emergency planners have been consulted on the proposals.
- The emergency services have been consulted on the proposals.
- A robust emergency/evacuation plan has been developed and communicated.
- The residual risk can be appropriately mitigated.
- The development would be structurally safe.
- 'Safe' access including the ability to escape to higher levels without having to pass through flood waters has been appropriately allowed for.

7.4.6 Functional Floodplain

For the purposes of this SFRA the Functional Floodplain throughout Brighton and Hove has been defined using that outlined in the previous SFRA (predominantly Flood Zone 3 but taking account of defences) across the area except around Shoreham Harbour where the defended 5% AEP outline from the recent modelling study was used (Section 5.4).

This definition should be used when considering whether future development proposals are commensurate with the type of flood risk. If the question of functionality arises then it will be the responsibility of the developer to challenge this designation through detailed hydraulic modelling.

7.5 For Developers

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

In general, all future developments should demonstrate:

- That the probability and consequences of flooding will be reduced.
- How actual and residual flood risk to the development and flood risk to others from all sources will be managed over the lifetime of the development, taking into account climate change.
- That development will be safe through the layout, form and floor levels of the development and mitigation measures.
- That surface water runoff is being managed.

A development will have certain requirements to fulfil, dependent upon which Flood Zone it is located within.

The following subsections contain information to assist developers where flood risk to and from a development is identified.

7.5.1 Managing surface water runoff

Standard SuDS techniques should be used on all new developments to control the surface water runoff from the site. Reference should be made to the Brighton and Hove City Council's emerging SuDS Supplementary Planning Document.

7.5.2 Managing flood risk from foul sewer flooding

There should not be the presumption that the existing sewer drainage network has enough capacity to accommodate the flows from all new developments. Consultation with Southern Water should be undertaken prior to development commencing.

Where there is an evidenced history of foul sewer flooding in an area resilience measures e.g. non-return valves should be considered in development design.

7.5.3 Managing flood risk from surface water flooding

Where a site is located with a Surface Water Flood Zone, a detailed flood risk assessment should be completed as per Section 7.4.2.

Brighton and Hove City Council require that all FRAs for developments consider as a minimum a 30% increase in peak rainfall intensity, and ideally a 40% increase in peak rainfall intensity.

Surface water flood risk mapping showing the extents of the 30% and 40% increases in peak rainfall has been prepared as part of the Level 1 SFRA. The surface water climate change mapping can be found in Figure 5-4. Further detailed maps can be found in Appendix B.2. High detail surface water climate change flood mapping can be requested from Brighton and Hove City Council for development sites using the following email address:

sustainable Drainage@brighton-hove.gov.uk

The design and layout of the development should be such that the risk is reduced. Where risk remains, the likely flow routes and depths across the site should be modelled. The site should be designed so that these flow routes are maintained and building design should provide resilience against the risk of surface water flooding.

Developments should seek to reduce surface water flood risk downstream by capturing the rainwater, particularly in areas situated within the Surface Water Flood Zones. Once captured this water should either be:

- Re-used for a range of purposes, such as toilet flushing and garden watering; or
- Infiltrated back to the ground. The permeable nature of the underlying chalk means infiltration is possible however consideration will need to be given to the EAs groundwater source protection zones as restrictions on infiltration may apply.

Managing this flood risk should be informed by the **Brighton and Hove SWMP** and consultation should be had with the Council to ensure any management options are in line with the SWMP Action Plan. FRAs prepared for SWFZs should include evidence that all parties responsible for managing surface water flood risk make a commitment to put in place measures so that development is safe for its intended lifetime and does not adversely affect third parties (it is accepted that the management of this risk might not be the responsibility of the applicant).

7.5.4 Managing flood risk from groundwater flooding

Groundwater flooding has a very different flood mechanism to any other. As it rises up from below ground level, many conventional flood defence and mitigation methods are not suitable. The only way to fully reduce flood risk would be through building design, ensuring that buildings are watertight and there is no use of basements. Site design would also need to preserve any flow routes followed by the groundwater overland and make sure flood risk is not increased downstream. The design of any new basements should ensure that flood risk is not increased for existing adjacent basements or properties by changes to groundwater flow patterns.

Where subterranean development is proposed the developer will need to ensure there is no risk from groundwater (or other sources of flooding). The development will also need to ensure no underground groundwater flow paths are impeded, so as not to increase the flood risk elsewhere. The design of any new subterranean development should ensure that flood risk is not increased for existing adjacent subterranean developments by changes to groundwater flow.

When redeveloping existing buildings, it may be acceptable to install pumps in basements as a resilience measure. However, for new development this is unlikely to be considered an acceptable solution.

7.6 Reducing flood risk through site layout and design

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development. Most large development proposals include a variety of land uses of varying vulnerability to flooding.

The NPPF states that a sequential, risk-based approach should be applied to try to locate more vulnerable land use to higher ground, while more flood-compatible development (e.g. parking, recreational space) can be located in more high risk areas.

Areas along known surface water flow routes can be used for recreation, amenity and environmental purposes, allowing the preservation of flow routes and flood storage, and at the same time providing valuable social and environmental benefits contributing to other sustainability objectives.

Landscaping should ensure safe access to higher ground from these areas, and avoid the creation of isolated islands as water levels rise.

7.6.1 Raising floor levels

The raising of internal floor levels within a development avoids damage occurring to the interior, furnishings and electrics in times of flood.

If it has been agreed with the Environment Agency that, in a particular instance, the raising of floor levels is acceptable, finished floor levels should be set to whichever is higher of the following:

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

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

The additional height that the floor level is raised above the maximum water level is referred to as the “freeboard”. Additional freeboard may be required because of risks relating to blockages to the channel, culvert or bridge and should be considered as part of an FRA.

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

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

Similarly, the use of basements should be avoided. Habitable uses of basements within Flood Zone 3 should not be permitted, whilst basement dwellings in Flood Zone 2 will be required to pass the Exception Test.

Ideally, access should be situated 300mm above the design flood level and waterproof construction techniques used. If safe access and egress cannot be achieved, the Defra/EA Technical Report: FD2320: Flood Risk Assessment Guidance for New Development, should be referred to, to determine the hazard to people posed along the access route. This can also be used to inform a Flood Response Plan for the site

In areas at risk of surface water flooding this approach could also be adopted to limit the consequence of flooding. Reference should be made to Section 7.4.2 for those development sites in Surface Water Flood Zone a or b (Figure 5-5).

7.6.2 Development and raised defences

Construction of localised raised floodwalls or embankments to protect new development is not a preferred option, as a residual risk of flooding will remain. Compensatory storage must be

provided where raised defences remove storage from the floodplain. It would be preferable for schemes to involve an integrated flood risk management solution.

Temporary or demountable defences are not acceptable forms of flood protection for a new development but might be appropriate to address circumstances where the consequences of residual risk are severe but the time required to install the defences, for example in an overtopping scenario, would be realistic. In addition to the technical measures the proposals must include details of how the temporary measures will be erected and decommissioned, responsibility for maintenance and the cost of replacement when they deteriorate. The storage and accessibility of such structures must be considered.

7.7 Modification of ground levels

Modifying ground levels to raise the land above the required flood level is an effective way of reducing flood risk to a particular site in circumstances where the land does not act as conveyance for flood waters. However, care must be taken at locations where raising ground levels could adversely affect existing communities and property.

All new development within the 1% AEP flood extent including an allowance for climate change (for the lifetime of the development) must not result in a net loss of flood storage capacity. Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage.

Where proposed development results in a change in building footprint, the developer should normally ensure that it does not impact upon the ability of the floodplain to store or convey water, and seek opportunities to provide floodplain betterment. Similarly, where ground levels are elevated to raise the development out of the floodplain, compensatory floodplain storage within areas that currently lie outside the floodplain should normally be provided to so the total volume of the floodplain storage is not reduced.

For compensatory flood storage to be effective and not require hydraulic modelling, it must be provided on a level for level, volume for volume basis on land which does not already flood and is within the site boundary. Where land is not within the site boundary, it must be in the immediate vicinity, in the applicant's ownership/control and linked to the site. Floodplain compensation should be considered in the context of the 1% annual probability (1% AEP) flood level including an allowance for climate change. When designing a scheme, flood water should normally be able to flow in and out unaided. An FRA should normally demonstrate that there is no loss of flood storage capacity and include details of an appropriate maintenance regime to ensure mitigation continues to function for the life of the development. Guidance on how to address floodplain compensation is provided in Appendix A3 of the CIRIA Publication C62430.

Raising ground levels can also deflect flood flows, so analyses should be performed to demonstrate that there are no adverse effects on third party land or property.

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

Any proposal for modification of ground levels will need to be assessed as part of a detailed flood risk assessment.

7.8 Developer contributions

In some cases, and following the application of the Sequential Test, it may be necessary for the developer to make a contribution to the improvement of flood defence provision that would benefit both proposed new development and the existing local community. Developer contributions can also be made to maintenance and provision of flood risk management assets, flood warning and the reduction of surface water flooding (i.e. SuDS).

Defra's Flood and Coastal Risk Management Grant in Aid (FCERMGiA)⁷ can be obtained by operating authorities to contribute towards the cost of a range of activities including flood risk management schemes that help reduce the risk of flooding and coastal erosion. Most schemes are only partly funded by FCERMGiA and therefore any shortfall in funds will need to be found

⁷ Flood and coastal defence funding: for risk management authorities (Environment Agency, 2014)
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from elsewhere when using Resilience Partnership Funding, for example local levy funding, local businesses or other parties benefitting from the scheme.

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

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

The appropriate route for the consideration of strategic measures to address flood risk issues is the LFRMS. The LFRMS describes the priorities with respect to local flood risk management, the measures to be taken, the timing and how they will be funded. It will be preferable to be able to demonstrate that strategic provisions are in accordance with the LFRMS, can be afforded and have an appropriate priority.

The Environment Agency is also committed to working in partnership with developers to reduce flood risk. Where assets are in need of improvement or a scheme can be implemented to reduce flood risk, the Environment Agency request that developers contact them to discuss potential solutions

7.9 Flood risk management guidance – resistance measures

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

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

Permanent barriers

Permanent barriers can include built up doorsteps, rendered brick walls and toughened glass barriers (Figure 7-2).

Figure 7-2: Permanent flood barriers



Temporary barriers

Temporary barriers consist of moveable flood defences which can be fitted into doorways and/or windows. The permanent fixings required to install these temporary defences should be discrete and keep architectural impact to a minimum. On a smaller scale temporary snap on covers for airbricks and air vents can also be fitted to prevent the entrance of flood water. The Environment Agency provides a list of manufacturers, with the Kitemark, of temporary defences on their website (<https://www.gov.uk/government/organisations/environment-agency>)

Temporary or demountable defences are not acceptable flood protection for a new development; however they are useful for protecting existing against flood risk.

Temporary defences or demountable defences should only be installed where there is a flood warning with an adequate lead-time to provide enough time for the defences to be put in place.

Community resistance measures

These include demountable defences that can be deployed by local communities to reduce the risk of water ingress to a number of properties. The methods require the deployment of inflatable (usually with water) or temporary quick assembly barriers in conjunction with pumps to collect water that seeps through the systems during a flood.

7.10 Flood risk management guidance – resilience measures

Wet-proofing

Interior design to reduce damage caused by flooding, for example:

- Electrical circuitry installed higher level with power cables being carried down from the ceiling not up from the floor level.
- Water-resistant materials for floors, walls and fixtures.

If redeveloping existing basements new electrical circuitry installed higher level with power cables being carried down from the ceiling not up from the floor level to minimise damage if the basement floods.

Non-Return Valves

Non-return valves prevent water entering the property from drains and sewers. Non-return valves can be installed within gravity sewers or drains, within the property's private sewer upstream of the public sewerage system. These need to be carefully installed and should be regularly maintained. The CIRIA publication, 'Low cost options for prevention of flooding from drains and sewers' (2017s6773 - Brighton & Hove City Council Level 1 and 2 SFRA FINAL (v2 Oct 2018))

sewers', provides further information. Additionally, manhole covers within the property's grounds could be sealed to prevent surcharging.

Pumps

When redeveloping existing buildings it may be acceptable to install pumps in basements as a resilience measure against surface water or groundwater flooding. However, for new development this is unlikely to be considered an acceptable solution.

7.10.1 Further guidance

The Environment Agency recommend that consideration is given to the use of flood proofing measures to reduce the impact of flooding if / when it occurs. To minimise the disruption and cost implications of a flood event the Environment Agency encourage development to incorporate flood resilience/resistance measures up to the 0.1% AEP (extreme) event plus climate change flood level. Both flood resilience and resistance measures can be used for flood proofing. Further information can be found in the following publications: '**Improving the flood performance of new buildings**' and '**Prepare your property for flooding**'.

8 Flood warning and emergency planning

8.1 Flood emergencies

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

In development planning, a number of emergency planning activities are already integrated in national building control and planning policies e.g. the NPPF Flood Risk Vulnerability and Flood Zone 'Compatibility' table seeks to avoid inappropriate development in areas at risk from all sources of flooding. However; safety is a key consideration for any new development and includes residual risk of flooding, the availability of adequate flood warning systems for the development, safe access and egress routes and evacuation procedures.

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

There are circumstances where a flood warning and evacuation plan⁸ is required and / or advised:

- It is a **requirement under the 2018 NPPF** that safe access and escape routes are included in an FRA where appropriate, as part of an agreed emergency plan.
- The **Environment Agency and DEFRA's standing advice** for undertaking flood risk assessments for planning applications states that details of emergency escape plans will be required for any parts of the building that are below the estimated flood level.

It is recommended that Emergency Planners at Brighton and Hove City Council (where appropriate) are consulted prior to the production of any emergency flood plan.

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

- How to manage the consequences of events that are un-foreseen or for which no warnings can be provided e.g. managing the residual risk of a breach.
- Proposed new development that places additional burden on the existing response capacity of the councils will not normally be appropriate.
- Developers should encourage those owning or occupying developments, where flood warnings can be provided, to sign up to receive them. This applies even if the development is defended to a high standard.
- The vulnerability of site occupants.
- Situations may arise where occupants cannot be evacuated (e.g. prisons) or where it is safer to remain "in-situ" and / or move to a higher floor or safe refuge area (e.g. at risk of a breach). These allocations should be assessed against the outputs of the SFRA and where applicable, a site-specific Flood Risk Assessment to help develop emergency plans.

Further emergency planning information links include:

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

⁸ Flood warning and evacuation plans may also be referred to as an emergency flood plan or flood response plan.

8.2 Flood warning systems

Flood warnings can be derived and, along with evacuation plans, can inform emergency flood plans or flood response plans. The Environment Agency is the lead organisation for providing warnings of fluvial flooding (for watercourses classed as Main Rivers) and coastal flooding in England. Flood Warnings are supplied via the Flood Warnings Service (FWS), to homes and business within Flood Zones 2 and 3. The difference levels of warning are shown in Table 8-1.

Table 8-1: Environment Agency Warnings explained

Flood Warning Symbol	What it means	What to do
	Flood Alerts are used to warn people of the possibility of flooding and encourage them to be alert, stay vigilant and make early preparations. It is issued earlier than a flood warning, to give customers advance notice of the possibility of flooding, but before there is full confidence that flooding in Flood Warning Areas is expected.	<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 on the Environment Agency website Stay tuned to local radio or TV Alert your neighbours Check pets and livestock Reconsider travel plans
	Flood Warnings warn people of expected flooding and encourage them to take action to protect themselves and their property.	<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 Seal up ventilation system if safe to do so Put flood protection equipment in place Be ready should you need to evacuate from your home 'Go In, Stay In, Tune In'
	Severe Flood Warnings warn people of expected severe flooding where there is a significant threat to life.	<ul style="list-style-type: none"> Stay in a safe place with a means of escape Co-operate with the emergency services and local authorities Call 999 if you are in immediate danger
Warnings no longer in force	Informs people that river or sea conditions begin to return to normal and no further flooding is expected in the area. People should remain careful as flood water may still be around for several days.	<ul style="list-style-type: none"> Be careful. Flood water may still be around for several days If you've been flooded, ring your insurance company as soon as possible

It is the responsibility of individuals to sign-up to this service in order to receive the flood warnings via FWS. Registration and the service is free and publicly available. It is recommended that any household considered at risk of flooding signs-up. Developers should also encourage those owning or occupying developments, where flood warnings can be provided, to sign up to receive them. This applies even if the development is defended to a high standard.

There are currently three Flood Warning Areas (FWAs) and three Flood Alert Areas (FAAs) covering tidal flood risk and one FWA and FAA that covers groundwater in Brighton and Hove. These are displayed in Figure 8-1. A list of the FAAs in the study area are shown in Table 8-2 and a list of the FWAs in the study area are shown in Table 8-3.

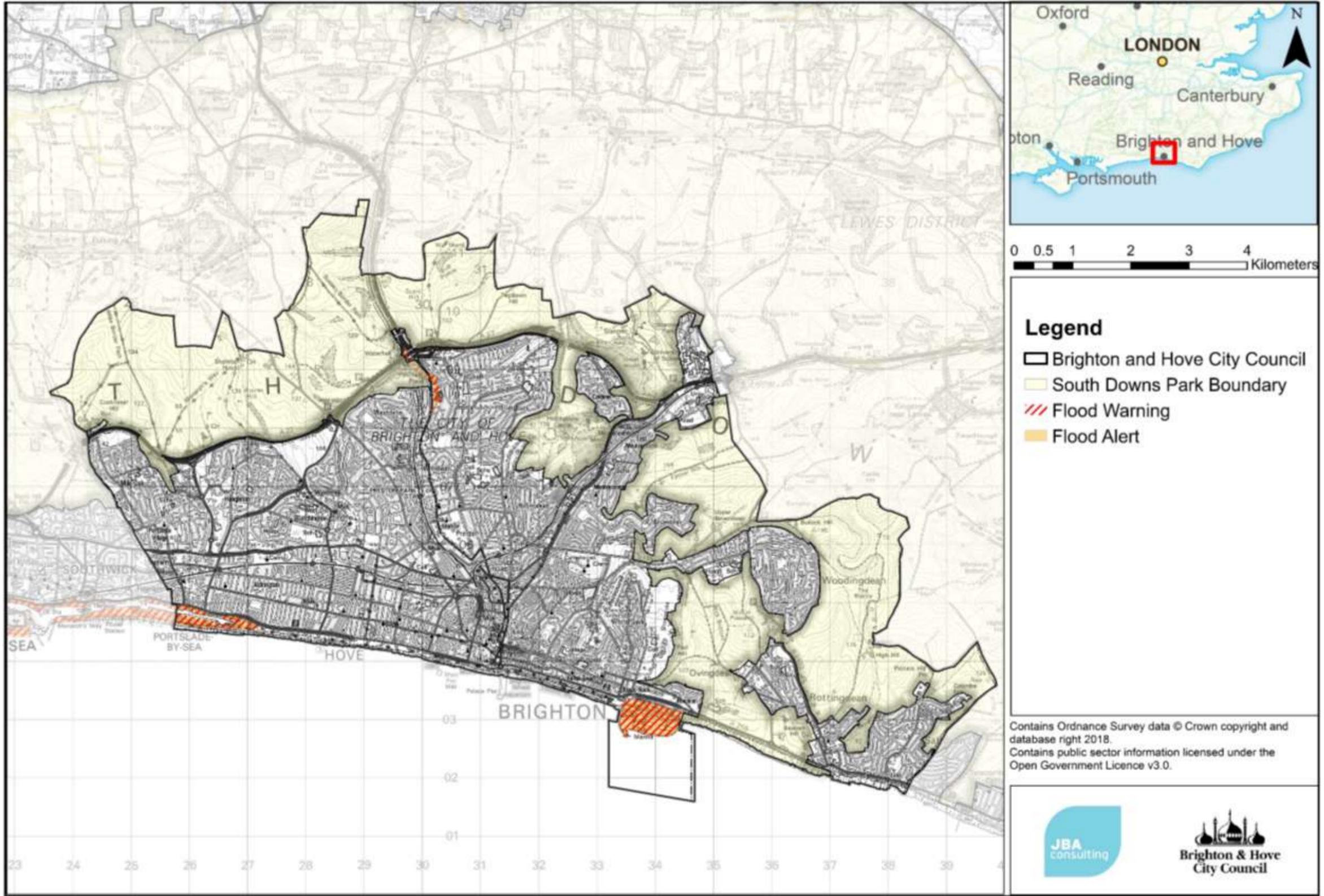
Table 8-2: Flood Alert Areas within Brighton and Hove

Flood Alert Code	Flood Alert Name	Watercourse	Coverage
065WAC408	Tidal areas of Shoreham Harbour	English Channel	Tidal areas of Shoreham Harbour including Shoreham Airport, Shoreham high street, areas of Riverside Road and Shoreham Harbour
065WAC409	Inland areas of Shoreham, Lancing and Southwick	English Channel	Areas of Shoreham at risk from a high tide including Eastern parts of North and South Lancing, Broadway and Willowbrook caravan parks, Adur recreation ground, Old Shoreham Road, Beach Green and Aldrington Basin
065WAC410	Coastal areas of Brighton Marina	English Channel	Coastal areas of Brighton Marina Village including the Strand
065FAG017	Groundwater flooding in Patcham	Groundwater	Areas at risk of groundwater flooding in Patcham including: Old London Road, parts of Church Hill and Mill Road where they meet the A23

Table 8-3: Flood Warning Areas within Brighton and Hove

Flood Warning Code	Flood Warning Name	Watercourse	Coverage
065FWC3001	Shoreham Harbour	English Channel	Tidal areas of Shoreham Harbour including: Shoreham Airport, Shoreham high street, areas of Riverside Road and Shoreham Harbour East arm
065FWC3002	Shoreham Town and Lancing	English Channel	Areas of Shoreham at risk from a high tide including Eastern parts of North and South Lancing, Broadway and Willowbrook caravan parks, Adur recreation ground, Old Shoreham Road, Beach Green and Aldrington Basin
065FWC3101	Brighton Marina	English Channel	Coastal areas of Brighton Marina Village including the Strand
065FWG017	Groundwater Flooding Old London Road Patcham	Groundwater	Areas at risk of groundwater flooding in Patcham including: Old London Road, parts of Church Hill and Mill Road where they meet the A23

Figure 8-1: Brighton and Hove flood warning and alert areas



8.3 Local arrangements for managing flood risk

The Brighton and Hove City Council's [website](#) provides advice on reporting flooding, flood alerts, health advice and advice for protecting your property during a flood event. In addition, the following guidance is available for Patcham

8.3.1 Patcham Flood Plan

As Patcham can be affected by groundwater flooding after long periods of heavy rain, a Flood Plan has been prepared by the Environment Agency, Brighton and Hove City Council and Southern Water for the area. The Flood Plan provides details about the inventory each RMA is responsible for and the required response for different levels of flooding.

8.3.2 Bevendean Emergency Flood Plan

Bevendean is affected by large volumes of surface water with a high groundwater table and/or saturated ground which reduces infiltration. The high groundwater table may contribute to the volume of runoff further. The plan sets out contact details, inventory details, monitoring, emergency plans and maintenance requirements for the area.

8.4 Emergency planning and development

8.4.1 NPPF

The NPPF Flood Risk Vulnerability and Flood Zone 'Compatibility' table seeks to avoid inappropriate development in areas at risk from all sources of flooding. It is essential that any development which will be required to remain operational during a flood event is located in the lowest flood risk zones to ensure that, in an emergency, operations are not impacted on by flood water or that such infrastructure is resistant to the effects of flooding such that it remains serviceable/operational during 'upper end' events, as defined in the Environment Agency's Climate Change allowances (February, 2016). For example, the NPPF classifies police, ambulance and fire stations and command centres that are required to be operational during flooding as Highly Vulnerable development, which is not permitted in Flood Zones 3a and 3b and only permitted in Flood Zone 2 providing the Exception Test is passed. Essential infrastructure located in Flood Zone 3a or 3b must be operational during a flood event to assist in the emergency evacuation process. All flood sources such as fluvial, surface, groundwater, sewers and artificial sources (such as canals and reservoirs) should be considered. In particular sites should be considered in relation to the areas of drainage critical problems highlighted in the [SWMP](#).

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

8.4.2 Safe access and egress

The NPPF Planning Practice Guidance outlines how developers can secure safe access and egress to and from development in order to demonstrate that development satisfies the second part of the Exception Test⁹. Access considerations should include the voluntary and free movement of people during a 'design flood' as well as for the potential of evacuation before a more extreme flood. The access and egress must be functional for changing circumstances over the lifetime of the development. The NPPF Planning Practice Guidance sets out that:

- Access routes should allow occupants to safely access and exit their dwellings in design flood conditions. In addition, vehicular access for emergency services to safely reach development in design flood conditions is normally required; and
- Where possible, safe access routes should be located above design flood levels and avoid flow paths including those caused by exceedance and blockage. Where this is unavoidable, limited depths of flooding may be acceptable providing the proposed access is designed with appropriate signage etc. to make it safe. The acceptable flood depth for safe access will vary as this will be dependent on flood velocities and risk of debris in the flood water. Even low levels of flooding can pose a risk to people in situ

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

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

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

8.4.3 Potential evacuations

During flood incidents, evacuation may be considered necessary. The NPPF Planning Guidance states practicality of safe evacuation from an area will depend on¹⁰.

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

The vulnerability of the occupants is also a key consideration. The NPPF and application of the Sequential Test aims to avoid inappropriate development in flood risk areas. However, developments may contain proposals for mixed use on the same site. In this instance, the NPPF Planning Practice Guidance states that layouts should be designed so that the most vulnerable uses are restricted to higher ground at lower risk of flooding, with development which has a lower vulnerability (parking, open space etc.) in the highest risk areas, unless there are overriding reasons to prefer a different location¹¹. Where the overriding reasons cannot be avoided, safe and practical evacuation routes must be identified.

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

- single storey buildings or ground floors that do not have access to higher floors can access a space above the estimated flood level, e.g. higher ground nearby;
- basement rooms have clear internal access to an upper level, e.g. a staircase; and
- occupants can leave the building if there is a flood and there is enough time for them to leave after flood warnings¹².

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

8.4.4 Flood warning and evacuation plans

Flood warning and evacuation plans are potentially mitigation measures to manage the residual risk, as stated in the NPPF Planning Practice Guidance. It is a requirement under the NPPF that a flood warning and evacuation plan is prepared for sites at risk of flooding used for holiday

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

11 NPPF Planning Practice Guidance, Flood Risk and Coastal Change (Paragraph: 053 Reference ID: 7-053-20140306) March 2015

12 Environment Agency and DEFRA (2012) Flood Risk Assessment: Standing Advice

or short-let caravans and camping are important at any site that has transient occupants (e.g. hostels and hotels).

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

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

Once the emergency flood plan is prepared, it is recommended that it is distributed to emergency planners at Brighton and Hove City Council and the emergency services. When developing a flood warning and evacuation plan, it is recommended that it links in with any existing parish / community level plan.

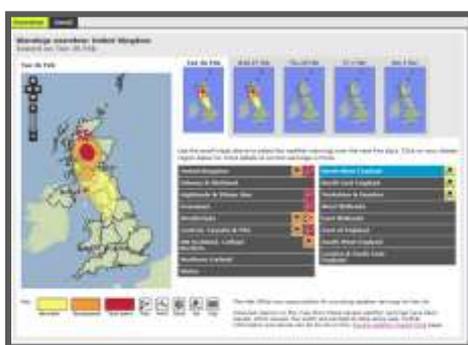
Guidance documents for preparation of flood response plans

- **Environment Agency (2012) Flooding – minimising the risk, flood plan guidance for communities and groups**
- **Environment Agency (2014) Community Flood Plan template**
- **Environment Agency Personal flood plans**
- **Flood Plan UK ‘Dry Run’ - A Community Flood Planning Guide**

8.4.5 Other sources of information



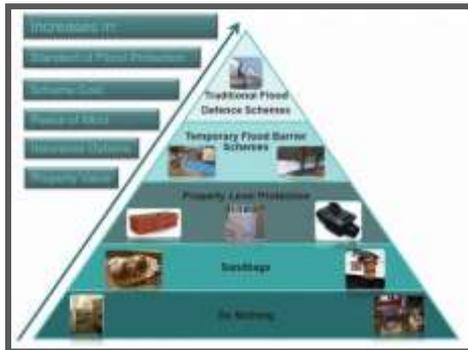
As well as being a statutory consultee for new development at risk of flooding, the Environment Agency can offer independent technical advice. The Environment Agency website contains a breadth of information on flood risk and there are numerous publications and guidance available. For example, the “**flooding from groundwater**” guide has been produced by the Environment Agency and Local Government Association to offer practice advice to reduce the impact of flooding from groundwater.



The Met Office provides a **National Severe Weather Warning Service** about rain, snow, wind, fog and ice. The severity of warning is dependent upon the combination of the **likelihood** of the event happening and the **impact** the conditions may have. In simplistic terms, the warnings mean: Yellow: Be Aware, Amber: Be Prepared, Red: Take Action. This service does not provide flood warnings. The Met Office provide many other services and products. For further information, please visit their [website](#).



The **National Flood Forum** (NFF) is a **national charity**, set up in 2002 to support those at risk and affected by flooding. The NFF helps people to prepare and recover from flooding as well as campaigning on behalf of flood risk communities, including providing advice on matters such as insurance.



Individual property-level protection (PLP) measures are design to help protect homes and businesses from flooding. These include a combination of **flood resistance measures** - trying to prevent water ingress – and **flood resilience measures** - trying to limit the damage and reduce the impact of flooding, should water enter the building. It is important that any measures have the **BSI Kitemark**. This shows that the measure has been tested and ensures that it meets industry standards. Please visit the **Government website: “Prepare for flooding”** for more information.

9 Strategic flood management

Strategic flood risk solutions may offer a potential opportunity to reduce flood risk in the district. The shoreline along the study area lies within the **Beachy Head to Selsey Bill Shoreline Management Plan (2006)**. Within this document several plans are outlined and should be considered when formulating strategic flood risk solutions which involve the shoreline.

- Whether the flood risk solution will make the development safe e.g. whether safe access and egress can be achieved
- How the flood risk solution will be managed and maintained for the lifetime of development
- The cost of implementing the solution (and maintaining it)
- Environmental implications of the flood risk solution (both during and after implementation)
- Whether an Environmental Permit is required from the Environment Agency or consent from the LLFA is needed.

The following sections outline different options which could be considered for strategic flood risk solutions.

9.1 Promotion of SuDS

By considering SuDS at an early stage in the development of a site, the risk from surface water can be mitigated to a certain extent within the site as well as reduce the risk that the site poses to third party land. SuDS should be promoted on all new developments to ensure the quantity and quality of surface water is dealt with sustainably to reduce flood risk. The emerging Brighton and Hove SPD should be referred to.

9.2 Natural flood management

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

Due to the heavy urbanisation in Brighton and Hove there is limited potential for NFM, however there are some opportunities for example, building earth banks to capture runoff, which could be cheaper and smaller-scale than implementing flood walls for example.

9.3 Flood defences

There are a number of formal flood and coastal defences present within the study area (see Section 6 for further information).

Flood mitigation measures should only be considered if, after application of the Sequential Approach, development sites cannot be located away from higher risk areas. If defences are constructed to protect a development site, it will need be demonstrated that the defences will not have a resulting negative impact on flood risk elsewhere, and that there is no net loss in floodplain storage.

9.4 Surface Water Attenuation

There is limited potential in city for surface water attenuation due to its urban nature and there is little open space to manage existing flow paths. However, there is some potential in Preston Park and Greensleas Football Pitch. The main way of addressing surface water strategically is through new development guidance provided in the SuDS SPD.

9.5 Green Infrastructure

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

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

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

A **Green Infrastructure Network Study (2009)** was prepared as part of the City Plan Part 1 to inform the development of site allocations.

An **Open Spaces Strategy (2017)** has been prepared by Brighton and Hove City Council and sets out the opportunities as well as the challenges facing parks and open spaces

10 Level 1 assessments of sites

10.1 Introduction

A number of allocated, committed and potential development sites were provided by Brighton and Hove City Council. These sites were screened against a suite of available flood risk information and spatial data to provide a summary of risk to each site. Indication is provided on the proportion of a given site affected by levels and types of flood risk, along with whether historic incidences of flooding have occurred. Not all of these sites will be allocated through City Plan Part 2.

The information provided is intended to enable a more informed consideration of the sites using the sequential approach.

10.2 Detailed site summary sheets

The following table provides detailed summaries of the 307 sites provided by BHCC from its Strategic Housing Land Availability Assessment (SHLAA) of potential housing sites, these were categorised using Brighton and Hove's adopted City Plan Part 1 Development Area boundaries. The areas which fall outside these boundaries were categorised as "outside area". These categories were used to provide unique ID codes for each SHLAA site, which are displayed in Table 10-1.

Table 10-1: Categorised Potential Housing Sites (as identified in the 2016 SHLAA update) according to Brighton and Hove development area boundaries

Brighton and Hove development area boundary	Site code
DA1 - Brighton Centre	DA1X
DA2 - Brighton Marina	DA2X
DA3 - Lewes Road	DA3X
DA4 - London Road and Preston Road	DA4X
DA5 - St James Street	DA5X
DA6 - Eastern Road and Edward Street Area	DA6X
DA7 - Toad's Hole Valley	DA7X
DA8 - Shoreham Harbour	DA8X
OA - Area outside an identified Brighton and Hove City Council development area	OAX

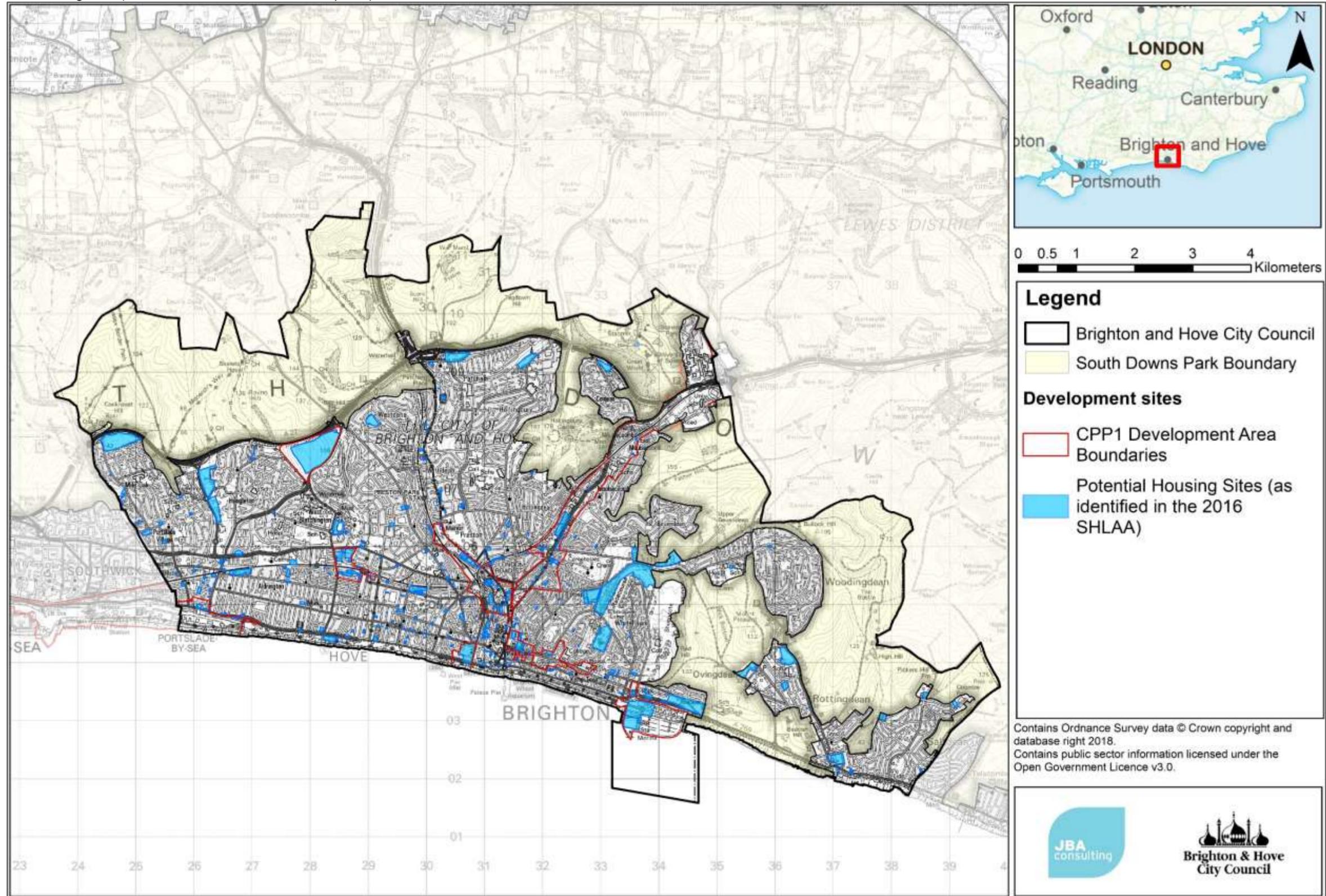
The locations of the potential housing sites and development areas provided by Brighton and Hove City Council are displayed in Figure 10-1.

JBA conducted modelling of surface water flood risk in Brighton and Hove to determine the surface water flood risk and the associated Surface Water Flood Zones. The effects of climate change on surface water flood risk was also considered. The Environment Agency's fluvial Flood Zones were obtained and used to determine fluvial flood risk. No additional detailed fluvial hydraulic modelling was conducted as there are no rivers within Brighton and Hove. Groundwater flood risk within Brighton and Hove was assessed using the JBA Groundwater Flood dataset. Using this information, detailed site summary tables have been produced for the specified SHLAA sites provided by Brighton and Hove City Council.

10.3 Overview site flood risk information

Appendix C provides a summary of flood risk information for each of the sites which have been considered as part of this SFRA.

Figure 10-1: Potential housing sites (as identified in the 2016 SHLAA update)¹³



¹³ Note that the 2016 SHLAA includes allocated development sites (CPP1) and sites with planning permission and urban fringe broad locations
2017s6773 - Brighton & Hove City Council Level 1 and 2 SFRA FINAL (v2 Oct 2018)

11 Level 2 Strategic Site Allocations

11.1 Introduction

The primary purpose of the Level 2 Strategic Flood Risk Assessment is to provide an appropriate understanding of the level of actual risk affecting development included in the Plan to identify appropriate arrangements, so it is implemented safely and remains safe over the intended life. The Level 2 assessment provides an understanding of actual risk and so in circumstances where there are existing flood risk management measures it is important to understand the level of protection these afford and how the standard of protection changes over time as a consequence of climate change effects. There are some locations in Brighton and Hove, such as the Marina and Shoreham harbour where the performance of existing tidal and coastal defences must be evaluated to understand the actual risk. There are also locations where the risk of flooding from surface water and groundwater must be evaluated together with the commitment to measures that maintain the safety of development over the intended life. Whilst the focus of the Level 2 assessment is to provide evidence to support the proposals included in the Plan, the principles and approach adopted for the assessment should be applied to windfall sites (proposed development not included in the plan), particularly with respect to providing evidence within FRAs that surface water flood risk will be appropriately managed over the life of proposed new development.

In Brighton and Hove, not all development can be allocated outside of flood risk areas as shown by the Sequential Test prepared for the City Plan Part 1. Therefore, a Level 2 Strategic Flood Risk Assessment was required in addition to the Level 1 assessment also documented in this report. The purpose of this Level 2 SFRA assessment was to consider the characteristics of the actual flood risk associated with the relevant site allocations.

Sites allocated for development were provided by the council for assessment in the SFRA. Following the screening assessment of the 307 sites provided by BHCC, 10 sites were brought forward to undergo the Level 2 assessment. The Level 2 assessment is based on the potential flood risk from all sources, including; tidal, surface water, groundwater and sewer flood risk to the sites. The sites included in the Level 2 SFRA were:

- 46-54 Old London Road, Patcham
- Brighton General Hospital
- Combined Engineering Depot, New England Road
- EDF Portland Road Business Park, Portland Road,
- Land at and adjoining Horsedean Recreation Ground
- Land at Lyon Close
- Marina Development
- Sackville Trading Estate and Coal Yard
- Site identified in the CPP1 for the King Alfred
- Telecom House 123-135, Preston Road

This assessment, as part of a Level 2 SFRA provides more detailed information on:

- The resolution and detail of the analysis used to assess the flood risk (more detailed data and higher resolution flood modelling has been prepared so appropriate evidence is available to consider the implications of satisfying the Exception Test.
- The severity and extent of actual flood risk across proposed sites;
- The site-specific flood risk assessment requirements; and
- The implications for the preparation of local policies to provide for sustainable developments as well as reducing flood risk to existing communities.
- Potential options to manage the flood risk which will be considered further by developers when preparing an FRA.

11.2 How to use the Level 2 SFRA

The Level 2 SFRA report gives a short non-technical summary of how the Level 2 sites were selected, the detailed flood risk data that was used to carry out individual site-level assessments for each of the Level 2 sites, and how climate change, other sources of flooding and residual risk were assessed.

The main output of the Level 2 assessment are the individual site summary sheets (Appendix D) which provide a site focussed strategic assessment of flood risk assessments and conclusions for the respective sites.

11.3 Criteria for a Level 2 assessment

Table 11-1 provides justification as to why these sites were considered in the Level 2 SFRA.

Table 11-1: List of sites taken forward for Level 2 SFRA analysis and their justification

Site Name	Justification
46-54 Old London Road, Patcham	The site is subject to a risk from both surface water and ground water flooding, therefore a Level 2 SFRA will provide a better understanding of the potential flood risk.
Brighton General Hospital	The site has been identified as a City Plan Part 2 site.
Combined Engineering Depot, New England Road	The site has been identified as a City Plan Part 2 site.
EDF Portland Road Business Park, Portland Road	The site has numerous flood flow routes through the site and therefore a Level 2 SFRA will provide a better understanding of the potential flood risk.
Land at and adjoining Horsedean Recreation Ground	The site is in an area of ground water flood risk, therefore a Level 2 SFRA will provide a better understanding of the potential flood risk.
Land at Lyon Close	The site has been identified as a City Plan Part 2 site.
Marina Development	The site has a combination of planning permission and no planning permission. The site will be development and therefore a Level 2 SFRA will provide a better understanding of the potential flood risk.
Sackville Trading Estate and Coal Yard	The site has been identified as a City Plan Part 2 site.
Site identified in the CPP1 for the King Alfred	The site is allocated in City Plan Part 1 and will be developed in the plan period, therefore a Level 2 SFRA will provide a better understanding of the potential flood risk.
Telecom House 123-135, Preston Road	The site is at risk from surface water flooding, therefore a Level 2 SFRA will provide a better understanding of the potential flood risk.

It should be noted that the Kingsway/Basin Road North site allocated in the draft City Plan Part 2 has an extant planning permission and an FRA was undertaken as part of the planning application. Therefore, no Level 2 assessment will be carried out for this site.

11.4 Site summary tables

As part of the Level 2 SFRA, detailed site summary tables have been produced for each of the sites brought forward for the Level 2 analysis (Appendix D). The summary tables set out the following information:

11.4.1 Basic site information:

- Area
- Proposed site use

- Current land use (greenfield or brownfield)

11.4.2 Environmental Descriptors:

- Geology
- Slope of site
- Groundwater source protection zones
- Location of any historic landfill sites

11.4.3 Sources of flood risk:

- Coastal flood risk
- Fluvial flood risk - Proportion of site at risk from mapping/modelling
- Surface Water - Proportion of site at risk including description from surface water mapping and Surface Water Flood Zones
- Groundwater
- Reservoir
- Watercourse
- Existing Drainage features
- Flood history
- Sewer incidents
- Flood Mechanism

11.4.4 Climate Change:

- Summary of climate change allowances and increase in extent compared to Flood Zones
- Description of implication to the site

UKCP18 is due to be completed in November 2018 which will provide more extensively evaluated climate change projection data. UKCP18 will build upon the outcomes of UKCP09. This updated information should be considered during the preparation of FRAs.

11.4.5 Flood risk management infrastructure:

- Defences - type, Standard of Protection and condition (if known) and description
- Description of any residual risk - No areas classified of benefitting from flood defences however defence overtopping has been considered.

11.4.6 Emergency Planning:

- Flood Warning Areas
- Access and egress

11.4.7 Requirements for drainage control and impact mitigation:

- Broadscale assessment of possible SuDS to provide indicative surface water drainage advice. This has been completed by the Project Centre who have addition written the SuDS Supplementary Planning Guidance for Brighton and Hove City Council.

11.4.8 NPPF Planning implication:

- Development vulnerability classification
- Exception Test requirements
- Requirements and guidance for site-specific FRA

11.4.9 Mapping information - description of data sources for the following mapped outputs:

- Flood Zones
- Climate Change
- Surface Water

- Surface Water Flood Zones
- Depth, velocity and hazard mapping

11.5 Accompanying mapping

To accompany each site summary table, mapping has been provided, with all mapped flood risk outputs per site. Mapping is intended to be read alongside the appropriate site summary table. Flood risk information on these maps include:

- Site boundary
- Environment Agency Coastal Flood Zones 2 (between 0.1% and 0.5% AEP) and 3a (greater than 0.5% AEP)
- Flood Zone 3b (functional floodplain (greater than 5% AEP))
- Risk of Flooding from Surface Water
- Surface Water Flood Zones
- Modelled coastal 1% AEP depth, velocity and hazard rating (if available)
- Modelled surface water 1% AEP depth and velocity
- Depth, velocity and hazard of the 1% AEP +30% climate change surface water event
- Climate change depth, velocity and hazard of the 0.5% AEP 2086 to 2115 Epoch coastal flood event
- JBA Groundwater flood risk

12 Summary

12.1 Overview

This Level 1 and 2 SFRA delivers a strategic assessment of all sources of flooding in Brighton and Hove. It also provides an overview of policy and provides guidance for planners and developers.

The study area comprises the administration area of the City of Brighton and Hove, excluding the area covered by South Downs National Park

12.2 Sources of flood risk

12.2.1 Historic flooding

There have been several recorded flood incidents across the study area, from a combination of sources. Based on the Brighton and Hove Incident Database the prominent sources of historic flooding are surface water and groundwater. The wards in Brighton and Hove with the most recorded flood incidents are Patcham, South Portslade, Central Hove, Brunswick and Adelaide and Regency. There are only four recorded incidents of tidal flooding on the database.

Further details regarding historic flooding in Brighton and Hove can be found in the 2011 Brighton and Hove PFRA, the Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy Review and Brighton and Hove City Council's Section 19 Investigations.

12.2.2 Fluvial flood risk

With no main rivers or ordinary watercourses within Brighton and Hove the SFRA does not include an assessment of fluvial flood risk.

12.2.3 Tidal flood risk

Brighton and Hove's coastline extends from Shoreham Port in the west to Saltdean in the east. Much of the area at risk from tidal flooding is protected by flood defences. In general, there are only two main areas of tidal flood risk throughout Brighton and Hove which are Portslade-by-Sea - including the eastern arm of Shoreham Harbour and Brighton Marina.

12.2.4 Tidal functional floodplain (Flood Zone 3b)

The Functional Floodplain for the majority of the area within Brighton and Hove was represented using Flood Zone 3a. JBA Extreme Sea Level Analysis (2004) and LIDAR has been used for the Brighton Marina area only. For these areas, wave overtopping has not been considered.

Since 2012 SFRA, a small section around Shoreham Port/ Aldrington Basin has been remodelled as part of the Arun to Adur section of the East Sussex Coastal modelling (2012). Flood Zone 3b is defined in this area using the defended 5% AEP outline and includes wave overtopping.

12.2.5 Coastal flood risk

The Beachy Head to Selsey Bill Shoreline Management Plan (2006) and Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy Review (2014) provide further information about the coastal flood risk to Brighton and Hove. These documents highlight the importance of the shingle beach along the coastline which protects from coastal erosion.

However, to maintain the shingle beach for the long term, significant lengths of new defences will be required where only a beach offers protection from flood damage and erosion loss. This is due to the nature of sea level rise where larger defence structures will be required associated with narrower beaches.

12.2.6 Surface water flood risk

The RoFSW dataset shows there is a significant surface water flood risk across Brighton and Hove. Areas of concern are shown to be along main road routes through Brighton, such as London Road, Lewes Road, Marlborough Place, Gloucester Place and Old Steine which are in the centre of Brighton providing access from North to South of the city. These areas act as flow routes from the high elevations of the South Downs in the north of the city to towards the seafront.

The largest affected areas are along the A23 and A270 which form a 'y' shaped flow route in the centre of the city. There are significant areas in Hove, which are more susceptible to surface water flooding. The largest area of surface water ponding in Hove lies between the A270 to Kingsway.

12.2.7 Surface Water and climate change

Surface water flood risk mapping showing the extents of the 1% AEP event plus 30% and 40% uplift for climate change has been prepared as part of the SFRA.

12.2.8 Surface Water Flood Zones

Surface Water Flood Zones (SWFZs) have been introduced to the this SFRA with the intention to define areas potentially at risk from surface water flooding to provide more strategic consideration of surface water flood risk in the land allocation and planning process.

The following SWFZs have been defined.

Surface Water Flood Zone a: Accumulation Zone

Surface Water Flood Zone a is defined based as land affected by a high probability event (1% chance in each and every year).

SWFZa is the risk extent not taking account of any existing measures to manage or control risk and as such defines the zone that could potentially be affected if no measures were in place.

Surface Water Flood Zone b: Conveyance Zone

The extent of SWFZb is based on the speed and depth with which surface water can flow over the ground surface and is to identify locations where the interruption or changing of flow direction could affect flood risk. It is defined by ground that has a gradient steeper than 1 in 20 (or gradient of 5%).

The FRA requirements for development falling within SWFZa or SWFZb are different, in reflection of their risk profiles.

12.2.9 Groundwater flood risk

Based on JBA's Groundwater Flood Map, groundwater levels vary throughout Brighton and Hove. Groundwater levels are closest to the surface along small areas of the coast and in Aldrington, Patcham and Falmer.

12.2.10 Sewer flood risk

The SIRF indicates a total of 84 recorded flood incidents in Brighton and Hove. The more frequently flooded postcodes are BN1 1 (10 incidents), BN1 8 (eight incidents), BN4 11 (eight incidents and BN3 6 (seven incidents).

12.2.11 Reservoirs

There are no reservoirs storing water above normal ground level in Brighton and Hove or reservoir flood risk within the study area.

12.2.12 Canals and other artificial sources

There are no known canals or 'other' potential artificial sources of flooding in Brighton and Hove.

12.3 Flood defences

A shingle beach offers protection from tidal flooding along the coastline of Brighton and Hove. Further tidal flood defences are also in place along the coastline. These are outlined in the Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy Review. The standard of protection offered by the defences in 2012 and the condition of the defences is outlined in the review.

The residual risk of the flood defences failing or being overtopped should be considered as part of a detailed FRA.

A number of Brighton and Hove City Council owned surface water flood assets have also been presented within this SFRA.

12.4 Development and Flood Risk

As part of the City Plan Part 1, the Sequential and Exception Tests were carried out for five of the 2018 Level 2 SFRA sites. It is recommended that Brighton and Hove City Council confirm that the conclusions of these tests are still valid based on the information presented in this document.

The Sequential and Exception Test have not previously been prepared for five sites which have been taken forward to the Level 2 SFRA Assessment. It is recommended that Brighton and Hove City Council perform the Sequential Test, and where necessary the Exception Test, for these sites based on the information provided in this document.

This SFRA defines Surface Water Flood Zones to encourage sustainable development in Brighton and Hove. It is not intended that Surface Water Flood Zones are used to perform a Sequential Test as applies to river or sea flood risk. This means that if a development site is located in a Surface Water Flood Zone it does not automatically cause the site to fail the Sequential Test or trigger the Exception Test.

Surface Water Flood Zones introduce an additional requirement to perform FRA's that will be submitted in support of planning applications and increase the emphasis that the site layout of a development adopts a sequential approach. **PPG** states that with each flood zone, surface water and other sources of flooding should be taken into account in apply the sequential approach to the location of development.

The Sequential and Exception Test procedures for site-specific FRAs have been documented, along with guidance for planners and developers. This includes guidance for development in Surface Water Flood Zones a and b.

Links have been provided for various guidance documents and policies published by Brighton and Hove City Council and the Environment Agency.

12.5 Relevant studies

There are many relevant regional and local key studies which complement the SFRA and have been considered, such as the PFRA, LFRMSs, the SWMP, CFMPs, and the SMPs. The emerging SuDS SPD will also complement the SFRA. Other policy considerations have also been incorporated, such as sustainable development principles, climate change and flood risk management.

13 Recommendations

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

13.1 Development management

13.1.1 Sequential approach to development

The NPPF supports a risk-based and sequential approach to development and flood risk in England, so that development is located in the lowest flood risk areas where possible; it is recommended that this approach is adopted for all future developments within Brighton and Hove City Council's authoritative area.

New development and re-development of land should wherever possible seek opportunities to reduce overall level of flood risk at the site, for example by:

- Reducing volume and rate of runoff through the use of SuDS, as informed by national and local guidance and the emerging Brighton and Hove SuDS SPD.
- Considering surface water depths and flow paths across a site.
- Consider whether basement development is appropriate if the site is at risk from groundwater flooding.
- Subterranean development should consider groundwater flow paths.
- Consideration must be given to the potential cumulative impact of development on flood risk.

13.1.2 Site specific flood risk assessments

Site specific FRAs are required by developers to provide a greater level of detail on flood risk and any protection provided by defences and, where necessary, demonstrate the development passes part b of the Exception Test.

Surface water considerations

For all development or change of use in within a SWFZ an FRA should be prepared. The FRA requirements for development falling within SWFZa or SWFZb are different, in reflection of their risk profiles. The policy for each SWFZ is outlined below:

Surface Water Flood Zone a: Accumulation Zone

As surface water in this zone is expected to pond, the development of basement dwellings is not normally permitted in SWFZa.

For all other development, an FRA is required to demonstrate that the proposal will be safe from surface water flooding for its lifetime and does not increase flood risk elsewhere. FRA requirements include:

- Assessment of flood risk from all sources.
- Consideration of flow paths across the site and how the proposed development may alter these.
- Demonstration that ground floor levels should be a minimum of whichever is higher of:
 - 300 mm above the general ground level of the site
 - 600mm above the estimated surface water level in the 1% AEP event with drainage plus 30% uplift to account for climate change
- Consideration of other surface water flood resilience measures.

As part of this assessment the 1% AEP event plus 30% uplift to account for climate change has been prepared. For detailed mapping to carry out any assessments, requests should be sent to sustainable drainage@brighton-hove.gov.uk.

Surface Water Flood Zone b: Conveyance Zone

This area is steeply sloping and so rainfall event and here runoff can be expected to flow over impermeable areas within SWFZb during rainfall.

all types of development could be compatible in SWFZb, providing FRA can demonstrate that the proposal will be safe from flooding for its lifetime and does not increase flood risk elsewhere. FRA requirements include:

- Assessment of flood risk from all sources.
- Consideration of flow paths across the site and how the proposed development may alter these. Overland flow modelling maybe required to demonstrate this.
- Consideration of surface water flood resilience measures.

The use of SuDS should be required on all new development. Reference should be made to the emerging Brighton and Hove City Council's SuDS SPD.

Groundwater considerations

It is recommended that the council require a flood risk assessment for all development or change of use, regardless of Flood Zone or size, where flood risk from groundwater is identified by the SFRA. The FRA should clearly state the degree of risk and how the risk to the development will be mitigated

The council should ensure that any subterranean development proposals prove there is no risk from groundwater or other sources of flooding and should prove that groundwater flow paths are preserved so as not to increase the flood risk elsewhere. The design of any new subterranean development should ensure that flood risk is not increased for existing adjacent subterranean developments by changes to groundwater flow paths.

Tidal flood risk considerations

In areas where there is a tidal flood risk, the impact of defence failure or wave overtopping will need to be considered. The condition of existing flood defences and whether they will be continued to be maintained and/or improved in the future will also need to be thoroughly explored.

Foul sewer considerations

Consultation with Southern Water should be undertaken prior to development commencing to confirm whether the sewer drainage network has enough capacity to accommodate the flows from all new development.

13.1.3 Sequential and Exception Tests

The SFRA has identified that areas of the study area are at risk of flooding from tidal sources but much of the city is located within Flood Zone 1. It is normally reasonable to presume and state that individual sites that lie in Zone 1 satisfy the requirements of the Sequential Test; however, consideration should be given to risks from all sources, including surface water and groundwater flood risk.

Developers should consult with Brighton and Hove City Council, the Environment Agency and Southern Water at an early stage to discuss flood risk including requirements for site-specific FRAs, detailed overland flow modelling, and drainage assessment and design.

13.1.4 Review of planning applications

Brighton and Hove City Council should consult the Environment Agency's '**Flood Risk Assessment: Local Planning Authorities**', last updated 28 February 2017, when reviewing planning applications for proposed developments at risk of flooding. The council will consult the relevant statutory consultees as part of the planning application assessment and they may, in some cases, also contact non-statutory consultees (e.g. Southern Water) that have an interest in the planning application.

13.1.5 Drainage Strategies and SuDS

For guidance regarding Drainage Strategies and SuDS reference should be made to the emerging Brighton and Hove SuDS SPD.

13.1.6 Infrastructure and safe access and egress

Safe access and egress will need to be demonstrated at all development sites. Emergency vehicular access should be possible during times of flood. Where development is located

behind, tidal defences, consideration should be given to the potential safety of the development, finished floor levels and for safe access and egress in the event of rapid inundation of water due to a defence breach with little warning. Resilience measures will be required if buildings are situated in the flood risk area.

13.1.7 Updates to SFRA

SFRAs are high level strategic documents and, as such, do not go into detail on an individual site-specific basis. This SFRA has been developed using the best available information, supplied at the time of preparation. This relates both to the current risk of flooding from all sources and the potential impacts of future climate change. The Environment Agency regularly reviews its flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a site-specific FRA. Other datasets used to inform this SFRA may also be periodically updated and following the publication of this SFRA, new information on flood risk may be provided by Risk Management Authorities.

Appendices

A Data Sources

Data	Description	Source
National Planning Policy Framework (NPPF) and Planning Practice Guidance (PPG)	Sets out the Government's requirements for the planning system	Ministry of Housing, Communities & Local Government
City Plan	City Plan Part 1 (2016) and 2	Brighton and Hove City Council
Ordnance Survey mapping	1:50,000 mapping for Brighton and Hove	Brighton and Hove City Council
	OS Vector Map	Ordnance Survey Open Data
Topography	DTM data - OS Terrain 50	Ordnance Survey Open Data
Geological data	Bedrock geology and Superficial deposits	British Geological Society
Historic flood risk	Brighton and Hove City Council's Flood Incident Database	Brighton and Hove City Council
	Environment Agency Recorded Flood Outlines	Environment Agency
	2008 and 2012 Brighton and Hove SFRAs	Brighton and Hove City Council
	2011 Brighton and Hove Preliminary Flood Risk Assessment	Brighton and Hove City Council
	Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy Review	Brighton and Hove City Council
	Section 19 Investigations	Brighton and Hove City Council
Tidal Flood Zones	Flood Zone 1, 2 and 3a Environment Agency Tidal Flood Zones	Environment Agency
	Flood Zone 3b Brighton and Hove Marina: Analysis was carried out using the tide level from JBA Extreme Sea Level Analysis (2004) ⁷ and LIDAR as prepared for the 2008 SFRA. Shoreham Port/ Aldrington Basin: Arun to Adur section of the East Sussex Coastal modelling (2012). This has been updated since the 2012 SFRA and includes wave overtopping. The Functional Floodplain for the rest of the area within Brighton and Hove has represented using Flood Zone 3a	JBA Consulting JBA Consulting Environment Agency
Existing models	Arun to Adur flood modelling 2012	Environment Agency

	Shoreham Harbour flood modelling June 2011	Environment Agency
Surface water flood risk	Risk of flooding from Surface Water (RoFfSW)	Environment Agency
Surface water climate change modelling	RoFfSW plus 30% and 40% climate change allowance	JBA Consulting
Surface Water Flood Zones	Accumulation Zone: RoFfSW without an allowance for drainage	JBA Consulting
	Conveyance Zone: All areas that have a gradient steeper than 1 in 20 (or gradient of 5%) using 5m DTM data	Brighton and Hove City Council
Groundwater flood Risk data	JBA Groundwater Map	JBA Consulting
Sewer Flood Risk	Records of historic sewer flooding based on the Sewage Incident Report File (SIRF)	Southern Water
Coastal defences	Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy Review	Brighton and Hove City Council
Surface water flood assets	2014 Brighton and Hove Surface Water Management Plan	Brighton and Hove City Council
	Further details about individual assets	Brighton and Hove City Council
Flood Alerts and Warnings	GIS layers of flood warning and alert area	Environment Agency

B Flood risk maps

B.1 Risk of Flooding from Surface Water maps

B.2 Surface water climate change mapping

B.3 JBA Groundwater flood map

C Site Screening Table

D Level 2 Site Summary Tables



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