Colas VolkerHighways AECOM

Working together to transform London's streets

LONDON HIGHWAYS ALLIANCE

London Borough of Islington

Strategic Flood Risk Assessment

TASK ORDER NUMBER	SM156227	**DATE**	August 2018

CONTRACT TITLE:	London Highways Alliance Contract		
CONTRACT AREA:	Central		
TASK ORDER NUMBER:	SM156227	**DATED:**	August 2018
NAME OF PROJECT:	London Borough of Islington Strategic Flood Risk Assessment		

PURPOSE OF ISSUE	BY	CHECKED	APPROVED	DATE	REV
Draft Issue	**Nicole Boakye**	**Emily Craven**	**Sarah Kelly**	**24/07/2017**	**001**
Updated Draft	**Hannah Booth**	**Chris Gordon**	**Sarah Kelly**	**24/11/2017**	**002**
Updated Draft	**Hannah Booth**	**Ela Shaw**	**Sarah Kelly**	**01/03/2018**	**003**
Final Issue	**Hannah Booth**	**Ela Shaw**	**Sarah Kelly**	**15/08/2018**	**004**

CONTENTS

ABBREVIATIONS

ACRONYM	DEFINITION
AEP	Annual Exceedance Probability
AOD	Above Ordnance Datum
BGS	British Geological Survey
CRT	Canal and River Trust
CDA	Critical Drainage Area
CRP	Council Response Plan
CFMP	Catchment Flood Management Plan
Defra	Department for Environment, Flood and Rural Affairs
DCLG	Department for Communities and Local Government
EA	Environment Agency
FCERM	Flood and Coastal Erosion Risk Management
FRA	Flood Risk Assessment
FRMP	Flood Risk Management Plan
FWMA	Flood and Water Management Act
GIS	Geographical Information System
GSPZ	Groundwater Source Protection Zone
ICM	Integrated Catchment Modelling
IDB	Internal Drainage Board
LBI	London Borough of Islington
LiDAR	Light Detection and Ranging
LFRZ	Local Flood Risk Zone
LFRMS	Local Flood Risk Management Strategy
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
MAFP	Multi-Agency Flood Plan
NPPF	National Planning Policy Framework
PFRA	Preliminary Flood Risk Assessment
PPG	Planning Practice Guidance for Flood Risk and Coastal Change
RoFSW	Risk of Flooding from Surface Water, formerly branded the updated Flood Map for Surface Water (uFMfSW)
SA	Sustainability Appraisal
SFRA	Strategic Flood Risk Assessment
SPD	Supplementary Planning Document

ACRONYM	DEFINITION
SPG	Supplementary Planning Guidance
STW	Sewage Treatment Works
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
TWUL	Thames Water Utilities Ltd

GLOSSARY OF TERMS

GLOSSARY	DEFINITION
Annual exceedance probability (AEP)	Annual exceedance probability (AEP) of occurrence in any one year, expressed as a percentage. For example, a 1 in 200 annual exceedance probability event has a 0.5% AEP of occurring in any year.
Aquifer	A source of groundwater comprising water bearing rock, sand or gravel capable of yielding significant quantities of water.
Attenuation	In the context of this report - the storing of water to reduce peak discharge of water.
Catchment Flood Management Plan	A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Climate Change (CC)	Long term variations in global temperature and weather patterns caused by natural and human actions.
Critical Drainage Area	A discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure
Culvert	A channel or pipe that carries water below the level of the ground.
DG5 Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years.
Exception Test	The exception test should be applied following the application of the sequential test. Conditions need to be met before the exception test can be applied.
Flood Defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Resilience	Measures that minimise water ingress (e.g. to buildings) and promotes fast drying and easy cleaning, to prevent permanent damage.
Flood Resistant	Measures that prevent flood water entering a building or damaging its fabric. This has the same meaning as flood proof.
Flood Risk	The level of flood risk is the product of the frequency or likelihood of the flood events and their consequences (such as loss, damage, harm, distress and disruption).
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and the Environment Agency under the Flood Risk Regulations 2009.
Flood Zone	Flood Zones refer to the probability of river and sea flooding, ignoring the presence of existing flood defences (i.e. the natural floodplain). It should be noted that Flood Zones on the Environment Agency Flood Map for Planning do not take account of the potential impact of climate change.
Freeboard	A freeboard is used to account for residual uncertainty within design, often an extra 300mm added to finished floor level above the design flood level to account for any uncertainty in flood levels as a safety factor.
Functional Floodplain	Land where water has to flow or be stored in times of flood.
Groundwater	Water that is in the ground, this is usually referring to water in the saturated zone

GLOSSARY	DEFINITION
	below the water table.
Lead Local Flood Authority (LLFA)	As defined by the Flood and Water Management Act, London Borough of Islington as LLFA are responsible for developing, maintaining and applying a strategy for local flood risk management (flooding from surface water, groundwater and ordinary watercourses) in their areas and for maintaining a register of flood risk.
Local Flood Risk Zone (LFRZ)	Discrete areas of flooding that do not exceed the national criteria for a 'Flood Risk Area' but still affect houses, businesses or infrastructure. A LFRZ is defined as the actual spatial extent of predicted flooding in a single location.
Local Planning Authority (LPA)	The public authority that is responsible for controlling planning and development through the planning system.
Main River	Watercourse defined on a 'Main River Map' designated by Defra. The Environment Agency has permissive powers to carry out flood defence works, maintenance and operational activities for main rivers only.
Mitigation measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere.
Ordnance Datum	In the British Isles, an ordnance datum is a vertical datum used by an ordnance survey as the basis for deriving altitudes on maps. A spot height may be expressed as AOD (Above Ordnance Datum), in this instance meaning above mean sea level at Newlyn in Cornwall.
Ordinary Watercourse	A watercourse that does not form part of a main river. This includes "all rivers and streams and all ditches, drains, cuts, culverts, dikes, sluices (other than public sewers within the meaning of the Water Industry Act 1991) and passages, through which water flows" according to the Land Drainage Act 1991.
Pluvial	Pluvial refers to flood events occurring throughout the direct action of rain – i.e. surface water flooding. Rather than water overflowing the banks of a river which is considered fluvial flooding.
Residual Flood Risk	The remaining flood risk after risk reduction measures have been taken into account. An example of residual flood risk includes the failure of flood management infrastructure (e.g. River Thames Flood Walls), or a severe flood event that exceed a flood management design standard, such as a flood that overtops a raised flood defence, or an intense rainfall event which the drainage system cannot cope with.
Return Period	Also known as a recurrence interval – an estimate of the likelihood of an event, such as a flood to occur.
Risk	Risk is a factor of the probability or likelihood of an event occurring multiplied by consequence: Risk = Probability x Consequence. It is also referred to in this report in a more general sense.
Sequential Test	Aims to steer vulnerable development to areas of lowest flood risk.
Sewer Flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
Source Protection Zone (SPZ)	Defined areas in which certain types of development are restricted to ensure that groundwater sources remain free from contaminants.
Surface Water	Flooding caused when intense rainfall exceeds the capacity of the drainage systems, or when during prolonged periods of wet weather, the soil is so saturated that it cannot accept any more water.
Sustainable Drainage Systems (SuDS)	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional

GLOSSARY	DEFINITION
	techniques.
Tidal Flooding	Temporary inundation of low lying areas during exceptionally high tide events
Topographic survey	A survey of ground levels.

EXECUTIVE SUMMARY

As a Local Planning Authority (LPA), the London Borough of Islington (LBI) has responsibility for the planning of future developments within its boundary. One of the key considerations in sustainable development is the early consideration of the risk of flooding within the Borough, now and in the future, in order to steer new development away from areas of high flood risk. This approach to planning, the sequential approach, is set out in the National Planning Policy Framework (NPPF) and associated Planning Practice Guidance for Flood Risk and Coastal Change (PPG).

This report is a Level 1 Strategic Flood Risk Assessment (SFRA) for LBI, which updates the Level 1 SFRA for North London produced in 2008. The purpose of this document is to facilitate flood risk management through identification of the spatial variation of flood risk across the Borough, using the most up to date and readily available flood risk information for the study area. This will serve as evidence base to support the London Borough of Islington Local Plan update, which is due for consultation in September 2018. This document will assess all potential sources of flooding including tidal flooding, flooding from rivers, surface water, groundwater, sewers, reservoirs and artificial sources. In order to complete this study, data has been collated from partner organisations including the British Geological Survey (BGS), the Environment Agency, Thames Water Utilities Ltd (TWUL) and the Canal and River Trust (CRT).

The data has been gathered and presented in flood maps to provide LBI with an overview of the flood risk issues across the study area, allowing for a Borough-wide comparison of future development sites with respect to flood risk conditions. The Environment Agency does not identify any tidal and fluvial floodplains associated with main rivers across the LBI, therefore LBI is wholly located within Flood Zone 1 and is perceived to be at low risk of tidal or fluvial flooding.

National surface water flood risk mapping released by the Environment Agency (The Risk of Flooding from Surface Water (RoFSW)) combined with data from the Surface Water Management Plan (SWMP) for Islington and detailed borough-wide surface water modelling undertaken in 2017, has been used to identify areas at risk from surface water flooding across the Borough. Three Critical Drainage Areas (CDAs) have been identified in the LBI SWMP, though it should be noted that these do not hold the same policy requirements as CDAs defined by the Environment Agency as outlined in the National Planning Policy Framework (NPPF). In addition, BGS geology data has been used to provide an understanding of the groundwater vulnerability, where underlying geology may enable the presence of groundwater below or at the surface level.

This SFRA should be used by LBI to apply the Sequential Test in future site allocations, in order to ensure that sites at the lowest risk of flooding are developed in preference to those at greater risk of flooding. This SFRA can also be used to apply the Sequential Test to individual planning applications

on unallocated sites which have not previously been subject to the Sequential Test. In addition, this SFRA provides guidance for developers, businesses and residents regarding requirements for managing and mitigating flood risk, preparing site-specific Flood Risk Assessments (FRAs) and recommendations for surface water management measures on future development sites.

1. INTRODUCTION AND USER GUIDE

1.1 Introduction

1.1.1 The National Planning Policy Framework (NPPF)[1] and the associated Planning Practice Guidance for Flood Risk and Coastal Change (PPG)[2] discuss the importance of Local Planning Authorities (LPAs) such as the London Borough of Islington (LBI) in adopting proactive strategies to ensure that flood risk is understood and managed effectively and sustainably throughout all stages of the planning process.

1.1.1 The NPPF outlines that Local Plans should be supported by a SFRA which LPAs should then utilise to inform strategic land planning. Figure 1.1 overleaf, reproduced from the PPG, illustrates how flood risk should be taken into account in the Local Plan for LBI.

1.1.2 This SFRA will provide an update to the Level 1 SFRA for North London, which was produced in 2008[3]. It will refine and collate the most up to date flood risk information for use by LBI as an evidence base to inform the updated Local Plan and subsequent planning documents, which is due for consultation late 2017. This will enable stringent decision-making by Development Management officers on a day-to-day basis.

1.1.3 As stated in the LBI Local Development Scheme[4], the Local Plan is currently made up of the following adopted documents:

- Islington Core Strategy (Adopted February 2011)[5];
- Islington Development Management Policies (June 2013)[6];
- Site Allocations (June 2013)[7];
- Finsbury Local Plan (June 2013)[8];
- Statement of Community Involvement (July 2006)[9];
- A range of Supplementary Planning Documents.

1.1.4 In order to achieve its purpose, the SFRA will inform the application of the Sequential and Exception Tests in the allocation of future development sites, as required by the NPPF, taking into account all sources of flooding.

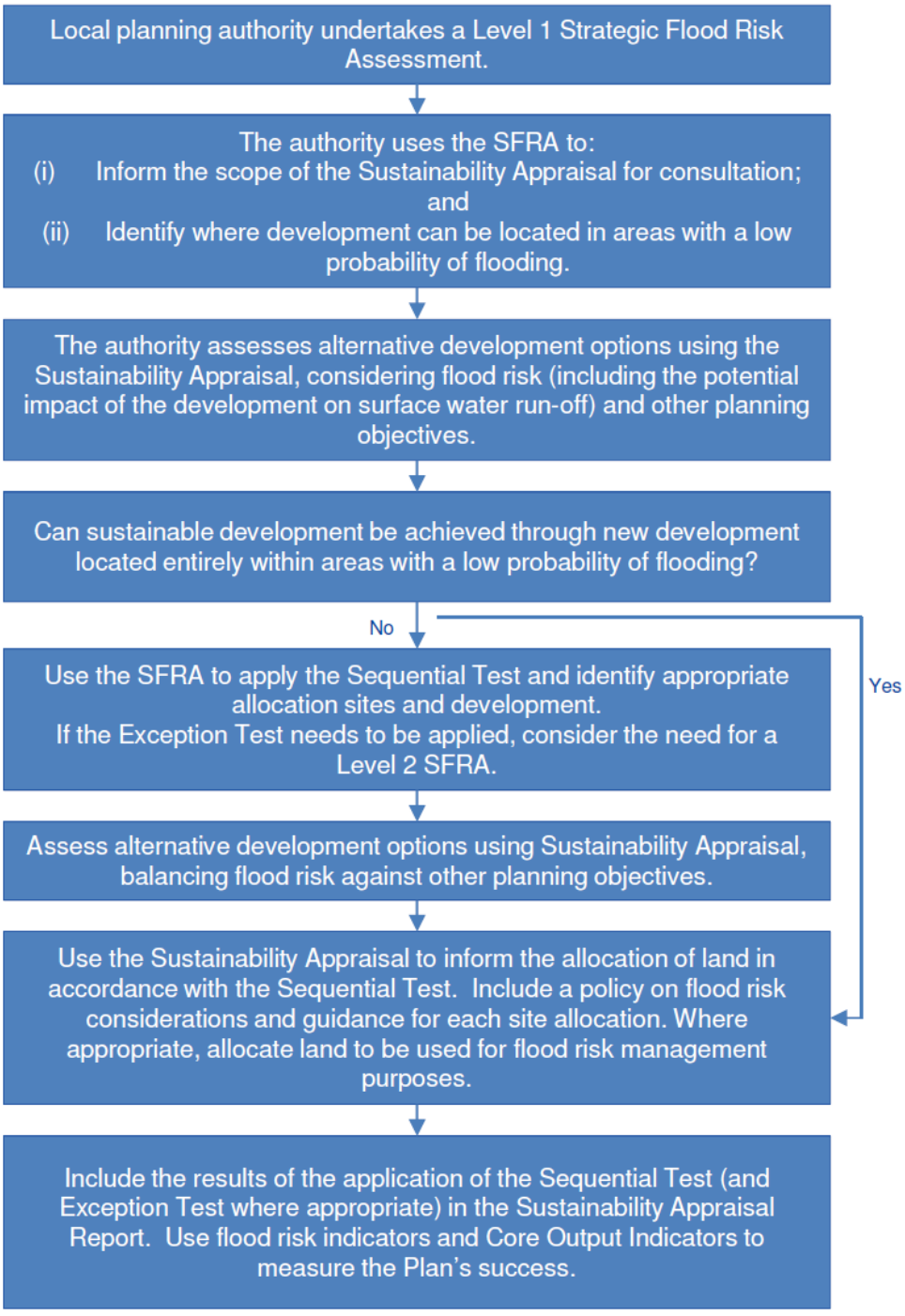


Figure 1.1. Taking flood risk into account in the preparation of a Local Plan (Planning Practice Guidance for Flood Risk and Coastal Change[2])

1.2 User Guide

1.2.1 It is anticipated that this SFRA will have a number of end users with slightly different requirements; hence this Section describes how to use the SFRA and how to navigate the report and mapping deliverables.

1.2.2 The LBI SFRA report is set out as follows:

- Section 2: Policy and Local Context
- Section 3: SFRA Methodology
- Section 4: Strategic Assessment of Flood Risk
- Section 5: Guidance on the application of the Sequential and Exception Tests
- Section 6: Guidance for preparing Site Specific FRAs
- Section 7: Sustainable Drainage Systems
- Section 8: Policy Options
- Appendix A: Data Register
- Appendix B: Borough Mapping

1.3 Strategic Planning and Policy

1.3.1 The main purpose of the SFRA for LBI, as explained in the NPPF, is to provide a strategic overview of flood risk within the borough to enable effective risk-based strategic planning for the future through the preparation of the Local Plan. Section 4 presents the information that should be used by LBI to inform their knowledge of flood risk from all sources, throughout the borough.

1.3.2 As part of this SFRA, a number of policy options have been developed for the borough and are presented in Section 8. These should be taken forward to inform the application of the Sequential and Exception Test during the Process of allocating development within the borough.

1.4 Applying the Sequential Test

1.4.1 The NPPF sets strict tests to protect people and property from flooding which all LPAs are expected to follow. The aim of the Sequential Test under the NPPF is to steer new development to areas with the lowest probability of flooding. Section 4 provides the data required to undertake the Sequential Test and Section 5 provides specific guidance on applying both the Sequential and, where appropriate, Exception Tests.

1.5 Emergency Planning

1.5.1 LBI is a Category One Responder under the Civil Contingencies Act 2004[10] and therefore has a responsibility, along with other organisations, for developing emergency plans to help reduce, control or ease the effects of an emergency. LBI has set out its response plan in the Islington Council Crisis Response Plan[11] (CRP).

1.5.2 The CRP sets out generic plans for any emergency event. However the complex nature of flooding and its subsequent impacts often requires a comprehensive and sustained response from a wide range of organisations. As such, LBI has prepared a Multi-Agency Flood Plan (MAFP)[12] to allow all responding parties to work together in a coordinated response to a flood event.

1.5.3 The SFRA deliverables should be used by the LBI Emergency Planning team as a useful source of up to date information about flood risk. The SFRA should be reviewed by the team such that the findings can be incorporated into their understanding of flood risk and any future revisions of the MAFP.

1.6 Preparing Site Specific FRAs

1.6.1 The SFRA can provide a useful starting point to the preparation of site specific Flood Risk Assessments (FRAs) for individual development sites as follows:

- Section 4 provides an overview of the key issues within the borough in relation to flood risk.
- Section 5 provides guidance on the application of the Sequential Test for sites that have not yet been tested by the LPA, as well as details on when the Exception Test is required and how to apply it.
- Section 6 provides specific guidance for preparing site specific FRAs in accordance with the checklist presented in the Planning Practice Guidance.

1.7 Assessing Planning Applications

1.7.1 Planning and development officers who are reviewing site specific FRAs as part of the planning application process should consult Section 4 of the SFRA to provide background for flood risk in the area relating to the planning application. Section 6 can also be used by those assessing applications as a checklist for issues that need to be addressed as part of site specific FRAs.

2. POLICY AND LOCAL CONTEXT

2.1 National Policy

Flood and Water Management Act (2010)

2.1.1 Following the severe national floods of 2007, the Government commissioned Sir Michael Pitt to undertake a review of flood risk management. In The Pitt Review[13], it was recognised that "the role of local authorities should be enhanced so that they take on responsibility for leading the co-ordination of flood risk management in their areas".

2.1.2 The Flood and Water Management Act (2010)[14] (FWMA) brought in new roles and responsibilities for local authorities as a response to the Pitt Review. In particular, the Act defines the role of the Lead Local Flood Authority (LLFA), which includes Unitary Authorities (including LBI) or County Councils. LLFAs are encouraged to bring together relevant bodies and stakeholders to effectively manage local flood risk, which may include County, City and District/Borough Councils, Internal Drainage Boards (IDBs), highways authorities, water companies and the Environment Agency.

2.1.3 Responsibilities outlined in the FWMA assigned to LLFAs include:

- Coordinated management of flooding from surface water, groundwater and ordinary watercourses;
- Development, maintenance and implementation of a Flood Risk Management Strategy;
- Investigation and recording of local flood events;
- Establishment and maintenance of a Flood Risk Asset Register; and,
- Ordinary watercourse regulation.

The Flood Risk Regulations (December 2009)

2.1.4 The Flood Risk Regulations[15] came into force on the 10th December 2009 and set out duties for the Environment Agency and LLFAs to prepare reports pertaining to flood risk management.

2.1.5 The Flood Risk Regulations (2009) transpose the EU Floods Directive (2007/60/EC)[16] into UK Law. One of the main impacts on LLFAs in England and Wales is that they are required

to complete Preliminary Flood Risk Assessments (PFRAs). Where Flood Risk Areas were identified within the PFRA, it is required that Flood Risk maps showing the extents and hazards of flooding are produced alongside the Flood Risk Management Plans. The LBI is an LLFA and is responsible for the following:

- Producing a PFRA report compiling information regarding significant flood risk from sources other than from the sea, main rivers and reservoirs. A PFRA for LBI was completed in April 2011[17] and updated in June 2017;
- Determining whether there is a significant flood risk in the LLFA area in line with the Environment Agency's guidance[18] and identify the part of the area, if any, where this risk exists (for sources other than that from sea, main rivers and reservoirs); and
- Where a Flood Risk Area is identified there is a requirement to prepare flood hazard and flood risk maps for these areas for publication by the Environment Agency. In addition, for these areas, a Flood Risk Management Plan must be prepared.

2.2 Additional Guidance and Strategy Documents

National Flood and Coastal Erosion Risk Management (FCERM) Strategy

2.2.1 In accordance with the FWMA, the Environment Agency has developed a National Strategy for Flood and Coastal Erosion Risk Management (FCERM) in England[19]. This strategy provides a framework for the work of all flood and coastal erosion risk management authorities.

2.2.2 The National FCERM Strategy sets out the long-term objectives for managing flood and coastal erosion risks and the measures proposed to achieve them. It sets the context for local flood risk management strategies to be produced by LLFAs, which will in turn provide the framework to deliver local improvements needed to help communities manage local flood risk. It also aims to achieve effective risk management by LLFAs, encouraging information sharing and cooperation between people, communities, business and the public sector to work together to:

- Secure a clear understanding of the risks of flooding and coastal erosion, nationally and locally, so that investment in risk management can be prioritised more effectively;
- Set out clear and consistent plans for risk management so that communities and businesses can make informed decisions about the management of the remaining risks;

- Encourage innovative management of risks taking account of the needs of communities and the environment;
- Ensure that emergency responses to flood incidents are effective and that communities are able to respond properly to flood warnings; and,
- Ensure informed decisions are made on land use planning.

2.2.3 The Environment Agency's 'Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities'[20] guidance is a supporting note for the National FCERM Strategy. It provides the UK Climate Projections (UKCP09) climate change factors for river flood flows, extreme rainfall, storm surge and wave climate for each river basin district, and provides advice on applying climate change projections in the FCERM. It is essential that projects for flood and coastal erosion management measures consider designing for adaptation to a changing climate where appropriate, in order to ensure an economically credible appraisal is made for investment opportunities.

National Planning Policy Framework (2018)

2.2.4 The NPPF[21] was originally published on 27 March 2012 together with accompanying Technical Guidance. The NPPF revoked most of the previous Planning Policy Statements (PPS) and Planning Policy Guidance, including PPS25: Development and Flood Risk. However, the NPPF did not revoke the PPS25 Practice Guide. This was revoked on the 6th March 2014 along with the NPPF Technical Guidance, when it was replaced by the Planning Practice Guidance for Flood Risk and Coastal Change (PPG)[22].

2.2.5 The revised NPPF[1] was published on 24 July 2018 and sets out the 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.

2.2.6 The NPPF consists of a framework within which councils and local people can produce local and neighbourhood plans that reflect the needs and priorities of their communities. The overall approach to flood risk is broadly summarised in NPPF Paragraph 163:

2.2.7 "When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment50. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;

b) the development is appropriately flood resistant and resilient;

c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;

d) any residual risk can be safely managed; and

e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan."

2.2.8 The revised NPPF also makes provision for the requirement for major development to incorporate sustainable drainage systems (SuDS), as set out in NPPF Paragraph 165;

"Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

a) take account of advice from the lead local flood authority;

b) have appropriate proposed minimum operational standards;

c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and

d) where possible, provide multifunctional benefits."

2.2.9 Sustainable Drainage Systems (SuDS) are an approach to managing rainwater and surface water that replicates natural drainage, the key objectives being to manage the flow rate and volume of runoff at source, in order to reduce risk of flooding and to improve water quality. Following the 'Ministerial Statement HCWS161: Sustainable Drainage'[23], from 6th April 2015, the PPG for Flood Risk and Coastal Change was amended to provide a stronger emphasis on the implementation of SuDS. This requirement is now incorporated in Paragraph 165 of the revised NPPF.

2.2.10 LPAs are required to ensure that SuDS are incorporated in all major development plans where appropriate, and through the use of planning conditions or planning obligations, make sure that there are clear arrangements in place for ongoing maintenance over the lifetime of the development.

2.2.11 LLFAs are statutory consultees for surface water drainage. As LLFAs, each local authority will need to be consulted on the drainage elements of planning applications for major development to ensure they take account of the Government's 'Sustainable Drainage Systems: Non-Statutory Technical Guidance'[24], as well as other national and local standards.

Catchment Flood Management Plan (CFMP)

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

2.2.13 The CFMPs are used to inform and support planning policies, statutory land use plans and implementation of the Water Framework Directive, so that future development in the catchment is sustainable in terms of flood risk. The approach that the Environment Agency would like to see taken to flood risk management within the Study Area is outlined in the Thames CFMP (2009)[25]. The CFMP aims to identify flood risk management policies for the catchment and sets out the preferred plan for sustainable flood risk management in the Thames region over the next 50 to 100 years.

2.2.14 The preferred policy for the LBI in the CMFP is Policy 4 - Take further action to sustain the current level of flood risk into the future, responding to the potential increases in risk from urban development, land use change and climate change.

Flood Risk Management Plan (FRMP)

2.2.15 A FRMP must be produced by the Environment Agency for each river basin district in accordance with the Flood Risk Regulations (2009). It is a planning document which provides an overview of the main sources of flood risk and how these can be managed in a sustainable framework.

2.2.16 As such, the Thames River Basin District FRMP[26] has been published and proposes measures to manage flood risk in the Thames River Basin District from 2015-2021 and continually in 6-year cycles. The document draws upon information from catchment flood management plans (CMFP) and local flood risk management strategies (LFRMS). The FRMP develops objectives which are agreed upon by the risk management authorities

following consultation with stakeholders within the catchment. These objectives are met with measures which work towards reducing flood risk in the catchment.

Local Flood Risk Management Strategy

2.2.17 As a LLFA, the LBI has a statutory duty to develop, maintain, apply and monitor a strategy for local flood risk management. LBI produced their LFRMS[27] in 2017, to outline the priorities for flood risk management over the next 6 years. The LFRMS will be used to inform this SFRA as it provides a sustainable strategy for flood risk management.

2.2.18 The LFRMS has been utilised to develop an action plan which will aim to manage flood risk in line with a Strategic Environmental Assessment, to ensure the impacts of the strategy on the environment are minimal. The development of the action plan included input from a range of RMAs in LBI to ensure the plan could be sustainable and beneficial for the community.

Surface Water Management Plan

2.2.19 A Surface Water Management Plan (SWMP) is a framework to understand the causes of surface water flooding and agree the most cost effective way of managing surface water flood risk. The main outputs are a coordinated Action Plan to prioritise projects to reduce surface water flood risk and detailed mapping of areas prone to surface water flood risk.

2.2.20 In 2010, the Greater London area was selected to receive UK Government funding to prepare SWMPs and Preliminary Flood Risk Assessments (PFRAs) for all 33 London Boroughs and develop on the ground solutions to surface water flooding across London. The Drain London project was established to deliver these tasks in a consistent and coordinated way across London, administered by the Greater London Authority (GLA). LBI published its SWMP[28] in 2011, and it has been used to inform this SFRA.

Preliminary Flood Risk Assessment

2.2.21 Under the Flood Risk Regulations, all LLFAs were required to prepare a Preliminary Flood Risk Assessment (PFRA) report. This is a high level assessment which identifies areas of significant flood risk across England. The administrative area of Greater London as a whole is shown to be included in an Indicative Flood Risk Area. As part of the Drain London project, PFRAs were prepared for all London Boroughs in 2011. The LBI PFRA was updated in June 2017 and will be published in December 2017 in accordance with the Flood Risk Regulations requirements.

2.2.22 The PFRA seeks to provide a high level overview of flood risk from local flood sources and includes flooding from surface water, groundwater, ordinary watercourses and canals. It excludes flood risk from main rivers, the sea and reservoirs, as these are assessed nationally by the Environment Agency. The 2011 LBI PFRA[17] report looks at past flooding and where future flooding might occur across the area and the consequences it might have to people, properties and the environment.

Flood Risk Assessments: Climate Change Allowances

2.2.23 Environment Agency guidance on Flood Risk Assessments: Climate Change Allowances[29] describes when and how to use climate change allowances in flood risk assessments and strategic flood risk assessments. It is published after the Local Plan and other guidance but will be included in updated Local Plan.

2.2.24 The guidance updates previous climate change allowances to support the NPPF. Previously a 30% increase in peak rainfall intensity was applied, however based on the new guidelines a 40% increase is applied.

2.3 Regional Policy

The London Plan (2016)

2.3.1 The London Plan (2016)[30] is the overall strategic plan for London which delivers an integrated framework for the development of London over the next 20-25 years. The plan provides details with regard to requirements of flood risk management and sustainable drainage.

2.3.2 The London Plan Policy 5.12 Flood Risk Management states that:

"Development proposals must comply with the flood risk assessment and management requirements set out in the NPPF and the associated technical Guidance on flood risk over the lifetime of the development and have regard to measures proposed in Catchment Flood Management Plans."

2.3.3 Flood risk management should ensure that development in areas at risk from flooding include flood resistance and resilience measures and are designed to be capable of adaptation in the face of climate change.

2.3.4 The London Plan Policy 5.13 Sustainable Drainage states that:

A Development should utilise sustainable urban drainage systems (SUDS) unless there are practical reasons for not doing so, and should aim to achieve greenfield run-off rates and

ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:

1) *store rainwater for later use*
2) *use infiltration techniques, such as porous surfaces in non-clay areas*
3) *attenuate rainwater in ponds or open water features for gradual release*
4) *attenuate rainwater by storing in tanks or sealed water features for gradual release*
5) *discharge rainwater direct to a watercourse*
6) *discharge rainwater to a surface water sewer/drain*
7) *discharge rainwater to the combined sewer.*

Drainage should be designed and implemented in ways that deliver other policy objectives of this Plan, including water use efficiency and quality, biodiversity, amenity and recreation.

2.3.5 The new Draft New London Plan showing Minor Suggested Changes[31] has been published. Policy 5.13 is replaced by Policy SI13 which includes a requirement that *"Lead Local Flood Authorities should identify – through their Local Flood Risk Management Strategies and Surface Water Management Plans – areas where there are particular surface water management issues and aim to reduce these risks"* and amends the drainage hierarchy set out in Policy 5.13 to prioritise those sustainable drainage methods which make use of infiltration or above ground storage and disposal.

2.3.6 The use of SUDS should be promoted for development unless there are practical reasons for not doing so. Such reasons may include the local ground conditions or density of development. In such cases, the developer should seek to manage as much runoff as possible on site and explore sustainable methods of managing the remainder as close as possible to the site.

The Mayor's Sustainable Design and Construction SPG

2.3.7 The Sustainable Design and Construction – Supplementary Planning Guidance (SPG) (2014)[32] sets out a number of 'Mayor's Priorities' relating to Flood risk management, which support the policies laid out in the London Plan.

2.3.8 The Mayor's Sustainable Design and Construction SPG contains guidance on mitigating flooding, managing surface water and incorporating SuDS into new developments within London.

The Mayor's Water Strategy (2011)

2.3.9 The Mayor's Water Strategy[33] outlines the Mayor's aim to "adopt a more creative approach to managing flood risk from rainfall in London. Taking opportunities to slow the progress of water from 'rain to drain' and using rainwater for non-potable uses to reduce demand for treated mains water."

2.3.10 The surface water runoff and sustainable drainage requirements of the London Plan are reiterated in Policy 2 respectively of the Mayor's Water Strategy.

London Sustainable Drainage Action Plan 2016

2.3.11 The London Sustainable Drainage Action Plan[34] outlines the importance of including sustainable drainage within developments and identifies how sustainable drainage can be integrated into new and existing developments within London.

The Mayor's Draft Environmental Strategy

2.3.12 The Mayor's Draft Environmental Strategy[35] outlines the Mayor's plan to create a better environment in London. The strategy includes the Mayor's improvement measures to reduce flood risk, improve water quality using sustainable drainage, installing new flood defences and adapting to the increased risk of flooding caused by climate change.

2.4 Local Policy

Islington Local Development Scheme (2016)

2.4.1 The Islington Local Development Scheme (LDS)[36] was published in 2016 and provides information on the documents which the Council intends to produce to form its planning policy framework in line with the Islington Local Plan and the London Plan. The LDS outlines a timetable for review of the Local Plan and the supplementary planning documents.

2.4.2 The LDS details that the Core Strategy and Development Management Policies which make up the Local Plan, are due to be updated for consultation in September 2018, and adopted in summer 2019. This SFRA will be used to support the updated Local Plan, providing an evidence base for the existing flood risk in the Borough.

Finsbury Local Plan (2013)

2.4.3 The Finsbury Local Plan[37] forms part of Islington's Local Plan, and includes policy consistent with that of the London Plan and National Policy. It has been developed in order to focus on specific areas of Islington which are likely to experience development pressure in the future, Bunhill and Clerkenwell. Objectives within the documents which are relevant to flood risk are listed below.

2.4.4 The Finsbury Local Plan defines policies for 6 locations which will experience high levels of development in the next 15 years, 2 of which fall within a Local Flood Risk Zone (LFRZ). As such, the policy for Old Street and Farringdon Station contains recommendations to design buildings in a way which reduces surface water run-off and incorporates permeable surfaces.

Islington Core Strategy (2011)

2.4.5 The Islington Core Strategy[38] was adopted in 2011 and presents the plan for the future of the Borough. Strategies within the documents which are relevant to flood risk are listed below.

CS10 Sustainable Design

The council will seek to minimise Islington's contribution to climate change and ensure that the Borough develops in a way which respects environmental limits and improves quality of life. It will do this by:

E. Requiring all development to demonstrate that it is designed to be adapted to climate change, particularly through design which minimises overheating and incorporates

sustainable drainage systems (SUDS), with more specific targets to be set out in the Development Management Policies. Developments may also be required to contribute to wider local adaptation schemes which mitigate the impacts of climate change.

CS15 Open Space and green infrastructure

G. Maximising the contribution of new and existing open spaces to broader sustainability objectives including SUDS, climate change adaptation and biodiversity. These opportunities will be set out in the aforementioned Open Space and Green Infrastructure Strategy.

Islington Development Management Policies (2013)

2.4.6 The Islington Development Management Policies[39] present detailed policies which are used to determine planning applications in the Borough. Policies relevant to flood risk in the document are listed below.

DM6.6 Flood Prevention

A. Applications for major developments creating new floor space and major Changes of Use that are likely to result in an intensification of water use are required to include details to demonstrate that Sustainable Urban Drainage Systems (SUDS) have been incorporated and meet the following design standards:

i) Quantity: schemes must be designed to reduce flows to a 'greenfield rate' of run-off (8 litres/second/hectare for Islington), where feasible. The volume of run-off that must be stored on site should be calculated based on the nationally agreed return period value of a 1 in 100 years flood plus a 30% allowance for climate change for the worst storm duration. Where it is demonstrated that a Greenfield run-off rate is not feasible, runoff rates should be minimised as far as possible. The maximum permitted runoff rate will be 50 litres/ second/ hectare.

ii) Quality: the design must follow the SUDS 'management train', maximise source control, provide the relevant number of 'treatment stages' and identify how the 'first flush' will be dealt.

iii) Amenity and biodiversity: the design must maximise amenity and biodiversity benefits, while ensuring flow and volumes of run-off entering open space are predictable and water at the surface is clean and safe. Schemes should maximise areas of landscaping and/or other permeable surfaces to support this.

B. Sites located in Local Flood Risk Zones (LFRZs) will be required to submit a Flood Risk Assessment (FRA) to assess the risk of flooding, particularly surface water flooding, taking climate change projections into account. Where the FRA indicates that an additional volume of run-off must be stored above and beyond the amount calculated based on the method above, this must be provided on site.

C. All minor new build developments of one unit or more are required to reduce existing run-off levels as far as possible, and as a minimum maintain existing run-off levels, including through the incorporation of SUDS.

D. Developments may be required to make contributions to addressing surface water flood risk, particularly where they are located in areas considered at high risk of surface water flooding and in exceptional cases where the SUDS quantity standards cannot be achieved on site

Islington Supplementary Planning Documents

2.4.7 Islington Supplementary Planning Documents (SPD): Basement Development[40] provides additional information on LBI planning policies included in the Local Development Scheme and gives guidance for basement development within the borough and the following objective in regards to flood risk:

> "Basement development should be located to avoid areas of existing flood risk, be designed to minimise risk from flooding within the site and not contribute to flooding elsewhere."

2.4.8 The guidance is relevant to new basement developments of existing properties which require planning permission, as well as basements which are part of a new build. It provides further detailed explanation and guidance on the stages required to deliver a basement development site investigation. The guidance states that all basement development should submit a Structural Method Statement and a Construction Management Plan with the planning application, in order to identify any potential risks from such development.

2.4.9 The Islington Environmental Design Planning Guidance[41] includes information on mitigating the impacts of surface water caused by climate change using SuDS. Guidance is also provided on how LBI planning policy requirements can be met and includes example mitigation measures for minor and major developments. Information is also provided for creating resilient foundations that will not be impacted by climate change.

2.5 Study Area Overview

2.5.1 The study area is defined by the administrative boundary of LBI, located within Greater London, approximately 870m to the North of the River Thames, covering approximately 14.9km2. LBI is bordered by the administrative areas of the London Borough of Haringey to the north, the London Borough of Hackney to the east, the City of London to the south and the London Borough of Camden to the west. LBI encompasses the areas of Clerkenwell, Highbury, Highgate, Holloway, Finsbury Park and Archway.

2.5.2 There are significant targets for new homes and jobs in Islington, to meet both local and strategic needs. In the 2011 Local Plan Core Strategy, LBI projected a total of 17,400 new homes and 45,000 jobs to be generated by 2025, demonstrating significant growth projection across the Borough and the importance of understanding flood risk to new developments.

2.5.3 It should be noted that the housing figures presented in Section 2.5.2 above may be updated as part of the emerging Local Plan which is due for consultation in September 2018.

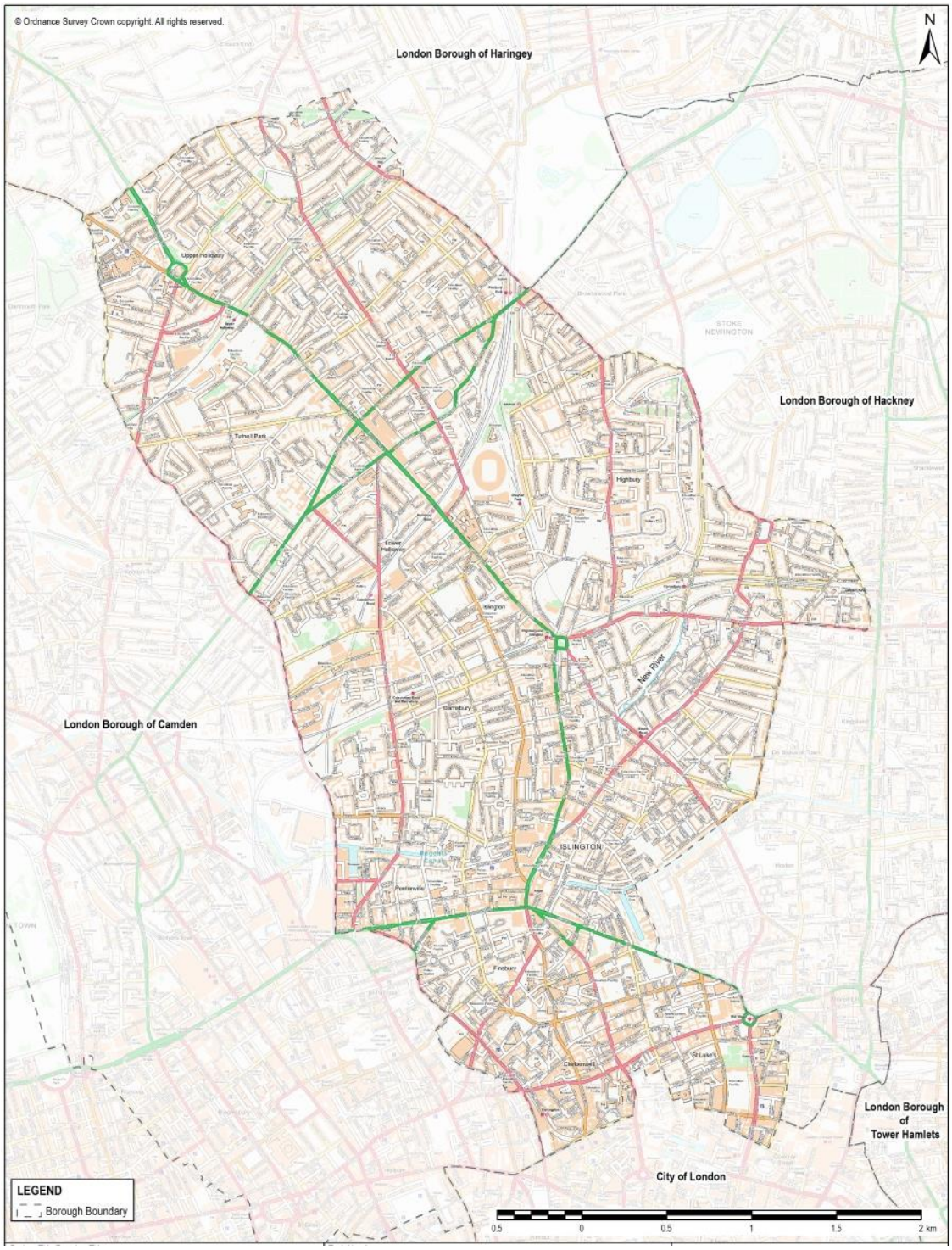


Figure 2.1 – London Borough of Islington Administrative Area

2.6 Topography

2.6.1 Figure A, Appendix B, shows Light Detection and Ranging (LiDAR) data. This is an airborne mapping technique which uses a laser to measure the distance between the aircraft and the ground. Up to 100,000 measurements can be made per second, allowing details terrain models to be generated at spatial resolutions of between 25cm and 2m.

2.6.2 LiDAR data outlines that the north of the Borough falls from a high point of 100m Above Ordnance Datum (AOD) near St Aloysius College towards a low point close to the Emirates stadium, and then rises back up to a ridge line at Highbury. This ridge line runs to the east of the A1 towards Islington, continuing in a southerly direction to Pentonville, before descending through Finsbury to the low point at Farringdon Station of 7m AOD. On the west boundary of the Borough towards Tufnell Park there is another localised high point centered on Hilldrop Road.

2.7 Waterbodies

Historic Rivers

2.7.1 Figure A of Appendix B shows there are currently no main rivers located in the LBI. Historically the New River aqueduct ran through Islington and supplied the City of London with water. The original termination point was at New River Head, near Clerkenwell. However in 1946, the New River Head was shorted at Stoke Newington to end at the East Reservoir. At present, a portion of artificially constructed New River runs through Canonbury, and is managed as a Thames Water asset.

Canals

2.7.2 The Regent's Canal was constructed in 1820 to form part of the Grand Union Canal, an amalgamation of 11 different canals connecting London to Birmingham. The Grand Union Canal stretches 135 miles and has 160 locks.

2.7.3 Regent's Canal is managed by the Canal and River Trust (CRT), and enters LBI in the west of the Borough, from the King's Cross area in the London Borough of Camden. The majority of the Canal is contained within an 886m long tunnel in LBI, which runs to Colebrook Row3. The Canal then continues east through the Borough, and up along the eastern border through the London Borough of Hackney. Regent's Canal is maintained by the Canal and River Trust. One lock gate, City Road Lock, is located along the section of Regent's Canal running through LBI.

Ordinary Watercourses

2.7.4 Ordinary watercourses include every river, stream, ditch, drain, cut, dyke, sluice, sewer (other than a public sewer) and passage through which water flows above ground or culverted, which is not designated as a main river.

2.7.5 As stated in the LFRMS, there are no ordinary watercourses within Islington. Flood risk from the New River and the Regent's Canal are considered under reservoirs, canals and other artificial sources within this SFRA.

2.8 Geology

2.8.1 Underlying geology can influence the presence and nature of groundwater in an area, and therefore potential groundwater flood risk. The geology can also impact on the potential for infiltration based drainage systems. The geology information for LBI has been obtained from the British Geological Survey data, and is displayed in Figure B and Figure C of Appendix B.

2.8.2 The bedrock geology (Figure C, Appendix B) of LBI is wholly comprised of Thames Group – Clay, Silt, Sand and Gravel.

2.8.3 The north of the Borough is shown to be free of superficial deposits (Figure B, Appendix B). River Terrace deposits can be found from Highbury southwards through Caledonian road and Upper Street, through to Finsbury and the south of the Borough. The area of Pentonville is also found to be free of superficial deposits.

2.9 Hydrogeology

Aquifer Type

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

2.9.2 In the Environment Agency aquifer type dataset, LBI is shown to possess no Bedrock aquifer designations. LBI is composed of Thames Group, which is a non-aquifer with low permeability that has negligible significance for water supply or river base flow.

2.9.3 The dataset also shows that LBI contains River Terrace Deposits, which comprise a number of superficial aquifer designations in the south of the Borough, are classified as Secondary A aquifers. The Environment Agency defines these as permeable layers capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of base flow to rivers.

2.9.4 Groundwater Source Protection Zones (GSPZs)[42] are zones that are likely to be at risk of contamination from activities that may cause pollution in the area. The presence of a GSPZ is not primarily of consideration in relation to flood risk, though should be taken into consideration when evaluating the environmental impact of a development. The Inner Zone of a Groundwater Source Protection Zone (GSPZ) is located between Barnsbury and Pentonville, and another around the A401 south of Angel Underground Station. A larger Outer Protection Zone covers a larger area around the two Inner Zones, from Highbury & Islington Rail Station, south to Finsbury.

Bedrock Permeability

2.9.5 Bedrock permeability can provide information relevant to surface water infiltration capacity, which could affect the subsequent surface water flood risk. The Environment Agency bedrock permeability datasets shows that the London Clay Formation, the uppermost sub-unit of the Thames Group, is classified as bedrock with permeability which is spatially variable, but likely to permit moderate infiltration.

3. SFRA METHODOLOGY

3.1 Overview

3.1.1 Under Section 14 of the NPPF, the risk of flooding from all sources must be considered as part of a SFRA, including flooding from the sea, rivers, land, groundwater, sewers and artificial sources. The study area is not located within an area at risk of tidal flooding and flood risk from this source will not be considered further as part of this SFRA. The methodology for the appraisal of flood risk from all sources is outlined below.

3.2 Data Collection and Methodology

Stakeholders

3.2.1 Table 3.1 outlines the stakeholders contacted during the development of this SFRA.

Table 3.1 Stakeholders contacted during the development of this SFRA.

Stakeholder Organisation	Role with respect to the LBI SFRA
LBI	As an LPA, LBI has a responsibility to consider flood risk in their strategic land use planning and the development of their Local Plan. The NPPF requires LPAs to undertake a SFRA and to use their findings, to inform strategic land use planning including the application of the Sequential Test which seeks to steer development towards areas of lowest flood risk. LBI is also required to consider flood risk when assessing applications for development. As defined by the Flood and Water Management Act, LBI as LLFA are responsible for developing, maintaining and applying a strategy for local flood risk management (flooding from surface water, groundwater and ordinary watercourses) in their areas and for maintaining a register of flood risk assets. LBI has the responsibility of maintaining a register of flood risk across the Borough. As such, records held by the Council of flood incidents in the Borough were used to help inform the flood risk within LBI in the preparation of this SFRA. The SFRA should be used by the LBI Emergency Planning team so that the findings are incorporated into their understanding of flood risk and the preparation of their Multi-Agency Flood Plans (MAFP).
Environment Agency	The Environment Agency has a role to provide technical advice to LPAs and developers on how best to avoid, manage and reduce the adverse impacts of flooding. Part of this role involves advising on the preparation of spatial plans and sustainability appraisals as well as the evidence base documents underlying such documents, including SFRAs. The Environment Agency undertakes systematic modelling and mapping of fluvial flood risk associated with all main rivers, as well as mapping of surface water flood risk (RoFSW), and will supply available datasets for use within the SFRA.
Thames Water Utilities Ltd	Thames Water is responsible for surface water drainage via adopted sewers and for maintaining public sewers into which much of the highway drainage connects. In relation to the SFRA, the main role that Thames Water plays is providing data regarding past sewer flooding.

Stakeholder Organisation	Role with respect to the LBI SFRA
British Geological Survey	The British Geological Survey holds a number of datasets that will inform the SFRA, including superficial and bedrock geology data.
Canal and River Trust	The Canal and River Trust (CRT) maintains over 2,000 miles of canals and rivers in the UK, including Regent's Canal which runs through LBI. The CRT provided details of the assets within LBI which they control.

3.3 Fluvial Flood Risk

3.3.1 Flooding from rivers occurs when water levels rise higher than bank levels causing floodwater to spill across adjacent land (floodplain).

3.3.2 The risk of flooding is derived from the probability of a flood event occurring and the consequence to the receptor as a result. The NPPF classifies areas of the fluvial floodplain into zones of low, medium and high probability, as defined in Table 3.2. This is also presented on the 'Flood Map for Planning (Rivers and Sea)' available on the Environment Agency website.

Table 3.2 Fluvial Flood Zones (Adapted from PPG[2])

Flood Zone	Flood Zone Definition for River Flooding	Probability of Flooding
Flood Zone 1	Land having a less than 1 in 1,000 chance of river flooding each year (0.1% AEP). Shown as clear on the Flood Map – all land outside Flood Zones 2 and 3.	**Low**
Flood Zone 2	Land having between a 1 in 100 and 1 in 1,000 chance of river flooding each year (between 1% and 0.1% AEP).	**Medium**
Flood Zone 3a	Land having a 1 in 100 or greater chance of river flooding each year (greater than 1% AEP).	**High**
Flood Zone 3b	Land where water has to flow or be stored in times of flood, or land purposely designed to be flooded in an extreme flood event (flood storage area). Flood Zone 3b is defined by the LPA, in this instance the 1 in 20 annual probability has been used to define Flood Zone 3b. Not separately distinguished from Flood Zone 3a on the Flood Map for Planning (Rivers and Sea).	**Functional Floodplain**

3.3.3 The New River which was historically located in LBI has now been diverted from Islington and incorporated into the East Reservoir. Although a section of the New River still exists in Islington, it should be considered as an artificial source rather than a fluvial source. There are also no ordinary watercourses within the Borough. Consequently, the entirety of LBI is located in Flood Zone 1 (low risk) considered as land having a less than 1 in 1,000 chance of river flooding each year (0.1% AEP).

Historic Flooding from rivers

3.3.4 The Environment Agency's Historic Flood Map was used to determine if any historic river flooding has occurred within LBI.

3.4 Surface Water Flood Risk

3.4.1 Overland flow and surface water flooding typically arise following periods of intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems. This occurs most commonly in urban areas where water is unable to enter the ground due to the presence of impermeable surfaces.

3.4.2 The Environment Agency has undertaken modelling of surface water flood risk at a national scale and produced mapping identifying those areas at risk of surface water flooding during three annual exceedance probability events: 1 in 30 year (3.33% AEP), 1 in 100 year (1% AEP) and 1 in 1,000 year (0.1% AEP). The latest version of the mapping is referred to as the Risk of Flooding from Surface Water (RoFSW)[i] and the extents have been made available to LBI as Geographical Information System (GIS) layers, presented in Figure D, Appendix B.

3.4.3 The RoFSW provides all relevant stakeholders, such as the Environment Agency, LBI (as the LLFA) and the public access to information on surface water flood risk which is consistent across England and Wales[43]. The modelling will help the Environment Agency to take a strategic overview of flooding and assist LBI in their duties relating to management of surface water flood risk. For the purposes of this SFRA, the mapping allows an improved understanding of areas within the LBI administrative area which may have a surface water flood risk.

3.4.4 The modelling represents a significant improvement on previous mapping, namely the Flood Map for Surface Water (FMfSW) (2010) and the Areas Susceptible to Surface Water Flooding (AStSWF) (2009), for example:

[i] The Risk of Flooding from Surface Water mapping (RoFSW), produced by the Environment Agency, replaces that which was formerly branded as the Updated Flood Mapping for Surface Water (uFMfSW).

- Increased model resolution to 2m grid;
- Representation of buildings and flow routes along roads and manual editing of the model for structural features such as flyovers;
- Use of a range of storm scenarios; and
- Incorporation of appropriate local mapping, knowledge and flood incident records.

3.4.5 However, it should be noted that this national mapping has the following limitations:

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

3.4.6 To provide a higher level assessment of the surface water flood risk within the Borough, detailed surface water modelling has been completed for LBI by CVU.

3.4.7 The aim of the project was to improve the understanding of surface water flood risk within the three Critical Drainage Areas (CDAs) within LBI, which were identified in the SWMP. This will help to identify and assess the feasibility of potential alleviation measures that could be suitable for Partnership Funding via the Environment Agency's Flood Risk and Coastal Erosion Risk Management (FCERM) process. The three CDAs identified in the SWMP cover the majority of the LBI and the decision has been taken to extend the modelling to cover the full extent of the LBI therefore providing a consistent dataset for the Borough.

3.4.8 The detailed modelling improves the understanding of surface water flood risk within the Borough by integrating the results of the TWUL sewer network model of the Beckton Sewage Treatment Works (STW) with a surface model constructed in InfoWorks Integrated Catchment Modelling (ICM) (v7.0). The TWUL sewer network model provides details on the capacity of the sewer network in all of the return period events assessed; this includes the volumes of flood water predicted to flood from the sewer network onto the surface at manholes and the water level within the sewer network over the duration of a storm event. This information has been utilised by the surface model to:

- Apply and route flood water arising from the sewer network across the ground to assess its impact on people, property and infrastructure within the Borough
- Limit the capability of gullies and drains within the Borough to remove surface water runoff from the ground surface where the water level within the sewer network is predicted to be high, the resulting surface water remains on the ground surface and is routed by the model to assess its impact on people, property and infrastructure.

The modelled surface water flooding outputs from the Borough wide modelling are presented in Figure E of Appendix B.

Climate Change

3.4.9 The RoFSW does not include a specific scenario to determine the impact of climate change on the risk of surface water flooding. However, the detailed surface water modelling undertaken by CVU includes an output with 40% allowance for climate change for the 1 in 100 year (1% AEP) storm event, in accordance with the Environment Agency Guidance on Flood Risk Assessments: Climate Change Allowances (2016). This provides an indication of the implications of climate change on surface water flood risk. Modelled outputs from the Borough wide surface water modelling including climate change are presented in Figure F of Appendix B.

Historic Flooding from Surface Water

3.4.10 There are very few records of historic flooding across LBI, however evidence from the SWMP suggests heavy rainfall events have previously led to surface water flooding.

3.5 Groundwater Flood Risk

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

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

- Direct contribution to channel flow – where the river channel intersects the water table and groundwater enters the streambed increasing water levels and causing flooding.
- Springs erupting at the surface.

- Inundation of drainage infrastructure – where the infrastructure has eroded over time.
- Inundation of low lying property (basements)

3.5.3 The main impacts of groundwater flooding are:

- Flooding of basements of buildings below ground level – this can range from seepage of small volumes of water through walls and temporary loss of services to larger volumes of water, catastrophic loss of belongings and failure of structural integrity.
- Overflowing of sewers and drains – surcharging of drainage networks can lead to overland flows causing localised damage to property. Sewer surcharging can lead to inundation of property by polluted water. However it is difficult to differentiate between groundwater flooding and other sources (surface water or sewer flooding).
- Flooding of buried services or other assets below ground level – prolonged inundation of buried services can lead to interruption and disruption of supply
- Inundation of roads, commercial, residential and amenity areas – inundation of hard-standing areas can lead to structural damage and the disruption of commercial activity.
- Flooding of ground floors of buildings above ground level – can result in structural damage. In addition, a groundwater flood event will typically have a long duration (compared to other flood sources), adding to the disruptive nature of the flood event.

3.5.4 In order to provide a strategic assessment of the risk of groundwater flooding in LBI, a review of the BGS GIS layers for superficial geology, bedrock geology and susceptibility to groundwater flooding was completed. As well as this, data from the LBI LFRMS and SWMP has been used to show the potential for elevated groundwater within the Borough.

3.5.5 The BGS layer for susceptibility to groundwater flooding was been developed through modelling of permeable superficial deposits and aquifer levels, to present areas where groundwater flooding could occur. This improves on the 'potential for elevated groundwater' mapping which was produced in the SWMP and LFRMS, as it uses three classes of groundwater flood susceptibility as follows:

- Limited potential for groundwater flooding to occur
- Potential for groundwater flooding of property situated below ground level
- Potential for groundwater flooding to occur at surface.

The groundwater flood risk information for LBI has been obtained from the British Geological Survey data, and is displayed in Figure G of Appendix B.

3.6 Sewer Flood Risk

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

1. The rainfall event exceeds the capacity of the sewer system/drainage system:

Sewer systems are typically designed and constructed to accommodate rainfall events with a 1 in 30 years (3.33% AEP) or less. Therefore, rainfall events with a return period of frequency greater than 3.3% AEP would be expected to result in surcharging of some of the sewer system. While TWUL are concerned about the frequency of extreme rainfall events, it is not economically viable to build sewers that could cope with every extreme rainfall event.

2. The system becomes blocked by debris or sediment:

3.6.2 Over time there is potential that road gullies and drains become blocked from fallen leaves, build-up of sediment and debris (e.g. litter).

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

3.6.3 Where the local area is served by 'combined' sewers i.e. containing both foul and storm water, if rainfall entering the sewer exceeds the capacity of the combined sewer and storm overflows are blocked by high water levels in receiving watercourses, surcharging and surface flooding may again occur but in this instance floodwaters will contain untreated sewage.

Historic Flooding from Sewers

3.6.4 TWUL has provided an extract from their DG5 Flood Register (Sewer Flood Records) for the study area, which shows properties that have been affected by sewer flooding in the last 20 years. This data is presented in Figure I of Appendix B. Due to data protection requirements, this data has not been provided at individual property level; rather the register comprises the number of properties within 4 digit postcode areas that have experienced flooding either internally or externally, over the last 20 years.

3.7 Risk of Flooding from Reservoirs, Canals and Other Artificial Sources

3.7.1 An artificial source is any water body which is not covered under other categories and typically includes canals, lakes and reservoirs. The failure of a reservoir or artificial source has the potential to cause catastrophic damage due to the sudden release of large volumes of water. The PPG encourages LPAs to identify any reservoirs and evaluate how they might modify the existing flood risk in the event of a flood in the catchment is located within, and/or whether emergency draw-down of the reservoir will add to the extent of flooding.

3.7.2 Within LBI the artificial sources include:

- The Regents Canal
- The New River
- Maiden Lane Reservoir
- Claremont Square Reservoir
- Water Supply Network

3.7.3 The Environment Agency's Risk of Flooding from Reservoirs Mapping[44] (Figure H of Appendix B) identifies areas that could be flooded if a large[ii] reservoir were to fail and release the water it holds. There are no large reservoirs within the LBI, however there is potential for flooding in the north from reservoirs located outside of the Borough. Reservoirs in the UK have an extremely good safety record; The Environment Agency is the regulatory authority for the Reservoirs Act 1975 in England and Wales. All large reservoirs must be inspected and supervised by reservoir panel engineers on an annual basis.

3.7.4 Both the Claremont Square Reservoir and the Maiden Lane Reservoir are covered water supply reservoirs, managed by Thames Water. They are not included in the risk of flooding from reservoirs mapping, and there are no open reservoirs within Islington.

3.7.5 The New River has been classified as an artificially constructed water body by Thames Water. Sections of the New River are elevated above ground level and a failure of the embankment at these locations would result in a significant discharge of flow in a similar way to reservoir breach. The purpose of the New River is water supply and therefore Thames Water does not permit any new connections for drainage purposes.

[ii] A large reservoir is one that holds over 25,000 cubic metres of water, equivalent to approximately 10 Olympic sized swimming pools.

3.7.6 It is unlikely that the Regent's Canal would flood, as canals generally have a very low risk of flooding compared to naturally occurring rivers. As it is an artificial waterbody, levels can be controlled to prevent overtopping. The Regent's Canal (managed by the Canal and Rivers Trust (CRT)) is therefore considered to pose a minimal likelihood of flooding.

3.7.7 Flood risks from the water supply network are predominantly from bust water mains. Flooding from bust water mains is very difficult to predict. Further information on management and response to water supply network flooding is available from TWUL.

Historic Flooding

3.7.8 There are currently no records held of flooding for reservoirs, or the Regents Canal, in the Borough. Any flooding which occurs from the New River should be fully investigated by Thames Water as the asset owner.

3.8 Summary

3.8.1 This Section has provided a description of the datasets that have been supplied for use as part of the SFRA. The following Section uses these datasets to provide an assessment of the flood risk within the Borough, to be utilised by LBI as the LPA for future development plans.

4. STRATEGIC ASSESSMENT OF FLOOD RISK WITHIN LONDON BOROUGH OF ISLINGTON

4.1 Flooding from Rivers

4.1.1 As stated in Section 3.3.3, all main rivers historically located within LBI are no longer present and there are no ordinary watercourses within the Borough. The Environment Agency's Historic Flood map also showed that no flooding has occurred within LBI from fluvial sources. Therefore, there is no fluvial flood risk within LBI. The New River is considered to be an artificial water source and is discussed in Section 4.5 as part of Reservoirs, Canals and other Artificial Sources.

4.2 Flooding from Surface Water

4.2.1 There are currently no Environment Agency defined Critical Drainage Areas (CDAs), however the LBI Surface Water Management Plan (SWMP) identified three CDAs within LBI which are defined in the SWMP as:

"A discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure."

4.2.2 Therefore a specific area within a CDA is not necessarily at higher risk from surface water than an area outside of a CDA. However, the location of an area within a CDA indicates that it is within a catchment area which contributes to a flooding hotspot. Within CDAs, surface water management should be a particular focus of new developments.

4.2.3 Figure D, Appendix B, shows that the majority of the Borough is located within a CDA identified in the SWMP – including the northern section up to Highbury, and the western strip along Liverpool Road down to the southern boundary. There is also an area of the south eastern corner of the Borough included in a CDA. Any development in areas of previously undeveloped land in LBI is likely to have a negative impact on surface water flood risk in LBI by reducing the potential for infiltration of runoff, unless appropriate surface water management is incorporated into the development to reduce the runoff from site post-development.

4.2.4 The SWMP also identifies eight Local Flood Risk Zones (LFRZ) (Figure 3.1 of SWMP and Figure D, Appendix B), and they are identified as:

"Discrete areas of flooding that do not exceed the national criteria for a 'Flood Risk Area' but still affect houses, businesses or infrastructure. A LFRZ is defined as the actual spatial extent of predicted flooding in a single location."

4.2.5 The Environment Agency RoFSW modelling for LBI is provided in Figure D of Appendix B. It shows that for the model scenarios (3.33% AEP, 1% AEP and 0.1% AEP) the surface water flood extent largely follows the man-made features such as roads and rail lines, particularly in the 1 in 30 year (3.33% AEP) events. Increased ponding can be identified in areas around properties for 1 in 1,000 year (0.1% AEP) events, particularly in areas of low topography around Canonbury and Clerkenwell Road, as well as the Upper Holloway area, between Tollington Road and the Emirates Stadium, and on Holloway Road.

4.2.6 Detailed Borough wide surface water modelling for LBI is available in Figure E of Appendix B. It shows that for the model scenarios (3.33% AEP, 1% AEP and 0.1% AEP) surface water flooding predominantly follows roads and heavily urbanised areas including Hornsey Road, Holloway Road and Courtauld Road. Surface water ponding is present in areas of low topography around Wray Crescent, Gillespie Road and to the south of Downcross Street.

4.2.7 It should be noted that the RoFSW data in Figure D of Appendix B and Detailed Borough wide modelling in Figure E of Appendix B, should be used together to assess flood risk. Although these two data sets are the most recent and up-to-date surface water modelling that has been undertaken, the following website should be checked for any updates to the data: https://flood-warning-information.service.gov.uk/long-term-flood-risk

4.3 Flooding from Groundwater

Geology

4.3.1 In LBI there are superficial deposits in the southern half of Islington comprising of River Terrace Deposits (Figure B, Appendix B). The named formations are Hackney Gravel Member (Sand and Gravel (S&G)), Taplow Gravel Formation (S&G), Alluvium (Clay, Silt, Sand and Gravel), Langley Silt Member (Silt), Boyn Hill Gravel Member (S&G) and Finsbury Gravel Member (S&G). The bedrock geology (Figure C, Appendix B) in the Borough is underlain primarily by Thames Group – clay, silt, sand and gravel.

Groundwater Flooding

4.3.2 Figure G of Appendix B shows the BGS layer for susceptibility to groundwater flooding in LBI. This dataset identifies which portions of the Borough fall into the three classifications as discussed in Section 3.5.4 –limited potential for groundwater flooding to occur, potential for groundwater flooding of property situated below ground level and potential for groundwater flooding to occur at the surface.

4.3.3 Within LBI, the areas which are likely to have the greatest potential for groundwater flooding to occur are generally in the south of the Borough, underlain by permeable superficial deposits (Figure B, Appendix B). However, the northern area around Saint Aloysius College has a 'limited potential for groundwater flooding to occur'. Equally there are areas with 'limited potential for groundwater flooding to occur' in the south of the Borough, around Barnsbury and Clerkenwell. Both of these areas are surrounded by larger regions with the 'potential for groundwater flooding of property situated below ground level'.

4.3.4 The areas which have 'potential for groundwater flooding to occur at the surface' are concentrated along the eastern boundary with Hackney, from Leconfield Road to the junction of City Road and Tabernacle Street in the south. There are also areas along the western boundary with Camden, from Margery Street along Farringdon Road, to the southern edge of the Borough, and further north around Highbury and Islington station.

4.3.5 It can be noted that a number of groundwater flooding incidents have been recorded outside the areas with potential for groundwater flooding to occur by the Environment Agency within the SWMP. Groundwater Flooding is often relatively small scale and site-specific, whereas the mapping shown in Figure G of Appendix B is produced from regional mapping and should only be used as a guide. Therefore there is a potential for groundwater flooding to occur outside the areas which have been identified within this SFRA.

4.4 Flooding from Sewers

4.4.1 LBI is served by a TWUL combined surface and foul water sewer system, which is typically designed and constructed to accommodate rainfall events with a 1 in 30 year (3.33% AEP) event or less. Therefore, rainfall events with a return period of frequency greater than 3.3% AEP would be expected to result in surcharging of some of the sewer system. However the North London SFRA[27] identified the sewer network within Islington as being particularly old, with some sections of sewer potentially designed to only convey storms up to the 10% AEP.

4.4.2 TWUL Sewer Flood records, presented in Figure I in Appendix B, show that internal and external sewer flooding incidents have been concentrated south of the Regent's Canal in the past 20 years. A high proportion of incidents occurred in the south of the Borough, with 4 postcode boundaries having over 20 incidents within each. Incidents also occurred in properties in the area of Clerkenwell, and in Barnsbury. There have also been 2 sewer flooding events in the northern area of Finsbury Park.

4.5 Flooding from Reservoirs, Canals and other Artificial Sources

The Regent's Canal

4.5.1 Canals generally present minimal flood risk as they have limited surface water inputs and no part of the canal appears to be on the embankment which removes the flood risk posed by an embankment failure. The water level within Regent's Canal is controlled by a series of lock gates, and the risk of flooding as a result of overtopping or breaching of the canal is low. There is one canal lock within LBI, and the following lock (halfway along Arlington Avenue in Hackney) is the first of several locks prior to discharging into the Thames at Limehouse. Therefore any malfunction to the east of the Borough would cause the water to flow through Hackney, not Islington.

The New River

4.5.2 As discussed in Section 3.7.5, the New River is categorised as an artificially constructed water source. It is utilised for water supply, with both its inlet and outlet controlled by Thames Water. It was constructed on a flat gradient, ensuring that the flow of water remains steady and controlled from its point of inlet from the River Lea in Hertfordshire to Clissold Park where Thames Water divert the flow for water supply.

Environment Agency Risk of Flooding from Reservoirs Mapping

4.5.3 The Environment Agency's Risk of Flooding from Reservoirs Mapping[44] identifies areas that could be flooded if a large reservoir were to fail and release the water it holds. The two reservoirs within Islington, Maiden Lane and Claremont Square, are both covered reservoirs managed by Thames Water and are therefore not included in the mapping. However there is a potential for flooding to occur within the Borough from reservoirs within the adjacent London Borough of Camden.

4.5.4 Figure H of Appendix B shows the potential of reservoir flooding within Islington. The Highgate Ponds No. 2 and 3 in the London Borough of Camden have the potential to flood, with waters flowing south-eastern into Islington, just above Tufnell Park underground station to Upper Holloway rail station, and along Tufnell Road and Holloway Road, just north of Holloway Road underground station. Estimated flood depths would predominantly be between 0.3m and 2m, with flood velocities primarily between 0.5m/s and 2m/s.

4.5.5 The Mapping also shows the potential for flooding from reservoirs within the London Borough of Waltham Forest. They have the potential to flood south west into Islington, down from Crouch Hill rail station through Tollington Park, up to Seven Sisters Road. The estimated flood depths would primarily be below 0.3m, and the flood speed 0.5m/s.

Other Sources

4.5.6 The LBI LFRMS[27] notes incidents of flooding from burst water mains in Wallace Road in November 2003 and Upper Street in February 2006. In December 2016, a TWUL ruptured water main on Upper Street in Angel led to surface water flooding in the surrounding area and affected numerous homes and businesses, particularly basements. It also caused the closure of Angel underground station for a brief period.

4.6 Consideration of Climate Change

4.6.1 The NPPF and PPG set out how the planning process should minimise vulnerability and provide resilience to the impacts of climate change. This includes demonstrating how flood risk will be managed now and over the lifetime of the development, with a consideration of climate change.

4.6.2 The Environment Agency published the latest climate change allowances for flood risk assessments in 2016, with predictions for anticipated change on:

- Peak river flow by river basin district
- Peak rainfall intensity
- Sea level rise
- Offshore wind speed and extreme height

4.6.3 The allowances help to maximise the resilience of flood management in the future by predicting flood risk changes based on UK Climate Projections (UKCP09) data. Full guidance can be found at the Environment Agency link: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

4.6.4 Within LBI, climate change is likely to predominantly increase flood risk from surface water. In order to account for the impacts of climate change in LBI, the detailed surface water modelling has included an output with a 40% allowance for climate change. Figure F of Appendix B shows the flood risk extent for the 1% AEP surface water extent scenario and the 1% AEP surface water extent scenario including an allowance of 40% for climate change.

5. GUIDANCE ON THE APPLICATION OF THE SEQUENTIAL AND EXCEPTION TEST

5.1 Overview

5.1.1 As described in Section 2, the NPPF and PPG for Flood Risk and Coastal Change set strict tests to protect people and property from flooding which LBI, as a LPA, must adhere to during the preparation of their Local Plan.

5.1.2 The emphasis of the NPPF is to steer new development away from areas at risk of flooding using the Sequential Test. Where development cannot be avoided in areas identified to be at risk of flooding, guidance is provided regarding the types of development that are appropriate, based on the vulnerability classification and criteria are set for when the Exception Test may be required before development can be permitted.

5.1.3 Guidance on the application of the Sequential and Exception Test is largely focused on flood risk from fluvial sources, as outlined in Figure 5.1 below, an extract from the Planning Practice Guidance for Flood Risk and Coastal Change.

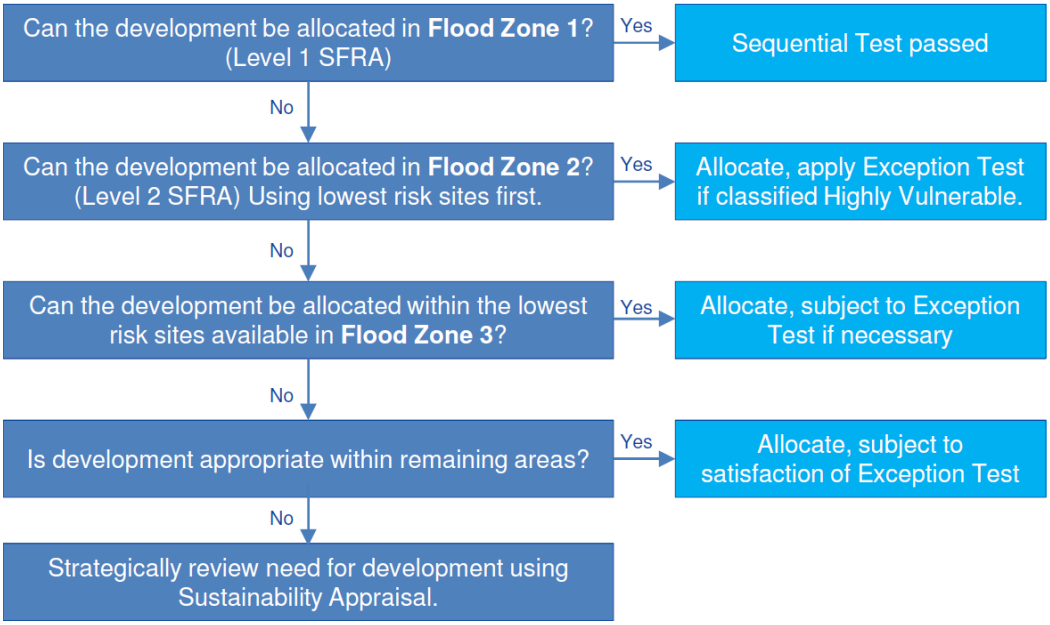


Figure 5.1: Application of Sequential Test for Local Plan preparation (Planning and Practice Guidance for Flood Risk and Coastal Change[2])

5.1.4 Despite the focus on fluvial flood risk, the PPG for Flood Risk and Coastal Change makes it clear that developments in Flood Zone 1 should consider and, where appropriate, be steered away from other sources of flooding such as surface water and groundwater.

5.1.5 The application of the sequential approach aims to manage the risk from flooding by avoidance. This will help avoid the promotion of sites that are inappropriate on flood risk grounds. The subsequent application of the Exception Test will ensure that new developments in flood risk areas will only occur where flood risk is clearly outweighed by other sustainability drivers.

5.2 Fluvial Flood Zones

5.2.1 As no main rivers are located within LBI, the entire Borough is located within Flood Zone 1. In this instance, the Sequential Test should consider flood risk from other sources.

Development Vulnerability

5.2.2 The NPPF provides guidance on the suitability of a development based on its vulnerability and location within a flood risk area. Flood risk vulnerability classifications, as defined in the PPG, are presented in Table 5.1.

Table 5.1: Flood Risk Vulnerability Classification (PPG[2])

Vulnerability Classification	Development Uses
Essential Infrastructure	Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. Wind turbines.
Highly Vulnerable	Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding. Emergency dispersal points. Basement dwellings. Caravans, mobile homes and park homes intended for permanent residential use. Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as "essential infrastructure").

Vulnerability Classification	Development Uses
More Vulnerable	Hospitals. Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. Non–residential uses for health services, nurseries and educational establishments. Landfill and sites used for waste management facilities for hazardous waste. Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable	Police, ambulance and fire stations which are not required to be operational during flooding. Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non–residential institutions not included in "more vulnerable", and assembly and leisure. Land and buildings used for agriculture and forestry. Waste treatment (except landfill and hazardous waste facilities). Minerals working and processing (except for sand and gravel working). Water treatment works which do not need to remain operational during times of flood. Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).
Water-Compatible Development	Flood control infrastructure. Water transmission infrastructure and pumping stations. Sewage transmission infrastructure and pumping stations. Sand and gravel working. Docks, marinas and wharves. Navigation facilities. MOD defence installations. Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. Water-based recreation (excluding sleeping accommodation). Lifeguard and coastguard stations. Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

5.2.3 The NPPF indicates suitability of a development based on its vulnerability and location within a fluvial flood zone (Table 5.2). However, the vulnerability classification of types of development is still relevant in considering flood risk from other sources. For example, a

basement dwelling will still be more vulnerable to surface water flooding than an office development.

Table 5.2: Flood Risk Vulnerability and Flood Zone 'Compatibility' (PPG[2])

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	1	✓	✓	✓	✓	✓
	2	✓	✓	Exception Test Required	✓	✓
	3A	Exception Test Required	✓	✗	Exception Test Required	✓
	3B	Exception Test Required	✓	✗	✗	✗

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

5.2.4 The NPPF acknowledges that some areas will be at risk of flooding from other sources than fluvial and tidal, despite the lack of guidance in Table 5.2 for other sources of flooding.

5.3 Recommended stages for LPA application of the Sequential Test in LBI

5.3.1 As LBI is located entirely in Flood Zone 1, there is no risk of flooding from fluvial or tidal sources, therefore other sources of flooding must be considered when looking to locate new development. Other sources of flooding requiring consideration when allocating new development include Surface Water, Groundwater, Sewers and Artificial sources.

5.3.2 The flood risk within Islington has been identified on a strategic basis in Section 4, with a number of areas identified as being at higher risk of flooding. The Islington SWMP provides Local Flood Risk Zones (LFRZ), where discrete surface water flooding is possible, affecting houses, businesses or infrastructure. Further to this, the RoFSW modelling has identified areas of potential surface water ponding in Canonbury and Clerkenwell Road, as well as the Upper Holloway area between Tollington Road and the Emirates Stadium.

5.3.3 LBI should consider utilising the Environment Agency's RoFSW which provides bandings of Low (with the flood extent during a 1 in 1000 year rainfall event), Medium (within the flood extent during a 1 in 100 year rainfall event) and High (within the flood extent during a 1 in 30 year rainfall event) surface water flood risk. The Low, Medium and High bands of surface water flood risk may be substituted in place of Flood Zones 1, 2 and 3 as given in Table 5.2. The flood risk banding should be utilised to initially allocate development in Islington towards areas of lower flood risk i.e. following a sequential approach to location of development. Following this, the detailed surface water mapping of the Borough should be used to provide a more detailed assessment of the surface water flood risk when planning mitigation measures for proposed developments.

5.3.4 Where a 'More Vulnerable' development is proposed in an area with a potential flood risk, suitable mitigation measures, such as raising finished floor levels and access levels and introducing thresholds to buildings, should be utilised in order to mitigate risks to property and people.

5.3.5 LBI should consider restricting development of 'Highly Vulnerable' development in 'High' surface water flood risk areas where a specific flood risk has been identified. For example new basement dwellings should be discouraged in such areas. Essential infrastructure associated with proposed developments may be discouraged from being placed on the ground floor in high risk areas.

5.3.6 LBI should consider requiring a FRA for More Vulnerable development in High surface water flood risk areas, and for Highly Vulnerable development in Medium surface water flood risk areas.

5.4 Applying the Sequential Test to proposed developments not included in London Borough of Islington's Allocated Sites

5.4.1 As illustrated in Figure 5.2, the flood risk Sequential Test can be considered adequately demonstrated if (1) the Sequential Test has already been carried out for the site for the same development type at the Local Plan level for allocated sites and (2) the development vulnerability is appropriate to the flood risk, as determined by LBI.

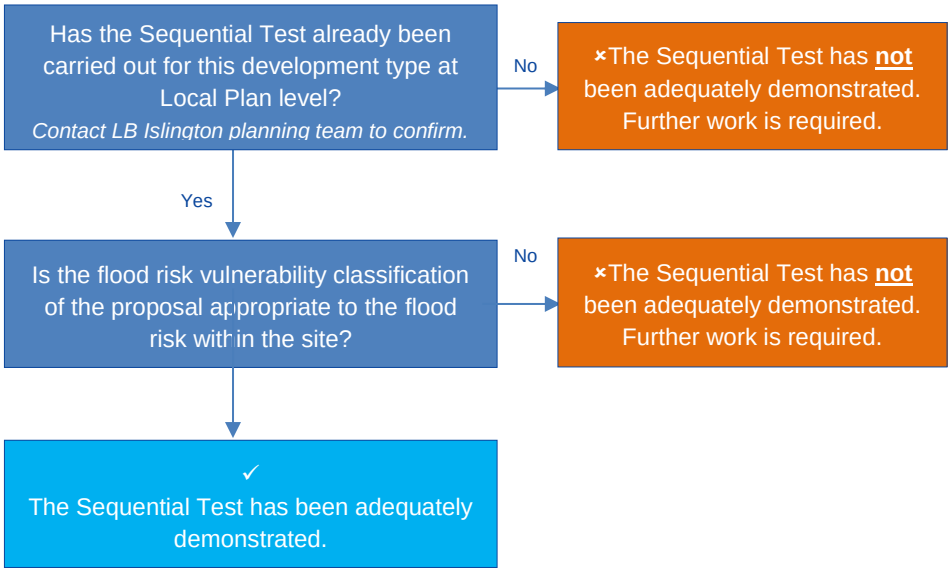


Figure 5.2: Determining when the Sequential Test is required (PPG[2])

5.4.2 If the answer to either of these two criteria is 'no', then it is necessary to undertake a Sequential Test for the site. The Environment Agency has set out the procedure for demonstrating the Sequential Test for Planning Applications in the NPPF Guidance[45] as follows:

- Identify the geographical area of search over which the test is to be applied; this could be the Borough area, or a specific catchment if this is appropriate and justification is provided (e.g. school catchment area or the need for affordable housing within a specific area).

- Identify the source of 'reasonably available' alternative sites; usually drawn from evidence base / background documents produced to inform the Local Plan.

- State the method used for comparing flood risk between sites; for example the Environment Agency Flood Map for Planning, the SFRA mapping, site-specific FRAs if appropriate, other mapping of flood sources.

- Apply the Sequential Test; systematically consider each of the available sites, indicate whether the flood risk is higher or lower than the application site, state whether the alternative option being considered is allocated in the Local Plan, identify the capacity of each alternative site, and detail any constraints to the delivery of the alternative site(s).

- Conclude whether there are any reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed.

- Where necessary, as indicated by Figure 5.2, apply the Exception Test.

- Apply the Sequential approach to locating development within the site.

5.5 Exception Test

5.5.1 The purpose of the Exception Test is to ensure that development is only permitted in medium and high flood risk areas where flood risk is clearly outweighed by other sustainability factors and where the development will be safe during its lifetime, considering climate change.

5.5.2 In the absence of fluvial flood zones in Islington, available information on flood risk from all sources should be consulted to determine the risk to a site or area. This SFRA includes flood risk data from the RoFSW, Environment Agency Risk of Flooding from Reservoirs Mapping and historic flood records. If available information indicates that the flood risk to a site is high and there is potential flood risk to the site – dependent on vulnerability of the site – then the exception test should be applied.

Requirements of the Exception Test

5.5.3 For the exception test to be passed:

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

(b) 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.

5.5.4 Both of the above elements of the test must be passed for development to be allocated or permitted.

5.5.5 In order to satisfy part (a) of the Exception Test, the objectives of the Sustainability Appraisal (SA) can be used to assess each potential development site. As explained in the NPPF, each LPA is required to develop a Sustainability Appraisal as part of the Local Plan. The LBI SA[46] includes a series of Sustainability Objectives which allow quantification of the sustainable development of a potential development site. When determining planning applications, LBI should ensure flood risk is not increased elsewhere. In order to consider development to be appropriate in an area at risk of flooding, it should be informed by a site-specific FRA, follow the Sequential Test, and if required the Exception Test, before demonstrating the following:

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

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

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

6. GUIDANCE FOR PREPARING SITE SPECIFIC FRAS

6.1 When is a Flood Risk Assessment required?

6.1.1 The Environment Agency and the Department for Environment, Food and Rural Affairs provides flood risk standing advice for applicants and agents on their website: https://www.gov.uk/planning-applications-assessing-flood-risk. This includes information on when a FRA is required and advice on the contents of FRAs for various development types in Flood Zone 1, Flood Zone 2 and Flood Zone 3.

6.1.2 The NPPF states that a site specific FRA is required in the following circumstances:

- Proposals for new developments (including minor developments and change of land use) in Flood Zones 2 and 3.
- Proposals of 1 hectare or greater located in Flood Zone 1.
- Proposals of less than 1 hectare in flood zone 1, including a change of use in development type to a more vulnerable class, which could be affected by sources of flooding other than rivers and the sea.
- Proposals in areas which are within Flood Zone 1 which have critical drainage problems as notified by the Environment Agency, for example surface water drains.

6.1.3 As LBI is located entirely within Flood Zone 1, advice relating to Flood Zone 2 and 3 is not relevant here.

6.1.4 The Environment Agency Guidance for FRAs in Flood Zone 1[47] should be consulted for advice on the approach and content of an FRA.

6.2 Scope of a site-specific FRA

6.2.1 The PPG states that site-specific FRAs should always be proportionate to the degree of flood risk and make optimum use of readily available information, for example the mapping presented within this SFRA. Table 6.1 is based on the checklist for site specific FRAs provided in the PPG. Where appropriate, references have been added to determine where the information can be found to support each required item.

Table 6.1: Site-Specific Flood Risk Assessment Checklist (Adapted from Planning Practice Guidance for Flood Risk and Coastal Change[2])

1. Development description and location	
1a. What type of development is proposed (e.g., new development, an extension to existing development, a change of use etc.) and where will it be located?	☐
1b. What is its flood risk vulnerability classification? **Refer to Section 5.2 Table 5.2.**	☐
1c. Is the proposed development consistent with the Local Plan for the area? LBI's Core strategy and Development Policies currently set out the vision of their Local Plan to 2025. The documents should be referred to on the LBI website: https://www.islington.gov.uk/planning/planningpol/local_dev_frame/pol_corestrat	☐
1d. What evidence can be provided that the Sequential Test and where necessary the Exception Test has/have been applied in the selection of this site for this development type? Consult LBI to determine if the site has been included in the Sequential Test. If not, refer to Section 5.3 for guidance on undertaking the Sequential Test for individual development sites and to determine whether the Exception Test is required.	☐
1e. Will your proposal increase overall the number of occupants and/or users of the building/land, or the nature or times of occupation or use, such that it may affect the degree of flood risk to these people? This is particularly relevant to minor developments (alterations & extensions) & changes of use.	☐
2. Definition of the flood hazard	
2a. What sources of flooding could affect the site? Refer to Section 4	☐
2b. For each identified source under 2a above, can you describe how flooding would occur, with reference to any historic records where these are available? Refer to Section 4	☐
2c. What are the existing surface water drainage arrangements for the site? Undertake a site survey to determine specific details. Where appropriate an asset location survey can be provided by Thames Water http://www.thameswater-propertysearches.co.uk/.	☐
3. Probability	
3a. Which flood zone is the site within? In the case of LBI, the Borough is entirely within Flood Zone 1 as defined by the Flood Map for Planning (Rivers and Sea) on the Environment Agency's website https://flood-map-for-planning.service.gov.uk/. Therefore Section 3a of this checklist does not apply.	N/A

3b. Does the SFRA show the same or a different flood zone compared with the Environment Agency's flood map? Both this SFRA and the Flood Map for Planning (Rivers and Sea) on the Environment Agency's website https://flood-map-for-planning.service.gov.uk/ indicate that the Borough is entirely within Flood Zone 1. If different you should seek advice from the local planning authority and, if necessary, the Environment Agency enquiries@environment-agency.gov.uk.	☐
3c. What is the probability of the site flooding, taking account of the maps of flood risk from rivers and the sea and from surface water, on the Environment Agency's website, and the SFRA, and of any further flood risk information for the site? Refer to mapping in Section 4.2 and Appendices B, as well as the Flood Map for Planning (Rivers and Sea) and the Flood Risk from Surface Water mapping on the Environment Agency's website https://flood-map-for-planning.service.gov.uk/. In the case of LBI the Flood Map for Planning (Rivers and the Sea) is not applicable due to LBI's location entirely within Flood Zone 1.	☐
3d. If known, what (approximately) are the existing rates and volumes of surface water run-off generated by the site?	☐
4. Climate change	
How is flood risk at the site likely to be affected by climate change? No main rivers are located within LBI and therefore there is no flood risk from fluvial sources. Refer to Section 4.6 for a description of how climate change will impact other sources of flooding.	☐
5. Detailed development proposals	
Where appropriate, are you able to demonstrate how land uses most sensitive to flood damage have been placed in areas within the site that are at least risk of flooding (including providing details of the development layout)? Refer to Section 6.3 regarding the use of the sequential approach within development sites.	☐
6. Flood risk management measures	
How will the site/building be protected from flooding, including the potential impacts of climate change, over the development's lifetime? Refer to Section 6.4 for details regarding finished floor levels, basement dwellings, flood resilient design, car parking considerations, and provision of safe access / egress.	☐
7. Off site impacts	
7a. How will you ensure that your proposed development and the measures to protect your site from flooding will not increase flood risk elsewhere? Refer to Section 6.11 regarding off-site impacts including flood routing and Section 7.	☐
7b. How will you prevent run-off from the completed development causing an impact elsewhere? Refer to Section 7 regarding surface water management. Refer to Section 7.5 regarding the use of specific types of SuDS throughout the Borough.	☐
7c. Are there any opportunities offered by the development to reduce flood risk elsewhere? Refer to Section 7 regarding surface water management. Refer to Section 7.5 regarding the use of specific types of SuDS throughout the Borough.	☐

8. Residual risks	
8a. What flood-related risks will remain after you have implemented the measures to protect the site from flooding?	☐
8b. How, and by whom, will these risks be managed over the lifetime of the development? (E.g., flood warning and evacuation procedures). Refer to Section 6.9 for details regarding flood warning and flood evacuation plans.	☐

6.3 Sequential Approach within Development Sites

6.3.1 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 and varying vulnerability to flooding. The sequential approach should be applied within development sites to locate the most vulnerable elements of a development in the lowest risk areas e.g. residential developments should be restricted to areas at a lower probability of flooding whereas parking, open space or proposed landscaped areas can be placed on lower ground with a higher probability of flooding.

6.3.2 If development pressure creates a need to develop more vulnerable land uses within the site in higher flood risk areas, appropriate mitigation measures should be incorporated that are proportionate to the flood risk and would not increase the risk of flooding to surrounding areas. Structures such as (bus, bike) shelters, park benches and refuse bins (and associated storage areas) located in areas with a high flood risk should be flood resilient and be firmly attached to the ground.

6.4 Flood Risk Management Measures

Finished Floor Levels

6.4.1 The Environment Agency has only published guidance for finished floor levels of developments at risk of flooding from fluvial sources, specifically all 'more vulnerable' and 'highly vulnerable' development within flood zones 2 and 3. They require a minimum freeboard of 300mm above the known or modelled 1 in 100 year (1% AEP) flood level, including an allowance for climate change.

6.4.2 Although there is no national guidance for finished floor levels other than development at flood risk from fluvial sources, LBI should consider a freeboard level for proposed developments in areas of surface water flood risk. Much of LBI is within a Critical Drainage Area (CDA) as defined in the LBI SWMP as *"A discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water,*

groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure."

Basement Development

6.4.3 LBI SPD: Basement Development[40] supports the policies of the Local Development Scheme. In regards to flood risk, any basement development must be located to avoid areas of existing flood risk, minimise the risk of flooding within the site and not contribute to flooding elsewhere. A structural method statement must be submitted with the planning application for a basement development. It must consider both groundwater level and flooding from all sources.

6.4.4 The structural method statement must consider how the basement will affect groundwater flow in the local area. This will be influenced by the underlying geology and the depths to the water table. The creation of a barrier in the sub-surface may cause an obstruction to groundwater flow, with can lead to a rise in the water table on the upstream side and a fall in the water table on the downstream side.

6.4.5 The groundwater vulnerability mapping (Figure G, Appendix B) should be used to help assess the suitability of potential basement developments. Basement dwellings will not be considered appropriate in areas that have 'potential for groundwater to occur at surface' (Figure G, Appendix B). However, it should be made clear that the maps are high level strategic and even though there are areas where no risk is mapped, it does not mean that there is no risk present. Therefore, it is recommended that ground investigations and groundwater monitoring should be undertaken at each potential development site.

6.4.6 Basements may cause displacement of groundwater flows through another course, causing consequences for other nearby receptors. Moreover, if a basement development is close to a well or a spring feeding a surface water feature, the effect of groundwater taking a new flow pathway may result in reduced flow to the well or spring. Alternatively, a dormant spring may be reactivated or new spring activated, causing groundwater to take a different flow path. A larger basement will have a larger impact on the groundwater flow regime.

6.4.7 The structural method statement must also discuss the way in which basement developments may be affected by surface water flooding. The dominant flood risk in Islington is surface water flooding, which makes basements vulnerable to potential egress issues in surface water flooding incidents. Basement dwellings are classified in the NPPF as Highly Vulnerable developments and therefore should be discouraged within areas at risk of surface water or groundwater flooding.

6.4.8 LBI outlines that in any basement planning application, FRAs, drainage and access details are required to be submitted for any development within a Local Flood Risk Zone (LFRZ) or an area at risk of flooding from other sources. It is likely that new, self-contained basements will be resisted; however basements which possess access to upper levels must demonstrate minimisation of flood risk through appropriate design.

6.4.9 Where basements are constructed, all drainage connections from basements to sewers must be fitted with a one way valve to prevent sewers from surcharging into basements. A 'positive pumped device' should also be installed to direct the flow of sewage away from the basement building if flooding should occur. When a basement is proposed to extend beyond the footprint of an existing building, there must be no net increase in surface water discharges from the site.

6.4.10 It will also be necessary to implement SuDS to improve the infiltration capacity of the site and prevent localised flooding or increased groundwater flood risk. It is also a requirement that a drainage layer with a minimum depth of 200mm above any basement that extends beyond the footprint of the building be implemented to ensure surface water drainage is managed.

Flood Resistant and Resilient Design

6.4.11 In order to mitigate any potential flood damage, there are a range of flood resilient construction techniques that can be implemented in new developments. The Department for Communities and Local Government (DCLG) published a document 'Improving the Flood Performance of New Buildings, Flood Resilient Construction'[48], the aim of which is to provide guidance to developers and designers on how to improve the resilience of new properties in low or residual flood risk areas, through the use of suitable materials and construction details. Figure 6.1 provides a summary of the Water Exclusion Strategy (flood resistance measures) and Water Entry Strategy (flood resilience measures) which can be adopted depending on the depth of floodwater that could be experienced.

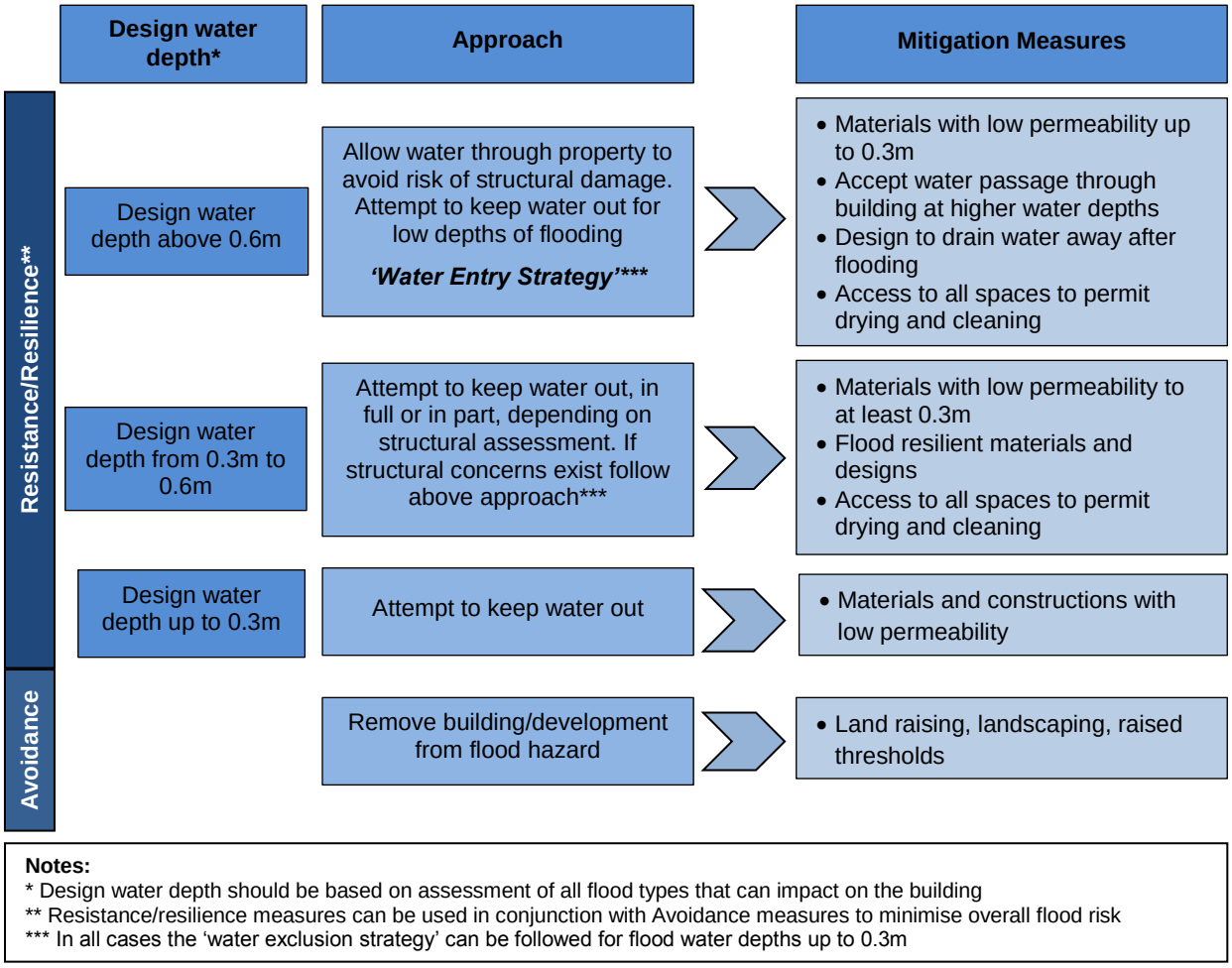


Figure 6.1: Flood Resilient Design Strategies, Improving Flood Performance (DCLG, 2007[48])

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

6.4.13 For flood depths greater than 0.6m, it is likely that structural damage could occur in traditional masonry construction due to excessive water pressures. In these circumstances, the strategy should be to allow water into the building, i.e. the Water Entry Strategy.

6.4.14 The principle behind the Water Entry Strategy is not only to allow water through the property to avoid the risk of structural damage, but also to implement careful design in order to minimise damage and allow rapid re-occupancy of the building. The NPPF considers these measures to be appropriate for both changes of use and for Less Vulnerable uses where temporary disruption is acceptable and suitable flood warning is received.

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

6.4.16 Due to the absence of fluvial flood risk, and the nature of surface water flood risk and the likely flood depths, the Water Exclusion Strategy is most appropriate within LBI for the majority of cases. In areas within the flood extent in the event of a reservoir breach, flood depths may potentially exceed 0.6m and therefore the Water Entry Strategy may be most appropriate. It is recommended that Environment Agency Risk of Flooding from Reservoirs Mapping be consulted for detailed information on potential flood water depths in the event of such a breach.

6.4.17 Further specific advice regarding suitable materials and construction techniques for floors, walls, doors and windows and fittings can be found in 'Improving the Flood Performance of New Buildings, Flood Resilient Construction' (DCLG, 2007)[48].

6.5 Property Level Resistance Measures

6.5.1 Intense rainfall events can lead to flooding through surface water and the local drainage network. Current climate change predictions suggest that intense rainfall events are likely to become more frequent, thereby putting a greater strain on the local drainage network and increasing the potential for surface water flooding. It is not possible for the drainage network to be upgraded to accommodate extreme rainfall events and consequently there remains a risk that sewer and surface water flooding can occur. To mitigate the effects of flooding from these extreme events the homeowner or developer can install permanent or temporary flood proofing measures.

6.5.2 The DCLG guide 'Improving the Flood Performance of New Buildings, Flood Resilient Construction' (2007)[48] outlines potential flood resistance measures:

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

6.6 Car Parks

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

6.7 Structures

6.7.1 Structures such as (bus, bike) shelters, park benches, refuse bins (and associated storage areas) located in areas with a high flood risk should be resilient and be firmly attached to the ground.

6.8 Safe Access and Egress

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

6.8.2 A safe access/egress route should allow occupants to safely enter and exit the buildings and be able to reach land outside the flooded area using public rights of way without the intervention of emergency services or others during design flood conditions, including climate change allowances.

6.8.3 For developments located in areas at flood risk, the Environment Agency considers 'safe' access/egress to be in accordance with 'FRA Guidance for new developments FD 2320'[49]. The requirements for safe access and egress from new developments in flood risk areas are as follows in order of preference:

1. Safe, dry route for people and vehicles;
2. Safe, dry route for people;
3. If a dry route for people is not possible, a route for people where the flood hazard, in terms of depth and velocity of flooding, is low and should not cause risk to people;
4. If a dry route for vehicles is not possible, a route for vehicles where the flood hazard (in terms of depth and velocity of flooding) is low to permit access for emergency vehicles.

6.9 Flood Warning and Evacuation Plans

6.9.1 Evacuation is where flood alerts and warnings provided by the Environment Agency enable occupants to evacuate homes, businesses and other premises unaided, without the deployment of trained personnel to help. Flood warning and emergency procedures tend to form part of higher level emergency plans for the wider area including information such as repair procedures, evacuation routes, refuge areas, flood warning dissemination and responsibilities.

6.9.2 No Environment Agency Flood Alerts or Warnings would be issued in LBI due to the absence of watercourses within the Borough. Met Office Severe Weather Warnings provide warning to communities of extreme weather events, including rainfall events, and can be viewed at http://www.metoffice.gov.uk/public/weather/warnings/?regionName=uk.

6.10 Emergency Plan

6.10.1 LBI has developed a Multi-Agency Flood Plan[12] (MAFP) to allow all responding parties to work together on an agreed coordinated response to severe flooding within the Borough. Where necessary the LBI Multi Agency Flood Plan should be reviewed in the light of information generated by this SFRA and updated where appropriate. This will ensure that emergency plans are appropriate to the conditions expected during a flood event and that the local authority and emergency services are fully aware of the likely conditions and how this may affect their ability to safeguard the local population.

6.10.2 When submitting FRAs for developments within flood risk areas, developers should make reference to local flood warning and emergency procedures to demonstrate their development will not impact on the ability of the local authority and the emergency services to safeguard the current population. The flood hazard in a particular area must be viewed in the context of the potential evacuation and rescue routes to and from that area and discussed as part of a site-specific FRA.

6.11 Flood Routing

6.11.1 In order to ensure that new developments do not increase flood risk elsewhere, development in the flood plain will need to prove that flood routing is not adversely affected. Potential overland flow paths should be determined and appropriate solutions proposed to minimise the impact of the development, for example by configuring road and building layouts to preserve existing flow paths and improve flood routing, whilst ensuring that flows are not diverted towards other properties elsewhere. Careful consideration should be given to the use of fences and landscaping walls so as to prevent causing obstruction to flow routes and increasing the risk of flooding to the site or neighbouring areas.

7. SUSTAINABLE DRAINAGE SYSTEMS

7.1 Overview

7.1.1 Flood risk management policies are designed to ensure that all developments can be considered 'safe', do not increase flood risk elsewhere, and reduce flood risk where possible. It is also strongly recommended that suitable surface water mitigation measures are incorporated into development, in order to manage and reduce surface water flood risk in the area of the proposed development. This can be achieved through the implementation of Sustainable Drainage Systems (SuDS).

7.1.2 The LBI LFRMS identifies that to achieve Objective 2 of the LFRMS to *"Support sustainable growth and development by understanding the needs of all parties and ensuring the best evidence feeds into decision making"* the council needs to *"Ensure all new developments are prioritising the use of SuDS and water sensitive urban design"*.

7.1.3 SuDS are soft engineering surface water drainage solutions designed to manage surface water runoff and mitigate the effects of urban storm water runoff by reducing flood risk and managing water as close to the source as possible. A preferred SuDS technique should, where possible, aim to meet the three goals identified below as fully as possible:

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

7.1.4 The application of SuDS is not limited to one single technique per site; a successful SuDS solution will utilise a combination of techniques, potentially meeting all of the above goals. SuDS can also be used at a strategic level in which a number of sites contribute to large scale, jointly funded and managed SuDS. However, each development site must offset its own runoff, and attenuation cannot be "traded" between developments.

7.1.5 The SuDS Manual CIRIA C679[50] identifies four processes which can be used to manage and control runoff from developed areas. Each option can provide opportunities for storm water control, flood risk management, water conservation and groundwater recharge:

1) **Infiltration:** the soaking of water into the ground. This is the most desirable SuDS solution, as it most imitates natural hydrological processes. This can be used to recharge groundwater sources and feed base flows of local watercourses. However, where groundwater sources are vulnerable or there is risk of contamination, infiltration

techniques are not suitable. This technique is dependent on the underlying ground conditions, and an assessment of the suitability of using SuDS techniques has been undertaken with use of the BGS Infiltration SuDS Map. However, it is also possible to use shallow infiltration techniques in combination with storage techniques on sites which have impermeable geology, and therefore these techniques should not be overlooked.

2) **Attenuation/Detention:** the slowing down of surface flows before their transfer downstream, usually achieved by creating a storage volume and a constrained outlet. This will enable a reduction in the peak rate of runoff, though the total volume will remain the same. Although not constrained by geology, in areas of permeable geology there will also be a degree of infiltration of runoff taking place.

3) **Conveyance:** the transfer of surface runoff from one place to another, e.g. through open channels, pipes and trenches.

4) **Water Harvesting:** the direct capture and use of runoff on site, e.g. for domestic use (flushing toilets) or irrigation of urban landscapes. The success of this function is dependent on the scale and the amount of storage available – particularly in a large flood event.

7.1.6 As with any SuDS scheme, consideration should be given to the long-term maintenance of SuDS to ensure that it remains functional for the lifetime of the development.

7.1.7 Table 7.1 has been reproduced from the SuDS Manual and outlines typical SuDS options and details their typical components.

Table 7.1: Typical SuDS Components

Component Description	Example
Filter Strips	Wide, gently sloping areas of grass or other dense vegetation that treat runoff from adjacent impermeable areas.
Swales	Swales are broad, shallow channels covered by grass or other suitable vegetation. They are designed to convey and/or store runoff, and can infiltrate the water into the ground (if ground conditions allow).

Component Description	Example
Infiltration Basins	Infiltration basins are depressions in the surface that are designed to store runoff and infiltrate the water to the ground. They may also be landscaped to provide aesthetic and amenity value.
Wetland Ponds	Wetland ponds are basins that can remove pollutants present within surface water. They provide runoff attenuation and wildlife benefits.
Extended Detention Basins	Extended detention basins are normally dry, though they may have small permanent pools at the inlet and outlet. They are designed to detain a certain volume of runoff as well as providing water quality treatment.
Constructed Wetlands	Constructed wetlands are ponds with shallow areas and wetland vegetation to improve pollutant removal and enhance wildlife habitat.
Filter Drains and Perforated Pipes	Filter drains are trenches that are filled with permeable material. Surface water from the edge of paved areas flows into the trenches, is filtered and conveyed to other parts of the site. A slotted or perforated pipe may be built into the base of the trench to collect and convey the water.
Infiltration Devices	Infiltration devices temporarily store runoff from a development and allow it to percolate into the ground.
Pervious Surfaces	Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, reuse, or release to surface water.
Green Roofs	Green roofs are systems which cover a building's roof with vegetation. They are laid over a drainage layer, with other layers providing protection, waterproofing and insulation. It is noted that the use of brown/green roofs should be for betterment purposes and not to be counted towards the

Component Description	Example
	provision of on-site storage for surface water. This is because the hydraulic performance during extreme events is similar to a standard roof (CIRIA C697).
Rainwater Harvesting	Storage and use of rainwater for non-potable uses within a building, e.g. toilet flushing. It is noted that storage in these types of systems is not usually considered to count towards the provision of on-site storage for surface water balancing because, given the sporadic nature of the use of harvested water, it cannot be guaranteed that the tanks are available to provide sufficient attenuation for the storm event.

7.2 SuDS Statutory Consultee Role

7.2.1 Lead Local Flood Authorities (LLFAs) are statutory consultees for *"major development with surface water drainage"* under Schedule 4 of the Town and Country Planning (Development Management Procedure) (England) Order 2015[51]. The revised NPPF[1] strengthens the position on the role of LLFA as Statutory Consultees in the planning process by stating that major developments should incorporate SuDS unless there is clear evidence that this would be inappropriate and that the SuDS used should take account of advice from the LLFA.

7.2.2 As an LLFA, LBI must ensure that SuDS are incorporated into all major development plans where appropriate, and that they adhere to necessary national and local SuDS standards.

7.3 The SuDS hierarchy

7.3.1 The aim should be to discharge surface water run-off as high up the following hierarchy of drainage options as reasonable practicable:

1) Discharge into the ground (infiltration)
2) Discharge to a surface water body
3) Discharge to a surface water sewer
4) Discharge to a combined sewer

7.3.2 Policy 5.13 of the London Plan sets out the drainage hierarchy that developers should follow for managing surface water in London Boroughs: *"The aim should be to achieve Greenfield*

run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:

1) *Store rainwater for later use*
2) *Use infiltration techniques, such as porous surfaces in non-clay areas*
3) *Attenuate rainwater in ponds or open water features for gradual release*
4) *Attenuate rainwater by storing in tanks or sealed water features for gradual release*
5) *Discharge rainwater to a direct watercourse*
6) *Discharge rainwater to a surface water sewer/drain*
7) *Discharge rainwater to the combined sewer"*

7.3.3 The Draft New London Plan showing Minor Suggested Changes has been published. Policy 5.13 is replaced by Policy SI13 which includes a requirement that *"Lead Local Flood Authorities should identify – through their Local Flood Risk Management Strategies and Surface Water Management Plans – areas where there are particular surface water management issues and aim to reduce these risks"* and amends the drainage hierarchy set out in Policy 5.13 to prioritise those sustainable drainage methods which make use of infiltration or above ground storage and disposal.

7.4 The SuDS technical standards

7.4.1 A set of non-statutory Technical Standards[52] have been published to be used in conjunction with supporting guidance in the PPG, which set the requirements for the design, construction, maintenance and operation of SuDS. The Technical Standards that are of most relevance to flood risk from development are listed below:

- Peak flow control:

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

S3. For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event but should never exceed the rate of discharge from the development prior to redevelopment for that event.

- Volume control:

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

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

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

- Flood risk within the development:

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

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

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

7.5 Islington Development Management Policies

7.5.1 Islington Development Management Policy DM6.6 Flood Prevention states the following:

A. Applications for major developments creating new floorspace and major Changes of Use that are likely to result in an intensification of water use are required to include details to demonstrate that Sustainable Urban Drainage Systems (SUDS) have been incorporated and meet the following design standards:

i) Quantity: schemes must be designed to reduce flows to a 'greenfield rate' of run-off (8 litres/second/hectare for Islington), where feasible. The volume of run-off that must be stored on site should be calculated based on the nationally agreed return period value of a 1 in 100 years flood plus a 30% allowance for climate change for the worst storm duration. Where it is demonstrated that a greenfield run-off rate is not feasible, runoff rates should be minimised as far as possible. The maximum permitted runoff rate will be 50 litres/second/hectare.

7.5.2 *ii) Quality: the design must follow the SUDS 'management train', maximise source control, provide the relevant number of 'treatment stages' and identify how the 'first flush' will be dealt with.*

7.5.3 Further information and guidance on SuDS is provided in Islington's Environmental Design SPD.

7.6 Feasibility of the SuDS Hierarchy in Islington

7.6.1 In line with the London Plan Policy 5.13 drainage hierarchy (set out in Section 7.3), opportunities for above ground surface water attenuation and water re-use, such as through use of water butts, should be considered as part of any new development, throughout the Borough.

Discharge into the ground

7.6.2 Areas within Islington which are suitable for SuDS that involve drainage into the ground will require suitable bedrock and superficial geology, in order to allow suitable infiltration. The suitability will also be dependent on the underlying water table depth as that will determine the total water amount that can be discharged into the ground.

7.6.3 LBI bedrock is composed of Thames Group, which is a non-aquifer with low permeability. However the superficial deposits found in the southern half of the Borough, River Terrace Deposits, are considered to be permeable layers capable of supporting water supplies at a local level. As such, the southern half of the Borough is likely to have the highest potential for implementation of infiltration SuDS, however the design should be influenced by local ground conditions.

8. POLICY OPTIONS

8.1 Overview

8.1.1 The NPPF and accompanying Planning Practice Guidance emphasises the responsibility of LBI as an LPA to understand and effectively manage flood risk in all stages of the planning process, to ensure sustainable development. This SFRA can be used within the planning process to provide key information in regards to the variation in flood risk across the Borough, allowing sufficient site comparison for future development. The mapping that has been created for this SFRA can be utilised by planners and developers to inform future site specific flood risk assessments.

8.2 Policy Aims within Flood Zone 1

8.2.1 The entirety of LBI is located within Flood Zone 1, which comprises land outside the extent of fluvial flooding in a 1 in 1,000 year (0.1% AEP) flood event. As set out in the NPPF, all types of development are considered appropriate within Flood Zone 1. Proposals for new development greater than 1 hectare in Flood Zone 1 will require a site specific FRA to ensure that surface water generated by the site is managed in a sustainable manner and does not increase the flood risk on existing infrastructure in the neighbouring area.

8.2.2 More than half of the Borough is located within a Critical Drainage Area, as defined by the LBI SWMP, and as such all opportunities should be taken during development to reduce existing runoff rates post-development. Policy 5.13 of the London Plan[29] states that all development should aim to achieve greenfield runoff rates, and where this is not possible, runoff rates post-development should not exceed those pre-development, as per the NPPF. The SWMP Critical Drainage Areas and Local Flood Risk Zones, and the Environment Agency's RoFSW dataset should be used as a starting point to indicate broad areas with a potential for surface water flood risk in the Borough. In the absence of fluvial flood risk within the Borough, a clear focus for new development should be a reduction in surface water runoff rates post-development, wherever practicable.

8.3 Policy Options

8.3.1 Spatial Planning

1. *Major Sites should be allocated in accordance with the Sequential Test to reduce the flood risk and ensure that the vulnerability classification of the proposed development is appropriate to the flood risk. As LBI is located entirely in Flood Zone 1 and there is no risk of fluvial flooding, available information, such as the Environment Agency's RoFSW, Flood Risk from Reservoirs and the detailed surface water modelling for the Borough should be utilised to direct development towards areas of lowest flood risk.*

2. *Basement dwellings and other 'Highly Vulnerable' development should be discouraged in areas where a high surface water flood risk has been identified, and where there is 'potential for groundwater flooding of property situated below ground level' or 'potential for groundwater flooding to occur at surface'.*

3. *LBI should consider requiring a FRA to accompany any planning application for 'Highly Vulnerable' development in an area of Medium surface water flood risk, and for 'More Vulnerable' development in an area of High surface water flood risk as defined by the RoFSW.*

4. *LBI should consider the cumulative impact of new development on flood risk.*

8.3.2 Flood Risk Management

1. *FRAs are required for proposals of 1 hectare or greater in Flood Zone 1 and for new development (including minor development and change of use) in an area of Flood Zone 1 which has critical drainage problems. The majority of the Borough is located within a CDA as defined by the LBI SWMP and therefore LBI should consider requiring FRAs for all development located within CDAs or Local Flood Risk Zones as defined by the SWMP, which show discrete areas of flooding.*

2. *Where changes of use result in an increase in the vulnerability classification of a development, applicants should be required to provide an assessment of flood risk to accompany their planning application. This should demonstrate how the flood risks to the development will be managed so that it remains safe through its lifetime including provision of safe access and egress.*

3. *Flood Risk to development should be assessed for all sources of flooding.*

4. *Surface water flooding should be investigated in detail as part of site specific FRAs for future developments and early liaison with LBI is recommended for appropriate management techniques.*

5. *Groundwater flooding should be investigated in more detail as part of site specific FRAs for developments located in areas of the borough which have been identified as having 'potential for groundwater flooding of property situated below ground level' or 'potential for groundwater flooding to occur at surface'.*

6. *When re-developing existing buildings in areas at risk from flooding, the use of flood resilient measures should be promoted at the individual property level.*

7. *A structural method statement must be submitted with each basement development planning application to identify any potential risks in relation to the groundwater or surface water flooding. Should any risks be identified, appropriate assessment of these risks should be carried out.*

8.3.3 Sustainable Drainage Systems & Surface Water Management

1. *Sustainable Drainage Systems (SuDS) should be included in new developments unless it is demonstrably not possible to manage surface water using these techniques. Section 7.3 should be consulted in the first instance for guidance on the potential for SuDS techniques.*

2. *NPPF requires the use of SuDS as an opportunity for managing flood risk, improving water quality and increasing amenity and biodiversity.*

3. *Policy 5.13 of the London Plan states that development should aim to achieve greenfield runoff rates.*

4. *Policy DM6.6 of the Development Management Policy states that major developments should aim to achieve greenfield runoff rates. Where it is demonstrated that a greenfield run-off rate is not feasible, runoff rates should be minimized as far as possible. All minor new build developments of one unit or more are required to reduce existing run-off levels as far as possible, and as a minimum maintain existing run-off levels*

5. *An allowance of 40% increase in rainfall intensity should be made for climate change, in accordance with Environment Agency Guidance on Flood Risk Assessments: Climate Change Allowances (2016), to ensure the volume runoff from the site can be stored on the site.*

6. *Potential overland flow paths should be considered to ensure that buildings do not obstruct flows.*

7. *Where basements are proposed the risk of surface water flooding should be considered, with possible mitigation options including raised thresholds and inclusion of storage for surface water in such developments.*

8. *Opportunities should be sought to reduce the risk of flooding from the sewer network through consultation with TWUL to determine key areas for maintenance and flood alleviation schemes.*

9. *At the site specific FRA level, the suitability of SuDS should be investigated for each development.*

10. *The vulnerability and importance of local ecological resources, such as water quality and biodiversity, should be considered when determining the suitability of SuDS.*

8.3.4 Residual Risk & Emergency Planning

1. *Where development within flood risk areas is absolutely necessary, flood proof construction methods should be employed to reduce the impact of flooding.*
2. *Where development is within flood risk areas, emergency planning strategies should be put in place in order to direct people to safety during times of flooding.*

APPENDIX A – DATA SOURCES

Dataset Description	Source	Format	Benefits/Limitations
Fluvial			
Flood Zones	Environment Agency Geostore	GIS Layer	Confirmation that LBI is located entirely within Flood Zone 1. Should new flood zone information become available, the data should be incorporated into the mapping.
Detailed River Network (DRN)	Environment Agency Geostore	GIS Layer	Identification of the river network and artificial waterways including the New River and Regent's Canal.
Historic Flood Map	Environment Agency Geostore	GIS Layer	Confirmation that no fluvial historic events have been recorded in LBI
Surface Water			
'Risk of Flooding from Surface Water' Dataset	Environment Agency Geostore	GIS Layer	Provides an indication of the broad areas likely to be at risk of surface water flooding, i.e. areas where surface water would be expected to flow or pond. This dataset does not show the susceptibility of individual properties to surface water flooding.
Surface Water Modelling for LBI	TBC	TBC	TBC
Groundwater			
Underlying Geology	British Geological Survey	GIS Layer	Illustrates bedrock and superficial geology across the Borough
Susceptibility to Groundwater Flooding	British Geological Survey	GIS Layer	This dataset produced by the British Geological Survey maps the potential for groundwater flooding to occur. It was derived through modelling of superficial geology deposits and aquifer levels.
Groundwater vulnerability zone	Environment Agency Geostore	GIS Layer	Broadly shows extents of aquifers in the Borough. Where aquifers are highly vulnerable, they often have a more permeable covering and, together with dry valley and watercourse networks, potential groundwater flooding areas can be identified.

Dataset Description	Source	Format	Benefits/Limitations
Increased Potential for Elevated Groundwater dataset	LBI	GIS Layer	This dataset was derived from four individual data sources (BGS Groundwater Flood Susceptibility maps; Environment Agency Thames Estuary 2100 groundwater hazard maps; DEFRA Groundwater emergence maps; and JBA. Groundwater flood maps) and identifies areas where there is increased potential for groundwater levels to rise within 2 m of ground surface following periods of higher than average recharge.
Groundwater Source Protection Zones	Environment Agency Geostore	GIS Layer	This dataset presents the Environment Agency defined Groundwater Source Protection Zones. These are areas which are at risk of contamination from any activities that may cause pollution in the area.
Aquifer Type Dataset	Environment Agency Geostore	GIS Layer	This dataset defines the aquifer designations based on geology mapping in the region, to determine the permeability and storage of the geology.
Sewer			
Sewer Flooding Records	Thames Water	MS Word Doc	Indicates post code areas that may be prone to flooding as have experienced flooding in the last 10 years due to hydraulic incapacity. However, given that TWUL target these areas for maintenance and improvements, areas that experienced flooding in the past may no longer be at greatest risk of flooding.
Canals			
Canal and River Trust asset information	Canal and River Trust	GIS Layer	Detailed information in GIS format of all Canal and River Trust asset data within LBI.
Reservoirs			
Environment Agency Risk of Flooding from Reservoirs Mapping	Environment Agency Geostore	GIS Layer	Provides an indication of the broad areas likely to be at risk of reservoir flooding
Planning			
OS Mapping of LBI administrative area	LBI	GIS Layer	Provides background mapping to other GIS layers. Designed for use at 1:50K and

Dataset Description	Source	Format	Benefits/Limitations
(1:10K Streetview, 1:50K, OS Mastermap)			1:10K scales.
GIS layer of administrative boundary	LBI	GIS Layer	Defines the administrative area of the Borough for mapping purposes
LiDAR Topographic Data	Environment Agency Geostore	GIS Layer	Details the Above Ordnance Datum (AOD) topography of the Borough.
Multi-Agency Flood Plan	LBI	PDF	Details the coordinated plan to manage flood emergencies in Islington
Surface Water Management Plan (SWMP) 2011	LBI	PDF	Details the management plan for surface water flooding within Islington, and determined the Critical Drainage Areas and Local Flood Risk Zones within Islington.
Local Flood Risk Management Strategy (LFRMS) 2017	LBI	PDF	Outlines Islington's priorities for local flood risk management and provides a delivery plan to manage the risk over the next 6 years.
Preliminary Flood Risk Assessment (PFRA) 2011	LBI	PDF	Outlines any significant local flood risk in Islington, identifying flood risk areas.
North London Level 1 Strategic Flood Risk Assessment (SFRA)	LBI	PDF	This is the existing SFRA for Islington, and will be superseded by this document. It provided details of previous flood risk within the Borough.

APPENDIX B – BOROUGH MAPPING

Figure A – Topography

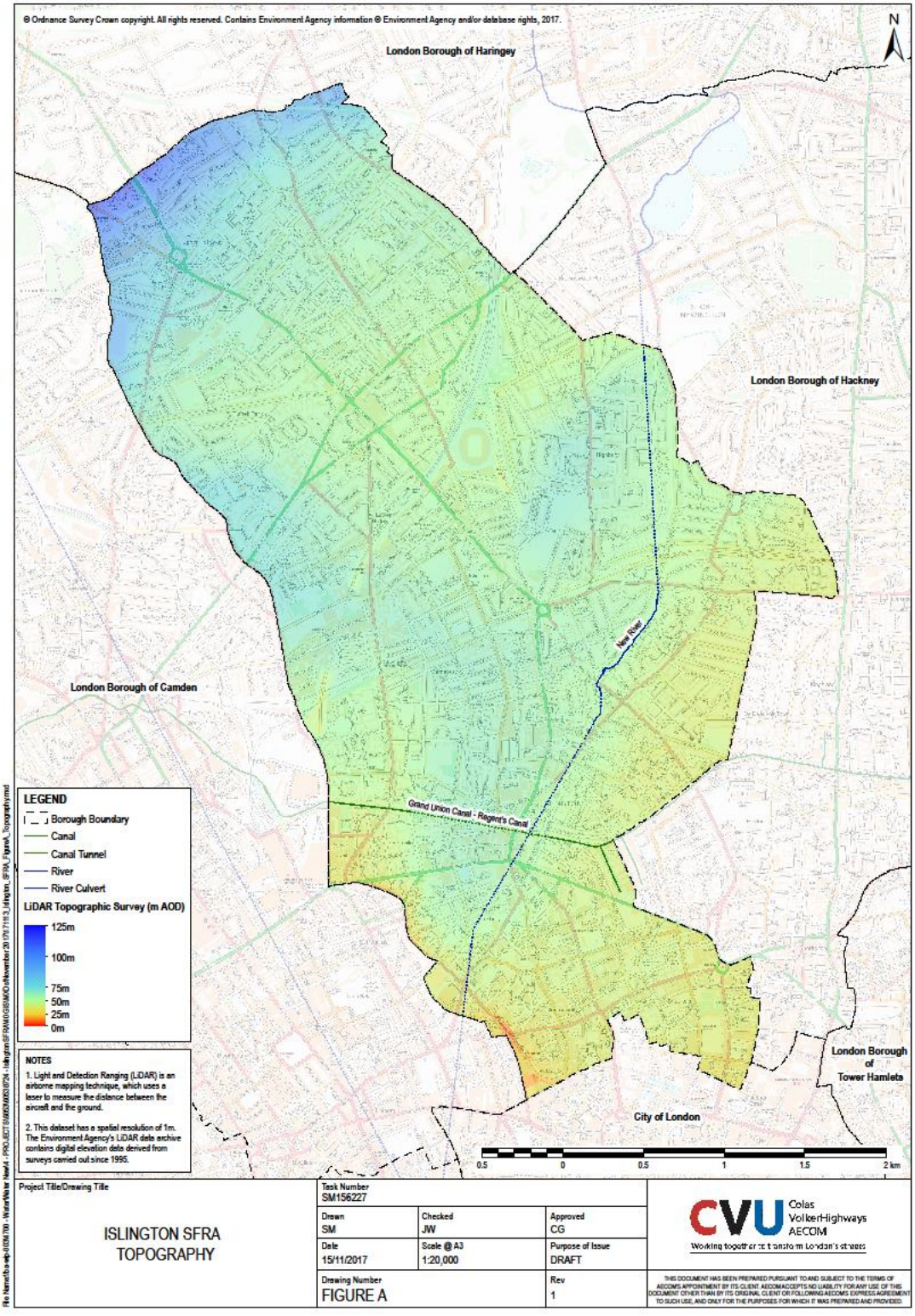


Figure B – Superficial Geology

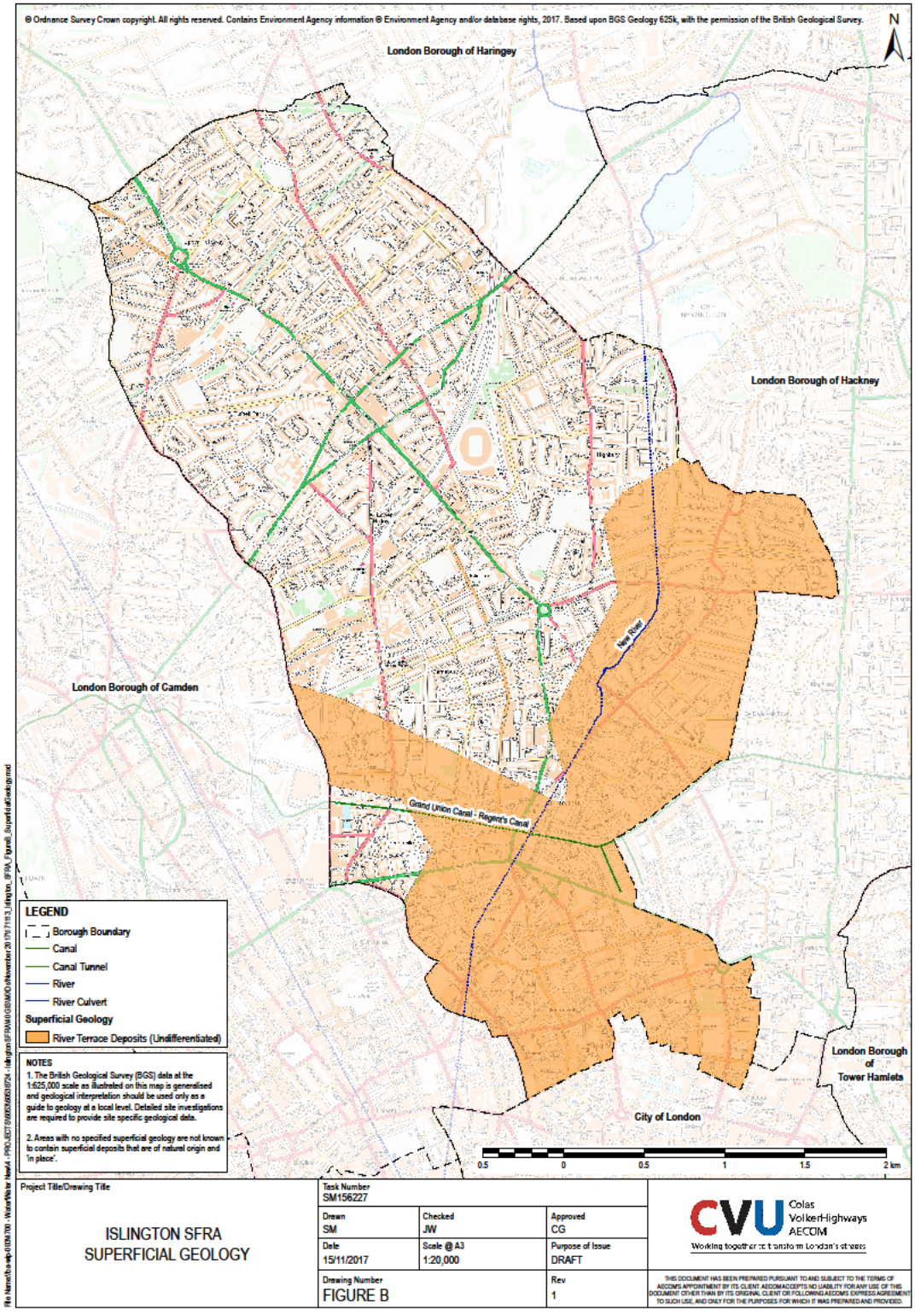


Figure C – Bedrock Geology

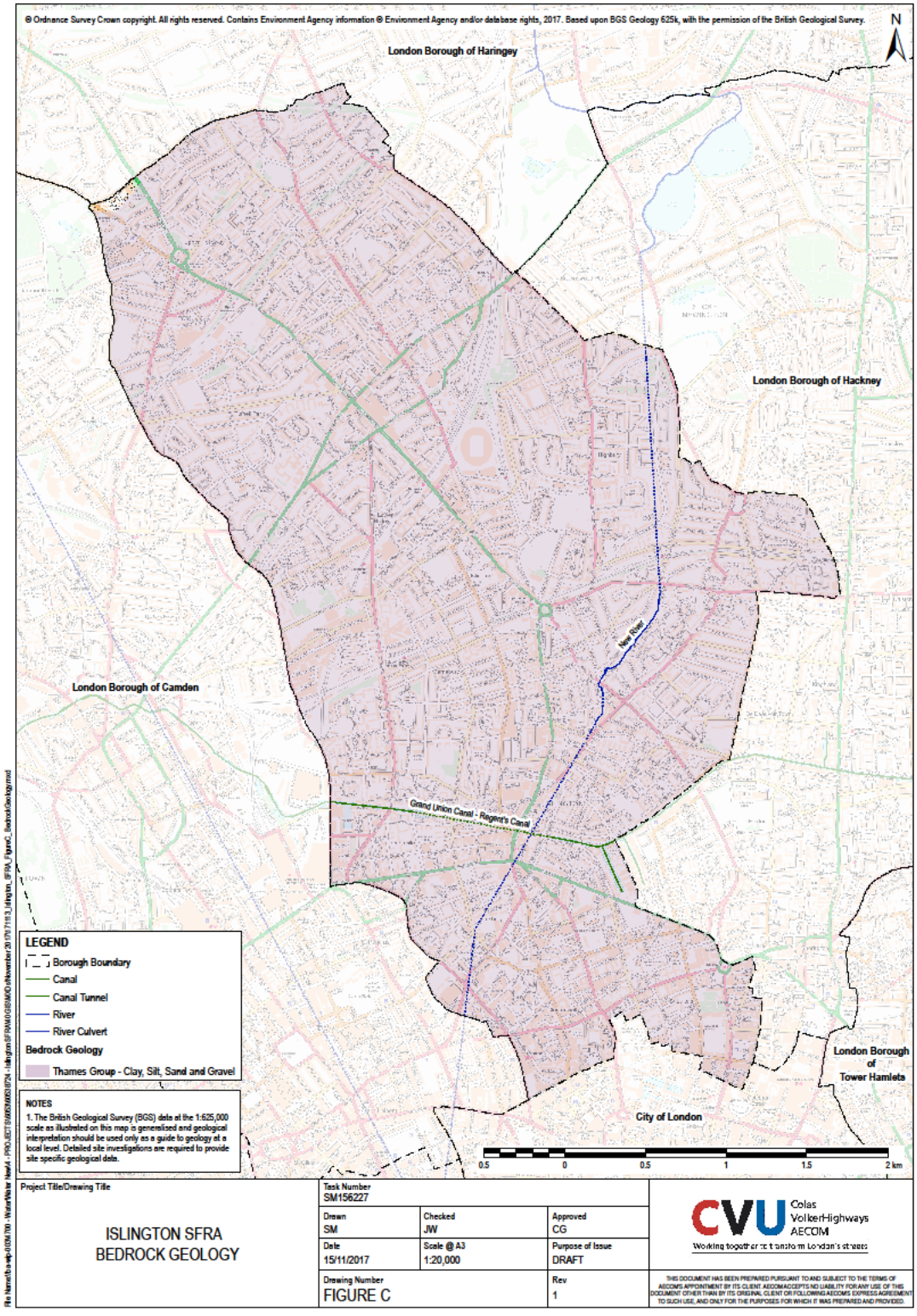


Figure D – Risk of Flooding from Surface Water (Environment Agency data)

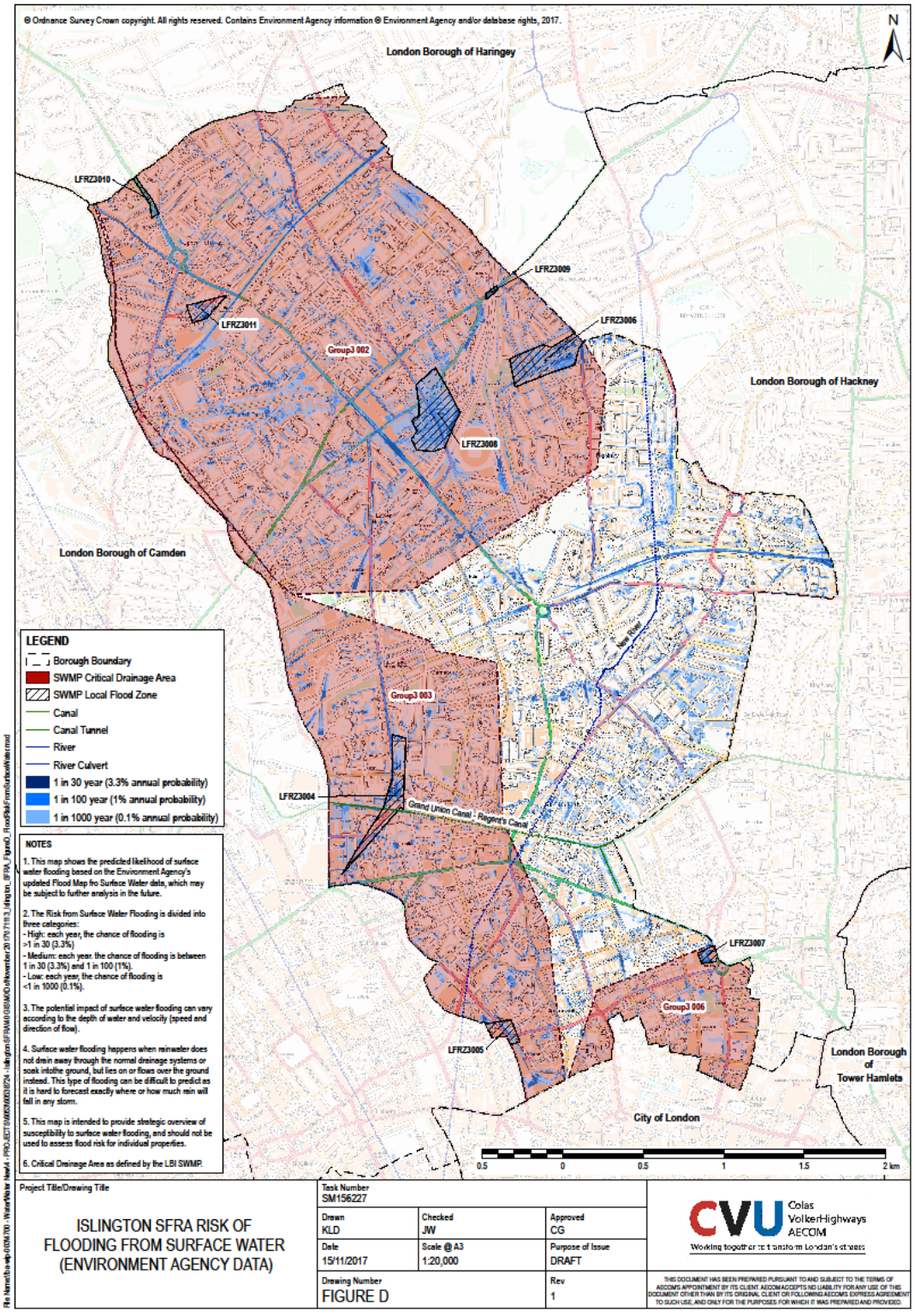


Figure E – Flood Risk from Surface Water (Borough Wide Modelling)

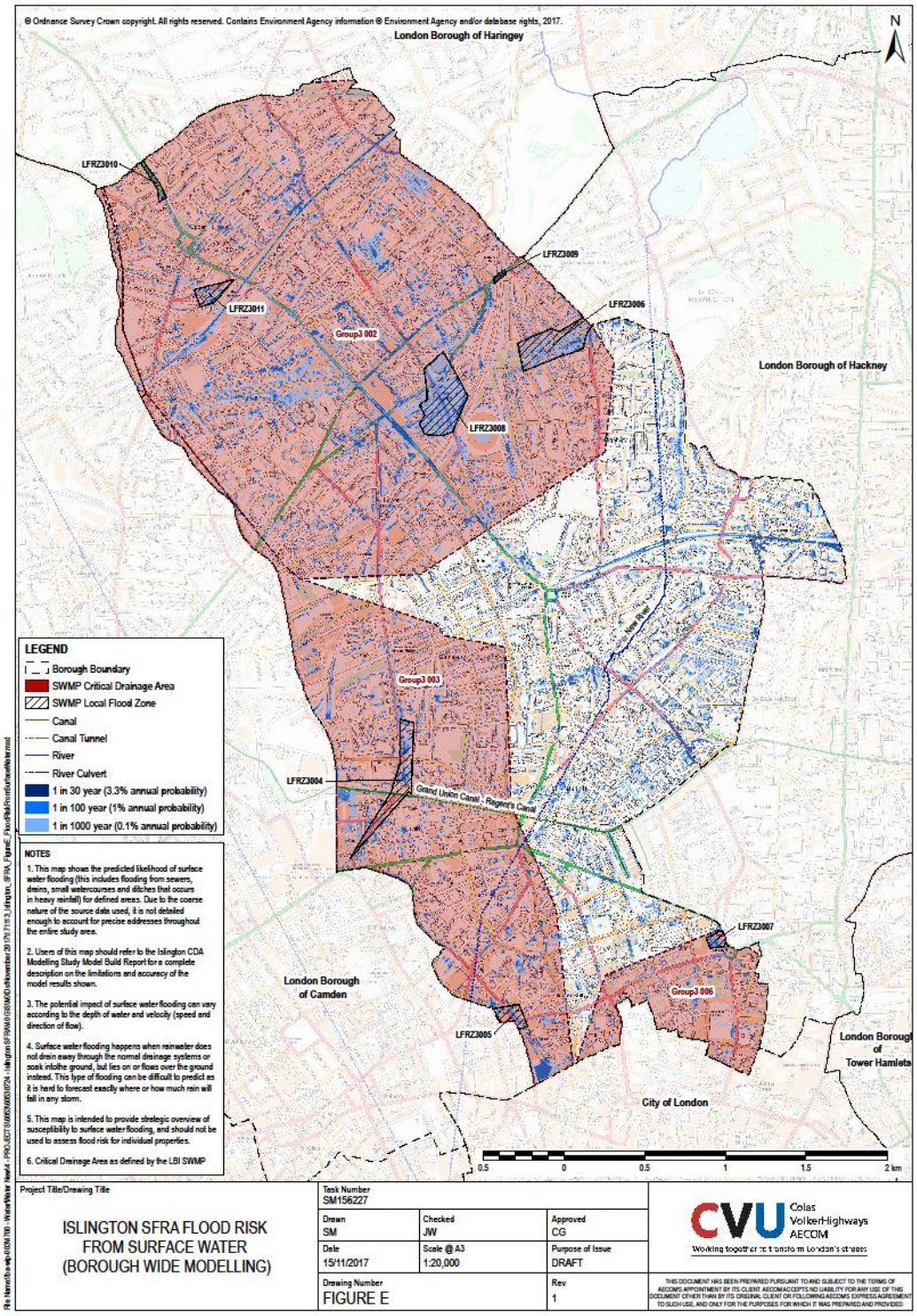


Figure F – Flood Risk from Surface Water including 40% Climate Change Allowance (Borough Wide Modelling)

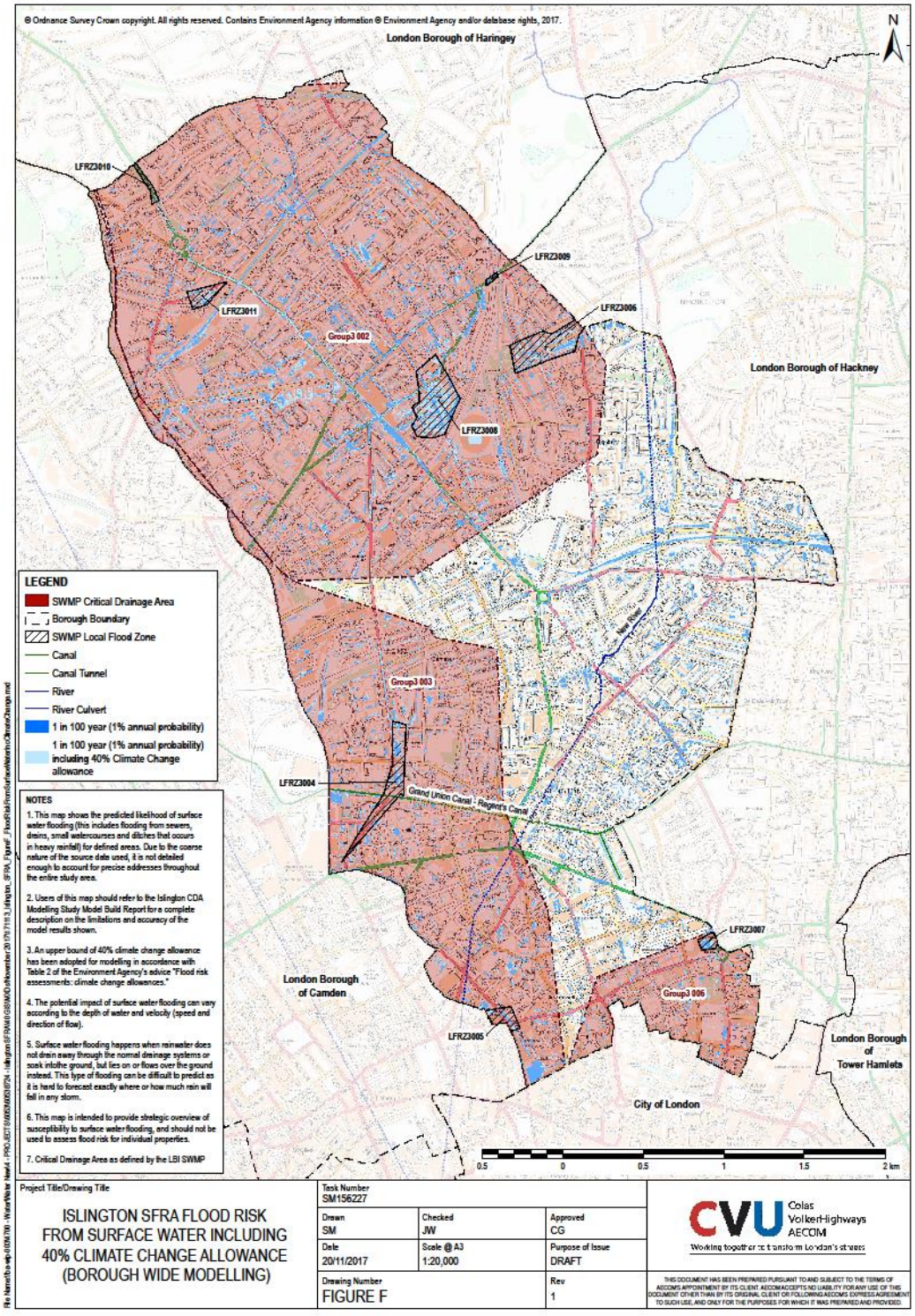


Figure G – Flood Risk from Groundwater

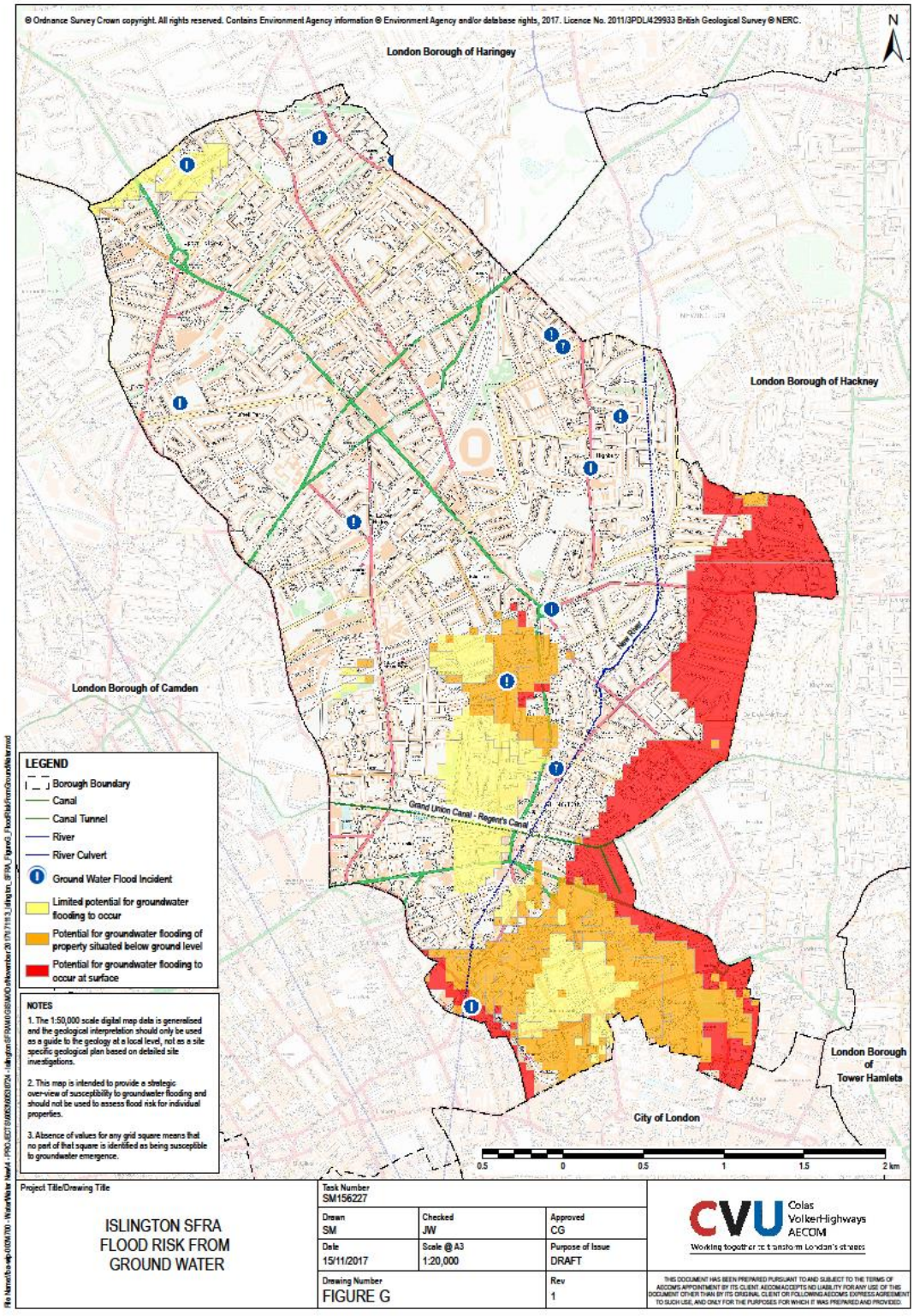


Figure H – Flood Risk from Reservoirs and Artificial Sources

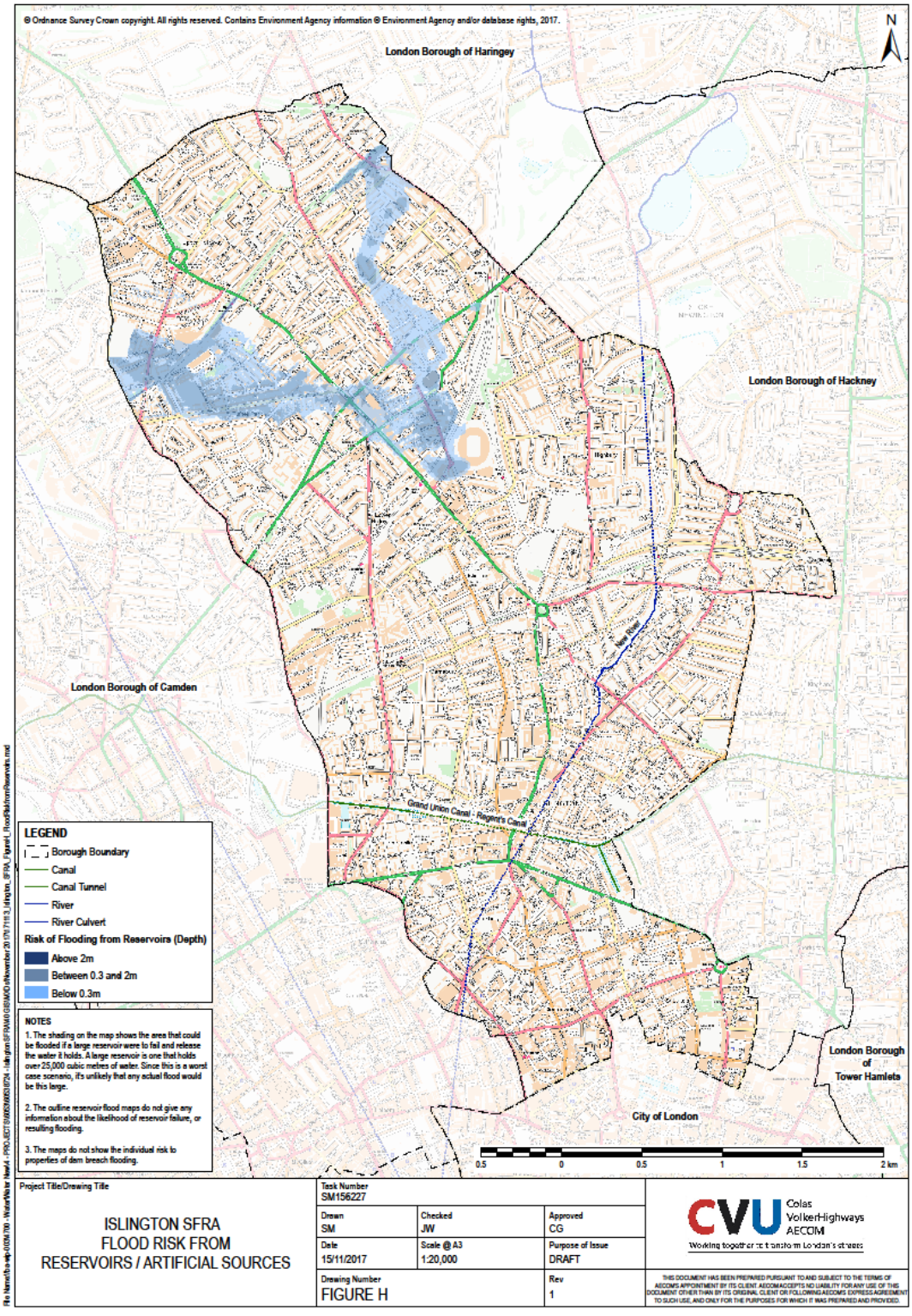
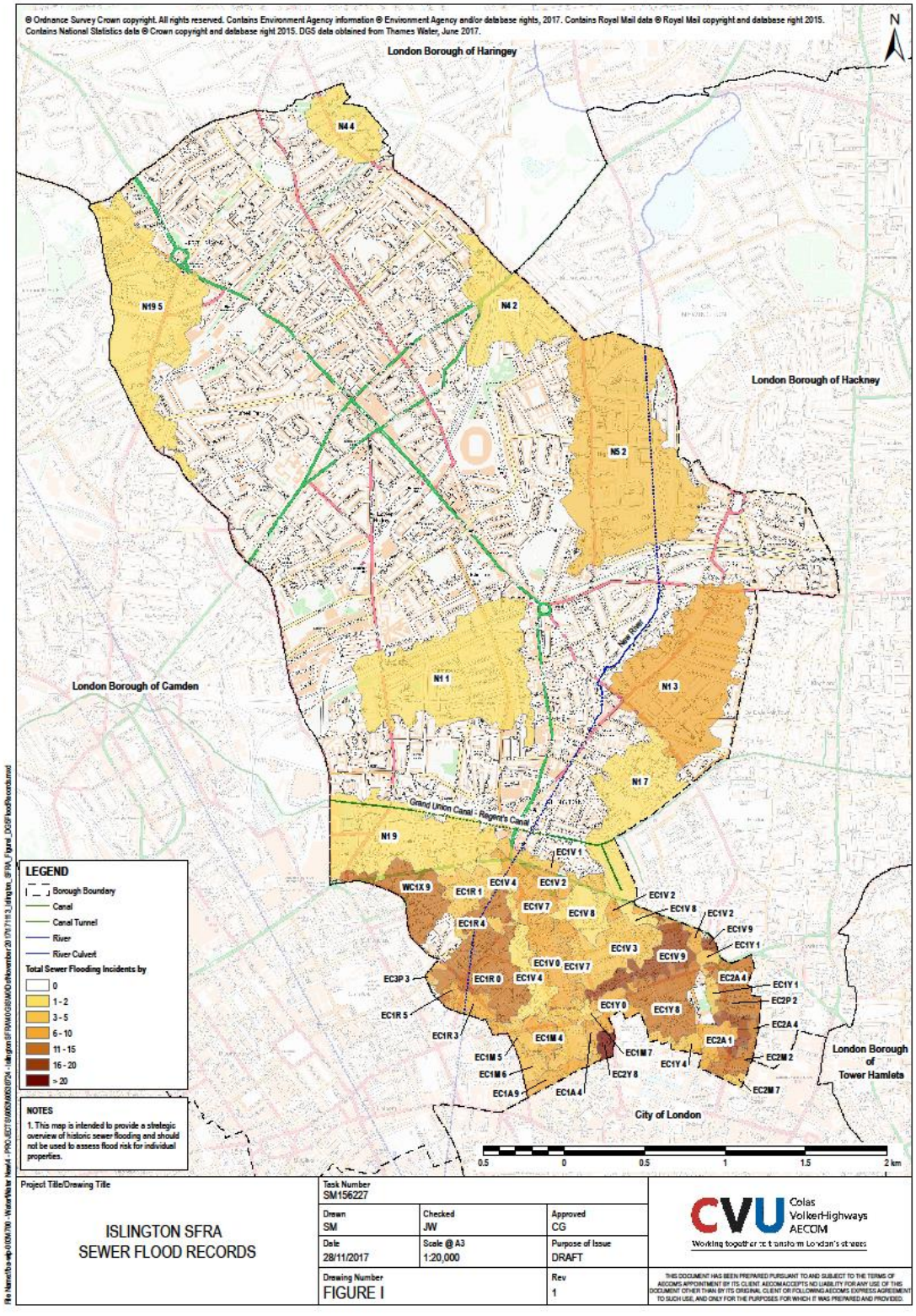


Figure I – Sewer Flood Records



APPENDIX C - REFERENCES

[1] Ministry of Housing, Communities & Local Government (2018) National Planning Policy Framework. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/728643/Revised_NPPF_2018.pdf

[2] Department for Communities and Local Government (2014) Planning Practice Guidance: Flood Risk and Coastal Change. Available from: https://www.gov.uk/guidance/flood-risk-and-coastal-change

[3] Mouchel (2008) North London Strategic Flood Risk Assessment

[4] London Borough of Islington (2016) London Borough of Islington Local Development Scheme. Available from: https://www.islington.gov.uk//~/media/sharepoint-lists/public-records/planningandbuildingcontrol/publicity/publicconsultation/20162017/20160601localdevelopmentschemeapril2016

[5] Islington's Core Strategy. Available from: https://www.islington.gov.uk///~/media/sharepoint-lists/public-records/environmentalprotection/qualityandperformance/reporting/20112012/20120303corestrategyfebruary2011

[6] Islington's Local Plan: June 2013 Development Management Policies. Available from: https://www.islington.gov.uk///~/media/sharepoint-lists/public-records/planningandbuildingcontrol/publicity/publicconsultation/20132014/20130621developmentmanagementpoliciesadoptiondraftjune2013

[7] Islington's Local Plan: Site Allocations June 2013. Available from: https://www.islington.gov.uk///~/media/sharepoint-lists/public-records/planningandbuildingcontrol/publicity/publicconsultation/20132014/20130621siteallocationsadoptiondraftjune2013

[8] Finsbury Local Plan Area Action Plan for Bunhill & Clerkenwell June 2013. Available from: https://www.islington.gov.uk///~/media/sharepoint-lists/public-records/planningandbuildingcontrol/publicity/publicconsultation/20132014/20130621finsburylocalplanadoptiondraftjune2013

[9] Islington's Planning - Statement of Community Involvement July 2006. Available from: http://democracy.islington.gov.uk/Data/Executive/200607201930/Agenda/Appx%20STATEMENTofCOMMUNITYINVOLVEMENT.pdf

[10] HSMO (2004) Civil Contingencies Act. Available from: http://www.legislation.gov.uk/ukpga/2004/36/contents

[11] London Borough of Islington (2016) Islington Council Crisis Response Plan. Available from: https://www.islington.gov.uk/~/media/sharepoint-lists/public-records/transportandinfrastructure/information/adviceandinformation/20152016/20150814lbidraftfloodplan

[12] London Borough of Islington (2009) Multi-Agency Flood Plan. Available from: https://www.islington.gov.uk/~/media/sharepoint-lists/public-records/transportandinfrastructure/information/adviceandinformation/20152016/20150814lbidraftfloodplan

[13] Sir Michael Pitt (2008) The Pitt Review: Lessons learned from the 2007 floods. Available from:

http://webarchive.nationalarchives.gov.uk/20100807034701/http:/archive.cabinetoffice.gov.uk/pittreview/thepittreview/final_report.html

[14] HMSO (2010) The Flood and Water Management Act. Available from: http://www.legislation.gov.uk/ukpga/2010/29/contents

[15]The Flood Risk Regulations (2009) Available from: http://www.legislation.gov.uk/uksi/2009/3042/contents/made

[16] European Commission (2007) EU Flood Directive (2007/60/EC) Available from: http://ec.europa.eu/environment/water/flood_risk/

[17] London Borough of Islington (2011) Preliminary Flood Risk Assessment. Available from: https://www.islington.gov.uk/~/media/sharepoint-lists/public-records/planningandbuildingcontrol/information/adviceandinformation/20122013/20120809preliminaryfloodriskassessment

[18] Department for Food, Environment and Rural Affairs (2013) Selecting and reviewing Flood Risk Areas for local sources of flooding: Guidance to Lead Local Flood Authorities. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/236385/flood-risk-method.pdf

[19] Department for Environment, Food and Rural Affairs (2011) The National Flood and Coastal Erosion Risk Management Strategy for England. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/228898/9780108510366.pdf

[20] Environment Agency (2016) Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities. Available from: https://www.gov.uk/government/publications/adapting-to-climate-change-for-risk-management-authorities

[21] Department for Communities and Local Government (2012) National Planning Policy Framework. Available from: https://www.gov.uk/government/publications/national-planning-policy-framework--2

[22] Ministry of Housing, Communities & Local Government (2014) Guidance: Flood risk and coastal change. Available from: https://www.gov.uk/guidance/flood-risk-and-coastal-change#planning-and-flood-risk

[23] Department for Communities and Local Government (2014) Ministerial Statement HCWS161: Sustainable Drainage. Available from: http://www.parliament.uk/documents/commons-vote-office/December%202014/18%20December/6.%20DCLG-sustainable-drainage-systems.pdf

[24] Department for Food, Environment and Rural Affairs (2015) Sustainable Drainage Systems: Non-statutory Technical Guidance for Sustainable Drainage Systems. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf

[25] Environment Agency (2009) Thames Catchment Flood Management Plan. Available from: https://www.gov.uk/government/publications/thames-catchment-flood-management-plan

[26] Environment Agency (2014) Thames River Basin District Flood Risk Management Plan 2015-2021. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/507138/LIT_10229_THAMES_FRMP_PART_A.pdf

[27] London Borough of Islington (2017) Local Flood Risk Management Strategy

[28] London Borough of Islington (2011) Surface Water Management Plan

[29] The Environment Agency (2016) Flood risk assessments: climate change allowances. Available from: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

[30] Greater London Authority (2016) The London Plan. Available from: https://www.london.gov.uk/sites/default/files/the_london_plan_2016_jan_2017_fix.pdf

[31] Greater London Authority, Draft New London Plan showing Minor Suggested Changes (2018). Available from: https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/download-draft-london-plan-0

[32] Greater London Authority (2014) Sustainable Design and Construction: Supplementary Planning Guidance. Available from: https://www.london.gov.uk/sites/default/files/gla_migrate_files_destination/Sustainable%20Design%20%26%20Construction%20SPG.pdf

[33] The Mayor's Water Strategy, 2011, Securing London's Water future. Available from:

https://www.london.gov.uk/priorities/environment/publications/securing-london-s-water-future-the-mayor-s-water-strategy

[34] London Sustainable Drainage Action Plan (2016). Available from:https://www.london.gov.uk/sites/default/files/lsdap_december_2016.pdf

[35] Draft London Environment Strategy. Available from: https://www.london.gov.uk/WHAT-WE-DO/environment/environment-publications/draft-london-environment-strategy

[36] London Borough of Islington (2016) Islington Local Development Scheme. Available from: https://www.islington.gov.uk//~/media/sharepoint-lists/public-records/planningandbuildingcontrol/publicity/publicconsultation/20162017/20160601localdevelopmentschemeapril2016

[37] London Borough of Islington (2013) Finsbury Local Plan. Available from: https://www.islington.gov.uk/~/media/sharepoint-lists/public-records/planningandbuildingcontrol/publicity/publicconsultation/20132014/20130906finsburylocalplanadoptedjune2013

[38] London Borough of Islington (2011) Islington Core Strategy. Available from: https://www.islington.gov.uk/~/media/sharepoint-lists/public-records/environmentalprotection/qualityandperformance/reporting/20112012/20120303corestrategyfebruary2011.pdf

[39] London Borough of Islington (2013) Islington Development Management Policies. Available from: https://www.islington.gov.uk/~/media/sharepoint-lists/public-records/planningandbuildingcontrol/publicity/publicconsultation/20132014/20131211developmentmanagementpoliciesadoptedjune2013.pdf

[40] London Borough of Islington (2016) Basement Development: Supplementary Planning Document. Available from: https://www.islington.gov.uk/~/media/sharepoint-lists/public-records/planningandbuildingcontrol/publicity/publicconsultation/20152016/20160122basementdevelopmentspdadoptedjan2016.pdf

[41] London Borough of Islington (2012) Environmental Design Planning Guidance. Available from: https://www.islington.gov.uk//~/media/sharepoint-lists/public-records/planningandbuildingcontrol/publicity/publicconsultation/20122013/20121022environmentaldesignspdfinal

[42] Environment Agency (2017) *What are Groundwater Source Protection Zones?* Available from: http://apps.environment-agency.gov.uk/wiyby/37833.aspx

[43]Environment Agency (2013) Risk of Flooding from Surface Water. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/297429/LIT_8986_eff63d.pdf

[44] Environment Agency (2014) Risk of Flooding from Reservoirs. Available from: http://watermaps.environment-agency.gov.uk/wiyby/wiyby.aspx?topic=reservoir#x=528087&y=186344&scale=10

[45] Department for Environment, Food and Rural Affairs and Environment Agency (2017) Flooding and Coastal Change Guidance – Flood Risk Assessment: the Sequential Test for Applicants. Available from: https://www.gov.uk/guidance/flood-risk-assessment-the-sequential-test-for-applicants

[46] London Borough of Islington (2010) Sustainability Appraisal: Core Strategy Submission Document. Available from: https://www.islington.gov.uk/~/media/sharepoint-lists/public-records/environmentalprotection/qualityandperformance/reporting/20112012/20120303corestrategysustainabilityappraisal.pdf

[47] Department for Environment, Food and Rural Affairs and Environment Agency (2017) Flooding and Coastal Change Guidance - Flood Risk Assessment: Flood Zone 1 and Critical Drainage Areas. Available from: https://www.gov.uk/guidance/flood-risk-assessment-in-flood-zone-1-and-critical-drainage-areas

[48] Department for Communities and Local Government (2007) Improving the Flood Performance of New Buildings: Flood Resilient Construction. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7730/flood_performance.pdf

[49] Environment Agency and Defra (2005) Flood Risk Assessment Guidance for New Development. Available from: http://evidence.environment-agency.gov.uk/FCERM/Libraries/FCERM_Project_Documents/FD2320_3364_TRP_pdf.sflb.ashx

[50] CIRIA (2015) The SuDS Manual (C753). Available from: http://www.ciria.org/Memberships/The_SuDs_Manual_C753_Chapters.aspx

[51] Town and Country Planning, England (2015) The Town and Country Planning (Development Management Procedure) (England) Order 2015. Available from: http://www.legislation.gov.uk/uksi/2015/595/introduction/made

[52] Department of Environment, Food and Rural Affairs (2015) Non-statutory technical standards for sustainable drainage systems. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf