

# Level 1 Strategic Flood Risk Assessment

London Borough of Croydon

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## Quality information

Prepared by	Checked by	Verified by	Approved by
Miguel Headley Graduate Engineer	Bernadine Maguire Principal Flood Risk & Coastal Consultant	Emily Craven Associate	Sarah Littlewood Principal Consultant
Lauren Lewis Water Consulting Apprentice			

## Revision History

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### Prepared for:

London Borough of Croydon

### Prepared by:

AECOM Limited  
Midpoint, Alencon Link  
Basingstoke  
Hampshire RG21 7PP  
United Kingdom

T: +44(0)1256 310200  
aecom.com

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# User Guide

It is anticipated that this Level 1 SFRA will have several end users with slightly different requirements; this Section describes how to use the SFRA and how to navigate the report and mapping deliverables. The report is set out as follows:

- Section 1 Introduction
- Section 2 Planning Policy and Guidance
- Section 3 Methodology
- Section 4 Assessing Flood Risk
- Section 5 Avoiding Flood Risk
- Section 6 Managing and Mitigating Flood Risk
- Section 7 Site Specific FRA guidance
- Section 8 Recommendations for Policy and Practice
- Section 9 Next Steps
- Appendix A – Figures
- Appendix B – Data Register

## Strategic Planning and Policy

The main purpose of the Level 1 SFRA for London Borough of Croydon (LB Croydon) as explained in the National Planning Policy Framework (NPPF)<sup>1</sup>, is to provide a strategic overview of flood risk within the Planning Authority Area in order to enable effective risk-based strategic planning for the future, through the preparation of the Local Plan. Sections 2 to 4 present the information that should be used by LB Croydon to inform their knowledge of flood risk from all sources throughout their area.

As part of this SFRA, several policy options have been developed and 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 Planning Authority Area.

## Applying the Sequential Test

The NPPF sets strict tests to protect people and property from flooding which all Local Planning Authorities (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 5 provides specific guidance on applying both the Sequential and, where appropriate, Exception Test.

Compliance with the Exception Test requires a detailed assessment of flood risk to a specific site, for example to quantify flood hazard. This level of information is provided in a Level 2 SFRA and is not addressed in this Level 1 SFRA report.

## Emergency Planning

LB Croydon is a Category One Responder under the Civil Contingencies Act 2004<sup>2</sup> and therefore has a responsibility, along with other risk management authorities, to develop emergency plans to help reduce, control or ease the effects of an emergency.

The Level 1 SFRA deliverables should be used by LB Croydon's 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

<sup>1</sup> MHCLG (July 2018 - updated February 2019). *Revised National Planning Policy Framework*. Available at: <https://www.gov.uk/government/collections/revised-national-planning-policy-framework>

<sup>2</sup> HSMO (2004) Civil Contingencies Act. Available from: <http://www.legislation.gov.uk/ukpga/2004/36/contents>

incorporated into their understanding of flood risk. Section 6 provides detail on Emergency Planning and Flood Warnings within the Planning Authority Area.

## Preparing Site Specific FRAs

The Level 1 SFRA can provide a useful starting point for the preparation of site-specific Flood Risk Assessments (FRAs) for individual development sites as follows,

- Sections 1-4 provide an overview of the key issues within the Planning Authority Area 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 details of measures that may need to be implemented to manage and mitigate flood risk, and
- Section 7 provides specific guidance for preparing site specific FRAs in accordance with the checklist presented in the Planning Practice Guidance (PPG)<sup>3</sup>.

## Assessing Planning Applications

Development Management officers who are reviewing site-specific FRAs as part of the planning application process should consult Sections 3 and 4 of the Level 1 SFRA to provide background for flood risk in the area relating to the planning application. Section 7 can also be used by those assessing applications as a checklist for issues that need to be addressed as part of site specific FRAs.

## Living Document

New information may influence future development control decisions within LB Croydon. Therefore, it is important that a SFRA is adopted as a 'living' document and is reviewed regularly considering emerging policy directives, flood risk datasets and an improving understanding of flood risk within the Planning Authority Area. The Level 1 SFRA for LB Croydon was first undertaken in 2015, this 2020 SFRA represents the first update of this living document.

This Level 1 SFRA has been developed building heavily upon existing knowledge with respect to flood risk within the LB Croydon and considering cross boundary flood risk issues. The Environment Agency review and update the Flood Map for Planning (Rivers and Sea)<sup>4</sup> on a quarterly basis and a rolling programme of detailed flood risk mapping is ongoing. LB Croydon maintain records of flooding and the causes of flooding which are updated as new events occur. This SFRA reviews the available information which was current at the time of preparation (April – November 2020).

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<sup>3</sup> MHCLG (March 2014). Planning Practice Guidance: Flood Risk and Coastal Change. Available at: <http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/>

<sup>4</sup> Environment Agency Flood Map for Planning <https://flood-map-for-planning.service.gov.uk/>

# 1. Introduction

## 1.1 Background

- 1.1.1 In its role as the Local Planning Authority (LPA), Croydon Council is currently preparing documents to support the Croydon Local Plan Review to develop the vision for future development across the Borough.
- 1.1.2 The National Planning Policy Framework<sup>5</sup> (NPPF) and accompanying Planning Practice Guidance (PPG)<sup>6</sup> emphasise the responsibilities for LPAs to ensure that flood risk is understood and managed effectively using a risk-based approach through all stages of the planning process. As such, LPAs are required to undertake a Strategic Flood Risk Assessment (SFRA) to support the preparation of their Local Plan.
- 1.1.3 AECOM has been commissioned by LB Croydon to review and revise their existing SFRA which was a joint document with the London Borough of Merton, London Borough of Sutton and London Borough of Wandsworth, completed in December 2016. This updated Level 1 SFRA is a standalone document for the London Borough of Croydon and the methodology applied complies with the NPPF<sup>5</sup> as well as the updated guidance from the Environment Agency (August 2019). The SFRA has been completed in collaboration with LB Croydon, the Environment Agency and Thames Water. The results of this SFRA are intended to inform strategic land use planning and decision making from a flood risk perspective and to support the development of the Local Plan Review.

## 1.2 Study Area

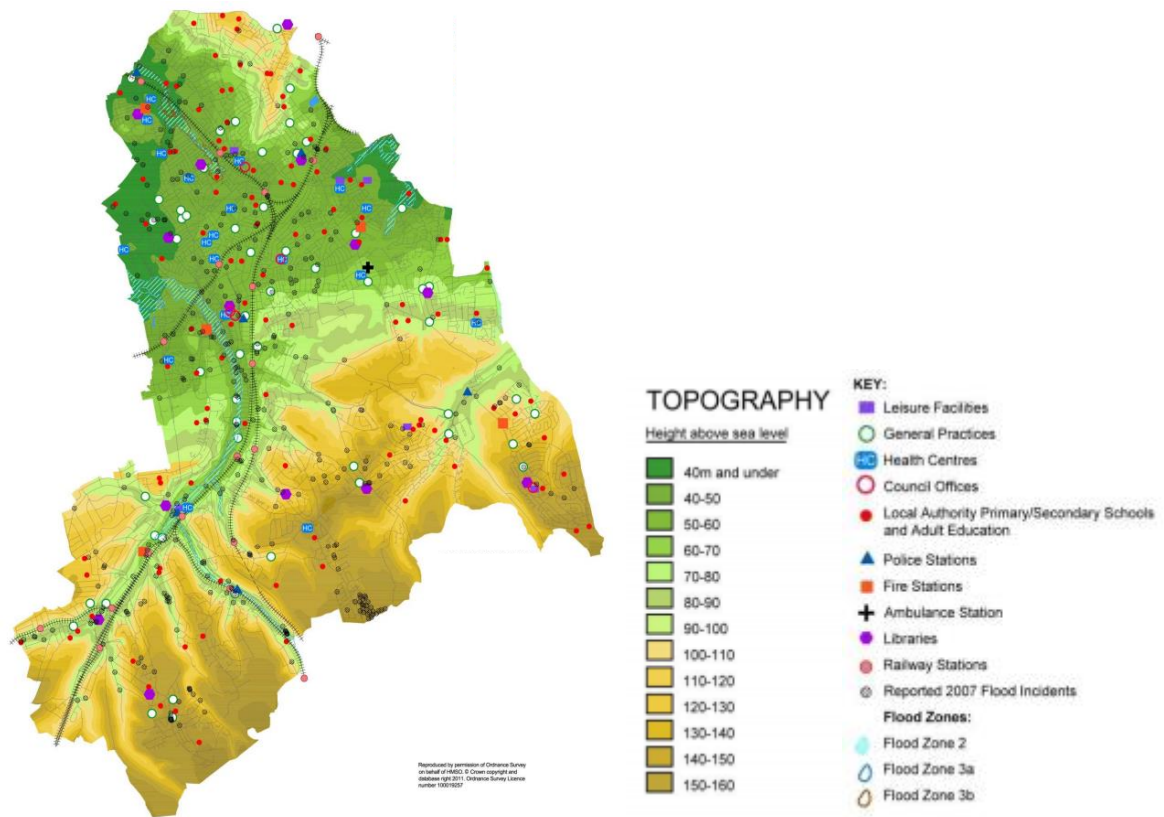
- 1.2.1 The study area is defined by the administrative boundary of the London Borough of Croydon, located in south London. London Borough of Croydon borders the London Boroughs of Merton and Lambeth to the north, London Borough of Bromley to the east, London Borough of Sutton to the west, and Surrey County to the south.
- 1.2.2 The Borough boundary encompasses an area of 8,600 ha and comprises of four Environment Agency designated Main Rivers; the River Wandle, the Norbury Brook, Caterham Bourne which is a tributary of the River Wandle, and Chaffinch Brook, which is a tributary of the Ravensbourne.

### Topography

- 1.2.3 The Borough topography, as shown in Figure 1.1, is characterised by steep slopes in Coulsdon in the south of the Borough which then level off to flatter land in the north. Brighton Road is in a natural valley, which is the flow path of the former River Wandle, now entirely culverted until it emerges at Wandle Park in South Croydon.
- 1.2.4 Much of the Borough drains into the catchment of the River Wandle, which passes into London Borough of Sutton. The northern part of the Borough drains into the Norbury Brook which feeds into the River Wandle further downstream. The south-eastern part of the Borough including the settlements of Forestdale and Addington is characterised by steeper topography and more rural land which drains into the tributaries of the River Ravensbourne which flows eastwards into London Borough of Bromley.

<sup>5</sup> Ministry of Housing, Communities and Local Government. February 2019. *National Planning Policy Framework*. Available at: <https://www.gov.uk/government/collections/revisted-national-planning-policy-framework>

<sup>6</sup> Communities and Local Government. 6th March 2014. *Planning Practice Guidance: Flood Risk and Coastal Change*. Available at: <http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/>



**Figure 1.1 London Borough of Croydon Topography**

(Source: Croydon Resilience Team Multi-Agency Flood Response Plan, Appendix G)



## 2. Planning Policy and Guidance

### 2.1 Policy and Local Context

- 2.1.1 A SFRA is a living document which is used as a tool by a planning authority to assess flood risk for spatial planning, determine planning applications, produce development briefs, set constraints, identify locations of emergency planning measures and indicate requirements for site specific flood risk assessments.
- 2.1.2 There is an established body of policy and guidance documents which are of importance when considering development and flood risk. These are identified in Table 2-1 along with links for where these documents can be found for further detail.

**Table 2-1 Flood Risk Policy and Guidance Documents**

Legislation and National Policy Documents		
National Planning Policy Framework (2019)	The NPPF <sup>5</sup> was published by the UK's MHCLG in March 2012 and updated in February 2019, consolidating over two dozen previously issued documents called <a href="#">Planning Policy Statements</a> (PPS) and <a href="#">Planning Policy Guidance Notes</a> (PPG <sup>6</sup> ) for use in England.	<a href="https://www.gov.uk/government/publications/national-planning-policy-framework--2">https://www.gov.uk/government/publications/national-planning-policy-framework--2</a>
Flood and Water Management Act (2010)	Provides for a more comprehensive management of flood risk.	<a href="http://www.legislation.gov.uk/ukpga/2010/29/pdfs/ukpga_20100029_en.pdf">http://www.legislation.gov.uk/ukpga/2010/29/pdfs/ukpga_20100029_en.pdf</a>
Flood Risk Regulations (2009)	The Flood Risk Regulations transpose the EU Floods Directive into law in England. It aims to provide a consistent approach to flood risk across Europe.	<a href="http://www.legislation.gov.uk/uksi/2009/3042/pdfs/uksi_20093042_en.pdf">http://www.legislation.gov.uk/uksi/2009/3042/pdfs/uksi_20093042_en.pdf</a>
National Flood and Coastal Erosion Risk Management Strategy for England (2020)	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 provides a framework for the work of all flood and coastal erosion risk management authorities.	<a href="https://www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england--2">https://www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england--2</a>
The Environmental Permitting (England and Wales) Regulations (2016)	In order to complete works on or near a main river, on or near a flood defence structure, in a floodplain or on or near a sea defence. Guidance on obtaining an environmental permit is available from the Environment Agency.	<a href="https://www.gov.uk/guidance/flood-risk-activities-environmental-permits">https://www.gov.uk/guidance/flood-risk-activities-environmental-permits</a> <a href="http://www.legislation.gov.uk/uksi/2016/1154/contents/made">http://www.legislation.gov.uk/uksi/2016/1154/contents/made</a>
Regional Flood Risk Policy		
The London Plan 2021	The London Plan 2021 is the Spatial Development Strategy for Greater London. It sets out a framework for how London will develop over the next 20-25 years and the Mayor's vision for Good Growth. The Plan is part of the statutory development plan for London, meaning that the policies in the Plan should inform decisions on planning applications across the capital. Borough's Local Plans must be in 'general conformity' with the London Plan.	<a href="https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/london-plan-2021">https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/london-plan-2021</a>
Thames Catchment Flood Management Plan (2009)	Role of the CFMP is to establish flood risk management policies which will deliver sustainable flood risk management for the long term (an Environment Agency Document).	<a href="https://www.gov.uk/government/collections/catchment-flood-management-plans">https://www.gov.uk/government/collections/catchment-flood-management-plans</a>
Guidance Documents		
Planning Policy Guidance – Flood Risk and Coastal Change (2014)	Describes the planning approach to development within areas at risk of flooding from all sources	<a href="https://www.gov.uk/guidance/flood-risk-and-coastal-change">https://www.gov.uk/guidance/flood-risk-and-coastal-change</a>
Environment Agency Flood Risk Assessment Standing Advice	Guidance on information to be included within robust site specific FRAs	<a href="https://www.gov.uk/guidance/flood-risk-assessment-standing-advice">https://www.gov.uk/guidance/flood-risk-assessment-standing-advice</a>
London Sustainable Drainage Action Plan, GLA December 2016	A plan to inspire, facilitate and co-ordinate a change in how we manage rainwater in London. It seeks to replace impermeable surfaces with green, sustainable drainage systems.	<a href="https://www.london.gov.uk/sites/default/files/lldap_december_2016.pdf">https://www.london.gov.uk/sites/default/files/lldap_december_2016.pdf</a>
Sustainable Design and Construction SPG, GLA, April 2014	Guidance on greenfield runoff rates, Sustainable Drainage Systems, flood resilience / resistance and flood risk management linking back to policies contained within the London Plan.	<a href="https://www.london.gov.uk/sites/default/files/gla_migrate_files_destination/Sustainable%20Design%20%26%20Construction%20SPG.pdf">https://www.london.gov.uk/sites/default/files/gla_migrate_files_destination/Sustainable%20Design%20%26%20Construction%20SPG.pdf</a>
Flood Risk Assessments: Climate Change	The guidance provides climate change allowance to consider in flood risk assessments in order to demonstrate how flood risks will managed over the design life of the development.	<a href="https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances">https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances</a>

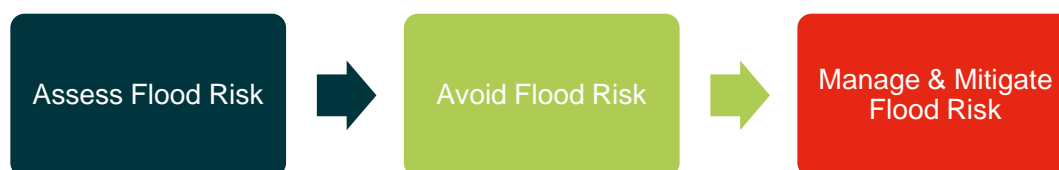
Allowances (2016) – Revised July 2020.		
<b>Local Documents and Strategies</b>		
Croydon Local Plan (2018)	The Croydon Local Plan 2018, comprising the Strategic Policies and the Detailed Policies and Proposals, was adopted on 27 February 2018 by Croydon Council.	<a href="https://www.croydon.gov.uk/planningandregeneration/framework/localplan/clppolicies">https://www.croydon.gov.uk/planningandregeneration/framework/localplan/clppolicies</a>
LB Croydon Multi-Agency Flood Response Plan v2.1, December (2016)	Describes the management structures and actions of local responders in response to a flooding event in the London Borough of Croydon.	<a href="https://www.croydon.gov.uk/sites/default/files/articles/downloads/Flood%20Response%20Plan.pdf">https://www.croydon.gov.uk/sites/default/files/articles/downloads/Flood%20Response%20Plan.pdf</a>
LB Croydon Surface Water Management Plan (2011)	A SWMP was produced for the London Borough of Croydon as part of the Drain London (GLA) study. This study included an assessment of flooding from sewers, drains, groundwater and runoff from land, small watercourses and ditches that occurs as a result of heavy rainfall.	<a href="https://www.croydon.gov.uk/sites/default/files/articles/downloads/swplan.pdf">https://www.croydon.gov.uk/sites/default/files/articles/downloads/swplan.pdf</a>
LB Croydon Public Realm Design Guide (PRDG)	Croydon Public Realm Design Guide is non-statutory formally adopted Corporate Guidance for all interventions within the public realm. The Guide is a supplementary document to the relevant British standards, national and regional policies and the Croydon Local Plan. The Croydon Public Realm Design Guide should be used by all those who are involved in either shaping or looking after Croydon's public realm including: Croydon Council teams involved in design, delivery and maintenance of public realm projects; developers and their consultants. The Guide is obligatory for all future Council projects.	<a href="https://www.croydon.gov.uk/sites/default/files/articles/downloads/Croydon%20PRDG%202019_r2.pdf">https://www.croydon.gov.uk/sites/default/files/articles/downloads/Croydon%20PRDG%202019_r2.pdf</a>
Croydon Local Flood Risk Management Strategy 2015:2020	As LLFA, the London Borough of Croydon has a statutory duty to develop, maintain, apply and monitor a strategy for local flood risk management in their administrative area. The London Borough of Croydon prepared a Local Flood Risk Management Strategy (LFRMS) in partnership with London Boroughs of Wandsworth, Merton, Sutton, Royal Borough of Kingston upon Thames and London Borough of Richmond upon Thames in order to encourage collaboration and enable flood risk across South West London to be managed more effectively and holistically. London Borough of Croydon adopted their LFRMS in 2015.	<a href="https://www.croydon.gov.uk/environment/flood-water/flood-management">https://www.croydon.gov.uk/environment/flood-water/flood-management</a>
Greater London Authority Preliminary Flood Risk Assessment	As part of the Drain London project, PFRAs were prepared for all London Boroughs in 2011 <sup>7</sup> . A PFRA Addendum was prepared in 2017. The PFRA seeks to provide a high level overview of flood risk from local flood sources and includes flooding from surface water (i.e. rainfall resulting in overland runoff), groundwater, ordinary watercourses (smaller watercourses and ditches) and canals. It excludes flood risk from main rivers, the sea and reservoirs, as these are assessed nationally by the Environment Agency. The PFRA 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. The report provides a useful baseline for each London Borough to inform their LFRMS.	<a href="https://www.croydon.gov.uk/sites/default/files/articles/downloads/preliminaryflood-assessment.pdf">https://www.croydon.gov.uk/sites/default/files/articles/downloads/preliminaryflood-assessment.pdf</a>
River Wandle Catchment Plan (2014)	The creation and implementation of the Wandle Catchment Plan is a partnership project facilitated by the Wandle Trust, an environmental charity dedicated to restoring and maintaining the health of the River Wandle and its catchment. The Wandle Trust works closely with policy makers, land managers and statutory bodies in addition to engaging with the local community in outreach and education activities. This has made the charity a natural choice to lead the consultation on local people's Vision and Action Plan for their river and develop and maintain the Wandle Catchment Plan in the future.	<a href="https://www.wandletrust.org/wp-content/uploads/2014/12/Wandle_Catchment_Plan_-_Sept_2014_-_full_document.pdf">https://www.wandletrust.org/wp-content/uploads/2014/12/Wandle_Catchment_Plan_-_Sept_2014_-_full_document.pdf</a>

## 2.2 Approach to Flood Risk Management

2.2.1 The NPPF<sup>5</sup> and associated PPG for Flood Risk and Coastal Change<sup>6</sup> emphasise the active role LPAs should take to ensure that flood risk is assessed, avoided, and managed effectively and sustainably

<sup>7</sup> Greater London Authority, 2011, Preliminary Flood Risk Assessment for London Borough of Merton; Greater London Authority, 2011, Preliminary Flood Risk Assessment for London Borough of Wandsworth; Greater London Authority, 2011, Preliminary Flood Risk Assessment for London Borough of Sutton; Greater London Authority, 2011, Preliminary Flood Risk Assessment for London Borough of Croydon

throughout all stages of the planning process. The overall approach for the consideration of flood risk set out in Section 1 of the PPG can be summarised as follows:



2.2.2 This has implications for LPAs and developers as described below.

## Assess flood risk

2.2.3 The NPPF outlines that strategic policies should be informed by a SFRA and should manage flood risk from all sources. Figure 1.1 reproduced from the PPG<sup>6</sup>, illustrates how flood risk should be considered in the preparation of the Local Plan by LB Croydon.

2.2.4 For sites in areas at risk of flooding (Refer to Section 4, Section 7) or with an area of 1 hectare or greater, developers must undertake a site-specific Flood Risk Assessment (FRA) to accompany planning applications (or prior approval for certain types of permitted development).

## Avoid flood risk

2.2.5 LB Croydon should apply the sequential approach to site selection so that development is, as far as reasonably possible, located where the risk of flooding from all sources is lowest, taking account of climate change and the vulnerability of future users to flood risk.

2.2.6 In decision-making this involves applying the Sequential Test and, if necessary, the Exception Test to future development sites, as described in Figure 2.1. Further information is included in Section 5.

2.2.7 In decision-taking this involves applying the Sequential Test and if necessary, the Exception Test for specific development proposals. Further information is included in Section 5.

## Manage and mitigate flood risk

2.2.8 Where alternative sites in areas at lower risk of flooding are not available, it may be necessary to locate development in areas at risk of flooding. In these cases, LB Croydon and developers must ensure that development is appropriately flood resilient and resistant, safe for its users for the lifetime of the development and will not increase flood risk overall.

2.2.9 LB Croydon and developers should seek flood risk management opportunities to reduce the level of flood risk in the area e.g. safeguarding land for flood risk management or where appropriate, through designing off-site works required to protect and support development in ways that benefit the area more generally.



**Figure 2.1 Taking flood risk into account in the preparation of a Local Plan (PPG Flood Risk and Coastal Change, p6)**

## 2.3 SFRA Level 1 and 2

- 2.3.1 There are two categories of SFRA; a 'Level 1' SFRA, which analyses flood risk at a strategic level across the Local Authority area, and a 'Level 2' SFRA, which provides a more detailed analysis of flood risk for specified development sites. A Level 2 SFRA is required in the event that a development is proposed in an area of flood risk, and the vulnerability of the land use requires an Exception Test. Flood risk vulnerability (or level of resilience to damages from flooding) reflects the land uses/property types within a site, the NPPF provides a classification system for these, ranging from Essential Infrastructure to Water-Compatible, which can be crossmatched with the flood zones to determine suitable land uses for a site. Further guidance on the production of a Level 2 SFRA and the application of the Exception Test is provided in Section 5.4.

## 3. Methodology

### 3.1 Overview

- 3.1.1 Under Section 10 of NPPF<sup>1</sup>, the risk of flooding from all sources must be considered as part of a SFRA, including flooding from rivers (fluvial), land (overland flow and surface water), groundwater, sewers and artificial sources. Flooding from the sea is not relevant to the study area.
- 3.1.2 The methodology for the appraisal of flood risk from these sources is outlined below:

### 3.2 Consultation

- 3.2.1 Under the Localism Act 2011<sup>8</sup>, there is now a legal duty on LPAs to co-operate with one another, County Councils and other Prescribed Bodies to maximise the effectiveness within which certain activities are undertaken as far as they relate to a 'strategic matter'.
- 3.2.2 In complying with the duty to cooperate, Government Guidance recommends that LPAs 'scope' the strategic matters of Local Plan documents at the beginning of the preparation process taking account of each matters 'functional geography' and identify those LPAs and Prescribed Bodies that need to be constructively and actively engaged.
- 3.2.3 Flood risk is identified as a strategic matter and specific engagement activities are proposed with several adjoining LPAs and Prescribed Bodies, both in relation to the preparation of the SFRA and the Local Plan. As part of the SFRA, several organisations were contacted and requested to provide data to inform the SFRA. A summary of the roles of each organization, and their involvement through the development of the SFRA, is provided in Table 3-1.

**Table 3-1 SFRA Stakeholder Organisations and Roles**

Stakeholder Organisation	Role with respect to LB Croydon SFRA
LB Croydon	<p>As an LPA LB Croydon 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, and those of other studies, to inform strategic land use planning including the application of the Sequential Test which seeks to steer development towards areas of lowest flood risk prior to consideration of areas of greater risk. LB Croydon is also required to consider flood risk and, when necessary, apply the Sequential and Exception Tests when assessing applications for development.</p> <p>As the LLFA, under the Flood and Water Management Act (FWMA) LB Croydon has a duty to take the lead in the coordination of local flood risk management, specifically defined as flooding from surface water, groundwater and ordinary watercourses and to this end has prepared the Local Flood Risk Management Strategy (LFRMS) for Croydon.</p> <p>LB Croydon, as the LLFA, is responsible for regulation and enforcement on ordinary watercourses and is a statutory consultee for future sustainable drainage systems (SuDS) for major developments in the county, following changes to the Town and Country Planning (Development Management Procedures) (England) Order 2015.</p> <p>LB Croydon is the Highways Authority and therefore has responsibilities for the effectual drainage of surface water from adopted roads insofar as ensuring that drains, including kerbs, road gullies and ditches and the pipe network which connect to the sewers, are maintained.</p> <p>During the preparation of the SFRA, LB Croydon has provided access to available datasets held by the Council regarding flood risk across the Borough. The SFRA will be used by LB Croydon Emergency Planning team to ensure that the findings are incorporated into their understanding of flood risk and the preparation of their Multi-Agency Flood Plan (MAFP).</p>

<sup>8</sup> HMSO (2011) Localism Act Available from: <http://www.legislation.gov.uk/ukpga/2011/20/contents/enacted>

Stakeholder Organisation	Role with respect to LB Croydon SFRA
Environment Agency	<p>The Environment Agency is responsible for managing the risk of flooding from Main Rivers and the sea and has a responsibility to provide a strategic overview for all flooding sources and coastal erosion.</p> <p>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, sustainability appraisals and evidence base documents, including SFRA as well as providing advice on higher risk planning applications.</p> <p>The Environment Agency undertakes systematic modelling and mapping of fluvial flood risk associated with all Main Rivers in the study area, as well as supporting Lead Local Flood Authorities (LLFA) with the management of surface water flooding by mapping surface water flood risk across England. The Environment Agency has supplied available datasets for use within the SFRA.</p> <p>The Environment Agency will be involved in reviewing the draft SFRA project deliverables.</p>
Thames Water Utilities Ltd	<p>Thames Water Utilities Ltd (TWUL) is responsible for surface water drainage from development 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 TWUL will play is providing data regarding historic sewer flooding.</p>
Neighbouring LPAs and other consultees	<p>The following LPAs adjoin LB Croydon; LB Merton, LB Lambeth, LB Sutton, LB Bromley, Tandridge District and Reigate and Banstead Borough Councils.</p>

### 3.3 Data Collection and Suitability Analysis

- 3.3.1 A large quantity of information and datasets have been made available by the stakeholder organisations and used to inform the assessment of flood risk. Descriptions of the datasets that have been used, along with details of their appropriate use or limitations, are included in Appendix B Data Register. The datasets have been used to develop the maps included in Appendix A.

## 4. Assessing Flood Risk

### 4.1 River Flooding

#### River Network

- 4.1.1 All watercourses in England and Wales are classified as either 'Main Rivers' or 'Ordinary Watercourses'. The difference between the two classifications is based largely on the perceived 'importance' of the watercourse with reference to its potential to cause significant and widespread flooding. However, it is not always the case the watercourses classed as ordinary watercourses can cause localised flooding.
- 4.1.2 The Environment Agency 'Detailed River Network' dataset has been used to identify watercourses in the study area and their designation (i.e. Main River or Ordinary Watercourse). The Environment Agency 'Statutory Main River Map' has been used to map the main rivers within the borough.

#### Appendix A Figure 1 Flood Map for Planning (Rivers and Sea)

- 4.1.3 There are four Main Rivers present within the Borough (Norbury Brook, River Wandle, Caterham Bourne and the Chaffinch Brook) as described below.

#### Norbury Brook

- 4.1.4 The Norbury Brook begins in Selhurst as an ordinary watercourse which flows in open channel through Heavers Meadow and is then culverted beneath Selhurst Road and Whitehorse Road. It then becomes a main river and flows northwest in open channel through the residential area of Thornton Heath and the Recreation Ground, beneath the railway line and into Norbury Park. Upon leaving Norbury Park the Norbury Brook flows north into London Borough of Lambeth and becomes the River Graveney, which itself is a tributary of the River Wandle.

#### River Wandle

- 4.1.5 The River Wandle catchment, which includes the River Graveney tributary, drains a total area of approximately 200km<sup>2</sup>. The Wandle flows from south to north from London Borough of Croydon through London Borough of Sutton, London Borough of Merton and discharges into the Thames at Bell Lane Creek in London Borough of Wandsworth. The southern half of the catchment is underlain by Chalk, which is highly permeable, allowing surface water to infiltrate into the ground rather than runoff into the Wandle. The northern half of the catchment is underlain by London Clay with very limited permeability which can generate significant volumes of rapid surface water runoff during periods of heavy rainfall.
- 4.1.6 There are two sources for the River Wandle, springs at Carshalton and Waddon, which rise at the junction between the Chalk and the overlying Clays and Gravels. In London Borough of Croydon, the River Wandle rises from natural springs at Waddon Ponds immediately west of Croydon town centre. It has recently been de-culverted to flow in an open section through Wandle Park before it is culverted again and flows west into the London Borough of Sutton.

#### Caterham Bourne

- 4.1.7 The Caterham Bourne is a groundwater-fed watercourse, which flows intermittently following periods of wet weather. Heavy flows are recorded approximately every 7 years. Source location can vary between flood events. The watercourse rises in Caterham in Surrey and flows northwest in and out of culverted sections through Whyteleafe, Kenley and Riddlesdown. It then becomes culverted and is designated as a surface water sewer which continues towards Purley. At Purley Cross the sewer passes north beneath the A23 Brighton Road and the A236 before discharging to the River Wandle at Wandle Park.

#### Chaffinch Brook

- 4.1.8 Chaffinch Brook catchment is a highly complex system of Main Rivers and ordinary watercourses. It flows in the north-east of the borough with some open sections close to the boundary with London Borough of Bromley. The Chaffinch Brook eventually joins the Pool River and River Ravensbourne.

#### Ordinary Watercourses

- 4.1.9 According to Environment Agency records, the mapped ordinary watercourses in Croydon include the upstream section of the Norbury Brook, near Selhurst in the north of the Borough, and the tip of the



Beck, which flows into the London Borough of Bromley. A number of other watercourses have been identified, including ephemeral bournes, which only flow when the groundwater is high. The London Borough of Croydon LFRMS<sup>13</sup> identifies the requirement for these watercourses to be mapped and riparian responsibilities clarified to aid future management.

- 4.1.10 Within Croydon, significant lengths of ordinary watercourse are culverted, with trash screens often located on the upstream end of culverts. Trash screens and culverts have the potential to become blocked by items such as plant debris and rubbish. Blockages can restrict the natural flow of water, increasing the chance of water flowing out of bank and causing local flooding due to the reduced conveyance potential of the associated watercourse. Further asset information and actions in place to address their risk to flooding are available in the London Borough of Croydon LFRMS<sup>13</sup> and Action Plan.
- 4.1.11 LB Croydon is aware of flooding problems associated with ordinary watercourses. The Merstham Bourne, an ephemeral watercourse which has an open section near Coulsdon South Station, caused flooding to residents' gardens during the wet weather of winter 2014, as did the drainage ditch running behind Wharfedale Gardens in Norbury. Several problems have been noted with flooding at Heavers Meadow allotments, which sit alongside the Norbury Brook in an open section where it is an ordinary watercourse. Numerous other open ditches and streams around the borough can cause problems where trash screens or downstream culverts get blocked. Problems associated with a drainage ditch in Park Hill Park in recent years have led to flooding threatening the main London to Brighton railway line. These issues have been exacerbated by a blockage in the downstream culvert and a burst water main in addition to local geography and capacity of the ditch itself.

## Flood Map for Planning (Rivers and Sea)

- 4.1.12 Flooding from rivers occurs when water levels rise higher than bank levels causing floodwater to spill across adjacent land (floodplain). The main reasons for water levels rising in rivers are:
- Intense or prolonged rainfall causing runoff rates and flows to increase in rivers, exceeding the capacity of the channel. This can be exacerbated by wet conditions and where there is significant groundwater base flow.
  - Constrictions in the river channel causing flood water to back up; and
  - Constrictions preventing discharge at the outlet of the river e.g. locked flood gates, or tide locking.
- 4.1.13 The risk of flooding is a function of the probability that a flood will occur and the consequence to the community or receptor as a direct result of flooding. The NPPF seeks to assess the probability of flooding from rivers by categorising areas within the fluvial floodplain into zones of low, medium and high probability, as defined in Table 4-1.

**Table 4-1 Fluvial Flood Zones (extracted from the PPG, 2014)**

Flood Zone	Fluvial Flood Zone Definition	Probability of Flooding
Flood Zone 1	Land having a less than 1 in 1,000 (0.1%) annual probability of river flooding. 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 annual probability of river flooding (between 1% and 0.1% annual probability of flooding each year).	Medium
Flood Zone 3a	Land having a 1 in 100 or greater annual probability of river flooding (greater than 1% annual probability of flooding each year).	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 (0.1% annual probability). The functional floodplain is not separately distinguished from Flood Zone 3a on the EA Flood Map for Planning (Rivers and Sea). LPAs are required to identify areas of functional floodplain as part of their SFRA, in discussion with the Environment Agency. For the purposes of this SFRA, the identification of the functional floodplain considers local circumstances and land modelled to flood during a 5% AEP event or greater in any year has been mapped, in agreement with the Environment Agency.	Functional Floodplain



- 4.1.14 The 'Flood Map for Planning (Rivers and Sea)' dataset is available on the Environment Agency website<sup>9</sup> and is the main reference for planning purposes as it contains Flood Zones 1, 2 and 3 which are referred to in the NPPF and presented in Table 4-1. The 'Flood Map for Planning (Rivers and the Sea)' provides information on the areas that would flood if there were no flood defences or buildings in the "natural" floodplain.
- 4.1.15 The 'Flood Map for Planning (Rivers and Sea)' also identifies areas which, in the event of a river flood with a 1% AEP (or a tidal flood with a 0.5% AEP) would be protected from flooding by the presence of flood defences. These areas are described as 'Areas Benefitting from Defences' (ABD).

**Appendix A Figure 1 Flood Map for Planning (Rivers and Sea)**  
**Appendix A Figure 2 Flood Modelling Outlines for the River Wandle**

- 4.1.16 The majority of London Borough of Croydon (97.8%) is defined as Flood Zone 1 Low Probability of flooding from rivers. Approximately 1.7% is defined as Flood Zone 2 Medium Probability, and less than 0.5% is defined as Flood Zone 3a High Probability and Flood Zone 3b Functional Floodplain.

**Table 4-2 Flood Zones within London Borough of Croydon**

Watercourse	Flood Zones
River Wandle:	Flood Zone 3a associated with the River Wandle extends across the western part of Wandle Park and the industrial area up to Factory Lane. Flood Zone 2 extends further to the north and west across the A23 Purley Way and up to the borough boundary. The open channel section of the River Wandle through Wandle Park is designated Flood Zone 3b Functional Floodplain.
Norbury Brook:	The floodplain associated with the Norbury Brook is approximately 100m wide along the majority of its open channel sections. Areas within the Recreation Ground and Norbury Park are designated Flood Zone 3b Functional Floodplain.
Caterham Bourne:	The floodplain associated with the Caterham Bourne in the south east of the borough is approximately 30m wide, increasing to approximately 100m wide along Brighton Road.
Chaffinch Brook:	There is a small portion of Flood Zone 2 and 3 in this part of the Borough, primarily associated with parkland areas.

- 4.1.17 It should be noted that a separate map is available on the Environment Agency website which is referred to as 'Risk of Flooding from Rivers and Sea'<sup>10</sup>. This map takes into account the presence of flood defences and so describes the actual chance of flooding, rather than the chance if there were no defences present. While flood defences reduce the level of risk, they do not completely remove it as they can be overtopped or fail in extreme weather conditions, or if they are in poor condition. As a result, the maps may show areas behind defences which still have some risk of flooding. This mapping has been made available by the Environment Agency as the primary method of communicating flood risk to members of the public, however for planning purposes the 'Flood Map for Planning (Rivers and the Sea)' and associated Flood Zones remains the primary source of information.

## Hydraulic Modelling Studies

- 4.1.18 Table 4-3 provides a summary of the hydraulic modelling studies that have been undertaken for the Main Rivers in London Borough of Croydon and used to inform the Environment Agency's Flood Map for Planning (Rivers and Sea). The type of model (1D or 2D) is also specified, along with the corresponding available sources of flooding used for each model.

<sup>9</sup> Environment Agency Flood Map for Planning (Rivers and Sea) <http://apps.environment-agency.gov.uk/wiyby/37837.aspx>

<sup>10</sup> Environment Agency 'Risk of Flooding from Rivers and Sea' <http://watermaps.environment-agency.gov.uk/wiyby/wiyby.aspx?topic=floodmap#x=237038&y=161974&scale=1>

**Table 4-3 Hydraulic models for Main Rivers in London Borough of Croydon (fluvial flood risk)**

Watercourse	Modelling Study	Model	Source of flooding
River Wandle and Norbury Brook	JBA Consulting (2015), River Wandle Remodeling Study  JBA Consulting (2017), Wandle Climate Change Modelling Technical Note	1D-2D ISIS-TUFLOW	The flood water source along the study reach is dominated by three mechanisms <ul style="list-style-type: none"> <li>fluvial flooding from exceedance of banks of the River Wandle, River Graveney, Norbury Brook and other channels</li> <li>surface water flooding arising from rain falling onto the urbanised catchment and exceeding the capacity of the sewer system.</li> <li>Groundwater contribution to flood flows from the upper parts of the catchment, but also potential groundwater emergence.</li> </ul>
Caterham Bourne	ATKINS (2019), Caterham Bourne Flood Alleviation Study Stage 2 Options Appraisal Report	Infoworks Integrated Catchment Model (ICM)	Flood risk in the Bourne Catchment, though driven by groundwater, is a combination of fluvial, surface water and sewer flooding. The modelling study has considered all these sources of flooding to understand how the combined risk, along with existing drainage infrastructure, impacts flood risk in the Catchment.  At the time of SFRA preparation this model is not in the public domain and cannot be used for planning applications.
Chaffinch Brook	AECOM (2020)	InfoWorks ICM	The model includes the following elements: <ul style="list-style-type: none"> <li>a hydrological model which represents a range of design rainfall events</li> <li>a hydraulic routing model which represents where rainfall landing on the surface flows; and</li> <li>a hydraulic model of the open channel watercourses, drainage and sewer networks within the catchment which represents how the systems collect, convey and ultimately discharge surface water.</li> </ul> At the time of SFRA preparation this model is not in the public domain and cannot be used for planning applications.

## Functional Floodplain Flood Zone 3b

- 4.1.19 The Functional Floodplain is defined in the NPPF as 'land where water has to flow or be stored in times of flood'. The Functional Floodplain (also referred to as Flood Zone 3b), is not separately distinguished from Flood Zone 3a on the Flood Map for Planning (Rivers and Sea). Rather the SFRA is the place where LPAs should identify areas of Functional Floodplain in discussion with the Environment Agency.
- 4.1.20 The PPG states that the identification of Functional Floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. However, land which would naturally flood with an annual probability of 1 in 20 (5% AEP) or greater in any year or is designed to flood (such as a flood attenuation scheme) in an extreme (0.1% annual probability) flood, should provide a starting point for consideration. The guidance goes on to say that 'areas which would naturally flood with an annual probability of 1 in 20 (5% AEP) or greater but are prevented from doing so by existing infrastructure or solid buildings will not normally be defined as functional floodplain'.
- 4.1.21 LB Croydon have used the modelled outlines for the 1 in 20 (5% AEP) event for the River Wandle and Norbury Brook to define the Functional Floodplain (Flood Zone 3b) associated with these watercourses. These areas are chiefly undeveloped areas within Wandle Park, Norbury Park and the Recreation Ground adjacent to Melfort Road.

## Climate Change

- 4.1.22 The NPPF<sup>5</sup> and supporting practice guide sets out how the planning system should help 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 development, taking climate change into account.
- 4.1.23 In previous SFRAs and site specific Flood Risk Assessments an allowance of 20% was added to the 1 in 100 year (1% AEP) return period to account for increases in flood risk due to climate change. In

February 2016, the Environment Agency published revised guidance on climate change allowances<sup>11</sup> including predictions of anticipated change for:

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

4.1.24 The guidance reflects an assessment completed by the Environment Agency between 2013 and 2015 using United Kingdom Climate Projections 2009 (UKCP09) data to produce more representative climate change allowances across England. The full guidance can be found using the following link to the gov.uk website and is discussed further below. <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>.

4.1.25 Climate change allowances applicable to London Borough of Croydon (Thames River Basin District) are set out in Table 4-4 below. For the purposes of strategic planning and completion of the sequential test, LB Croydon are advised to use the '2070 to 2115' development lifetime. For more vulnerable, residential development this correlates to a climate change range of impacts of between + 35% and + 70% on the 1 in 100 year (1% AEP).

**Table 4-4 Peak River Flow Allowances<sup>12</sup> for Thames River Basin District (using 1961 to 1990 baseline)**

River Basin District	Allowance Category	Total potential change anticipated for the '2020's (2015 to 2039)	Total potential change anticipated for the '2050's (2040 to 2069)	Total potential change anticipated for the '2080's (2070 to 2115)
Thames	Upper End	25%	35%	70%
	Higher Central	15%	25%	35%
	Central	10%	15%	25%

4.1.26 In order to determine which range of allowances should be assessed for a proposed development or plan, the flood zone and vulnerability classification should be considered, as set out below.

#### **Flood Zone 2:**

- Essential Infrastructure – use the higher central and upper end to assess a range of allowances
- Highly Vulnerable – use the higher central and upper end to assess a range of allowances
- More Vulnerable – use the central and higher central to assess a range of allowances
- Less Vulnerable – use the central allowance
- Water Compatible – use none of the allowances

#### **Flood Zone 3a:**

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

#### **Flood Zone 3b:**

<sup>11</sup> <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

<sup>12</sup> Allowances' in this context is the amount as a % that is added to estimated peak river flows to account for climate change increases. Guidance is available at <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>.

- Essential Infrastructure – use the upper end allowance
  - Highly Vulnerable – development should not be permitted
  - More Vulnerable – development should not be permitted
  - Less Vulnerable – development should not be permitted
  - Water Compatible – use the central allowance
- 4.1.27 The lifetime of the development should also be considered when determining which climate change allowance time period should be used. The lifetime of a proposed development should be judged based on the characteristics of the development. In the case of a residential development, a minimum lifetime of 100 years should be taken when selecting climate change allowance percentages. For other types of development, the applicant should assess how long they anticipate the development to be in place for and justify the lifetime of the development. Otherwise, a 75-year lifetime should be used.
- 4.1.28 **River Wandle modelling: Appendix A Figure 2** includes the modelled outline for the River Wandle for the 1% AEP event including 35% and 70% allowances for climate change. These modelled scenarios also include the presence of flood defences along the watercourses. The results show a minimal increase in the flood outline north of Wandle Park.
- 4.1.29 **Caterham Bourne FAS modelling:** While modelling outputs have been provided for the Caterham Bourne, the 1 in 100 year (1% AEP) plus updated climate change outlines are not available. Therefore, existing Environment Agency mapping has been referenced.
- 4.1.30 **Chaffinch Brook modelling:** The study has provided outputs for the combined fluvial and surface water flooding for the 1 in 30 year (3.33% AEP) 1 in 100 year (1% AEP), 1 in 1000 year (0.1% AEP) and 1 in 100 year (1% AEP) including climate change events. The study is still ongoing

## Flood defences

- 4.1.31 Flood defences are typically raised structures that alter natural flow patterns and prevent floodwater from entering property in times of flooding. They are generally categorised as either 'formal' or 'informal' defences. A 'formal' flood defence is a structure that is maintained by its respective owner, regardless of whether it is owned by the Environment Agency. An 'informal' flood defence is a structure that has often not been specifically built to retain floodwater and is not maintained for this specific purpose. Boundary walls and industrial buildings situated immediately adjacent to rivers often act as informal flood defences.
- 4.1.32 The Environment Agency Flood Map for Planning does not identify any formal flood defences along the Main Rivers in Croydon.
- 4.1.33 The Environment Agency has provided an extract from the Asset Information Management System (AIMS) which contains details of flood defence assets associated with Main Rivers in Croydon. This dataset provides a good starting point for identifying significant local defences and potential areas benefiting from defences, but the quantity and quality of information provided differs considerably between structures. The AIMS is intended to provide a reasonable indication of the condition of an asset and should not be considered to contain consistently detailed and accurate data.
- 4.1.34 The AIMS data identifies that the Norbury Brook flows through a concrete lined channel which is privately maintained. Concrete walls are present on both banks along sections of the watercourse. The watercourse is culverted in three locations, beneath Selhurst Road and Whitehorse Road, beneath the railway line adjacent to Norbury Park, and beneath the A23 at the borough boundary with London Borough of Lambeth.

### Appendix A Figure 1 Flood Map for Planning (Rivers and Sea)

## Historic Records

- 4.1.35 Significant flood events associated with the Caterham Bourne have been recorded. During January to March 2014, and throughout the winter of 2000-2001, disruption lasted over several months. The high groundwater levels that were experienced during these events resulted in floodwaters receding very

slowly. There are also records of a number of similarly damaging floods during the 20th century, when the Bourne was in flow.

- 4.1.36 The London Borough of Croydon LFRMS<sup>13</sup> notes that historic flood records dating back to the 1960s indicate numerous incidents associated with the Norbury Brook as a result of overtopping in open sections as well as surcharging of manholes and culverts in its culverted sections.
- 4.1.37 The Environment Agency Historic Flood Map does not provide many records of fluvial flooding in Croydon. There is a small extent associated with the Chaffinch Brook at Elmers End, although this is more significant across the borough boundary in London Borough of Bromley.
- 4.1.38 Within the historic records supplied by London Borough of Croydon, none are identified as fluvial flooding. However, it should be noted that there are numerous records of flooding along Brighton Road, which is located in the topographic depression along the route of a former watercourse. The source of these events is typically recorded as surface water or sewer flooding rather than fluvial flooding, as the watercourse has been culverted and can no longer be seen.

## 4.2 Flooding from Surface Water

- 4.2.1 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 the drainage systems. It can run off land quickly and result in localised flooding. This occurs most commonly in urban areas where water is unable to enter the ground due to the presence of impermeable surfaces.

### Risk of Flooding from Surface Water

- 4.2.2 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 including, high risk (less than 3.33% AEP); medium risk (between 1% and 3.33% AEP); and low risk (between 0.1% and 1% AEP). The latest version of the mapping is referred to as the 'Risk of flooding from Surface Water' (RoFSW) and is available on the Environment Agency website.
- 4.2.3 The RoFSW provides all relevant stakeholders access to information on surface water flood risk which is consistent across England and Wales<sup>14</sup>. The modelling helps the Environment Agency take a strategic overview of flooding and assists LB Croydon in their duties as LLFA relating to management of surface water flood risk. For the purposes of this SFRA, the mapping allows an improved understanding of areas within the Borough which may be at risk from a surface water flooding. The RoFSW mapping has a 2m model resolution and includes the representation of buildings, flow routes along roads, and modifications to include structural features such as flyovers. A range of storm scenarios have been considered and the modelling incorporates local mapping, knowledge and flood incidents. 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, and
  - As with all models, the RoFSW is affected by a lack of, or inaccuracies, in available data.

#### Appendix A Figure 3A & 3B Risk of Flooding from Surface Water

- 4.2.4 The RoFSW mapping for the London Borough of Croydon illustrates that the risk of surface water flooding is widespread throughout the Borough. Overland flow follows the natural topography of the land

<sup>13</sup> Croydon Council. Capita URS, June 2014, London Borough of Croydon Local Flood Risk Management Strategy, Draft for consultation.

<sup>14</sup> Environment Agency (2013) 'What is the updated Flood Map for Surface Water?'

and accumulates in the natural depressions created by ditches, streams and tributaries of the primary watercourses.

## Climate Change

- 4.2.5 The RoFSW mapping does not include a specific scenario to determine the impact of climate change on the risk of surface water flooding. However, a range of events are mapped and therefore it is possible to use with caution the low risk (between 0.1% and 1% AEP) event outline as a substitute dataset to provide an indication of the implications of climate change.

## Surface water modelling – Purley Cross and Caterham Drive

- 4.2.6 London Borough of Croydon secured Defra funding to update local surface water modelling and Risk of Flooding from Surface Water (RoFSW) mapping information, as part of the Boosting Action for Surface Water programme. Arcadis Consulting (UK) Limited were subsequently commissioned by London Borough of Croydon to undertake detailed and up-to-date surface water modelling for two key Critical Drainage Areas (CDAs) covering the Purley Cross to River Wandle CDA and Caterham Drive area .
- 4.2.7 The project required the development of a detailed and integrated 1D-2D hydraulic model of the catchment to provide the necessary resolution and confidence in the prediction of flood depths and extent, commensurate with the requirements for the Environment Agency RoFSW.
- 4.2.8 The outputs from this modelling have been mapped in this Level 1 SFRA, where coverage is available. The maximum depth outputs and hazard outputs have been presented for both the 1% AEP (1 in 100 year) event the 0.1% AEP (1 in 1000 year) event.

### Appendix A Figure 7 10 Surface Water Modelling

## Drainage Catchments

- 4.2.9 Drainage Catchments (DCs) have previously been determined across the study area as part of the joint south west London Level 1 SFRA (2015)<sup>15</sup>. Drainage catchments outline the area of the land that influences the surface water drainage at a certain point. The scale of a drainage catchment varies depending on the point of interest. The extent of a natural drainage catchment follows peaks in the local topography that surface water will drain from. The DCs determined by this study are based on the natural catchments and watersheds that cover the borough, which are provided within the Flood Estimation Handbook CD-ROM and have then been amended using local knowledge to account for significant infrastructure within the study area that could impact on drainage such as railway lines.
- 4.2.10 It is intended that these DCs will be useful for identifying the natural drainage patterns in the local area when considering new development and future regeneration in the study area. The potential for implementing new approaches and requirements for surface water management can be considered by LB Croydon within the context of specific DCs. For example, local topography could be used to determine flow paths within each DC, which could highlight potential areas to focus surface water management techniques.
- 4.2.11 Nineteen DCs have been identified in London Borough of Croydon. The majority of the DCs in the south of the Borough form part of the River Wandle catchment. The DCs in the north of the Borough drain into the Norbury Brook. Along the north eastern edge of the Borough, the topography slopes towards London Borough of Bromley, and these DCs drain towards the River Ravensbourne.

### Appendix A Figure 3A Risk of Flooding from Surface Water with Drainage Catchments

## Critical Drainage Areas (CDAs)

- 4.2.12 The Environment Agency refers to a Critical Drainage Area (CDA) as an area within Flood Zone 1 which has 'critical drainage issues'. However, within the Surface Water Management Plan (SWMPs) for London Borough of Croydon, CDAs were delineated based on the following working definition: 'a discrete geographic area (usually within an urban setting) where there may be multiple and interlinked

<sup>15</sup> London Boroughs of Croydon, Merton, Sutton and Wandsworth (2015), Level 1 Strategic Flood Risk Assessment



sources of flood risk and where severe weather is known to cause flooding of the area thereby affecting people, property or local infrastructure'. Sixteen CDAs were identified in London Borough of Croydon and outlined in the Croydon SWMP (2011)<sup>16</sup>.

## Appendix A Figure 3B Risk of Flooding from Surface Water with CDAs

### Historic Records

#### Historic Records of Surface Water Flooding

- 4.2.13 Historic flooding records from local residents and businesses, Network Rail, Transport for London and the Environment Agency have been gathered by London Borough of Croydon as part of the preparation of the PFRA, SWMP and the LFRMS. These records have been obtained and used to inform this Level 1 SFRA. Where possible, the source of the flooding has been identified. Records of flooding which are reported to be from a surface water source are presented in **Appendix A Figure 3A & 3B**.
- 4.2.14 London Borough of Croydon has experienced a number of historic surface water flood events, the most notable of which were in July 2007, December-February 2014/2015, August 2015, June 2016 and June 2019. The most frequent area to surface water flooding is Brighton Road and the Purley Cross roundabout. Specific episodes of surface water flooding are also recorded in the following locations:
- Kenley Lane and Kenley Station
  - Brighton Road in Coulsdon
  - Purley Oaks Road and station
  - Norbury and Thornton Heath
  - Caterham Drive.
- 4.2.15 Approximately 460 records of surface water flooding have been provided by LB Croydon and mapped in Appendix A Figure 3.

#### Croydon S19 Flood Investigation Report<sup>17</sup> (24 August 2015)

- 4.2.16 During August 2015, the London Borough of Croydon experienced severe surface water flooding in several locations around the Borough due to torrential rain. Areas particularly affected included Purley Cross Underpass, Purley Oaks Road and localised highway flooding in Kenley, Purley, Coulsdon and New Addington. Flooding affected a number of commercial and residential properties and major transport routes as well as more localised incidents. Risk Management Authorities with responsibilities in respect of this event included, Croydon Council, the Environment Agency and Thames Water. Additionally, London Fire Brigade and the Metropolitan Police carried out emergency response roles. Surface water was the main source of flooding, but sewer and fluvial flooding were also identified as sources.
- 4.2.17 The flood events reported across the Borough in August 2015 are considered to be as a result of an exceptional rainfall event, which exceeded the design capacity of road gullies and the highway drainage network. Whilst some road gullies were reportedly blocked, the volume of water meant the flood events were considered to be largely unavoidable, without increasing the design capacity of drainage networks throughout the Borough. Specifically, at Purley Cross, the drainage network upstream and downstream of the pump station did not have sufficient capacity to manage the volume of water encountered. In addition, the extreme nature of the rainfall event had a knock on effect leading to the failure of the Transport for London (TfL) operated pumps at the pedestrian underpass due to flooding of the control box, further exacerbating the flooding at this location. Therefore, actions included engagement with Thames Water and TfL about Purley Cross determining whether sewer condition influenced flood risk, engagement with Thames Water regarding the drainage mechanism of the sewer network at Purley Oaks and a review of the drainage capacity and gully cleansing schedules at flooding locations.

<sup>16</sup> London Borough of Croydon (2011), Surface Water Management Plan, available at: <https://www.croydon.gov.uk/sites/default/files/articles/downloads/swplan.pdf>

<sup>17</sup> AECOM, November 2016, Croydon Flood Investigation Report 24<sup>th</sup> August 2015 <https://www.croydon.gov.uk/environment/flood-and-water-management/flood-investigations>

## Caterham Bourne Flood Investigation<sup>18</sup>

- 4.2.18 The period from December 2013 to January 2014 was the wettest two month period on record in the South London area, with 213mm of rainfall recorded in January 2014. The prolonged period of heavy rainfall experienced during this period caused groundwater levels to rise, which in turn led to significant flooding within the London Borough of Croydon from multiple sources:
- High groundwater caused Caterham Bourne to flow, with sources rising above ground in Woldingham, and Caterham, Surrey and flowing into Croydon along the route of the A22 towards Purley,
  - Foul sewer flooding occurred as groundwater ingress and emergency pumping put pressure on the sewer system, and
  - Surface water flooding occurred as a combination of the heavy rainfall and saturated soil and extreme pressure on the road drainage infrastructure.
- 4.2.19 Significant flooding was experienced in the areas of Kenley and Purley as well as Woldingham and Whyteleafe in Surrey, where the bourne flows prior to entering the London Borough of Croydon. The scale of the flooding was declared a Major Incident by Croydon Council (CC) on 6th February 2014 and a significant pumping operation was implemented in an effort to protect homes, businesses and critical infrastructure.
- 4.2.20 The Flood Investigation Report provides details of the mechanisms of flooding, areas affected, the response from risk management authorities, lessons learnt and future potential mitigation options.

## Caterham Drive S19 Flood Investigation report<sup>19</sup> (7 June 2016)

- 4.2.21 In June 2016 heavy localised rainfall led to severe surface water flooding in south London before the weather system moved north across the country. The London Borough of Croydon was particularly affected on 7<sup>th</sup> June 2016 resulting in localised deep, fast-flowing water, which sub-merged/floated vehicles and entered properties at several locations. On the 7<sup>th</sup> and 8<sup>th</sup> June 2016 Thames Water received over 80 calls relating to flooding in the area around Caterham Drive. Four properties in the north of Caterham Drive and a further two in the south reported flooding to the council. It is likely that flooding of properties to the south of Caterham Drive was influenced by surface water runoff from Rydon's Lane. Surface waters then propagated northward down Caterham Drive following the road gradient and flooding properties at the end of the road adjacent to Dollypers Hill. Risk Management Authorities with responsibilities in respect of this event included, Croydon Council, the Environment Agency and Thames Water. Additionally, London Fire Brigade and the Metropolitan Police carried out emergency response roles.
- 4.2.22 Overall the responsible authorities carried out their legal responsibilities in their response to the event. Several actions to better address mitigation of flood risk in this area were identified in the Flood Investigation report; a key action going forward was to encourage further engagement between Risk Management Authorities and residents.

## Croydon Flood Alleviation Study<sup>20</sup>

- 4.2.23 London Borough of Croydon has identified flood hotspots within the Borough that are frequently subjected to flooding following intensive rainfall but where the flooding is limited to roads, gardens and driveways and therefore do not meet LBC's current criteria for triggering a formal Section 19 flood investigation under the FWMA; nor do they meet requirements to gain additional government funding for flood alleviation e.g. through the national Flood and Coastal Erosion Management (FCERM) Grant in Aid (GiA) process administered by the Environment Agency. The locations are:
1. Asmar Close, Coulsdon
  2. Stoneyfield Road, Coulsdon
  3. Farm Fields, South Croydon
  4. Sanderstead Court Avenue, South Croydon

<sup>18</sup> URS, October 2014, Caterham Bourne Flood Investigation March 2014. <https://www.croydon.gov.uk/environment/flood-and-water-management/flood-investigations>

<sup>19</sup> AECOM, January 2017, Caterham Drive Flood Investigation Report, 7<sup>th</sup> June 2016.

<https://www.croydon.gov.uk/environment/flood-and-water-management/flood-investigations>

<sup>20</sup> AECOM, June 2018, Croydon Flood Alleviation Study (Surface Water Hotspots) Stage 1. Final Report.



5. Old Lodge Lane, South Croydon
6. Lower Barn Road, Riddlesdown Station,
7. Meadow Hill, Smitham Bottom Lane, South Croydon.

## 4.3 Flooding from Groundwater

- 4.3.1 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.

### Geology

- 4.3.2 The underlying bedrock of the London Borough of Croydon is Middle and Upper Chalk in the south, which is overlain by Thanet Sand Formation (fine sand), Lambeth Group (clay and sand), Harwich Formation (sand and flint) and the London Clay Group in the north. The Drift deposit geology is dominated by River Terrace Deposits, with Alluvium also present along the Wandle valley and Clay with flints present along the southern boundary of London Borough of Croydon.
- 4.3.3 Due to the dominance of Chalk throughout the south of the study area, across the southern parts of London Borough of Croydon, extensive aquifers are found here with many used for potable and/or industrial water supply. In addition, most of the watercourses in the area are spring-fed, indicating groundwater levels are at or very close to the ground surface in some locations.
- 4.3.4 Further information on geology can be found on the British Geological Survey (BGS) Website.<sup>21</sup>

### Susceptibility to Groundwater Flooding

- 4.3.5 In response to the need for more information on groundwater flooding, BGS has produced the first national dataset on the susceptibility of groundwater flooding. Based on geological and hydrogeological information, the digital data can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface. Note, it is a susceptibility dataset, so it does not indicate hazard or risk, i.e. it does not provide any information on the depth to which groundwater flooding occurs or the likelihood of the occurrence of an event of a particular magnitude.
- 4.3.6 The 'Susceptibility to Groundwater Flooding' dataset is divided into three classes – High, Medium and Low risk as follows:
- High – areas with the potential for groundwater flooding to occur at the surface
  - Medium – areas which may experience groundwater flooding of property situated below the ground surface i.e. basements
  - Low – areas with limited potential for groundwater flooding to occur.
- 4.3.7 BGS state that the dataset is suitable for use for regional or national planning purposes where the groundwater flooding information will be used along with a range of other relevant information to inform land-use planning decisions. It might also be used in conjunction with other factors, such as, records of previous incidents of groundwater flooding, rainfall, property type, and land drainage information, to establish relative, but not absolute, risk of groundwater flooding at a resolution of greater than a few hundred metres. The susceptibility data should not be used on its own to make planning decisions at any scale and should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding.

#### Appendix A Figure 4 BGS Susceptibility to Groundwater Flooding & Flooding Records

<sup>21</sup> <http://www.bgs.ac.uk>

- 4.3.8 London Borough of Croydon is divided into two distinct areas with respect to bedrock geology. The north of the Borough is underlain by impermeable London Clay, whereas the south is underlain by permeable chalk. River terrace deposits are present along the river corridors throughout the Borough.
- 4.3.9 The BGS Susceptibility to Groundwater Flooding dataset identifies the areas along the river corridors to be potentially susceptible to groundwater flooding at surface. This stretches throughout the Borough from the land along the Caterham Bourne, north along Brighton Road and into the north of the Borough in the vicinity of the Norbury Brook.

## Historic Records

- 4.3.10 LB Croydon has more than 40 records of groundwater flooding in the Borough which are shown in **Appendix A Figure 4**. Instances of groundwater flooding have been reported in several areas in Croydon with some regular hotspots in the north of the Borough.
- 4.3.11 The highest profile and widespread floods influenced by high groundwater have been associated with the Caterham Bourne in the south of the Borough, which caused significant disruption in the winter of 2000-2001, in early 2014, and the winter of 2019-2020, threatening significant numbers of homes, essential infrastructure and transport networks.

### Caterham Bourne S19 Flood Investigation Report (January-March 2014)

- 4.3.12 December 2013 to January 2014 was the wettest two-month period on record in the South London area. The prolonged heavy rainfall caused groundwater to rise to exceptionally high levels which led to significant flooding in the London Borough of Croydon in the areas of Kenley and Purley around the route of the Caterham Bourne. Within the Borough, flooding was experienced at locations along the A22 and surrounding areas with residential properties affected at Bourne Park Close, Brighton Road, Dale Road, Foxley Hill Road, Godstone Road, Lansdown Road and Purley Park Road. There was a significant multi-agency response (including Croydon Council, London Fire Brigade, Metropolitan Police, Environment Agency, Sutton and East Surrey Water, Thames Water and Transport for London) following declaration of an emergency on 6th February 2014.
- 4.3.13 The number of properties which suffered internal flooding to the ground floor was limited due to the scale of the round-the-clock relief effort following declaration of an emergency. Short to medium term management options have been identified to recover and restore the Bourne following the flooding and to prepare for the coming winter as much as possible. Actions included clearance, dredging and desilting of channels and culverts, establishing more regular maintenance and inspection and partnership working between LB Croydon and Thames Water to agree a way forward on asset maintenance. This included investigating influences on the problems at Dale Road.

### Merstham Bourne S19 Flood Investigation Report (January-March 2014)

- 4.3.14 Exceptionally high rainfall in December 2013 and January 2014 caused groundwater to rise rapidly along the course of Merstham Bourne and this is the predominant source of flooding during this event. However, further sources (such as surface water, fluvial and sewer flooding) contributed to the scale of flooding, particularly where the catchment becomes more urban. Areas affected included Reddown Road, as well as a railway between Woodplace Lane and Start Bridge and Merstham Tunnel, both reported by Network Rail. The authorities which responded to this flood event were Croydon Council, Thames Water, the Environment Agency and Network Rail. Risk Management Authorities and Network, as riparian owner, carried out appropriate response activities to manage and respond to the flood.
- 4.3.15 However, several issues were identified which could be improved to manage the risk from the Bourne going forward. This flood event highlighted the need for an ongoing maintenance regime of the watercourse and better communication between Network Rail and Croydon Council regarding flood management works and clarification of riparian owner responsibilities. It is also evident that there is incomplete understanding about the full route and source locations of the Merstham Bourne and how sewer infrastructure interacts with other sources of flooding such as groundwater incursion.

## 4.4 Flooding from Sewers

- 4.4.1 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 3.3% AEP or less. Therefore, rainfall events with a return period of frequency less than 3.3% AEP would be expected to result in surcharging of some of the sewer system. While Thames Water, as the sewerage undertaker for the study area, recognise the impact that more extreme rainfall events may have, it is not cost beneficial to construct sewers that could accommodate every extreme rainfall event.

*(2) The system becomes blocked by debris, sediment or fat:*

Over time there is potential that road gullies and drains become blocked from fallen leaves, build-up of sediment and debris (e.g. litter). Fat build up within the main sewer system is also a contributing factor of sewer flooding.

*(3) The system surcharges due to high water levels in receiving watercourses:*

Within the study area there is potential for surface water outlets to become submerged due to high river levels. When this happens, water is unable to discharge effectively. Once storage capacity within the sewer system itself is exceeded, water will overflow into streets and potentially into properties. 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 hindered by high water levels in receiving watercourses, surcharging and surface flooding may again occur but in this instance floodwaters will contain untreated sewage.

## Historic Records

- 4.4.2 Water companies are required to maintain a register of properties which are at risk of flooding due to hydraulic overloading of the sewers (the sewer pipe is too small, or at too shallow a gradient). Thames Water has provided an extract from their DG5 Flood Register for the study area, which records historic internal and external sewer flooding events. Due to data protection requirements the data has not been provided at individual property level; rather the register comprises the number of properties within four digit postcode areas that have experienced flooding either internally or externally within the last 10 years.
- 4.4.3 It should be noted that these are flooding incidents that have been reported to Thames Water by the property owners. There are likely to be incidents that don't get reported and therefore will not show on the database. Incidents of sewer flooding can be retrospectively reported to Thames Water via their website – <http://thameswater.co.uk/help-and-advice/9782.htm>. Records of sewer flooding can help to inform Thames Water of areas in need of funding for further maintenance and investment in the sewer system.
- 4.4.4 Thames Water and London Borough of Croydon have supplied records of sewer flooding for the Borough. These indicate that incidents of sewer flooding have occurred throughout the Borough and are not limited to specific areas.

### Appendix A Figure 5A Internal Sewer Flooding Records, Appendix A Figure 5B External Sewer Flooding Records

- 4.4.5 The Croydon LFRMS identifies that numerous incidents in the historic flood register are attributed to surcharging sewers although evidence is anecdotal, and it is not always clarified whether highway drainage or culverted watercourses have influenced the incident. Several incidents are recorded in Thornton Heath and Broad Green in close proximity to the Norbury Brook as well as known surface water hotspots in Coulsdon.

## Climate Change

- 4.4.6 Climate change is anticipated to increase the potential risk from sewer flooding as summer storms become more intense and winter storms more prolonged. This combination is likely to increase the pressure on the existing efficiency of sewer systems, thereby reducing their design standard and leading to more frequent localised flooding incidents. Any sewer flooding that may occur could be exacerbated as a result of surface water runoff during extreme rainfall events.

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

## 4.5 Flooding from Other Sources

### Risk of Flooding from Reservoirs

- 4.5.1 The failure of a reservoir has the potential to cause catastrophic damage due to the sudden release of large volumes of water. The PPG encourages LPAs to identify any impounded reservoirs and evaluate how they might modify the existing flood risk in the event of a flood in the catchment it is located within, and / or whether emergency draw-down of the reservoir will add to the extent of flooding.
- 4.5.2 The Environment Agency dataset 'Risk of Flooding from Reservoirs' identifies areas that could be flooded if a large<sup>22</sup> reservoir was to fail and release the water it holds. This dataset has been reviewed on the Environment Agency website<sup>23</sup> to inform the SFRA.
- 4.5.3 There have been no recorded incidents of reservoir flooding within London Borough of Croydon. The Environment Agency Flood Risk from Reservoirs mapping available online identifies that if the Russell Hill Reservoir were to fail it would impact areas of West Croydon and Waddon. If South Norwood Lake were to fail then the impact would be almost entirely within London Borough of Bromley, affecting areas of Penge, Beckenham and Lower Sydenham.

**Table 4-5 Areas at risk of flooding from reservoirs**

Name	Owner	Local Authority	Grid Ref	Areas affected
Russell Hill	Thames Water Utilities Ltd	Croydon	531451, 162811	From Roundshaw Park northwards along the A23 towards Stafford Road and Waddon railway station. Veers west and branches following the course of the River Wandle towards Beddington and Hackbridge.
South Norwood Lake	LB Croydon	Croydon	534189, 169419	Penge, Beckenham and Lower Sydenham (within London Borough of Bromley).

- 4.5.4 Reservoirs in the UK have an extremely good safety record. The Environment Agency is the enforcement 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. As the enforcement authority for the Reservoirs Act 1975 in England, the Environment Agency are responsible for ensuring that reservoirs are inspected regularly, and essential safety work is carried out. As the undertaker for South Norwood Lake, LB Croydon is required to ensure that inspections are carried out by a qualified panel engineer and that necessary safety work is completed as required to reduce the likelihood of any failure. On this basis the possible risk of failure of these reservoirs is considered to be minimal.

### Interaction between Flood sources

- 4.5.5 An overview of the flooding issues in the London Borough of Croydon reveals areas that are affected by multiple sources of flood risk. These include complex interactions between urban watercourses, direct surface water ponding, overland flow paths, groundwater ingress and the surface water sewer system.

### Interactions between fluvial and surface water flooding

- 4.5.6 Surface water flooding often occurs in combination with fluvial flooding. An example area of fluvial and surface water flooding interaction has been modelled in the Chaffinch Brook study (ongoing study).

<sup>22</sup> A large reservoir is one that holds over 25,000 cubic metres of water, equivalent to approximately 10 Olympic sized swimming pools.

<sup>23</sup> Environment Agency, Long term flood risk assessment <https://flood-warning-information.service.gov.uk/long-term-flood-risk/>

### **Interactions between surface water and groundwater flooding**

- 4.5.7 Groundwater flooding can often cause or exacerbate surface water flooding. Rising levels of groundwater can often lead to reduced infiltration during times of flooding as well as overwhelming road drainage that would otherwise accommodate surface water flows. A combination of surface water and groundwater has the potential to cause extensive flooding within an area.

### **Interactions between groundwater and sewer flooding**

- 4.5.8 Sewer systems are vulnerable to groundwater through two main mechanisms:
- groundwater ingress forced through cracks in the access chambers or pipes
  - Groundwater creating surface flows that flow into drain and sewers.
- 4.5.9 Sewer pipes aren't designed to carry the groundwater load in addition to surface water flows, and so can easily back up or create airlocks which mean that toilets and taps cannot work properly. At its worst, effluent could be pushed back up into the properties, creating a potential contamination hazard. Because of the sheer scale of groundwater below ground, it presents significant management challenges. Groundwater cannot be easily stored or pumped from site, so the sewer system needs to be more resilient to ingress. Sewers in areas at risk of groundwater flooding must be inspected closely and lined to ensure they are watertight, with priority given to particularly vulnerable areas.
- 4.5.10 Groundwater seepage can also create surface flows along roads and through properties.

## **4.6 Flood Risk Management Schemes**

- 4.6.1 The following documents have been reviewed to identify flood risk opportunities.

### **London Borough of Croydon Surface Water Management Plan Preferred options**

- 4.6.2 The SWMP (2011) identified several opportunities for next steps and quick wins in order to reduce the causes and impacts of flooding; some of them include:
- In conjunction with Thames Water, determining the capacity of the existing sewer network along Rees Gardens and Teevan Road (CDA\_046 Woodside) and investigating options for increasing the surface water sewer capacity at this location
  - Undertaking a Drainage Capacity Study for the three CDAs that cover the Purley Cross Junction and Brighton Road corridor (CDA\_040, CDA\_41 and CDA\_042) to determine the drainage capacity and potential for future improvements such as the construction of a deep interceptor sewer or online storage tank
  - Checking the capacity and maintenance of the oversized soakaway located at the junction between the B2032 and the A23 Brighton Road to ensure that it is providing adequate storage
  - Undertaking a feasibility study to assess the potential for flood storage in South Norwood Country Park (CDA\_047 South Norwood)
  - Undertaking a feasibility study to assess the potential for flood storage in the South Croydon playing fields and the Whitgift House playing fields (CDA\_042 South and Central Croydon)
  - Undertaking a feasibility study to assess the potential for flood storage in the recreation grounds off Christchurch Road parallel to the Brighton Road (CDA\_041 Brighton Road).

### **London Borough of Croydon Local Flood Risk Management Study Preferred options**

- 4.6.3 The LBC Local Flood Risk Management Study Action Plan (2015) also identified several opportunities related to areas that should be prioritised for flood risk alleviation work. Several examples are below:
- Commencing first stage of Kenley flood alleviation scheme in CDA Group8\_037;
  - Developing flood alleviation scheme for Caterham Bourne;

- Investigating localised flood problems around the Chaffinch Brook in Ashburton; and
  - Investigating influences of regular flooding hotspots.
- 4.6.4 Additionally, several actions that are related to meeting with Network Rail / Thames Water / Sutton & East Surrey Water / TfL to discuss areas where their infrastructure falls in Croydon's flood hotspots.
- Engaging with Network Rail regarding planned maintenance to their assets along route of the Caterham Bourne; and
  - Engaging with Sutton & East Surrey Water regarding their Flood Action Plan for Kenley Water Treatment work.

## Flood Risk Feasibility studies

- 4.6.5 There are a number of Flood Risk Feasibility studies that are currently ongoing across the Borough. Examples include:

### Graveney Flood Alleviation Scheme

- 4.6.6 The Environment Agency has identified more than 700 properties at risk of flooding in and around Graveney<sup>24</sup>. The Environment Agency is working together with LB Croydon to develop a scheme to reduce this risk to 340 homes along the River Graveney and Norbury Brook in Thornton Heath and Norbury. In February 2018, a Public Engagement event took place informing the residents about the scheme and considering three shortlisted options:

- A flood storage area in Norbury park with restoration of a natural river channel
- A flood storage area in Thornton Heath Recreation Ground
- Combined storage at Norbury Park and Thornton Heath Recreation Ground.

- 4.6.7 Subsequently, Option A (Norbury Park) was selected as the preferred option. This is the creation of a more natural looking river by removing the existing culvert, and the creation of a flood water storage area. This option fits in well with Croydon's existing masterplan for the area and was also the favoured option for residents around Norbury Park.
- 4.6.8 Should applications for funding be successful, the design will be refined further, environmental surveys will be undertaken and a planning application will be submitted.

### Caterham-on-the-Hill Flood Alleviation Scheme Outline Business Case<sup>25</sup>

- 4.6.9 Caterham-on-the-Hill has a history of flooding, most recently in June 2016. A Strategic Outline Case (SOC), published in March 2018, outlined the flooding mechanisms in the catchment through modelling and local evidence. The catchment is at high risk of surface water flooding particularly in high intensity rainfall storm events. A short-list of five options mainly based on flood storage were identified to reduce flooding. The analysis also concluded that there is limited space to intercept overland flow in this predominantly steep urban area.
- 4.6.10 An Outline Business Case (OBC) was subsequently submitted in August 2020 to seek £1,900,000 to install property flood resilience (PFR) measures to 205 properties affected by flooding in Caterham Hill and Old Coulsdon, located in an upstream sub-drainage area of the Wandle catchment.

### Croydon Flood Alleviation Study<sup>20</sup>

- 4.6.11 London Borough of Croydon has identified flood hotspots within the Borough that are frequently subjected to flooding following intensive rainfall but where the flooding is limited to roads, gardens and driveways and therefore do not meet LBC's current criteria for triggering a formal Section 19 flood investigation under the FWMA; nor do they meet requirements to gain additional government funding for flood alleviation e.g. through the national Flood and Coastal Erosion Management (FCERM) Grant in Aid (GiA) process administered by the Environment Agency. As a result, seven locations have been investigated to improve the understanding of the flooding mechanisms, identify viable long term

<sup>24</sup> Environment Agency (2019), Graveney Flood Alleviation Scheme Shortlist. <https://consult.environment-agency.gov.uk/ksles/graveney-flood-alleviation-scheme-shortlist/>

<sup>25</sup> Business Case for Caterham-on-the-Hill flood alleviation scheme, August 2020. <https://mycouncil.surreycc.gov.uk/documents/s70674/ANNEX%201-%20Caterham-on-the-Hill%20OBC.pdf>



measures that could alleviate or minimise the impact of future flooding and inform whether there may be benefits to implement flood management at multiple sites concurrently. The locations are:

1. Asmar Close, Coulsdon
2. Stoneyfield Road, Coulsdon
3. Farm Fields, South Croydon
4. Sanderstead Court Avenue, South Croydon
5. Old Lodge Lane, South Croydon
6. Lower Barn Road, Riddlesdown Station,
7. Meadow Hill, Smitham Bottom Lane, South Croydon.

4.6.12 Following this study, works at Lower Barn Road in Riddlesdown commenced in Summer 2021.

- Phase 1 – involves the installation of a linear drainage system across Lower Barn Road junction with Mitchley Avenue to intercept the flow of water flowing down Mitchley Avenue and then discharge into a soakaway in the green space adjacent to St Edmund's Church.
- Phase 2 – involves the installation of a new soakaway in the green space adjacent to the railway station. The new soakaway will act as an overflow for the existing soakaway located at the low point by the railway bridge. This work is expected to commence immediately after Phase 1.

### Chaffinch Brook Flood Alleviation Scheme

4.6.13 A project is underway to alleviate flooding along the Chaffinch Brook in the east of the Borough. The option appraisal stage of the project is currently being undertaken which includes identification of options, screening from long list to short list, option modelling and economic assessment to select the preferred option(s).

## Natural Flood Management

4.6.14 Natural flood management involves techniques that aim to work with natural hydrological and morphological processes, features and characteristics to manage the sources and pathways of flood waters. Techniques include the restoration, enhancement and alteration of natural features and characteristics, but exclude traditional flood defence engineering that works against or disrupts these natural processes. The NPPF<sup>1</sup>, paragraph 157 specifically cites considering opportunities for Natural Flood management where appropriate within new developments to reduce the causes and impacts of flooding. Further guidance on the use of natural flood management processes is available from the Environment Agency in their 'Working with Natural Processes –Evidence Directory'<sup>26</sup>.

## River Restoration

4.6.15 One of the methods for reducing flooding using natural flood management is river restoration. During the last century, many rivers were modified using hard engineering techniques to straighten or canalise them. The disadvantages of these techniques have now become apparent which include the damage to the environment and ecosystems as well as an increase in flooding.

4.6.16 River restoration contributes to flood risk management by supporting the natural capacity of rivers to retain water. By re-connecting brooks, streams and rivers to floodplains, former meanders and other natural storage areas, and enhancing the quality and capacity of wetlands, river restoration increases natural storage capacity and reduces flood risk. Excess water is stored in a timely and natural manner in areas where values such as attractive landscape and biodiversity are improved and opportunities for recreation can be enhanced.

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<sup>26</sup> Working with Natural Processes – Evidence Directory  
[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/681411/Working\\_with\\_natural\\_processes\\_evidence\\_directory.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/681411/Working_with_natural_processes_evidence_directory.pdf)

- 4.6.17 Returning rivers to a more natural state can often include the removal of structures such as weirs or culverts which can have multiple benefits for biodiversity in addition to improving the flow regime<sup>27</sup>.
- 4.6.18 Further guidance on river restoration is available from the Environment Agency<sup>28</sup>.

## Flood Storage

- 4.6.19 Flood Storage Areas (FSA's) are natural or man-made areas that temporarily fill with water during periods of high river level, retaining a volume of water which is released back into the watercourse after the peak river flows have passed. There are two main reasons for providing temporary detention of floodwater:
- to compensate for the effects of catchment urbanisation;
  - to reduce flows passed downriver and mitigate downstream flooding.
- 4.6.20 Providing flood storage within a development area or further upstream of a development can manage and control the risk of flooding. In some cases, it can provide sufficient flood protection on its own; in other cases, it may be chosen in conjunction with other measures. The advantage of flood storage is that the flood alleviation benefit generally extends further downstream, whereas the other methods benefit only the local area, and may increase the flood risk downstream.
- 4.6.21 Further guidance on Flood Storage is provided within Chapter 10 of the Environment Agency's Fluvial Design Guide<sup>29</sup>.

## 4.7 Cross Boundary Issues

- 4.7.1 A summary of the cross-boundary interactions with LB Sutton, LB Merton, LB Bromley and Surrey County Council has been provided in the LB Croydon Surface Water Management Plan, published in 2011.
- 4.7.2 **Interactions with LB Sutton:** The boundary between London Boroughs of Croydon and Sutton largely follows the topographical highpoint and there are few significant cross boundary flows with the exception of the path of the River Wandle. This fluvial watercourse is culverted throughout London Borough of Croydon, with an open section at Wandle Park before passing west into London Borough of Sutton. Ongoing work relating to the maintenance and management of this watercourse will be led by the Environment Agency and will require buy-in from both Boroughs.
- 4.7.3 **Interactions with LB Merton:** The catchment of the Norbury Brook, drains the northern part of London Borough of Croydon and feeds into London Borough of Merton. Proposals underway to create use open spaces along the corridor of the Norbury Brook for temporary flood storage, are likely to result in benefits for the downstream catchment which lies within London Borough of Merton. Modelling shows predicted surface water flooding within Upper Norwood and Norwood New Town that affects both London Borough of Merton and London Borough of Croydon. Any works to manage this flooding at the source will require collaborative working between these two Boroughs.
- 4.7.4 **Interactions with LB Bromley:** Surface water flow in the location of Monks Orchard and South Norwood Country Park feed the catchment that continues into London Borough of Bromley. In addition, significant flows are modelled to flow into London Borough of Bromley from the area surrounding Forestdale and Addington. The steep catchment drains a large area and feeds the ordinary watercourses that subsequently drain to the Ravensbourne catchment in London Borough of Bromley
- 4.7.5 **Interactions with Surrey County Council (including Tandridge District Council, Reigate and Banstead Borough Council):** London Borough of Croydon adjoins the administrative area of Surrey County Council to the south of the Borough. Significant flows of surface water from Surrey County Council into London Borough of Croydon have been identified around the edge of the Borough, most notably at Chipstead Valley Road, Woodplace Lane in Coulsdon, Kenley, Hamsey Green and Court

<sup>27</sup> European Centre for River Restoration <http://www.ecrr.org/RiverRestoration/Floodriskmanagement/HealthyCatchments-managingforfloodriskWFD/Environmentalimprovementscasesstudies/Removeculverts/tabid/3125/Default.aspx>

<sup>28</sup> Environment Agency, Fluvial Design Guidance Chapter 8 <http://evidence.environment-agency.gov.uk/FCERM/en/FluvialDesignGuide/Chapter8.aspx?pagenum=4>

<sup>29</sup> Environment Agency, Fluvial Design Guidance Chapter 10 <http://evidence.environment-agency.gov.uk/FCERM/en/FluvialDesignGuide/Chapter10.aspx?pagenum=2>



Wood Lane adjacent to Selsdon Wood. The topography at the boundary between these areas is steep and runoff generated further up the catchment in Surrey has the potential to result in flooding to significant depths in London Borough of Croydon. Any source control and attenuation measures to manage the flood risk in these areas will require collaborative working between London Borough of Croydon and Surrey County Council (or the relevant District Council, where responsibilities have been delegated from Surrey County Council).

## 4.8 Cumulative impacts

### Spatial Strategic Options

- 4.8.1 The Croydon Local Plan Review document – Issues and Options (2019)<sup>30</sup> presents three strategic spatial options for delivering 46,040 homes in Croydon between 2019 and 2039. They each represent a particular, and distinct way of meeting the identified housing need.
- 4.8.2 Spatial Strategic Option 3 is an economically and socially sustainable option but with the greatest impact on green spaces in the borough as it involves a limited release of Green Belt land for residential development to reduce the pressure on the suburbs of Croydon. Potentially this option would have the largest effect on surface water flood risk around the Borough. The Strategic Option 3 includes:
- Limited release of Green Belt in New Addington, Selsdon and Sanderstead for 5,300 homes (including masterplans for each site), in place of a radical redevelopment of the Purley Way
  - 10% of new homes will be in the Purley Way area as part of a comprehensive regeneration of the retail parks along the Purley Way
  - Continued protection for Conservation Areas, Local Heritage Areas and all other heritage assets and their settings, and
  - Smaller 'windfall' sites will accommodate about a quarter of all new homes in the borough. Mainly this will be through evolution of existing character, although some areas close to services with good public transport accessibility may see some intensification
- 4.8.3 In addition to consideration of flood risk within the development site, it is important to consider the effect on the surrounding area. Where development takes place on an area subject to flooding, it may change the pattern of flood risk. In particular, additional built-up area, such as the Strategic Option 3 proposal, may reduce the space for flood water causing it to be diverted elsewhere. In case London Borough of Croydon Preferred Option is Option 3, then Development planning should include measures to avoid this, using techniques such as providing alternative floodplain storage or use of SuDS (refer to Section 7).
- 4.8.4 Furthermore, it is not sufficient to assume that locating development away from Flood Zones 2 and 3 and localised flooding areas and the use of sustainable drainage systems (SuDS) will automatically render flood risk to third parties adequately low irrespective of location. A situation may arise in which there is no spare capacity at an outfall (for example a surface water drainage system located a few kilometres downstream from the proposed allocation). The approach could be to produce a specific policy in which development will not take place until the downstream surface water drainage system is upgraded (unless an alternative outfall is identified and subject to approval by the planning authority and the Environment Agency). It is important to note that a local upgrade in channel or pipe capacity may increase flood risk downstream which may result in the need for storage or wetland areas to attenuate flows. All surface water drainage systems need to consider the requirements in the document 'Rainfall runoff management for developments – Interim national procedure' including controlling the peak rates, the additional volume, and exceedance.
- 4.8.5 The paving over of front and back gardens can increase the risk of flooding in urbanised catchments. An increase in impermeable areas causes larger amounts of floodwater run-off (during periods of heavy rain) than a traditional lawn or permeable surface. This run off causes build-up of water on roads and in areas vulnerable to surface water flooding. Increased runoff can also contribute to increased pressure on drainage and sewer systems.

<sup>30</sup> Croydon Local Plan Review – Issues and Options (2019). Available at: <https://www.croydon.gov.uk/planningandregeneration/framework/localplan/croydon-local-plan-review>

- 4.8.6 The assessment of flood risk in this chapter leads to the conclusion that careful investigation of local flood risk (with a detailed investigation of flood incident records, management and maintenance issues) is required at most locations in London Borough of Croydon before development is allocated. There are also opportunities to reduce flooding from both fluvial and surface water sources using a number of mitigation measures. Further guidance on mitigation measures is provided in Section 6.

## **Croydon Area Remodelling Scheme**

- 4.8.7 One of the key aims in all the three strategic spatial options that could have an impact on surface water flood risk in the East Croydon area is supporting Network Rail to deliver the Croydon Area Remodelling Scheme which seeks to increase rail capacity through East Croydon by removing one of the most challenging bottlenecks on the British rail network (at Selhurst Triangle).

## **Surface water management in Caterham and Coulsdon**

- 4.8.8 There are significant surface water flooding issues in the south of the borough within the Caterham and Coulsdon areas. Development of individual development sites in these areas has the potential to lead to significant cumulative impact on the risk of flooding. The RoFSW mapping (including the new updates described in paragraph 4.2.6) could be used to screen development sites and set more stringent requirements for surface water management, for example from minor development. This would enable the cumulative impact of small scale development on flood risk to be more closely managed.

# 5. Avoiding Flood Risk

- 5.1.1 The NPPF<sup>5</sup> approach aims to ensure that flood risk is considered at all stages of the planning process, and to avoid inappropriate development in areas of greatest flood risk; steering development towards areas of lower risk.
- 5.1.2 Development is only permissible in areas at risk of flooding (see Table 5-1 below) in exceptional circumstances where it can be demonstrated that there are no reasonably available sites in areas of lower risk, the sustainability benefits outweigh flood risks and, the development will be safe for its lifetime without increasing flood risk elsewhere. Such development is required to include mitigation/management measures to minimise risk to life and property should flooding occur.
- 5.1.3 Building on these principles, the NPPF<sup>5</sup> and Technical Guidance have established a process for the assessment of flood risk, with each stage building upon the previous assessment with a refinement of the evidence base. Utilising a Source – Pathway – Receptor approach, the source of flooding, the spatial distribution of flood risk and the vulnerability of development types are assessed to inform decision making through each of the key stages of the Flood Risk Management Hierarchy, as outlined in the Technical Guidance and shown in Table 5-1 below.

**Table 5-1 Flood Risk Management Hierarchy and the SFRA Process**

Stage	Approach
Level 1 SFRA	Assessment (broad scale and comprehensive)
Sequential Test Across Planning Area	Avoidance
Level 2 SFRA (if required)	Detailed Assessment (Growth Area or Site Specific)
Sequential Approach at Site	Avoidance
Control and Improvement	Through Design (e.g. SuDS)
Mitigate Remaining Risks	Flood Resilient Design and Construction

## 5.2 Sequential Test

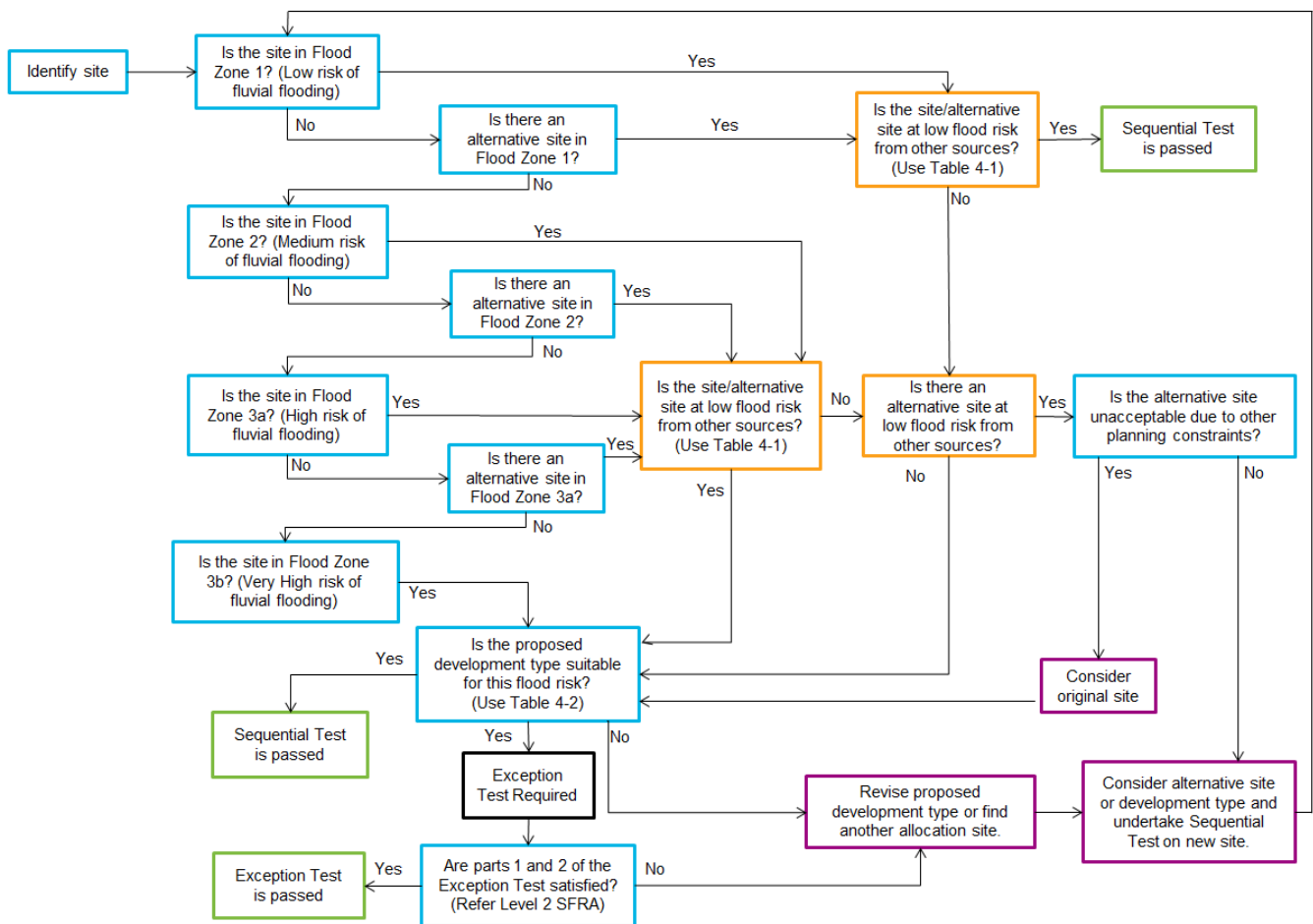
- 5.2.1 The sequential test is a decision-making tool designed to ensure that sites at little or no risk of flooding are developed in preference to sites at higher risk. This will help avoid the development of sites that are inappropriate on flood risk grounds. The subsequent application of the Exception Test where required will ensure that new developments in flood risk areas will only occur where flood risk is clearly outweighed by other sustainability drivers.
- 5.2.2 The sequential approach can be applied at all levels and scales of the planning process, both between and within Flood Zones. All opportunities to locate new developments (except Water Compatible) in reasonably available areas of little or no flood risk should be explored, prior to any decision to locate them in areas of higher risk.

## 5.3 Applying Sequential Test – Plan Making

- 5.3.1 As the LPA, LB Croydon must demonstrate that throughout the site allocation process a range of possible sites have been considered in conjunction with the flood risk and vulnerability information from the SFRA, and that the Sequential Test, and where necessary the Exception Test, has been applied.
- 5.3.2 Table 5-2 shows the flood risk definitions for all sources of flooding and should be used to inform the Sequential Test. The flow diagram presented in Figure 5.1 illustrates how the Sequential Test process should be applied to identify the suitability of a site for allocation, in relation to the flood risk classification.

**Table 5-2 Flood Risk Definitions for Sequential Test**

Risk	Fluvial / Tidal Flood Zone	Other Sources of Flood Risk			
		Surface Water	Groundwater	Sewer Consideration	Reservoir
Low	Flood Zone 1	RoFSW Very Low	“Not considered to be at risk of groundwater flooding” OR “Limited potential for groundwater flooding”	Thames Water to assess the sewer network for each site	Use EA Flooding from Reservoirs map
Medium	Flood Zone 2	RoFSW Low to Medium	“Potential for groundwater flooding of property below ground surface” OR “Potential for groundwater flooding at surface”		N/A
High	Flood Zone 3a	RoFSW High	Historic records of groundwater flooding		N/A
Very High	Flood Zone 3b	N/A	N/A		N/A



**Figure 5.1 Application of the Sequential Test for the Plan Making Process**

5.3.3 The Sequential Test requires an understanding of the flood zones in the study area and the vulnerability classification of the proposed developments. Flood zone definitions are provided in Table 4-1 and mapped in Appendix A Figure 1 (Flood Map for Planning (Rivers and Sea) and on the Environment Agency website. Flood risk vulnerability classifications, as defined in the PPG, are presented in Table 5-3.

**Table 5-3 Flood Risk Vulnerability Classification (after Table 2 PPG<sup>6</sup> March 2014)**

Vulnerability Classification	Development Uses
Essential Infrastructure	<ul style="list-style-type: none"> <li>• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk.</li> <li>• 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.</li> <li>• Wind turbines.</li> </ul>
Highly Vulnerable	<ul style="list-style-type: none"> <li>• Police stations, ambulance stations and fire stations and command centers and telecommunications installations required to be operational during flooding.</li> <li>• Emergency dispersal points.</li> <li>• Basement dwellings.</li> <li>• Caravans, mobile homes and park homes intended for permanent residential use.</li> <li>• 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").</li> </ul>
More Vulnerable	<ul style="list-style-type: none"> <li>• Hospitals.</li> <li>• Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.</li> <li>• Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.</li> <li>• Non-residential uses for health services, nurseries and educational establishments.</li> <li>• Landfill and sites used for waste management facilities for hazardous waste.</li> <li>• Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.</li> </ul>
Less Vulnerable	<ul style="list-style-type: none"> <li>• Police, ambulance and fire stations which are not required to be operational during flooding.</li> <li>• 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.</li> <li>• Land and buildings used for agriculture and forestry.</li> <li>• Waste treatment (except landfill and hazardous waste facilities).</li> <li>• Minerals working and processing (except for sand and gravel working).</li> <li>• Water treatment works which do not need to remain operational during times of flood.</li> <li>• Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).</li> </ul>
Water-Compatible Development	<ul style="list-style-type: none"> <li>• Flood control infrastructure.</li> <li>• Water transmission infrastructure and pumping stations.</li> <li>• Sewage transmission infrastructure and pumping stations.</li> <li>• Sand and gravel working.</li> <li>• Docks, marinas and wharves.</li> <li>• Navigation facilities.</li> <li>• MOD defense installations.</li> <li>• Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location.</li> <li>• Water-based recreation (excluding sleeping accommodation).</li> <li>• Lifeguard and coastguard stations.</li> <li>• Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.</li> <li>• Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.</li> </ul>

5.3.4 The NPPF acknowledges that some areas will (also) be at risk of flooding from sources other than fluvial. All sources must be considered when planning for new development including, flooding from land or surface water runoff; groundwater; sewers; and artificial sources. If a location is recorded as having experienced repeated flooding from the same source this should be acknowledged within the Sequential Test.

5.3.5 The recommended steps in undertaking the Sequential Test are detailed below. This is based on the flood zone and flood risk vulnerability and is summarised in Table 5-4. Table 5-4 indicates the compatibility of different development types with the flood zones.

**Table 5-4 Flood Risk Vulnerability and Flood Zone ‘Compatibility’ (PPG<sup>6</sup>, 2014)**

Flood Risk Vulnerability Classification		Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zone	1	✓	✓	✓	✓	✓
	2	✓	Exception Test Required	✓	✓	✓
	3a	Exception Test Required	✗	Exception Test Required	✓	✓
	3b <sup>*1</sup>	Exception Test Required*	✗	✗	✗	✓*

✓ Development is appropriate ✗ Development should not be permitted

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

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

## Stages for LPA application of the Sequential Test in Plan-Making

5.3.6 The recommended steps in undertaking the Sequential Test are detailed below. This is based on the Flood Zone and Flood Risk Vulnerability and is summarised in Table 5-4. The information required to address many of these steps is provided in the accompanying maps presented in Appendix A.

1. Assign potential developments with a vulnerability classification (Table 5-3). Where development is mixed, the development should be assigned the highest vulnerability class of the developments proposed.
2. The location and identification of potential development should be recorded.
3. The Flood Zone classification of potential development sites should be determined based on a review of the Flood Map for Planning (Rivers and Sea). Where these span more than one Flood Zone, all zones should be noted, preferably using percentages.
4. The design life of the development should be considered in accordance with NPPF<sup>5</sup> guidelines with respect to *climate change*, being:
  - **Residential development** should be considered for a minimum of **100 years**, unless there is specific justification for considering a shorter period.
  - The lifetime of non-residential development depends on the characteristics of that development. Planners should use their experience within their locality to assess how long they anticipate the development being present for. Developers would be expected to justify why they have adopted a given lifetime for the development, for example when they are preparing a site-specific flood risk assessment. Typically, a timeframe of **75 years** is applied to **commercial / industrial** developments.
5. Identify existing flood defences serving the potential development sites to outline areas at residual flood risk. However, it should be noted that for the purposes of the Sequential Test, Flood Zones ignoring defences should be used.
6. Highly Vulnerable developments to be accommodated within the Borough should be located on those sites identified as being within Flood Zone 1. If these cannot be located in Flood Zone 1,

because the identified sites are unsuitable or there are insufficient sites in Flood Zone 1, sites in Flood Zone 2 can then be considered. If sites in Flood Zone 2 are inadequate, then additional sites in Flood Zones 1 or 2 may need to be identified to accommodate development or opportunities sought to locate the development outside the Borough.

7. Once all Highly Vulnerable developments have been allocated to a development site, consideration can be given to those development types defined as More Vulnerable. In the first instance More Vulnerable development should be located on sites in Flood Zone 1. Where these sites are unsuitable or there are insufficient sites remaining, sites in Flood Zone 2 can be considered. If there are insufficient sites in Flood Zone 1 or 2 to accommodate More Vulnerable development, sites in Flood Zone 3a can be considered. More Vulnerable developments in Flood Zone 3a will require application of the Exception Test. As with Highly Vulnerable development, within each flood zone More Vulnerable development should be directed to areas at lowest risk from all sources of flooding. It should be noted that More Vulnerable development is not appropriate in Flood Zone 3b.
  8. Once all More Vulnerable developments have been allocated to a development site, consideration can be given to those development types defined as Less Vulnerable. In the first instance Less Vulnerable development should be located on sites in Flood Zone 1, continuing sequentially with Flood Zone 2, then 3a. Less Vulnerable development types are not appropriate in Flood Zone 3b – Functional Floodplain.
  9. Essential Infrastructure should be preferentially located in the lowest flood risk zones, however this type of development may be located in Flood Zones 3a and 3b, provided the Exception Test is satisfied.
  10. Water Compatible development has the least constraints with respect to flood risk and it is considered appropriate to allocate these sites last. The sequential approach should still be followed in the selection of sites; however, it is appreciated that Water Compatible development by nature often relies on access and proximity to water bodies.
  11. On completion of the Sequential Test, consideration may need to be given to the risks posed to a site within a Flood Zone in more detail in a Level 2 SFRA. By undertaking the Exception Test, this more detailed study should consider the detailed nature of flood hazard to allow a sequential approach to site allocation within a Flood Zone. Consideration of flood hazard within a flood zone would include:
    - flood risk management measures,
    - the rate of flooding,
    - flood water depth,
    - flood water velocity.
- 5.3.7 Where the development type is Highly Vulnerable, More Vulnerable, Less Vulnerable or Essential Infrastructure and a site is found to be impacted by a recurrent flood source (other than tidal or fluvial), the site and flood sources should be investigated further regardless of any requirement for the Exception Test.

## Windfall Sites

- 5.3.8 Windfall sites are those which have not been specifically identified as available in the Local Plan process. They comprise previously developed sites that have unexpectedly become available. In cases where development cannot be fully met through the provision of site allocations, a realistic allowance for windfall development should be assumed, based on past trends. It is recommended that the acceptability of windfall applications in flood risk areas should be considered at the strategic level through a policy setting out broad locations and quantities of windfall development that would be acceptable or not in Sequential Test terms.



## 5.4 Applying the Sequential Test – Planning Applications

- 5.4.1 It is necessary to undertake a sequential test for a planning application if both of the following apply:
- The proposed development is in Flood Zone 2 or 3.
  - A sequential test has not already been done for a development of the type you plan to carry out on your proposed site (check with LB Croydon).
- 5.4.2 The Environment Agency publication ‘Demonstrating the flood risk Sequential Test for Planning Applications<sup>31</sup>’ sets out the procedure for applying the sequential test to individual applications as follows:
- Identify the geographical area of search over which the test is to be applied; this could be the 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 Table 4-2, apply the Exception Test.
  - Apply the Sequential approach to locating development within the site, as described in Section 5.2.
- 5.4.3 It should be noted that it is for LB Croydon, taking advice from the Environment Agency as appropriate, to consider the extent to which Sequential Test considerations have been satisfied, taking into account the particular circumstances in any given case. The developer should justify with evidence what area of search has been used when making the application.
- 5.4.4 Ultimately, after applying the Sequential Test, LB Croydon needs to be satisfied in all cases that the proposed development would be safe and not lead to increased flood risk elsewhere. This needs to be demonstrated within a FRA (see Section 7) and is necessary regardless of whether the Exception Test is required.

### Sequential Test Exemptions

- 5.4.5 It should be noted that the Sequential Test does not need to be applied in the following circumstances:
- Individual developments proposed on sites which have been allocated in development plans through the Sequential Test.
  - Minor development, which is defined in the NPPF<sup>5</sup> as:
    1. Minor non-residential extensions: industrial / commercial / leisure etc. extensions with a footprint <250m<sup>2</sup>.
    2. Alterations: development that does not increase the size of buildings e.g. alterations to external appearance.
    3. Householder development: for example, sheds, garages, games rooms etc. within the curtilage of the existing dwelling, in addition to physical extensions to the

<sup>31</sup> Environment Agency (2012) Demonstrating the flood risk Sequential Test for Planning Applications, Version 3.1. Available from: <https://www.gov.uk/guidance/flood-risk-assessment-the-sequential-test-for-applicants>



existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling e.g. subdivision of houses into flats.

- Change of Use applications, unless it is for a change of use of land to a caravan, camping or chalet site, or to a mobile home site or park home site. However, such sites still need to meet the requirements for site-specific flood risk assessments<sup>32</sup>.
- Development proposals in Flood Zone 1 (land with a low probability of flooding from rivers or the sea) unless the SFRA, or other more recent information, indicates there may be flooding issues now or in the future (for example, through the impact of *climate change*).
- Redevelopment of existing properties (e.g. replacement dwellings), provided they do not increase the number of dwellings in an area of flood risk (i.e. replacing a single dwelling within an apartment block).

## 5.5 Exception Test

- 5.5.1 The purpose of the Exception Test is to ensure that, following the application of the Sequential Test, new development is only permitted in Flood Zone 2 and 3 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 order to pass the Exception Test, the NPPF<sup>5</sup> paragraph 160 identifies two elements that need to be demonstrated/fulfilled to the satisfaction of the LPA:
- *Part 1* - The development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared; and
  - *Part 2* - A site-specific flood risk assessment (FRA) must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, reducing flood risk overall.
- 5.5.3 Both elements of the test will have to be passed for development to be allocated or permitted.
- 5.5.4 In order to determine Part 1) of the Exception Test, applicants should assess their scheme against the objectives set out in the London Borough of Croydon's Sustainability Appraisal. The objectives have been set out in Table 5-5.
- 5.5.5 In order to demonstrate satisfaction of Part 2) of the Exception Test, the measures presented within Section 6 should be applied and demonstrated within a site-specific FRA as detailed in Section 7.
- 5.5.6 When determining planning applications, LB Croydon 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
  - Development incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate
  - Any residual risk can be safely managed, and
  - Safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

<sup>32</sup> Note that while the sequential test is not required, a site specific FRA is required for all proposals for new development including minor development and change of use in Flood Zone 2 and 3. NPPF Footnote 50 referring to paragraph 103.

**Table 5-5 London Borough of Croydon Sustainability Appraisal Objectives (December 2019)<sup>33</sup>**

Topic	Sustainability Objectives
Air Quality	<ul style="list-style-type: none"> <li>Take action to reverse the trend for increasing emissions by supporting and enabling the use of low emission technologies and actively encouraging sustainable modes of transport such as walking and cycling, particularly where it is possible to leverage the opportunities presented by a new development.</li> <li>Locate and design development so that current and future residents will not regularly be exposed to poor air quality.</li> </ul>
Biodiversity	<ul style="list-style-type: none"> <li>Minimise, and avoid where possible, impacts to biodiversity, both within and beyond designated and non-designated sites of national and local significance.</li> <li>Achieve biodiversity net gain including through the long-term enhancement and creation of well-connected, functional habitats that are resilient to the effects of climate change.</li> </ul>
Climate change adaptation	<ul style="list-style-type: none"> <li>Adapt to current and future flood risk by directing development away from the areas of the Borough at the highest risk of flooding from all sources and provide sustainable management of current and future flood risk through sensitive and innovative planning, development layout and construction.</li> </ul>
Climate change mitigation	<ul style="list-style-type: none"> <li>Continue to drive down the CO<sub>2</sub> emissions from all sources by achieving high standards of energy efficiency in new development, by providing attractive opportunities to travel by sustainable means and by protecting land suitable for renewable and low carbon energy generation, including community schemes.</li> </ul>
Economy and employment	<ul style="list-style-type: none"> <li>Improve the physical and mental health and wellbeing of Croydon residents, including through enhancing access to outdoor recreational spaces, and reduce health inequalities between local communities within the Borough.</li> </ul>
Health	<ul style="list-style-type: none"> <li>Improve the physical and mental health and wellbeing of Croydon residents, including through enhancing access to outdoor recreational spaces, and reduce health inequalities between local communities within the Borough.</li> </ul>
Heritage	<ul style="list-style-type: none"> <li>Protect, conserve and enhance heritage assets, including their setting and significance, and contribute to the maintenance and enhancement of historic character through design layout and setting of new development.</li> </ul>
Housing	<ul style="list-style-type: none"> <li>Support timely delivery of an appropriate mix of housing types and tenures, including a focus on maximizing the potential from strategic brownfield opportunities, to ensure delivery of good quality, affordable and specialist housing that meets the needs of Croydon's residents, including older people, people with disabilities and families with children.</li> </ul>
Land and soils	<ul style="list-style-type: none"> <li>Promote the efficient and sustainable use of land and natural resources, including supporting development which makes effective use of the previously developed land and avoids the best and most versatile agricultural land where applicable.</li> </ul>
Landscape	<ul style="list-style-type: none"> <li>Protect and enhance the character, quality and diversity of the Borough's landscapes and townscapes through appropriate design and layout of new development, including the preservation of important open gaps and key views.</li> </ul>
Population and communities	<ul style="list-style-type: none"> <li>Support good access to existing and planned services, facilities and community infrastructure, including green infrastructure, for new and existing residents, mindful of the potential for community needs to change over time.</li> </ul>
Transport	<ul style="list-style-type: none"> <li>Ensure that the provision of infrastructure is managed and delivered to meet local population and demographic change whilst helping to reduce congestion and travel times. This includes providing infrastructure that maximises accessibility for all and connects new housing developments to the public realm, including key services.</li> </ul>
Water	<ul style="list-style-type: none"> <li>Promote sustainable forms of development which minimizes pressure on water resources, water consumption and wastewater flows, including the use of innovative features and techniques where possible, to maintain and enhance water quality consistent with the aims of the Water Framework Directive.</li> </ul>

<sup>33</sup> London Borough of Croydon (2019), Sustainability Appraisal (SA) of the Croydon Local Plan Review: Interim SA Report. [https://www.croydon.gov.uk/sites/default/files/articles/downloads/Croydon\\_Local\\_Plan%20Interim\\_SA\\_report.pdf](https://www.croydon.gov.uk/sites/default/files/articles/downloads/Croydon_Local_Plan%20Interim_SA_report.pdf)

## 6. Managing and Mitigating Flood Risk

### 6.1 Overview

- 6.1.1 The NPPF<sup>5</sup> appreciates that it may not always be possible to avoid locating development in areas at risk of flooding. This Section provides guidance on the range of measures that could be considered in order to manage and mitigate flood risk. These measures should be considered when preparing a site-specific FRA as described in Section 7.
- 6.1.2 It is essential that the development control process influencing the design of future development within the Borough carefully mitigates the potential impact that climate change may have upon the risk of flooding. As a result, mitigation measures should be designed with an allowance for climate change over the lifetime of the proposed development as follows:
- 100 years for residential developments; and,
  - 75 years for commercial / industrial developments, or other time horizon specific to the non-residential use proposed

### 6.2 Development Layout and Sequential Approach

**A sequential approach to site planning should be applied within new development sites**

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

### 6.3 Finished Floor Levels

**All More Vulnerable and Highly Vulnerable development within Flood Zones 2 and 3 should set Finished Floor Levels to whichever is higher, 600mm above the general ground level of the site or 300mm above the modelled 1% AEP (1 in 100 year) flood level including an allowance for climate change**

- 6.3.1 When developing in areas of Flood Zone 2 and 3, areas with a history of surface water flooding, or areas shown to be at risk of surface water flooding in available modelling, the recommended method of mitigating flood risk to people, particularly with More Vulnerable (residential) and Highly Vulnerable development types, is to ensure internal floor levels are raised a freeboard level above the design flood level and that sleeping accommodation is not permitted on the ground floor.
- 6.3.2 The following are presented in order of preference:
1. Undercroft spaces on the ground floor that can be used as amenity areas or car parks with residential accommodation from the first floor upwards.
  2. Raising floor levels 600mm above general ground levels OR 300mm above the 1% AEP flood level including an allowance for climate change if data is available. For most sites this will provide sufficient room for voids under the ground floor for flood storage purposes.
  3. If neither of the above are achievable, More Vulnerable uses would not be accepted on ground floors. Less Vulnerable uses would be acceptable if deployed with extensive resilience measures.
- 6.3.3 In certain situations (e.g. for proposed extensions to buildings with a lower floor level or conversion of existing historical structures with limited existing ceiling levels), it could prove impractical to raise the internal ground floor levels to sufficiently meet the general requirements. In these cases, the Environment Agency and/or LB Croydon should be approached to discuss options for a reduction in the

minimum internal ground floor levels provided flood resistance measures are implemented up to an agreed level.

- 6.3.4 There are also circumstances where flood resilience measures should be considered first. These are described further below. For both Less and More Vulnerable developments where internal access to higher floors is required, the associated plans showing the access routes and floor levels should be included within any site-specific FRA.
- 6.3.5 Table 6-1 provides an overview of the requirements for finished floor levels in areas of at risk of fluvial flooding.

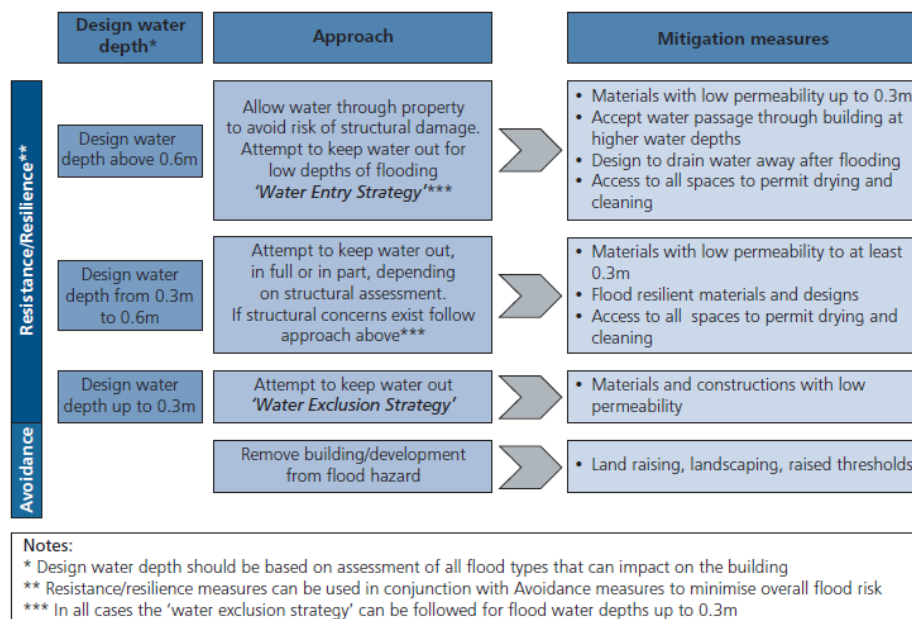
**Table 6-1 Finished Floor Levels for fluvial or surface water flood risk areas**

Development Type	Flood Zone 3 or area at risk of surface water flooding	Flood Zone 2
Minor development (i.e. non-residential extensions with a floor space <250m <sup>2</sup> and householder developments)	Floor levels within the proposed development must be set no lower than existing levels AND, flood proofing of the proposed development must be incorporated where appropriate. Details of flood proofing / resilience and resistance techniques to be included in accordance with 'Improving the flood performance of new buildings' CLG (2007). OR, Floor levels within the extension must be set 300mm above the known or modelled 1% AEP flood level (1 in 100 year) including climate change, or 600mm above the ground level where modelling is not available. Applicants should provide a plan showing floor levels relative to flood levels. All levels should be stated in relation to Ordnance Datum.	Floor levels within the proposed development must be set no lower than existing levels AND, flood proofing of the proposed development must be incorporated where appropriate. Details of flood proofing / resilience and resistance techniques to be included in accordance with 'Improving the flood performance of new buildings' CLG (2007).
New residential development (More Vulnerable)	Residential accommodation should be set at first floor level and above, with undercroft space used for amenity uses. Where residential is proposed at ground flood level, finished floor levels should be set a minimum of whichever is higher: <ul style="list-style-type: none"> <li>• 600mm above the general ground level of the site</li> <li>• 300mm above the 1% AEP flood level (1 in 100 year) including climate change, and sleeping accommodation is not permitted at ground floor level.</li> </ul> The design flood level should be derived for the immediate vicinity of the site (i.e. relative to the extent of a site along a watercourse as flood levels are likely to vary with increasing distance downstream) as part of a site-specific FRA.	
New non-residential development (e.g. Less Vulnerable)	Finished floor levels do not need to be raised for Less Vulnerable development. However it is recommended that finished floor levels should be set a minimum of 300 mm above the 1% AEP (1 in 100 year) flood level including climate change. The design flood level should be derived for the immediate vicinity of the site (i.e. relative to the extent of a site along a watercourse as flood levels are likely to vary with increasing distance downstream) as part of a site-specific FRA. If finished floor levels are not raised, flood resilience measures must be deployed to reduce the damage caused during possible flooding and facilitate rapid re-occupancy after a flood. Internal access must be provided to upper floors (first floor or a mezzanine level) to provide safe refuge in a flood event. Such refuges will have to be permanent and accessible to all occupants and users of the site and a Flood Warning and Evacuation Plan should be prepared to document the actions to take in the event of a flood.	
Basements	Basements, basement extensions, conversions of basements to a higher vulnerability classification or self-contained units are not permitted in Flood Zone 3b. Self-contained residential basements and bedrooms at basement level are not permitted in Flood Zone 3a. Internal access to a higher floor situated 300mm above the 1% AEP flood level (1 in 100 year) including climate change must be provided for all other basements, basement extensions and conversions.	All basements, basement extensions and conversions must have internal access to a higher floor situated 300mm above the 1% AEP flood level (1 in 100 year) including climate change.

## 6.4 Flood Resistance 'Water Exclusion Strategy'

- 6.4.1 There is a range of flood resistance and resilience construction techniques that can be implemented in new developments to mitigate potential flood damage. The Department for Communities and Local Government (CLG) have published a document 'Improving the Flood Performance of New Buildings,

Flood Resilient Construction<sup>34</sup>, the aim of which is to provide guidance to developers and designers on how to improve the resistance and resilience of new properties to flooding through the use of suitable materials and construction details. Figure 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 Resistant / Resilient Design Strategies, Improving Flood Performance, CLG 2007**

6.4.2 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 should be adopted where depths are between 0.3m and 0.6m and there are no structural concerns

**In areas at risk of flooding of low depths (<0.3m), implement flood resistance measures such as:**

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

6.4.3 There are a range of property flood protection devices available on the market which are designed specifically to resist the passage of floodwater. These include removable flood barriers and gates designed to fit openings, vent covers and stoppers designed to fit WCs. These measures can be appropriate for preventing water entry associated with fluvial flooding as well as surface water and sewer flooding. The efficacy of such devices relies on their being deployed before a flood event occurs. It should also be borne in mind that devices such as air vent covers, if left in place by occupants as a precautionary measure, may compromise safe ventilation of the building in accordance with Building Regulations.

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[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/7730/flood\\_performance.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/7730/flood_performance.pdf)

## 6.5 Flood Resilience 'Water Entry Strategy'

- 6.5.1 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, but to implement careful design in order to minimise damage and allow rapid re-occupancy. This is referred to as the Water Entry Strategy. These measures are appropriate for uses where temporary disruption is acceptable and suitable flood warning is received.
- 6.5.2 Materials should be used which allow the passage of water whilst retaining their structural integrity and they should also have good drying and cleaning properties. Alternatively, sacrificial materials can be included for internal and external finishes; for example, the use of gypsum plasterboard which can be removed and replaced following a flood event. Flood resilient fittings should be used to at least 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.

**In areas at risk of frequent or prolonged flooding, implement flood resilience measures such as:**

- **Use materials with either, good drying and cleaning properties, or, sacrificial materials that can easily be replaced post-flood.**
- **Design for water to drain away after flooding.**
- **Design access to all spaces to permit drying and cleaning.**
- **Raise the level of electrical wiring, appliances and utility metres.**
- **Coat walls with internal cement based renders; apply tanking on the inside of all internal walls.**
- **Ground supported floors with concrete slabs coated with impermeable membrane.**
- **Tank basements, cellars or ground floors with water resistant membranes.**
- **Use plastic water resistant internal doors.**

- 6.5.3 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'<sup>34:35</sup>.
- 6.5.4 Structures such as (bus, bike) shelters, park benches and refuse bins (and associated storage areas) located in areas with a high flood risk should be flood resilient and be firmly attached to the ground and designed in such a way as to prevent entrainment of debris which in turn could increase flood risk and/or breakaway posing a danger to life during high flows.

## 6.6 Safe Access/Egress

- 6.6.1 Safe access/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.
- 6.6.2 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 (e.g. within Flood Zone 1) using public rights of way without the intervention of emergency services or others during design flood conditions, including climate change allowances. This is of particular importance when contemplating development on sites located on dry islands.

<sup>35</sup> CLG, 2007, Improving the Flood Performance of New Buildings, Flood Resilient Construction.  
[http://www.planningportal.gov.uk/uploads/br/flood\\_performance.pdf?bcsi\\_scan\\_E956BCBE8ADBC89F=0&bcsi\\_scan\\_filename=flood\\_performance.pdf](http://www.planningportal.gov.uk/uploads/br/flood_performance.pdf?bcsi_scan_E956BCBE8ADBC89F=0&bcsi_scan_filename=flood_performance.pdf)



**For developments located in areas at risk of fluvial flooding safe access and egress must be provided for new development as follows in order of preference:**

- **Safe dry route for people and vehicles.**
- **Safe dry route for people.**
- **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.**
- **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. However, the public should not drive vehicles in floodwater.**

**For fluvial flooding, a 'dry' access/egress is a route located above the 1% AEP flood level (1 in 100 year) including an allowance for climate change.**

## Safe Refuge

- 6.6.3 In exceptional circumstances, dry access above the 1% AEP flood level (1 in 100 year) including climate change may not be achievable. In these circumstances the Environment Agency and LB Croydon should be consulted to ensure that the safety of the site occupants can be satisfactorily managed; this will be informed by the type of development, the number of occupants and their vulnerability and the flood hazard along the proposed egress route. For example, this may entail the designation of a safe place of refuge on an upper floor of a building, from which the occupants can be rescued by emergency services. It should be noted that sole reliance on a safe place of refuge is a last resort, and all other possible means to evacuate the site should be considered first. Provision of a safe place of refuge will not guarantee that an application will be granted.

## 6.7 Floodplain Compensation Storage

**Any increase in building footprint within the modelled flood extent for the 1% AEP event including an allowance for climate change associated with fluvial watercourses must not result in a net loss of flood storage capacity. Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage.**

- 6.7.1 Where proposed development results in a change in building footprint, the developer must ensure that it does not impact upon the ability of the floodplain to store water and should seek opportunities to provide a betterment with respect to floodplain storage.
- 6.7.2 Similarly, where ground levels are elevated to raise the development out of the floodplain, compensatory floodplain storage within areas that currently lie outside the floodplain must be provided to ensure that the total volume of the floodplain storage is not reduced.
- 6.7.3 As depicted in Figure 6.2, floodplain compensation must be provided on a level for level, volume for volume basis on land which does not already flood and is within the site boundary. Where land is not within the site boundary, it be in the immediate vicinity, in the applicant's ownership and linked to the site. Floodplain compensation must be considered in the context of the 1% annual probability (1 in 100 year) flood level including an appropriate allowance for climate change.
- 6.7.4 As described in the online Environment Agency guidance<sup>36</sup> the appropriate allowance to assess off-site impacts and calculate floodplain storage compensation depends on land uses in affected areas, as follows:
- In most cases the higher central allowance should be used to calculate floodplain storage compensation.
  - Use the upper end allowance to calculate floodplain storage compensation when the catchment is particularly sensitive to small changes in volume, which could cause significant increases in flood

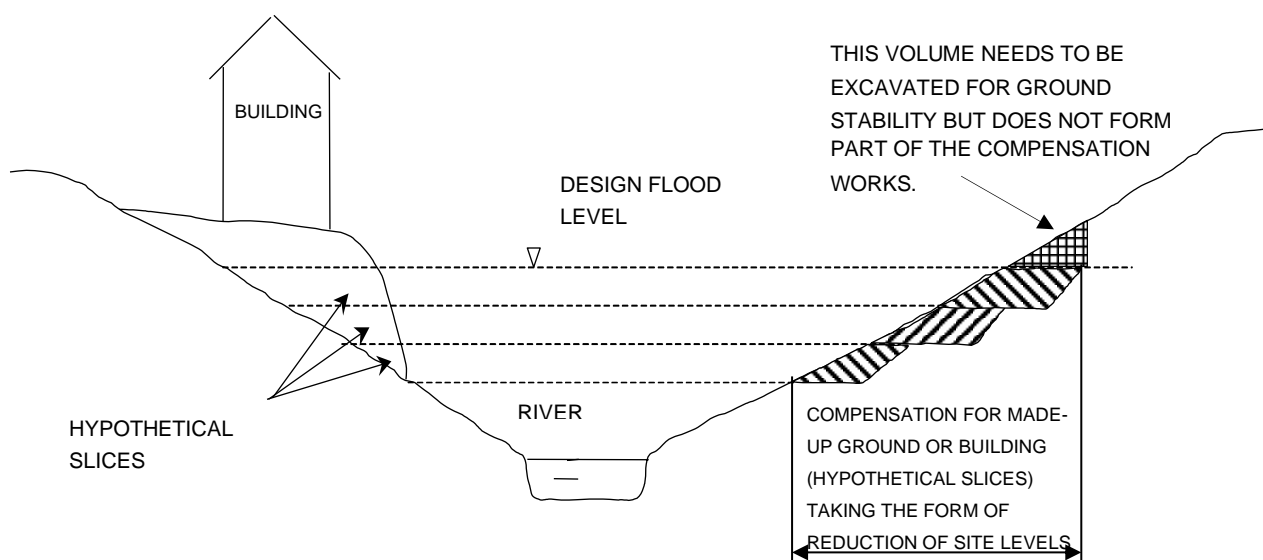
<sup>36</sup> <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#types-of-allowances>



depth or hazard; or when the affected area contains essential infrastructure or vulnerable uses, such as primary schools, caravans, bungalows or basement dwellings.

- Use the central allowance for floodplain storage compensation if you can demonstrate that the affected area contains only low vulnerability uses, such as water compatible development.

6.7.5 When designing a scheme flood water must be able to flow in and out and must not pond. An FRA must demonstrate that there is no loss of flood storage capacity and include details of an appropriate maintenance regime to ensure mitigation continues to function for the life of the development. Guidance on how to address floodplain compensation is provided in Appendix A3 of the CIRIA Publication C624<sup>37</sup>.



**Figure 6.2 Example of Floodplain Compensation Storage (Environment Agency 2009)**

6.7.6 The requirement for no loss of floodplain storage means that it is not possible to modify ground levels on sites which lie completely within the floodplain (when viewed in isolation), as there is no land available for lowering to bring it into the floodplain. It is possible to provide off-site compensation within the local area e.g. on a neighbouring or adjacent site, or indirect compensation, by lowering land already within the floodplain, however, this would be subject to detailed investigations and agreement with the Environment Agency to demonstrate (using an appropriate flood model where necessary) that the proposals would improve and not worsen the existing flooding situation or could be used in combination with other measures to limit the impact on floodplain storage

## 6.8 Flood Voids

- 6.8.1 The use of under-floor voids with adequate openings beneath the raised finished floor levels can be considered for development in Flood Zone 2 and 3. They are generally considered to provide indirect compensation or mitigation, but not true compensation for loss of floodplain storage. The use of under-floor voids will typically require a legal agreement or planning condition and maintenance plan for them to remain open for the lifetime of the development and agreement that LB Croydon will enforce. Sole reliance on the use of under-floor voids to address the loss of floodplain storage capacity is generally not acceptable on undeveloped sites or for individual properties.
- 6.8.2 Should it not be possible to achieve all the level for level compensation required, the Environment Agency may consider that the remainder be provided through the use of under-floor voids instead. The amount of level for level compensation would need to be maximised and any under-floor voids would need to be appropriately designed and kept clear to enable them to function effectively.
- 6.8.3 Ideally, void openings should be a minimum of 1m long and open from existing ground levels to at least the 1% AEP flood level (1 in 100 year) plus an allowance for climate change. By setting finished floor levels at 300mm above the design flood level, there is usually enough space provision for voids below.

<sup>37</sup> CIRIA January 2004, CIRIA Report 624: Development and Flood Risk - Guidance for the Construction Industry.

There should be a minimum of 1m of open void length per 5m length of wall. Void openings should be provided along all external walls of the proposed extension. If security is an issue, 10mm diameter vertical bars set at 100mm centres can be incorporated into the void openings. The Environment Agency is likely to seek confirmation from LB Croydon that the voids be maintained in a free and open condition for the lifetime of the development.

## 6.9 Car Parks

- 6.9.1 Where car parks are specified as areas for the temporary storage of surface water and fluvial floodwaters, flood depths should not exceed 300mm given that vehicles may be moved by water of greater 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.

## 6.10 Flood Routing

**All new development in Flood Zones 2 and 3, areas at risk of surface water flooding, or areas at risk of groundwater flooding should not adversely affect flood routing and thereby increase flood risk elsewhere. Opportunities should be sought within the site design to make space for water, such as:**

- **Removing boundary walls or replacing with other boundary treatments such as hedges, fences (with gaps).**
- **Considering alternatives to solid wooden gates or ensuring that there is a gap beneath the gates to allow the passage of floodwater.**
- **On uneven or sloping sites, consider lowering ground levels to extend the floodplain without creating ponds. The area of lowered ground must remain connected to the floodplain to allow water to flow back to river when levels recede.**
- **Create under-croft car parks or consider reducing ground floor footprint and creating an open area under the building to allow flood water storage.**
- **Where proposals entail floodable garages or outbuildings, consider designing a proportion of the external walls to be committed to free flow of floodwater.**

- 6.10.1 In order to demonstrate that 'flood risk is not increased elsewhere', development in the floodplain will need to prove that flood routing is not adversely affected by the development, for example giving rise to backwater affects or diverting floodwaters onto other properties.
- 6.10.2 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.
- 6.10.3 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.

## 6.11 Riverside Development

**Retain an 8 metre wide undeveloped buffer strip alongside Main Rivers and Ordinary Watercourses and explore opportunities for riverside restoration. New development within 8m of a Main River or Ordinary Watercourse will require consent from either the Environment Agency or LB Croydon (as LLFA) respectively.**

- 6.11.1 The Environment Agency is likely to seek an 8 metre wide undeveloped buffer strip alongside fluvial main rivers for maintenance purposes and would also ask developers to explore opportunities for riverside restoration as part of any development. This also applies to culverted sections of main rivers, (for example such as some sections of the Caterham Bourne). Any potential damage to or alteration of

the culvert could cause an increase in flood risk and it therefore encouraged to keep an undeveloped buffer adjacent to the culverted section.

- 6.11.2 Under the Environmental Permitting (England and Wales) Regulations (2016), an environmental permit is required if works are to be carried out:
- on or near a main river
  - on or near a flood defence structure
  - in a flood plain
- 6.11.3 Further guidance is available on the Environment Agency website<sup>38</sup>
- 6.11.4 Under Section 109 of the Water Resources Act 1991 and/or Environment Agency Byelaws, any works within 8 metres of any statutory Main River (both open channels and culverted sections) requires a Flood Risk Activity Permit (FRAP) from the Environment Agency. Whilst FRAPs are dealt with outside of the planning process, since requirements of the permitting process in relation to flood risk, biodiversity and pollution may result in changes to development proposals or construction methods, the Environment Agency aims to advise on such issues as part of its statutory consultee role in the planning process. Should proposed works not require planning permission the Environment Agency can be consulted regarding permission to do work on or near a river, flood or sea defence by contacting [enquiries@environment-agency.gov.uk](mailto:enquiries@environment-agency.gov.uk).
- 6.11.5 Responsibility for the consenting of works by third parties on Ordinary watercourses under Section 23 of the Land Drainage Act 1991 (as amended by the Flood and Water Management Act 2010) has transferred from the Environment Agency to LB Croydon as LLFA. LB Croydon is now responsible for the consenting of works to ordinary watercourses and has powers to enforce un-consented and non-compliant works. This includes any works (including temporary) within 8 metres that affect flow within the channel (such as in channel structures or diversion of watercourses). Enquiries and applications for ordinary watercourse consent should be sent to [floodandwater@croydon.gov.uk](mailto:floodandwater@croydon.gov.uk).
- 6.11.6 Consent will be refused if the works would result in an increase in flood risk, a prevention of operational access to the watercourse and/ or an unacceptable risk to nature conservation.

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<sup>38</sup> <https://www.gov.uk/guidance/flood-risk-activities-environmental-permits>

## 6.12 Flood Warning and Evacuation Plans

- 6.12.1 Evacuation is where flood alerts and warnings provided by the Environment Agency enable timely actions by residents or occupants to allow evacuation to take place unaided, i.e. without the deployment of trained personnel to help people from their homes, businesses and other premises. Rescue by the emergency services is likely to be required where flooding has occurred, and prior evacuation has not been possible.

**For all developments (excluding minor developments and change of use) proposed in Flood Zone 2 or 3, a Flood Warning and Evacuation Plan should be prepared to demonstrate what actions site users will take before, during and after a flood event to ensure their safety, and to demonstrate their development will not impact on the ability of the local authority and the emergency services to safeguard the current population.**

**For sites in Flood Zone 1 that are located on 'dry islands', it may also be necessary to prepare a Flood Warning and Evacuation Plan to determine potential egress routes away from the site through areas that may be at risk of flooding during the 1% annual probability (1 in 100 year) flood event including an allowance for climate change.**

**The Environment Agency has a tool on their website to create a Personal Flood Plan. The Plan comprises a checklist of things to do before, during and after a flood and a place to record important contact details. Where proposed development comprises non-residential extension <250m<sup>2</sup> and householder development (minor development), it is recommended that the use of this tool to create a Personal Flood Plan will be appropriate.**

- 6.12.2 Flood Warning and Evacuation Plans should include:

- How flood warning is to be provided, such as:
  - Availability of existing flood warning systems;
  - Where available, rate of onset of flooding and available flood warning time; and,
  - How flood warning is given.
- What will be done to protect the development and contents, such as:
  - How easily damaged items (including parked cars) or valuable items (important documents) will be relocated;
  - How services can be switched off (gas, electricity, water supplies);
  - The use of flood protection products (e.g. flood boards, airbrick covers);
  - The availability of staff/occupants/users to respond to a flood warning, including preparing for evacuation, deploying flood barriers across doors etc.; and,
  - The time taken to respond to a flood warning.
- Ensuring safe occupancy and access to and from the development, such as:
  - Occupant awareness of the likely frequency and duration of flood events, and the potential need to evacuate;
  - Safe access route to and from the development;
  - If necessary, the ability to maintain key services during an event;
  - Vulnerability of occupants, and whether rescue by emergency services will be necessary and feasible; and,
  - Expected time taken to re-establish normal use following a flood event (clean-up times, time to re-establish services etc.)

- 6.12.3 There is no statutory requirement for the Environment Agency or the emergency services to approve evacuation plans. LB Croydon is accountable via planning condition or agreement to ensure that plans are suitable. This should be done in consultation with emergency planning staff.

## Flood Warning Areas

- 6.12.4 The Environment Agency provides a free Flood Warning Service<sup>39</sup> for many areas at risk of flooding from rivers and the sea. In some parts of England the Environment Agency may be able to provide warnings when flooding from groundwater is possible. This free warning service can provide advance notice of flooding can provide time to prepare. The Environment Agency has provided a GIS layer of Flood Warning Areas in Croydon.

### Appendix A Figure 6 Flood Warning Areas

- 6.12.5 There are three Environment Agency Flood Warning Areas in Croydon:
- River Wandle at Beddington Park
  - Norbury Brook at Thornton Heath and Streatham Vale
  - Chaffinch Brook and St James Stream at Elmers End and Upper Elmers End.
- 6.12.6 The Environment Agency issue flood warnings to homes and businesses that have registered for the service when flooding is expected. Upon receipt of a warning, occupants should take immediate action.
- 6.12.7 To sign up to get warnings in England by phone, email or text message if your home or business is at risk of flooding visit the [GOV.UK website](https://www.gov.uk).

## Emergency Rest Centres

- 6.12.8 LB Croydon has designated emergency rest centres across the Borough. In the case of emergency evacuation, the emergency services will offer the option of going to a local emergency rest centre. This is likely to be a public building and will be a place of safety and a source of information for the duration of the emergency. Details of these centres have not been provided within the SFRA. It should be noted that whether each of the emergency rest centres are operational during a flood event is dependent upon the locations and extent of flooding across the Borough at that particular time. The Multi Agency Flood Plan<sup>40</sup> prepared by the Croydon Resilience Forum will provide more detail on the appropriate use of each rest centre.

## 6.13 Surface Water Management

### What are Sustainable Drainage Systems?

**All major developments (10 or more dwellings and 100m<sup>2</sup> floorspace) and other development should not result in an increase in surface water runoff, and where possible, should demonstrate betterment in terms of rate and volumes of surface water runoff.**

- 6.13.1 Sustainable Drainage Systems (SuDS) are surface water drainage solutions designed to manage surface water runoff and mitigate the adverse effects of urban storm water runoff by reducing flood risk and controlling pollution<sup>41</sup>. SuDS techniques allow surface water runoff from development to be controlled in ways that imitate natural drainage by controlling the rate of discharge to a receiving watercourse. SuDS may also provide valuable habitat and amenity value when carefully planned for in development.
- 6.13.2 The SuDS Manual<sup>42</sup> identifies four processes that can be used to manage and control runoff from developed areas. Each option can provide opportunities for storm water control, flood risk management, water conservation and groundwater recharge:

**Infiltration:** the soaking of water into the ground. This is the most desirable solution as it mimics the natural hydrological process. The rate of infiltration will vary with soil type and condition, the antecedent conditions and with time. The process can be used to recharge groundwater sources and feed

<sup>39</sup> Environment Agency Flood Warning Service <http://apps.environment-agency.gov.uk/wiyby/37835.aspx>

<sup>40</sup> Croydon Resilience Forum (2016), Multi-Agency Flood Response Plan v2.1 (Public) - <https://www.croydon.gov.uk/sites/default/files/articles/downloads/Flood%20Response%20Plan.pdf>

<sup>41</sup> Defra, Environment Agency (March 2015) Cost Estimation for SuDS – Summary of Evidence

<sup>42</sup> CIRIA C753 SuDS Manual. [http://www.ciria.org/Memberships/The\\_SuDs\\_Manual\\_C753\\_Chapters.aspx](http://www.ciria.org/Memberships/The_SuDs_Manual_C753_Chapters.aspx)

baseflows of local watercourses, but where groundwater sources are vulnerable or there is risk of contamination, infiltration techniques are not suitable.

The use of traditional infiltration techniques that infiltrate to the ground is dependent on the underlying ground conditions. An assessment of the suitability of using infiltration SuDS techniques across the Borough has been undertaken as part of the SWMP for each London Borough using the detailed 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.

**Detention/Attenuation:** the slowing down of surface flows before their transfer downstream, usually achieved by creating a storage volume and a constrained outlet. In general, though the storage will enable a reduction in the peak rate of runoff, the total volume will remain the same, just occurring over a longer duration.

Detention measures are not constrained by geology, though in areas of permeable geology, there will also be a degree of infiltration of runoff taking place.

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

**Water Harvesting:** the direct capture and use of runoff on site, e.g. for domestic use (flushing toilets) or irrigation of urban landscapes. The ability of these systems to perform a flood risk management function will be dependent on their scale, and whether there will be a suitable amount of storage always available in the event of a flood.

- 6.13.3 As part of any SuDS scheme, consideration should be given to the long-term maintenance of the SuDS to ensure that it remains functional for the lifetime of the development. Table 6-2 has been reproduced from the SuDS Manual, CIRIA C753 and outlines typical SuDS techniques.

**Table 6-2 Typical SuDS Components** (Y: primary process, \* some opportunities subject to design)

Technique	Description	Conveyance	Detention	Infiltration	Harvesting
Pervious Surfaces	Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, reuse, or release to surface water.		Y	Y	*
Filter Drains	Linear drains/trenches filled with a permeable material, often with perforated pipe in the base of the trench. Surface water from the edge of paved areas flows into the trenches, is filtered and conveyed to other parts of the site.	Y	Y		
Filter Strips	Vegetated strips of gently sloping ground designed to drain water evenly from impermeable areas and filter out silt and particulates.	*	*	*	
Swales	Shallow vegetated channels that conduct and/or retain water and can permit infiltration when unlined.	Y	Y	*	
Ponds	Depressions used for storing and treating water.		Y	*	Y
Wetlands	As ponds, but the runoff flows slowly but continuously through aquatic vegetation that attenuates and filters the flow. Shallower than ponds. Based on geology these measures can also incorporate some degree of infiltration.	*	Y	*	Y
Detention Basin	Dry depressions designed to store water for a specified retention time.		Y		
Soakaways	Sub-surface structures that store and dispose of water via infiltration.			Y	
Infiltration Trenches	As filter drains but allowing infiltration through trench base and sides.	*	Y	Y	
Infiltration Basins	Depressions that store and dispose of water via infiltration.		Y	Y	
Green Roofs	Green roofs are systems which cover a building's roof with vegetation. They are laid over a drainage layer, with other layers providing protection, waterproofing and insulation. It is noted that the use of brown/green roofs should be for betterment purposes and not to be counted towards the provision of on-site storage for surface water. This is because the hydraulic performance during extreme events is similar to a standard roof (CIRIA C697).		Y		
Rainwater Harvesting	Storage and use of rainwater for non-potable uses within a building, e.g. toilet flushing. It is noted that storage in these types of systems is not usually considered to count towards the provision of on-site storage for surface water balancing 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.	*	*	*	Y

6.13.4 The application of SuDS is not limited to a single technique per site. Often a successful SuDS solution will utilise a combination of techniques, providing flood risk, pollution and landscape/wildlife benefits. In addition, SuDS can be employed on a strategic scale, for example with a number of sites contributing to large scale jointly funded and managed SuDS. It should be noted, each development site must offset its own increase in runoff and attenuation cannot be “traded” between developments.

6.13.5 Other measures may also be required in relation to water and sewerage infrastructure that might include pipes and below ground storage required as part of a wider strategic scheme, to deal with surface water flood risk. Options may include:

- Increasing capacity in drainage systems;
- Separation of foul and surface water sewers;
- Improved drainage maintenance regimes; and,
- Managing overland flows.



## Management Train

- 6.13.6 The concept used in the development of drainage systems is the surface water ‘management train’<sup>43</sup> whereby different techniques can be used in series to change the flow and quality characteristics of runoff in stages that attempt to mimic natural drainage. The hierarchy of techniques that should be considered in developing the management train are<sup>49</sup>:
1. **Prevention** – the use of good site design and site housekeeping measures to prevent runoff and pollution (e.g. sweeping to remove surface dust and detritus from car parks), and rainwater reuse/harvesting. Prevention policies should generally be included within the site management plan.
  2. **Source controls** – control of runoff at or very near its source (e.g. soakaways, other infiltration methods, green roofs, pervious pavements).
  3. **Site controls** – management of water in a local area or site (e.g. routing water from building roofs and car parks to a large soakaway, infiltration or detention basin.)
  4. **Regional controls** – management of runoff from a site or several sites, typically in a balancing pond or wetland.
- 6.13.7 Policy SI13 in the London Plan 2021 sets out the drainage hierarchy that developers should follow for managing surface water in London Boroughs.
- 6.13.8 Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the following drainage hierarchy:
- 1) rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)
  - 2) rainwater infiltration to ground at or close to source
  - 3) rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens)
  - 4) rainwater discharge direct to a watercourse (unless not appropriate)
  - 5) controlled rainwater discharge to a surface water sewer or drain
  - 6) controlled rainwater discharge to a combined sewer.
- 6.13.9 Where possible, stormwater should be managed in small, cost-effective landscape features located within small sub-catchments rather than being conveyed to and managed in large systems at the bottom of drainage areas. The techniques that are higher in the hierarchy are preferred to those further down so that prevention and control of water at the source should always be considered before site or regional controls. However, where upstream control opportunities are restricted, a number of lower hierarchy options should be used in series. Water should only be conveyed elsewhere if it cannot be dealt with at the site.
- 6.13.10 The passage of water between stages of the management train should be considered through the use of natural conveyance systems (e.g. swales and filter trenches) wherever possible. Pipework and sub-surface proprietary produce may still be required, especially where space is limited. Pre-treatment (i.e. the removal of silt and sediment loads) and maintenance is vital to ensure the long-term effectiveness of SuDS. Overland flow routes will also be required to convey and control floodwaters safely and effectively during extreme flood events. Generally, the greater the number of techniques used in a series the better the performance is likely to be and the lower the risk of overall system failure.
- 6.13.11 SuDS can be applied in all development situations, although individual site constraints may limit the potential of some sites achieving full benefits for all functions. The variety of SuDS available allows planners and designers to make full potential of the local land and consider the needs of local people when implementing the drainage design. The wishes of all the relevant stakeholders needs to be balanced in addition to the risk associated with each design option.

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<sup>43</sup> [http://www.ciria.org.uk/suds/suds\\_management\\_train.htm](http://www.ciria.org.uk/suds/suds_management_train.htm)

## Technical Standards and supporting guidance

All major<sup>44</sup> developments and other development should not result in an increase in surface water runoff, and where possible, should demonstrate betterment in terms of rate and volumes of surface water runoff.

Sustainable Drainage Systems (SuDS) should be used to reduce and manage surface water run-off to and from proposed developments as near to source as possible in accordance with the requirements of the Technical Standards and supporting guidance published by DCLG and Department for the Environment, Food and Rural Affairs (Defra)<sup>45</sup>.

- 6.13.12 A set of non-statutory Technical Standards 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 sustainable drainage systems (SuDS).
- 6.13.13 The Technical Standards<sup>45</sup> that are of chief concern in relation to the consideration of flood risk to and from development relating to peak flow control and volume control are presented below:

### Peak flow control

**S2** For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event 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 100 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 same 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 discharged at a rate that does not adversely affect flood risk.

<sup>44</sup> Major development – 10 or more dwellings and 1000 sqm floorspace.

<sup>45</sup> Sustainable drainage systems: non-statutory technical standards - <https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards>; PPG Flood Risk and Coastal Change - <http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/reducing-the-causes-and-impacts-of-flooding/why-are-sustainable-drainage-systems-important/>

**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 convey 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 utility 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 in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property.**

## Sustainable Drainage Strategy

- 6.13.14 As of 6 April 2015, all major development should include provision for SuDS and, as the LLFA, LB Croydon is a statutory consultee on surface water management drainage issues for all such major developments. LB Croydon has set out clear advice and guidance documents on their website<sup>46</sup>.
- 6.13.15 This includes the 'Advice to Planning Applicants' document, which provides a summary of information and a developer's checklist as well as a London Sustainable Drainage Proforma to assist applicants with producing a satisfactory surface water drainage assessment for their development in accordance with national and local planning policy. The Surface Water Drainage Summary Pro-forma which should be completed in full and accompany the submitted drainage statement and supporting evidence. This must be cross-referenced within an FRA where appropriate.
- 6.13.16 LB Croydon also includes the 'Sustainable Drainage Design and Evaluation Guide' in their website<sup>46</sup>, developed by McCloy Consulting and Robert Bray Associates, which gives a background context for SuDS design and describes the SuDS concept design, outline design and detailed design.
- 6.13.17 Applicants are strongly encouraged to discuss their proposals with LB Croydon at the pre-application stage. A request can be made via [floodandwater@croydon.gov.uk](mailto:floodandwater@croydon.gov.uk).
- 6.13.18 For smaller schemes located within Flood Zones 2 and 3, SuDS will need to be addressed as part of an FRA and will be assessed by LB Croydon.

## Suitability for Infiltration SuDS

- 6.13.19 Improper use of infiltration SuDS can lead to contamination of superficial deposits and bedrock aquifers, leading to deterioration of groundwater quality, or increased flood risk. On the other hand, appropriate use of infiltration SuDS may improve groundwater quality status and decrease the flood risk.
- 6.13.20 The locations most appropriate for infiltration SuDS exist where there is a combination of high ground and permeable geology. However, when implementing this type of SuDS, it is vital that the impact on properties down gradient is considered. Increasing infiltration in an area will lead to increased groundwater levels, thus an increased susceptibility to groundwater flooding down the catchment.
- 6.13.21 At each development site groundwater levels should be assessed prior to the implementation of SuDS. This will help confirm their potential function (e.g. soakaways) even after long periods of rainfall. This is particularly important where superficial deposit dominate as their thickness is unpredictable. If they are thick and impermeable, shallow soakaways may not intercept the underlying permeable bedrock. If they are thin and permeable, but perched over impermeable bedrock, they may not receive the additional recharge from the infiltration SuDS.
- 6.13.22 Infiltration SuDS should not be implemented near to areas of historic landfill or any other areas of known contamination. This is to ensure that drainage does not re-mobilise latent contamination which would exacerbate the risk to groundwater quality.

<sup>46</sup>London Borough of Croydon SuDS Planning Advice <https://www.croydon.gov.uk/environment/flood-water/advice-to-planning-applicants>

- 6.13.23 If ground conditions are not suitable for infiltration SuDS techniques, then surface waters can still be managed using surface infiltration techniques in combination with attenuation SuDS measures. These techniques attenuate surface water runoff to reduce flood risk both within the site and to the surrounding areas. Furthermore, areas upstream of critical flood areas can be used to install attenuation SuDS to slow the flood of water reaching the high risk area.
- 6.13.24 The rest of this section identifies where infiltration SuDS could be applied across Croydon based on the bedrock and superficial geology of each area. The information is supported by the SWMP.
- 6.13.25 As mentioned in Section 3.1.2, the bedrock geology of Croydon comprises of Upper Chalk in the south, which is overlain by Thanet Sand Formation (fine sand), Lambeth Group (clay and sand), Harwich Formation (sand and flint) and the London Clay Group in the north. This is overlain by of Head, Clay with Flints and River Terrace Deposits.
- 6.13.26 The Suitability of Infiltration SuDS, shown in the Croydon SWMP (2011)<sup>47</sup>, is based on Geology which is summarised as follows:
- There have been several groundwater flooding events in the Harwich Formation in the Spring Park, Addiscombe and Monks Orchard areas. Therefore, infiltration SuDS should not be allocated here.
  - Groundwater levels in the London Clay Formation, Lambeth Group and Thanet Sand Formation depends on their hydraulic connectivity with the underlying Chalk and the presence of any clay. Therefore, to establish the suitability of infiltration SuDS in this location will require specific site investigations to confirm the depth of the groundwater and any seasonal fluctuations prior to any development.
  - The Upper Chalk bedrock is water bearing and therefore has increased potential for elevated groundwater. This includes Addington to the east, Waddon and South Croydon in the west and Purley in the south. There has been extensive groundwater flooding in the south of the Borough in recent years, and therefore infiltration SuDS should not be considered in these locations.
  - There is a history of groundwater flooding the in the northwest where superficial geology overlays the London Clay Formation, this therefore indicates that it would not be appropriate to implement infiltration SuDS, particularly around Broad Green. The depth of the groundwater level in these superficial deposits is likely to vary and therefore further investigations should take place to assess the suitability of infiltration SuDS here, particularly in the topographic lows near the surface water courses.
  - Another factor for consideration is the location of historic landfill. Infiltration SuDS must not promote the re-mobilisation of latent contamination that would promote groundwater quality risks. In the north there are a few areas of historic landfill (namely South Norwood Country Park), which must be avoided for use of infiltration SuDS.
  - Where the London Clay Formation is at the surface and there are no overlying superficial deposits the potential for elevated groundwater is negligible and therefore infiltration SuDS should not be installed here.
  - Much of the south of Croydon consists of unconfined chalk and Basal Sands where groundwater can be elevated. There is a history of groundwater flooding in the southern part of the Borough and in these locations the use of SuDS is not advisable. Where the London Clay Formation is present infiltration SuDS are not suitable.
  - The areas in-between (i.e. the superficial River Terrace Deposits) requires further investigation to assess the ability of the ground to store and transmit infiltration without processing flooding or drainage issues. Where the Clay and Flints dominate the suitability of infiltration SuDS will depend on the thickness of this layer – any soakaways will need to penetrate the underlying chalk.

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<sup>47</sup> London Borough of Croydon (2011), Surface Water Management Plan, available at: <https://www.croydon.gov.uk/sites/default/files/articles/downloads/swplan.pdf>

## 7. Site Specific FRA Guidance

### 7.1 What is a Flood Risk Assessment?

- 7.1.1 A site-specific FRA is a report suitable for submission with a planning application which provides an assessment of flood risk to and from a proposed development, and demonstrates how the proposed development will be made safe, will not increase flood risk elsewhere and where possible will reduce flood risk overall in accordance with paragraph 160 of the NPPF<sup>5</sup> and PPG<sup>6</sup>. A FRA must be prepared by a suitably qualified and experienced person and must contain all the information needed to allow LB Croydon to satisfy itself that policy requirements have been met.

### 7.2 When is a Flood Risk Assessment required?

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

- **Proposals for new development (including minor development and change of use) in Flood Zones 2 and 3;**
- **Proposals for new development (including minor development and change of use) in an area within Flood Zone 1 which has critical drainage problems (as notified by the Environment Agency);**
- **Proposals of 1 hectare or greater in Flood Zone 1;**
- **Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.**

### 7.3 How detailed should a FRA be?

- 7.3.1 The PPG<sup>6</sup> states that site-specific FRAs should be proportionate to the degree of flood risk, the scale and nature of the development, its vulnerability classification and the status of the site in relation to the Sequential and Exception Tests. Site-specific FRAs should also make optimum use of readily available information, for example the mapping presented within this SFRA and available on the Environment Agency website, although in some cases additional modelling or detailed calculations will need to be undertaken.
- 7.3.2 Table 7-1 presents the different levels of site-specific FRA as defined in the CIRIA publication C624<sup>48</sup> and identifies typical sources of information that can be used.

<sup>48</sup> CIRIA, 2004, Development and flood risk – guidance for the construction industry C624.

**Table 7-1 Levels of Site-Specific Flood Risk Assessment**

Description
<p><b><u>Level 1 Screening Study</u></b></p> <p>Identify whether there are any flooding or surface water management issues related to a development site that may warrant further consideration. This should be based on readily available existing information. The screening study will ascertain whether an FRA Level 2 or 3 is required.</p> <p>Typical <b>sources of information</b> include:</p> <ul style="list-style-type: none"> <li>• London Borough of Croydon SFRA</li> <li>• Flood Map for Planning (Rivers and Sea)</li> <li>• Environment Agency Standing Advice</li> <li>• NPPF Tables 1, 2 and 3</li> </ul>
<p><b><u>Level 2 Scoping Study</u></b></p> <p>To be undertaken if the Level 1 FRA indicates that the site may lie within an area that is at risk of flooding, or the site may increase flood risk due to increased run-off. This study should confirm the sources of flooding which may affect the site. The study should include:</p> <ul style="list-style-type: none"> <li>• An appraisal of the availability and adequacy of existing information;</li> <li>• A qualitative appraisal of the flood risk posed to the site, and potential impact of the development on flood risk elsewhere; and</li> <li>• An appraisal of the scope of possible measures to reduce flood risk to acceptable levels.</li> </ul> <p>The scoping study may identify that sufficient quantitative information is already available to complete a FRA appropriate to the scale and nature of the development.</p> <p>Typical <b>sources of information</b> include those listed above, plus:</p> <ul style="list-style-type: none"> <li>• Local policy statements or guidance.</li> <li>• Thames Catchment Flood Management Plan.</li> <li>• Data request from the EA to obtain result of existing hydraulic modelling studies relevant to the site and outputs such as maximum flood level, depth and velocity.</li> <li>• Consultation with EA/LB Croydon/sewerage undertakers and other flood risk consultees to gain information and to identify in broad terms, what issues related to flood risk need to be considered including other sources of flooding.</li> <li>• Historic maps.</li> <li>• Walkover survey to assess potential sources of flooding, likely routes for floodwaters, the key features on the site including flood defences, their condition.</li> <li>• Site survey to determine general ground levels across the site, levels of any formal or informal flood defences</li> </ul>
<p><b><u>Level 3 Detailed Study</u></b></p> <ul style="list-style-type: none"> <li>• To be undertaken if a Level 2 FRA concludes that further quantitative analysis is required to assess flood risk issues related to the development site. The study should include:</li> <li>• Quantitative appraisal of the potential flood risk to the development;</li> <li>• Quantitative appraisal of the potential impact of the development site on flood risk elsewhere; and</li> <li>• Quantitative demonstration of the effectiveness of any proposed mitigations measures.</li> </ul> <p>Typical <b>sources of information</b> include those listed above, plus:</p> <ul style="list-style-type: none"> <li>• Detailed topographical survey.</li> <li>• Detailed hydrographic survey.</li> <li>• Site-specific hydrological and hydraulic modelling studies which should include the effects of the proposed development.</li> <li>• Monitoring to assist with model calibration/verification.</li> <li>• Continued consultation with the LPA, Environment Agency and other flood risk consultees.</li> </ul>

## Environment Agency Data Requests

7.3.3 The Environment Agency offers a series of 'products' for obtaining flood risk information suitable for informing the preparation of site-specific FRAs as described on their website <https://www.gov.uk/planning-applications-assessing-flood-risk>.

- Products 1 – 4 relate to mapped deliverables including flood level and flood depth information and the presence of flood defences local to the proposed development site
- Product 5 contains the reports for hydraulic modelling of the Main Rivers, or Breach Modelling
- Product 6 contains the model output data so the applicant can interrogate the data to inform the FRA
- Product 7 comprises the hydraulic model itself

- Product 8 contains flood defence breach hazard mapping.
- 7.3.4 Products 1 – 6 and 8 can be used to inform a Level 2 FRA. In some cases, it may be appropriate to obtain Product 7 and to use as the basis for developing a site-specific model for a proposed development as part of a Level 3 FRA. This can be requested via either their National Customer Contact Centre via [enquiries@environment-agency.gov.uk](mailto:enquiries@environment-agency.gov.uk) or the Customer and Engagement Team via [KSLEnquiries@environment-agency.gov.uk](mailto:KSLEnquiries@environment-agency.gov.uk).
- 7.3.5 It is noted that there are large parts of LB Croydon that don't have detailed modelling available. In these situations, development proposals will still need to employ mitigation measures, such as raising finished floor levels 600mm above ground levels, as described in Section 6.3.

## Modelling of Ordinary Watercourses

- 7.3.6 It should be noted that the scope of modelling studies undertaken by the Environment Agency typically cover flooding associated with Main Rivers, and therefore Ordinary Watercourses that form tributaries to the Main Rivers may not always be included in the model. Where a proposed development site is in close proximity to an Ordinary Watercourse and either no modelling exists, or the available modelling is considered to provide very conservative estimates of flood extents (due to the use of national generalised JFLOW modelling), applicants may need to prepare a simple hydraulic model to enable more accurate assessment of the probability of flooding associated with the watercourse and to inform the site-specific FRA. This should be carried out in line with industry standards and in agreement with the Environment Agency and LB Croydon.

## 7.4 What needs to be addressed in a Flood Risk Assessment?

- 7.4.1 The PPG<sup>6</sup> states that the objectives of a site-specific flood risk assessment are to establish:
- Whether a proposed development is likely to be affected by current or future flooding from any source
  - Whether it will increase flood risk elsewhere
  - Whether the measures proposed to deal with these effects and risks are appropriate
  - The evidence for the local planning authority to apply (if necessary) the Sequential Test, and
  - Whether the development will be safe and pass the Exception Test, if applicable.

## 7.5 Flood Risk Assessment Checklist

- 7.5.1 Table 7-2 provides a checklist for site-specific FRAs listing the information that will likely need to be provided along with references to sources of relevant information. As described in Section 7.3, the exact level of detail required under each heading will vary according to the scale of development and the nature of the flood risk. It is expected that this Checklist is completed for all planning applications.



**Table 7-2 Site-Specific Flood Risk Assessment Checklist (building on guidance in PPG<sup>6</sup>)**

What to Include in the FRA		Source(s) of Information
<b>1. Site Description</b>		
Site address	-	-
Site description	-	-
Location plan	Including geographical features, street names, catchment areas, watercourses and other bodies of water	-
Site plan	Plan of site showing development proposals and any structures which may influence local hydraulics e.g. bridges, pipes/ducts crossing watercourses, culverts, screens, embankments, walls, outfalls and condition of channel	OS Mapping Site Survey
Topography	Include general description of the topography local to the site. Where necessary, site survey may be required to confirm site levels (in relation to Ordnance datum). Plans showing existing and proposed levels.	
Geology	General description of geology local to the site.	
Watercourses	Identify Main Rivers and Ordinary Watercourses local to the site.	SFRA Appendix A, Figure 1
Status	Is the development in accordance with London Borough of Croydon's Local Plan?	Seek advice from LB Croydon if necessary
<b>2. Assessing Flood Risk</b>		
The level of assessment will depend on the degree of flood risk and the scale, nature and location of the proposed development. Refer to Table 7-1 regarding the levels of assessment. Not all of the prompts listed below will be relevant for every application.		
Flooding from Rivers	Provide a plan of the site and Flood Zones. Identify any historic flooding that has affected the site, including dates and depths where possible. How is the site likely to be affected by climate change? Determine flood levels on the site for the 1% annual probability (1 in 100 chance each year) flood event including an allowance for climate change. Determine flood hazard on the site (in terms of flood depth and velocity). Determine the flood level, depth, velocity, hazard, rate of onset of flooding on the site.	SFRA Appendix A, Figures 1-2 Environment Agency Flood Map for Planning (Rivers and Sea). Environment Agency Products 1-7. New hydraulic model (where EA data not available)
Flooding from Land	Identify any historic flooding that has affected the site. Review the local topography and conduct a site walkover to determine low points at risk of surface water flooding. Review the Risk of Flooding from Surface Water mapping & SWMP report.	SFRA Appendix A, Figure 3 Topographic survey. Site walkover. Risk of Flooding from Surface Water mapping (EA website).
Flooding from Groundwater	Desk based assessment based on high level BGS mapping in the SFRA. Ground survey investigations. Identify any historic flooding that has affected the site.	SFRA Appendix A, Figures 4 Ground Investigation Report
Flooding from Sewers	Identify any historic flooding that has affected the site.	SFRA Appendix A, Figure 5 Where appropriate an asset location survey can be provided by Thames Water Utilities Ltd <a href="http://www.thameswater-propertysearches.co.uk/">http://www.thameswater-propertysearches.co.uk/</a>
Reservoirs, Docks, canals and other artificial sources	Identify any historic flooding that has affected the site. Review the Risk of Flooding from Reservoirs mapping & EA breach modelling for the Docks	Risk of Flooding from Reservoirs mapping (EA website).
<b>3. Proposed Development</b>		
Current use	Identify the current use of the site.	-
Proposed use	Will the proposals increase the number of occupants / site users on the site such that it may affect the degree of flood risk to these people?	-
Vulnerability Classification	Determine the vulnerability classification of the development. Is the vulnerability classification appropriate within the Flood Zone?	SFRA Table 5-4

4. Avoiding Flood Risk		
Sequential Test	Determine whether the Sequential Test is required. Consult LB Croydon to determine if the site has been included in the Sequential Test. If required, present the relevant information to LB Croydon to enable their determination of the Sequential Test for the site on an individual basis.	SFRA Table 5.2
Exception Test	Determine whether the Exception Test is necessary. Where the Exception Test is necessary, present details of: Part 1) how the proposed development contributes to the achievement of wider sustainability objectives as set out in the London Borough of Croydon Sustainability Appraisal Scoping Report. (Details of how part 2) can be satisfied are addressed in the following part 5 'Managing and Mitigating Flood Risk'.)	SFRA Section 5.4
5. Managing and Mitigating Flood Risk		
<p>Section 6 of the SFRA presents measures to manage and mitigate flood risk and when they should be implemented. Where appropriate, the following should be demonstrated within the FRA to address the following questions:</p> <p>How will the site/building be protected from flooding, including the potential impacts of climate change, over the development's lifetime?</p> <p>How will you ensure that the proposed development and the measures to protect your site from flooding will not increase flood risk elsewhere?</p> <p>Are there any opportunities offered by the development to reduce flood risk elsewhere?</p> <p>What flood-related risks will remain after you have implemented the measures to protect the site from flooding (i.e. residual risk) and how and by whom will these be managed over the lifetime of the development (e.g. flood warning and evacuation procedures)?</p>		
Development Layout and Sequential Approach	Plan showing how sensitive land uses have been placed in areas within the site that are at least risk of flooding.	SFRA Section 6.2
Finished Floor Levels	Plans showing finished floor levels in the proposed development in relation to Ordnance Datum taking account of indicated flood depths.	SFRA Section 6.3
Flood Resistance	Details of flood resistance measures that have been incorporated into the design. Include design drawings where appropriate.	SFRA Section 6.4
Flood Resilience	Details of flood resilience measures that have been incorporated into the design. Include design drawings where appropriate.	SFRA Section 6.5
Safe Access / Egress	Provide a figure showing proposed safe route of escape away from the site and/or details of safe refuge. Include details of signage that will be included on site.  Where necessary this will involve mapping of flood hazard associated with river flooding. This may be available from Environment Agency modelling or may need to be prepared as part of hydraulic modelling specific for the proposed development site.	SFRA Section 6.6
Flow Routing	Provide evidence that proposed development will not impact flood flows to the extent that the risk to surrounding areas is increased. Where necessary this may require modelling.	SFRA Section 6.10
Riverside Development Buffer Zone	Provide plans showing how a buffer zone of relevant width will be retained adjacent to any Main River or Ordinary Watercourse in accordance with requirements of the Environment Agency/LB Croydon	SFRA Section 6.11
Surface Water Management	Pre application advice from LB Croydon should be sought to gain advice on suitable SuDS and drainage for individual development sites. Details of the following should be included within the FRA: Calculations (and plans) showing areas of the site that are permeable and impermeable pre and post-development. Calculations of pre and post-development runoff rates and volumes including consideration of climate change over the lifetime of the development. Details of the methods that will be used to manage surface water (e.g. permeable paving, swales, wetlands, rainwater harvesting). Information on proposed management arrangements Where appropriate, reference the supporting Outline or Detailed Drainage Strategy for the site.	SFRA Section 6.13
Flood Warning and Evacuation Plan	Where appropriate reference the Flood Warning and Evacuation Plan or Personal Flood Plan that has been prepared for the proposed development (or will be prepared by site owners).	SFRA Section 6.12

## 7.6 Pre-application Advice

- 7.6.1 At all stages, LB Croydon, and where necessary the Environment Agency and/or Thames Water Utilities Limited may need to be consulted to ensure the FRA provides the necessary information to fulfil the requirements for planning applications.
- 7.6.2 Pre-application advice enables issues to be addressed early in the planning process and reduces the risk of objections to applications.
- 7.6.3 The Environment Agency and LB Croydon each offer pre-application advice services which should be used to discuss particular requirements for specific applications.
- Environment Agency: Please email [enquiries@environment-agency.gov.uk](mailto:enquiries@environment-agency.gov.uk) if you require any pre-application advice. Please see: <https://www.gov.uk/guidance/environment-agency-fees-and-charges#planning-application-advice>
  - LB Croydon  
<https://www.croydon.gov.uk/planningandregeneration/pre-application-meeting-service>
- 7.6.4 The following government guidance sets out when LPAs should consult with the Environment Agency on planning applications <https://www.gov.uk/flood-risk-assessment-local-planning-authorities>.

## 8. Recommendations for Policy

### 8.1 Local Policy review

8.1.1 The Croydon Local Plan adequately addresses the issues arising from surface water management and it goes one step further than the New London Plan stating that SuDS should achieve better than greenfield runoff rates.

8.1.2 The London Plan 021 (Policy SI13), states 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 those risks.*

*Development proposals should aim to achieve greenfield runoff rates and ensure that surface water runoff is managed as close to its source as possible in line with the following drainage hierarchy:*

1. *Rainwater harvesting (including a combination of green and blue roofs)*
2. *Infiltration techniques and green roofs*
3. *rainwater attenuation in open water features for gradual release*
4. *rainwater discharge direct to a watercourse (unless not appropriate)*
5. *rainwater attenuation above ground (including blue roofs)*
6. *rainwater attenuation below ground*
7. *rainwater discharge to a surface water sewer or drain*
8. *rainwater discharge to a combined sewer.*

*Development proposals for impermeable paving should be refused where appropriate, including on small surfaces such as front gardens and driveways.*

*Drainage should be designed and implemented in ways that address issues of water use efficiency, river quality, biodiversity, amenity and recreation.*

8.1.3 The LB Croydon Local Plan (Policy DM25.3) states that SuDS are required in all developments and should:

- a. Ensure surface run-off is managed as close to the source as possible;
- b. Accord with the London Plan Sustainable Drainage Hierarchy;
- c. Achieve better than greenfield runoff rates;
- d. Be designed to be multifunctional and incorporate sustainable drainage into landscaping and public realm to provide opportunities to improve amenity and biodiversity;
- e. Achieve improvements in water quality through a sustainable drainage system management train; and
- f. Be designed with consideration of future maintenance.

8.1.4 Additionally, the LB Croydon Local Plan (Policy DM25) advises that where a site is at risk of groundwater, the Council will request a Basement Impact Assessment as part of the Flood Risk Assessment for any basement application. These assessments should be informed by ground investigations to help assess the flood risks to basement development.

8.1.5 The existing flood risk and surface water management policies within the Croydon Local Plan are sufficient to enable future development proposals to be assessed to ensure they adequately address any identified flood risk issues.

## 9. Next Steps

### 9.1 Sequential Test

9.1.1 Using the strategic flood risk information presented within this Level 1 SFRA, LB Croydon should undertake the Sequential Test to document the process whereby future development is steered towards areas of lowest flood risk.

### 9.2 Level 2 SFRA

9.2.1 Where it is not possible to accommodate all the necessary development outside those areas identified to be at risk of flooding, a Level 2 SFRA will be required to provide information to support the application of the Exception Test for future development sites. The scope of the Level 2 SFRA will be to consider the detailed nature of the flood characteristics within a flood zone including:

- flood probability
- flood depth
- flood velocity
- rate of onset of flooding, and
- duration of flood.

9.2.2 The Level 2 SFRA will provide a more detailed assessment of the flood risk for specific development sites which may require the application of the Exception Test.

### 9.3 Future Updates to the SFRA

9.3.1 The Environment Agency review and update the Flood Map for Planning (Rivers and Sea) on a quarterly basis and a rolling programme of detailed flood risk mapping is underway. Future new modelling of watercourses in the area will improve the current knowledge of flood risk within London Borough of Croydon and may marginally alter predicted flood extents within parts of the Borough in the future.

9.3.2 New information may influence future development management decisions within these areas. Therefore, it is important that the SFRA is adopted as a 'living' document and is reviewed regularly in light of emerging policy directives, flood risk datasets and an improving understanding of flood risk within the Borough.

9.3.3 The Level 1 SFRA may need to be reviewed and updated following amendments to:

- the predicted impacts of climate change on flood risk
- detailed flood modelling - such as from the Environment Agency or lead local flood authority
- the local plan, spatial development strategy or relevant local development documents
- local flood management schemes
- flood risk management plans
- shoreline management plans
- local flood risk management strategies
- national planning policy or guidance

9.3.4 **The SFRA should be reviewed after a significant flood event.**

# Appendix A Figures

Figure 1 Flood Map for Planning (Rivers and Sea)

Figure 2 Flood Modelling Outlines for the River Wandle

Figure 3A Risk of Flooding from Surface Water with Drainage Catchments

Figure 3B Risk of Flooding from Surface Water with CDAs

Figure 4 BGS Susceptibility to Groundwater Flooding & Groundwater Flooding Records

Figure 5A Internal Sewer Flooding Records

Figure 5B External Sewer Flooding Records

Figure 6 Flood Warning Areas

Figure 7 Surface water modelling Flood Depth 1% AEP

Figure 8 Surface water modelling Flood Hazard 1% AEP

Figure 9 Surface water modelling Flood Depth 0.1% AEP

Figure 10 Surface water modelling Flood Depth 0.1% AEP

# Appendix B Data Register



	Dataset	Source	Format	Description	Limitations	Map
Topography and Watercourses	LiDAR data (DTM, ASCII)	Defra Data Services Platform	GIS ASCII	The Environment Agency's LiDAR data archive contains digital elevation data derived from surveys carried out since 1998. The data has a spatial resolution of 2m.	None	
	Statutory Main Rivers	Defra Data Services Platform	GIS Layer	The Environment Agency Statutory Main Rivers Map is a spatial (polyline) dataset that defines statutory watercourses in England designated as Main Rivers by Environment Agency.	None	
	OS Rivers	Ordnance Survey Opendata	GIS Layer	The OS Open Rivers dataset identifies the location of freshwater rivers, tidal estuaries and canals.	Not all rivers may be mapped within this dataset	
Fluvial	Flood Map for Planning (Rivers and Sea) Flood Zones 2 and 3	Defra Data Services Platform	GIS Layer	This dataset covers Flood Zone 2 (1 in 1000-year flood risk, 0.1% AEP) and Flood Zone 3 (1 in 100 year, 1% AEP) and is the Environment Agency's best estimate of the areas of land at risk of flooding, when the presence of flood defences are ignored.	The information provided is largely based on modelled data and is therefore indicative rather than specific. Locations may also be at risk from other sources of flooding, such as high groundwater levels, overland run off from heavy rain, or failure of infrastructure such as sewers and storm drains. The information indicates the flood risk to areas of land and is not sufficiently detailed to show whether an individual property is at risk of flooding, therefore properties may not always face the same chance of flooding as the areas that surround them. This is because we do not hold details about properties and their floor levels.	Appendix A – Figure 1
	Spatial Flood Defences	Defra Data Services Platform	GIS Layer	The Environment Agency's Spatial Flood defences layer shows flood defences currently owned, managed or inspected by the EA.	No private flood defences are shown.	
Historic Flooding	Recorded Flood Outlines	Defra Data Services Platform	GIS Layer	A single GIS layer showing the extent of historic flood events created using best available information at time of publication.	Some of the data is based on circumstantial and subjective evidence. There is not always available metadata, e.g. date of flood event or type of flooding	Appendix A Figure 1
	Flooding incidents and enquiries	LB Croydon	GIS layer	A single GIS layer showing the locations in which HCC have records of flooding. These records have been categorised by the source of flooding	Not all sources of flooding are known.	

	Dataset	Source	Format	Description	Limitations	Map
Surface Water	'Risk of Flooding from Surface Water' dataset	Defra Data Services Platform	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.	Appendix A - Figure 3A & 3B
	Surface water modelling for Purley Cross and Caterham Drive CDAs	LB Croydon (Arcadis)	GIS Layers	Modelling outputs (flood depth and flood hazard ASC grids) for the 1% and 0.1% AEP events	This dataset does not show the susceptibility of individual properties to surface water flooding.	Appendix A Figure 7 -10
Sewer	Register of sewer flooding incidents, by post code area.	Thames Water	Excel Sheet	Indicates post code areas that may be prone to flooding as have experienced flooding in the last 10 years due to hydraulic incapacity.	It should be noted that these are flooding incidents that have been reported to TWUL by the homeowners. This will not account for any incidents that don't get reported and therefore do not show on the register. Incidents of sewer flooding can be retrospectively reported to TWUL via their website – <a href="http://thameswater.co.uk/help-and-advice/9782.htm">http://thameswater.co.uk/help-and-advice/9782.htm</a> .	Appendix A - Figure 5A & 5B
	GIS layer of post code boundaries	LB Croydon	GIS Layer	Delineates post code boundaries for the Borough. Enables mapping of Thames Water datasets which are provided by post code sector.	None	
Flood Warning and Flood Alert Areas	Flood Warning Areas	Defra Data Services Platform	GIS Layer	Indicates which areas are covered by the flood warning system.	None	Appendix A - Figure 6
	Flood Alert Areas	Defra Data Services Platform	GIS Layer	Indicates which areas are covered by Environment Agency flood alerts.	None	Appendix A - Figure 6
Planning	OS Mapping of London Borough of Croydon administrative area (OS District)	OS Open data	GIS Layer	Provides background mapping to other GIS layers. Designed for use at a district level scale.		Appendix A- All maps
	GIS layer of administrative boundary	OS Open data	GIS Layer	Defines the administrative area of the Borough for mapping purposes.		

