London Borough of Lewisham Strategic Flood Risk Assessment

Level 1 Report

October 2018

60580647

Quality information

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Executive Summary

The National Planning Policy Framework (NPPF) and accompanying Planning Policy Guidance (PPG) emphasise the responsibility of Local Planning Authorities (LPAs) to ensure that flood risk is understood and managed effectively and sustainably throughout all stages of the planning process.

This Level 1 Strategic Flood Risk Assessment (SFRA) aims to facilitate this process by identifying the spatial variation in flood risk across the London Borough of Lewisham (the 'Borough') thus allowing an area-wide comparison of future development sites with respect to flood risk considerations. There are several sources of flood risk across the Borough, including: fluvial, tidal, pluvial, groundwater, sewer and artificial. These are summarised below.

The Borough falls in the Ravensbourne Catchment, which encompasses all of the Borough but its northern tip. Fluvial flooding is largely associated with the River Ravensbourne and its main tributaries, the Pool River and the River Quaggy. North of Deptford Bridge the Ravensbourne becomes the tidal Deptford Creek, which meets the River Thames approximately 1 kilometre further north. Tidal defences are present along the banks of both the Thames and Deptford Creek, and there are associated residual tidal flooding risks in surrounding areas of the Borough.

The Environment Agency (EA) historic flood maps show significant flooding in the 1960s across the Ravensbourne Catchment, as well as a less severe flooding event of the Thames in 1928. There are now sections of formal and informal flood defences along the full length of the tidal Thames and parts of the Ravensbourne, which did not exist during the aforementioned recorded events. Nonetheless, fluvial flood risk still exists in several areas of the Borough, as indicated in the Flood Zone maps.

Surface water flooding occurs when high intensity rainfall generates runoff which flows and ponds in low-lying areas. It is generally associated with intense rain, saturated soils and an insufficient drainage capacity of the surface water system. Surface water flooding is becoming an increasing issue due to urban sprawl (increased impermeable area) and climate change (greater rainfall intensity). The Lewisham Surface Water Management Plan (SWMP) (2011) estimated a total of 2,228 properties at risk of surface water flooding, 327 of these to a depth of 0.5m or higher. Developers and planners must consider the use of Sustainable Drainage Systems (SuDS) in developments to mitigate this source of flood risk and minimise the impact of climate change. Priority should be given to storage of rainwater for later use and utilisation of infiltration SuDS in line with SuDS hierarchy as set out in Policy 5.13 of the current London Plan. The British Geological Survey (BGS) have prepared mapping based on the underlying geology indicating the suitability of land for the incorporation of infiltration SuDS.

Groundwater flooding occurs as a result of the water table reaching the ground surface. This is most likely to occur in low-lying areas which are underlain by permeable rock (aquifers) and more likely to appear after periods of sustained rainfall. Most of the highly permeable superficial deposits in Lewisham are located along the centre of the Borough, following the flood plains of the River Ravensbourne and River Quaggy. It should however be noted that no significant known issues with groundwater flooding have been identified in the Borough. The BGS have prepared mapping based on the underlying geology and aquifer locations indicating the susceptibility of land to groundwater flooding. This mapping should be utilised by developers and planners to ensure development in these areas carry out detailed ground investigation and consider the risk of groundwater flooding, particularly to basement development.

The Borough has a mix of separate and combined sewer systems. Sewer flooding can arise in the foul system when surface water enters via misconnection, or where the capacity of combined systems is exceeded. In both cases this results in surcharge of contaminated surface water. Thames Water records sewer flooding incidents by postcode area, and this gives an indication of sewer flood risk across the Borough.

The final source of flood risk is from reservoirs. There are no designated reservoirs within the Borough boundary; however, this does not mean to say there is no risk. As shown by the EA Reservoir maps, the flood extents for the Sutcliffe Park and Weigall Road Flood Storage Areas (Greenwich), the Nunhead covered reservoir (Southwark) and the Honor Oak covered reservoir (Southwark) show that should a failure occur then

parts of the Borough will be affected by flooding. However, the risk of failure is very low due to rigorous safety and inspection regimes in place for all designated reservoirs.

The Functional Floodplain (Flood Zone 3b) is land classified as having a 5% annual exceedance probability (AEP) (1 in 20 Year) of flooding. In Lewisham, both the River Ravensbourne and the River Quaggy have some extent of Functional Floodplain, notably near Ladywell and Lewisham Town Centre. The designated flood storage area on the Quaggy in the southeast of the Borough is also classified as Functional Floodplain.

A spatial planning solution to flood risk management should be sought wherever possible. The maps and supporting information presented in this SFRA are intended to inform and facilitate the decision making process by Lewisham Council ('Council') with regards to the NPPF risk-based approach to planning. This is based upon determining compatibility of various types of development within each flood zone, subject to the application of the Sequential Test and Exception Test (when needed). Guidance to undertaking these processes is included within the report.

The SFRA provides an overview of the risk of flooding across the Borough and assists in the development of policy formulation, strategic planning, development control and flood risk management. It is recommended that policy options are expanded to include greater emphasis on the management of surface water flood risk through the use of SuDS. The policies in the existing River Corridor Improvement Plan should be retained to ensure appropriate use of the floodplain and making space for water. Existing corridors of land along the river frontage should be safeguarded and opportunities taken to set back development to enable sustainable and cost effective flood risk management, including upgrading of river assets. Flood awareness and robust emergency planning and response will additionally be critical to sustainable ongoing flood risk management.

In the future, climate change is anticipated to have an impact on all sources of flood risk within the Borough. It is important that planning decisions recognise the potential risk that increased runoff poses to property and plan development accordingly so that future sustainability can be assured. The EA published updated climate change allowances in February 2016, which were used for the hydraulic models which define flood risk from the River Ravensbourne and its tributaries.

At the time of preparing this SFRA, the modelling has been partially completed for the River Ravensbourne and as such the 25% and 35% allowances for climate change have been included within this report. The 70% allowance for climate change for the River Ravensbourne will be prepared by the EA in the future and will be included within this report either as a revision or addendum when available.

The report additionally contains specific recommendations for both the Borough and local developers, for effectively managing and mitigating flood risk, including guidance on the requirements for site specific Flood Risk Assessments and the implementation of Sustainable Drainage Systems.

This Level 1 SFRA report will be complemented by further detailed assessment of the allocated development sites within the Borough, during the subsequent Level 2 SFRA.

Contents

Abbreviations

Acronym	Definition
AEP	Annual Exceedance Probability
BGS	British Geological Survey
CDA	Critical Drainage Area
CFMP	Catchment Flood Management Plan
DLR	Docklands Light Railway
EA	Environment Agency
FAS	Flood Alleviation Scheme
FCERM	Flood and Coastal Erosion Risk Management
FWMA	Flood and Water Management Act
FRA	Flood Risk Assessment
FWD	Flood Warnings Direct
GIS	Geographical Information Systems
KSL	Kent, South London and East Sussex Operational Region of the Environment Agency
LCDA	Local Critical Drainage Area
LFRMS	Local Flood Risk Management Strategy
LFRZ	Local Flood Risk Zone
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
m AOD	Metres Above Ordnance Datum. Elevations use Ordnance Datum, Newlyn
NPPF	National Planning Policy Framework
PFRA	Preliminary Flood Risk Assessment
PPG	NPPF Planning Practice Guidance
RBMP	River Basin Management Plan
RBD	River Basin District
RCIP	River Corridor Improvement Plan
RFRA	Regional Flood Risk Appraisal
SFRA	Strategic Flood Risk Assessment
SoP	Standard of Protection
SPG	Supplementary Planning Guidance
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan

TE2100	Thames Estuary 2100 Plan
TWUL	Thames Water Utilities Limited
WFD	Water Framework Directive

Glossary

Term	Definition
Annual Exceedance Probability (AEP)	In flood risk terms, the AEP represents the probability of a particular return period event occurring in any given year. (e.g. 1 in 100 year return period event = 1% AEP – there is a 1% chance every year that this event will take place).
Aquifer	A source of groundwater comprising water-bearing rock, sand or gravel capable of yielding significant quantities of water.
Areas Benefiting from Defences	The area that is protected by a defence or defence system against flooding from a 1% (1 in 100) annual probability fluvial event and 0.5% (1 in 200) annual probability tidal event, assuming all defences remain intact and function perfectly.
Blue-green infrastructure	Combining green spaces and surface water management infrastructure within the urban environment to facilitate natural hydrological processes whilst minimising flooding, enhancing biodiversity, facilitating recreation and assisting adaption to climate change.
Catchment	The land (and its area) which drains (normally naturally) to a given point on a river, drainage system or other body of water.
Catchment Flood Management Plan	A high-level planning strategy through which the Environment Agency works with key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Combined Sewer	Combined sewers are designed to collect surface water runoff, domestic sewage, and industrial wastewater in the same pipe.
Critical Drainage Area	A discrete geographic area where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding during severe weather, affecting people, property or local infrastructure.
Culvert	A channel or pipe that carries water below the level of the ground.
Exception Test	The Exception Test is required for certain development sites following application of the Sequential Test. The Exception Test must demonstrate that the development provides wider sustainability benefits to the community that outweigh flood risk, and that the site is safe from flood risk for its lifetime.
Flood Defence	Flood defence infrastructure, such as flood walls and embankments, intended to protect an area against flooding to a specified standard of protection (SoP).
Flood Map	A map produced by the Environment Agency providing an indication of the likelihood of flooding in all areas of England, assuming there are no flood defences.
Flood Resilience	Flood resilience involves design and construction of buildings and structures to reduce the impact of flooding so that, although flood water may enter the building, its impact is minimised, structural integrity is maintained, and repair, drying & cleaning are facilitated.

Term	Definition
Flood Resistance	Flood resistance involves design and construction of buildings or other structures to prevent entry of flood water or minimising the amount that may enter.
Flood Risk Assessment	A study to assess the risk to an area or site from flooding from all sources, now and in the future, and to assess the impact that any changes or development on the site or area will have on flood risk to the site and elsewhere. It may also identify, particularly at more local levels, how to manage those changes to ensure that flood risk is not increased.
Flood Risk Management	The activity of understanding the probability and consequences of flooding, and seeking to modify these factors to manage flood risk to people, property and the environment in line with agreed policy objectives.
Flood Warning	If a flood warning is issued in an area, it means flooding is expected and will cause disruption.
Flood Zone	A geographic area within which flood risk is within a particular range as defined by NPPF and its Practice Guidance.
Flood Zone 1	Land where flooding from rivers and the sea is very unlikely. There is less than a 0.1 per cent (1 in 1,000) chance of flooding occurring each year.
Flood Zone 2	Land which has between a one in 100 and one in 1,000 annual probability (chance) of river flooding (1% - 0.1%); or between a one in 200 and 1 in 1,000 annual probability (chance) of sea flooding (0.5% - 0.1%).
Flood Zone 3	Land which has a greater than one in 100 annual probability (chance) of river flooding (>1%); or greater than one in 200 annual probability (chance) of sea flooding (>0.5%).
Flood Zone 3a (High probability)	This is a subset of Zone 3 (above), which is not within the functional floodplain (Flood Zone 3b), as defined below. Therefore this land is typically expected to have an annual probability of flooding between 1 in 20 and 1 in 100 or (from fluvial sources) or 1 in 200 (from tidal sources) in any year.
Flood Zone 3b (Functional Floodplain)	Land where water has to flow or be stored in times of flood. Specifically, this land would flood with an annual probability of 1 in 20 (5 %) or greater in any year, or as otherwise agreed by the Local Authority and the Environment Agency.
Flooding Hotspot	Also known as flood prone areas. These are locations where concentrations of flooding incidents within a limited geographical context have appeared over time.
Floodplain	Area of land that borders a watercourse, an estuary or the sea, over which water flows in time of flood, or would flow but for the presence of flood defences where they exist.
Functional Floodplain	Refer to Flood Zone 3b definition.
Greenfield Runoff Rate	The greenfield runoff rate is the rate at which rainfall would runoff from an undeveloped, naturally permeable catchment.
Local Critical Drainage Area	A surface water catchment, defined in the Lewisham SWMP, which drains to a LFRZ. These are primarily related to surface water flooding and do not meet the standard for listing as a CDA by the EA.

Term	Definition
Main River	A watercourse designated on a statutory map of Main Rivers, maintained by DEFRA, on which the Environment Agency has permissive powers to construct and maintain flood defences.
National Planning Policy Framework	The NPPF is a framework which aims to simplify and accentuate accessibility on current policy in planning of development of an area, particularly for local planning authorities and decision makers.
Ordinary Watercourse	All rivers, streams, ditches, drains, cuts, dykes, sluices, sewers (other than public sewers) and passages through which water flows which do not form part of a Main River. Local authorities and, where relevant Internal Drainage Boards, have similar permissive powers on Ordinary Watercourses as the Environment Agency has on Main Rivers.
Overtopping	The process of water rising over the top of a barrier intended to contain it (e.g. sea defence).
Pathway	A route that enables a hazard to move from a 'source' to a 'receptor', as in the 'source-pathway-receptor' concept. A pathway must exist in order for a hazard to be realised. Pathways can be constrained in order to mitigate the risks.
Planning Policy Guidance	This document provides additional technical guidance to ensure the effective implementation of the planning policy set out in the National Planning Policy Framework.
Reservoir	A large raised structure, raised lake or other area capable of storing at least 25,000 cubic metres of water above natural ground level, created artificially or enlarged. This is defined by the Reservoirs Act, 1975.
Residual risk	The risk which remains after all risk avoidance, reduction and mitigation measures have been implemented.
Return Period	The long-term average period between events of a given magnitude which have the same annual exceedance probability of occurring.
Run-off	The flow of water from an area caused by rainfall.
Section 19	Refers to Section 19 of the FWMA, which gives LLFAs the responsibility to investigate and report on the causes of significant flood events within their boundaries.
Sequential Test	The aim of the sequential test is to steer new development toward areas with the lowest probability of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for that development in areas of lower probability of flood risk.
Site Allocation	Location identified by the Local Planning Authority as likely to experience change or development in the short to medium term.
Standard of Protection	The design event or standard to which a building, asset or area is protected against flooding, generally expressed as an annual exceedance probability.
Strategic Flood Risk Assessment	An area-wide study, undertaken by one or more local authorities, to assess the risks that all sources of flooding poses to a Borough or District, both now and in the future. It incorporates the impacts of further land changes and climate change in the development of an area and if these factors impact the risk of flooding.
Surface Water Flooding	In this context, surface water flooding describes flooding from sewers, drains, groundwater, and runoff from land, small water courses and ditches that occurs as a result of heavy rainfall.

Term	Definition
Sustainability Appraisal	An integral part of the plan-making process which seeks to appraise the economic, social and environmental effects of a plan in order to inform decision-making that aligns with sustainable development principles.
Sustainable Drainage Systems	A sequence of management practices and control structures, often referred to as SuDS, designed to drain water in a more sustainable manner than some conventional techniques.
TE2100	The Thames Estuary 2100 plan outlines how the Environment Agency is planning to manage tidal flood risk in the Thames estuary until the year 2100.
Tidal Surge	A local high rise in sea level caused by climatic conditions, creating wind and low atmospheric pressure. Tidal flooding is of greatest risk when tidal surges combine with high tides.
Vulnerability Classes	NPPF provides a vulnerability classification to assess which uses of land may be appropriate in each flood risk zone.

1 Introduction

1.1.1 The National Planning Policy Framework (NPPF) and accompanying Technical Guidance emphasise the responsibility of Local Planning Authorities (LPAs) to ensure that flood risk is understood and managed effectively using a risk-based approach throughout all stages of the planning process. As such, LPAs are required to undertake Strategic Flood Risk Assessments (SFRAs) to support the preparation of their Local Plan.

1.1.2 AECOM has been commissioned by the London Borough of Lewisham ('Council') to review and revise the Strategic Flood Risk Assessment (SFRA) for the Borough, which was originally completed in 2008 and updated in 2015. The methodology followed in the study has been designed to comply with the NPPF and the accompanying Technical Guidance as well as guidelines from the Environment Agency (EA). The SFRA has been carried out in collaboration with a range of officers from the Council, the EA and Thames Water Utilities Limited (TWUL). The results of this assessment are described in this report and are intended to inform strategic land use planning and decision making, from a flood risk perspective.

1.2 SFRA Aims and Objectives

1.2.1 The aim of this SFRA is to collate and analyse the most up-to-date flood risk information from all sources, to provide an overview of flood risk issues across Lewisham. The resulting report and mapping is intended to be used by the Council as evidence to inform the emerging Local Plan, ensuring flood risk is taken into account when considering development options and in the preparation of strategic land use policies. The Council plans to consult on its proposed submission Draft Local Plan at the start of 2019 in accordance with Regulation 19 of the Town and Country Planning (Local Planning) (England) Regulations 2012. This is intended to be the final statutory consultation before being submitted to the Secretary of State for independent examination.

1.2.2 In addition to providing an evidence base to support the Local Plan, the SFRA will enable the Council to:

- Determine the spatial variations in flood risk from all sources across the Borough;
- Prepare broad policies for the management of flood risk;
- Steer development towards areas of lowest flood risk, through the application of the Sequential Test and, where necessary, the Exception Test;
- Assist the decision making process on flood risk issues;
- Consider opportunities to reduce flood risk to existing communities through better management of surface water, provision for conveyance and storage for flood water;
- Identify the level of detail required for site-specific Flood Risk Assessments; and
- Determine the acceptability of flood risk in relation to emergency planning capability.

1.2.3 Based upon EA guidance, the key objectives of this SFRA are to:

- Provide maps showing the LPA area including main rivers, ordinary watercourses and flood zones, including the functional floodplain (defined by the 5% AEP (1 in 20 Year)) flood event;
- Assess and map the distribution of flood risk from all sources across the Borough, including an assessment of the potential implications of climate change;
- Identify relevant flood risk management measures, including the location and standard of infrastructure and the coverage of flood warning systems;
- Undertake an appraisal of the current condition of flood assets and likely future flood management policy;
- Provide advice on the preparation of site-specific flood risk assessments for sites of varying risk across the flood zones, including information about the use of sustainable drainage techniques;

- Identify policies and practices required to ensure development satisfies the Exception Test;
- Provide meaningful recommendations to inform policy, development control and technical issues; and
- Provide advice on appropriate mitigation measures, including the likely applicability of sustainable drainage system techniques for managing surface water run-off.

1.2.4 It is intended that this Level 1 SFRA report will be complemented by further detailed assessment of the allocated development sites within the Borough in a Level 2 SFRA.

1.3 Using this SFRA

1.3.1 This SFRA is broadly divided into 6 sections, as described below:

- *Chapter 1* (this chapter) includes an overview of the aims and objectives of the updated SFRA, provides contextual background information about the Borough and summarises the methodology used to undertake this assessment;
- *Chapter 2* provides a brief overview of the legislative as well as national, regional and local planning policy context relevant to the Borough and referenced in the preparation of this SFRA;
- *Chapter 3* presents a broad overview of flood risk from all sources across the Borough, including flood history and the anticipated impact of climate change;
- *Chapter 4* summarises the NPPF risk-based approach to managing flood risk through planning, including step-by-step guidance on the application of the Sequential Test and the Exception Test. This is followed by specific recommendations to inform local planning policy, development control and emergency planning;
- *Chapter 5* provides guidance to developers in undertaking site-specific flood risk assessments and measures available for appropriately managing and mitigating flood risk; and
- *Chapter 6* summarises the key findings of the SFRA, including the primary recommendations for flood risk management in Lewisham.

1.3.2 A number of appendices are also attached within this SFRA, as summarised below:

- *Appendix A* contains mapping summarising contextual information for Lewisham and illustrating the spatial variability of flood risk across the Borough;
- *Appendix B* provides more detailed information on commonly used SuDS techniques and their applicability;
- *Appendix C* provides a summary of the datasets collated throughout the SFRA preparation and describes each of the datasets contained within the SFRA maps; and
- *Appendix D* summarises the key aspects to be considered to ensure that the SFRA is kept up-to-date.

1.3.3 While it is generally recommended that this SFRA be considered holistically, the key sections deemed to be most relevant to various parties are summarised below.

Development Control

1.3.4 A key objective of the SFRA is to collate, assess and map all forms of flood risk across the Borough and use this information to steer new development towards areas of lowest flood risk, through the Sequential Test process. The spatial distribution of different sources of flood risk across the Borough is illustrated in the mapping contained in Appendix A, and further described in Chapter 3. These sections will provide a broad indication of the sources of flood risk impacting on any potential development sites, and the flood zone in which they are situated.

1.3.5 Chapter 4 summarises the Sequential Test process to be followed when establishing the compatibility of certain developments types within each flood zone, describing how the mapping and associated information should be used to assess planning applications.

Strategic Planning

1.3.6 The maps contained within Appendix A illustrate the spatial distribution of flood risk across the Borough, and are intended to inform strategic land use planning and development allocation. Greater detail on each source of flood risk is contained in Chapter 3.

1.3.7 Chapter 4 provides an overview of the NPPF risk based approach to sequential planning, which should inform development planning and site allocations. This is followed by specific recommendations for managing flood risk across the Borough, intended to inform planning policy, development control and emergency planning.

Guidance for Developers

1.3.8 When considering proposed development, it is recommended that developers refer to the mapping contained in Appendix A to obtain an overall understanding of the different sources and level of flood risk which may affect their site. Further detail on any relevant sources of flooding can be found in Chapter 3.

1.3.9 Chapter 5 provides detailed guidance in undertaking site-specific flood risk assessments, depending on the Flood Zone and the type of development. This chapter also describes common measures which are available for appropriately managing and mitigating flood risk. Further detail on the applicability and use of different types of SuDS is provided in Appendix B.

1.3.10 Developers should also refer to Chapter 4 in order to understand the compatibility between different types of development and levels of flood risk, and how the Sequential Test will be used by the Council to assess planning applications.

1.4 Study Area

Location

1.4.1 The study area is defined by the administrative boundary of the London Borough of Lewisham, illustrated on Map 001, Appendix A. The Borough covers an area of approximately 35 km^2 and lies in the south east of Inner London. The Borough is bordered by the Royal Borough of Greenwich to the east, the London Borough of Bromley to the south, and the London Borough of Southwark to the west. The Borough is also bordered by the London Borough of Tower Hamlets, across the River Thames to the north.

1.4.2 The Borough falls in the Ravensbourne Catchment, which encompasses the entire Borough aside from the northern tip, which drains to the tidal River Thames. The Borough fronts the River Thames for approximately 1km in the north. The Main Rivers in the Borough are shown on Map 001, Appendix A, and listed below:

- The Pool River (southwest)
- The Ravensbourne (north-south through Borough)
- River Quaggy (southeast and northeast)
- Deptford Creek (north)

1.4.3 The Borough lies within the Thames River Basin District (RBD) and is covered generally by the Thames RBD River Basin Management Plan[1] (RBMP) and by the Thames Catchment Flood

[1] Department for Environment, Food and Rural Affairs and the Environment Agency; Thames river basin district river basin management plan; February 2016; Accessible at: https://www.gov.uk/government/publications/thames-river-basin-district-river-basin-management-plan

Management Plans (CFMP)[2].It is located in the Environment Agency's Kent, South London and East Sussex (KSL) Operational Region.

1.4.4 The public sewer provider is TWUL. The majority of the Borough has a combined sewer system. Some areas in the southeast of the Borough have a separate sewer system, with the majority of surface water sewers in these areas discharging directly to Main Rivers. The sewer system in the Borough is shown in map 006, Appendix A.

Land Use

1.4.5 Part of Inner London, Lewisham is an economically buoyant Borough. It is largely built up, with some significant areas of open space throughout.

1.4.6 The population of the Borough was 275,885, in 2011[3]. The main urban centres are Lewisham and Catford. District hubs have also been identified by the Council in Deptford, New Cross, Forest Hill, Sydenham, Lee, and Blackheath. They are defined as concentrations of local economic activity, supported by good public transport.

1.4.7 The Borough currently does not have any London Underground stations; however Transport for London is currently in consultation to decide whether to extend the Bakerloo line to Lewisham[4]. The Borough does have significant rail routes, with stations operated by London Overground, Docklands Light Railway (DLR), Thameslink, Southeastern, and Southern. The A2, A20 and A205 cross the Borough west-to-east.

Topography

1.4.8 The general topography of Lewisham is illustrated on Map 002, Appendix A.

1.4.9 The highest points of Lewisham are in the southwest and southeast of the Borough. In the southwest, Upper Sydenham and Forest Hill sit between approximately 100 m AOD and 110 m AOD. In the southeast, ground elevation reaches approximately 70 m AOD in the Grove Park area. The rest of the Borough is much lower, sitting at approximately 30 m AOD on average, with shallow valleys following the river paths. In the northernmost area, near the River Thames, the ground level reduces significantly to around 5 m AOD.

River Network

1.4.10 The River Network within the Borough is illustrated on Map 001, Appendix A.

1.4.11 The Borough lies predominantly in the Ravensbourne Catchment. The **River Ravensbourne** flows northwards through the Borough, from Beckenham Place Park to Deptford Bridge, at which point it becomes the tidal **Deptford Creek**. Deptford Creek joins the River Thames approximately 1 kilometre north of Deptford Bridge. The Ravensbourne has a number of tributaries in the Borough, and these are described in more detail below.

1.4.12 The **Pool River** flows northwards from the London Borough of Bromley and through Sydenham. It joins the River Ravensbourne in Catford, approximately 1.5 km north of the Borough boundary.

1.4.13 The **River Quaggy** first enters the Borough in its south-eastern corner, before flowing north through the Royal Borough of Greenwich. It then re-enters the Borough near Lee Green Post Office and joins the River Ravensbourne in Lewisham Town Centre.

[2] Environment Agency Thames Catchment Flood Management Plan; December 2009; Accessible at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/293903/Thames_Catchment_Flood_Management_Plan.pdf
[3] Office for National Statistics Census Data for Population; 2011; Accessible at: https://www.ons.gov.uk/census/2011census
[4] Bakerloo Line Extension; Accessible at: https://tfl.gov.uk/corporate/about-tfl/how-we-work/planning-for-the-future/bakerloo-line-extension

1.4.14 A tributary of the River Quaggy, the **Quaggy Hither Green,** rises in Hither Green and joins the Quaggy 1 km downstream. It is culverted for its full length.

1.4.15 **Spring Brook**, rises south of Shaftesbury Park in the London Borough of Bromley, and runs as an open watercourse through the park. North of Shaftesbury Park it enters the Borough, continuing as an open watercourse for approximately 800 m alongside a series of playing fields. Spring Brook enters a culvert near the junction of Downham Way and Bromley Road, and this culvert ultimately connects to the River Ravensbourne. The culvert is shown on Thames Water asset maps and is understood to be a public sewer.

1.4.16 The **Ravensbourne Honor Oak**, (also Honor Oak Stream or Chudleigh Ditch), is an isolated section of Main River running parallel to Chudleigh Road in Ladywell. The Ravensbourne Honour Oak enters a culvert just south of Ladywell Road, and this culvert is thought to ultimately drain to the River Ravensbourne to the north of Council's Wearside Depot. The culvert is shown on Thames Water asset maps and is understood to be a public sewer.

Geology

1.4.17 The underlying geology across Lewisham can be examined on the BGS online geology viewer[5].

Bedrock

1.4.18 The southern half of the Borough is underlain by the London Clay Formation, which is predominantly clay and silt, with the exception of the southernmost tip near Beckenham. This area and most of the northern half of the Borough are underlain by ribbons of Lambeth Group formed of clay, silt and sand; and ribbons of Thanet Formation formed of sand, silt and clay. There is also some extent of White Chalk Subgroup beneath some parts of Deptford and Lewisham.

Superficial Deposits

1.4.19 The majority of the Borough is not overlain with superficial deposits and bedrock would be encountered immediately below made ground. Areas along the River Ravensbourne, the River Quaggy, and the Pool River are overlain with Kempton Park Gravel Member, which is formed of sand and gravel. Additionally, small areas of undifferentiated Alluvium Deposits are found along the River Ravensbourne and the Pool River. These two layers extend closer to the Thames. Isolated pockets of Head Deposit made of clay, silt, sand, and gravel can be found throughout the Borough.

1.5 Methodology and Approach

1.5.1 This SFRA is a desk-based study undertaken using readily available information and existing datasets to enable the assessment of flood risk across the Borough. The information is presented in a suitable graphical format to facilitate the decision making process by the Council. The SFRA will be used to inform the application of the Sequential Test to local development sites and to identify if any require the application of the Exception Test.

1.5.2 The main activities undertaken in the preparation of this SFRA are summarised below:

- Organise and attend an inception meeting with the Council as well as a steering group meeting with key stakeholder organisations to establish the main objectives of the study (from each organisation's perspective), aid collaborative working and discuss available information and datasets;
- Liaise with the Council to request relevant datasets and information from stakeholders;
- Interrogate received data and review against the objectives of the SFRA to identify any gaps in the required information;

[5] BGS Online Geology Viewer; Accessible at: https://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html

- Consult with key stakeholders to agree approach, and define datasets to be included within the SFRA;
- Assess flood risk from all sources, including sea, rivers (fluvial), land (overland flow and surface water), groundwater, sewers and artificial sources; and
- Produce strategic flood risk maps, GIS deliverables and a technical report.

1.5.3 The key datasets selected for inclusion within this SFRA are summarised in Appendix D.

Consultation

1.5.4 The following stakeholders were engaged to provide data and information during this SFRA.

- *Lewisham Council* **–** The Council is the Local Planning Authority, with responsibility for strategic planning of future development, determination of planning applications and emergency planning, as well as development control within the Borough. Additionally, the Council have a role as the Lead Local Flood Authority, responsible for leading the management of flood risk from surface water, groundwater and ordinary watercourses. In particular, officers responsible for the areas of Strategic Planning, and Flood Risk and Drainage were closely involved in the preparation of this SFRA.
- *Environment Agency* **–** The EA is responsible for taking a strategic overview of the management of all sources of flooding and erosion. The Borough falls entirely in the Environment Agency's KSL Operational Region. The EA has discretionary powers under the Water Resources Act (1991) for all Main Rivers and their associated flood defences.
- *Thames Water Utilities Limited* **–** TWUL is responsible for management of the sewer system across the Borough. This includes managing the risk of flooding from surface water, foul and combined sewer systems. In addition, private individuals may be responsible for drainage systems that operate prior to discharge either into a watercourse or into a public sewer.

1.5.5 There are a number of other organisations that play a role in effectively managing flood risk across the Borough. These include The Greater London Authority, Neighbouring London Boroughs, the London Fire Brigade, Network Rail, Transport for London, the Highways Agency and Natural England, among others.

2 Legislative and Planning Policy Framework

2.1.1 This section provides a brief overview of the legislative and national, regional and local planning policy context relevant to the Borough and referenced in the preparation of this SFRA. Hyperlinks providing further detail on each of the described documents are contained in the footnote references where possible.

2.2 National Policy

Flood and Water Management Act (2010)

2.2.1 The Flood and Water Management Act (FWMA)[6] was enacted in 2010, with the intention of enabling the provision of more comprehensive and effective flood risk management. The act formalises flood risk management responsibilities across a range of organisations including the EA, water companies and highways authorities, and requires cooperation across all groups. Local authorities, including Lewisham Council, are designated as Lead Local Flood Authorities (LLFA), with responsibility to lead and co-ordinate local flood risk management. As such, the Council's responsibilities include:

- Coordinate management of flooding from surface water, ground water and ordinary watercourses;
- Develop, maintain and implement Flood Risk Management Strategies;
- Investigate and record local flood events; and
- Establish and maintain a Flood Risk Asset Register.

2.2.2 The Act further required the preparation of a number of other studies and strategies, as described in the following sections.

National Strategy for Flood and Coastal Erosion Risk Management

2.2.3 In accordance with the Act, the EA has developed a National Strategy for Flood and Coastal Erosion Risk Management (FCERM) in England[7]. Developed around the notion of understanding risks, empowering communities and building resilience, this Strategy provides a framework for the work of all flood and coastal erosion risk management authorities.

Flood Risk Regulations

2.2.4 As well as the duties under the FWMA, the Council have legal obligations under the EU Floods Directive, which was transposed into UK Law through the Flood Risk Regulations 2009 ('the Regulations')[8].

2.2.5 The regulations set out duties for the EA and LLFAs in the preparation of a range of studies and mapping outputs. As such, the Council is required to produce a Preliminary Flood Risk Assessment (PFRA), Flood Risk Maps showing the extents and hazards of flooding in their area and Flood Risk Management Plans. These studies are summarised in the following sections.

[6] Flood and Water Management Act; 2010; http://www.legislation.gov.uk/ukpga/2010/29/contents
[7] National Flood and Coastal Erosion Risk Management Strategy for England; May 2011; https://www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england
[8] Flood Risk Regulations; 2009; http://www.legislation.gov.uk/uksi/2009/3042/contents/made

National Planning Policy Framework and Guidance

2.2.6 The NPPF[9] was published in July 2018, and presents a structure and context for planning within England, providing a framework for local authorities and residents to produce local and neighbourhood plans that reflect the needs and priorities of their communities. The Planning Practice Guidance[10] (PPG) supports the framework and is published online and regularly updated.

2.2.7 As part of the three overarching objectives of NPPF, set out in Paragraph 8, it is stated that the planning system should, amongst other things: "Contribute to protecting and enhancing our natural, built and historic environment, including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change (…)."

2.2.8 Section 14 of the NPPF, titled 'Meeting the challenge of climate change, flooding and coastal change', establishes the principles for assessing and managing flood risk through the planning and development process, and is supported by the Flood Risk and Coastal Change PPG.

2.2.9 The overall approach of the NPPF to flood risk is broadly summarised in Paragraph 163:

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

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

b) the development is appropriately flood resilient and resistant;

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

d) any residual risk can be safely managed; and

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

2.2.10 This is achieved by delineating the probability of flooding in any area into three main Flood Zones, as defined in Table 1 of the Flood Risk and Coastal Change PPG. Flood Zone 3 is additionally delineated into Flood Zone 3a (high probability area) and Flood Zone 3b (the functional floodplain, where water has to flow or be stored in times of flood). Each of these Flood Zones is described in Table 2-1.

[9] The NPPF; 2018; https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/740441/National_Planning_Policy_Framework_web_accessible_version.pdf

[10] The PPG; 2014; https://www.gov.uk/government/collections/planning-practice-guidance

Table 2-1 - *Flood Zone Definitions (as defined in the NPPF)*

Flood Zone	Definition	Probability of Flooding
Flood Zone 1	At risk from flood event greater than the 1 in 1,000 year event (greater than 0.1% annual probability of flooding each year).	Low Probability
Flood Zone 2	At risk from a tidal flood event between the 1 in 200 and 1 in 1,000 year event (between 0.5% and 0.1% annual probability of flooding each year), or a fluvial flood event between the 1 in 100 and 1 in 1,000 year event (between 1% and 0.1% annual probability of flooding each year).	Medium Probability
Flood Zone 3a	At risk from a tidal flood event less than or equal to the 1 in 200 year event (greater than 0.5% annual probability of flooding each year), or a fluvial flood event less than or equal to the 1 in 100 year event (greater than 1% annual probability of flooding each year).	High Probability
Flood Zone 3b	At risk from a flood event less than or equal to the 1 in 20 year event or otherwise agreed between the Local Planning Authority and the Environment Agency.	Functional Floodplain

2.2.11 Each LPA is responsible for preparing an SFRA to inform the allocation of development sites within their administrative areas in accordance with their established Sustainability Appraisal. The policy levels of this process in the context of flood risk and the position of the SFRA within the planning framework are shown in Figure 2-1 below.

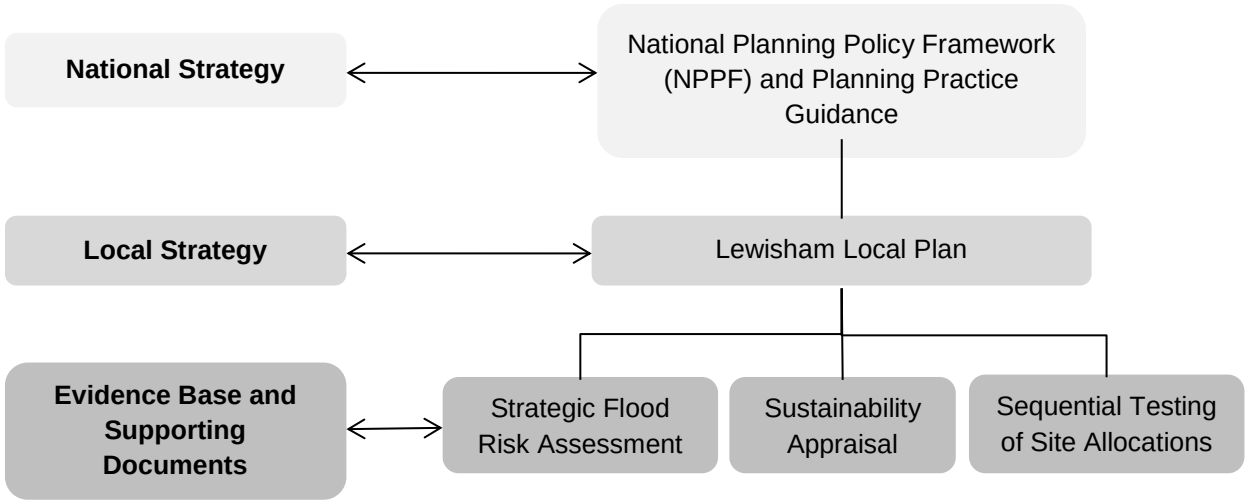


Figure 2-1*: Overview of Policy Levels and Documents in the context of Flood Risk*

2.2.12 Further detail regarding the application of the Sequential and Exception Tests is included in Section 4.1.

2.3 Regional Flood Risk Policy

London Plan

2.3.1 The London Plan[11], last updated in January 2017, is the core planning and development guidance document for all of Greater London. Flood risk is considered in the London Plan under the section dealing with response to climate change. Policy 5.12 requires developers to follow the guidance of NPPF, TE2100 and the SFRA in undertaking a site specific flood risk assessment. Policy 5.13

[11] The current London Plan; 2016; https://www.london.gov.uk/what-we-do/planning/london-plan/current-london-plan

requires developers to follow the SuDS hierarchy when devising surface water management strategies, ensuring where possible surface water is attenuated and stored at source. A key recommendation is that all developments should aim to achieve greenfield runoff rates where possible.

2.3.2 Supplementary Planning Guidance (SPG) has been published to provide further guidance on policies within the London Plan, which cannot be addressed in sufficient detail within the main plan. The SPG for Sustainable Design and Construction was published in April 2014[12], and provides further practical detail on flood risk and sustainable drainage.

2.3.3 To ensure clarity for stakeholders, it is important that Council's local policy is aligned with the minimum recommendations of the London Plan, particularly with respect to SuDS requirements.

2.3.4 The New London Plan[13] is a broad new plan to shape the way Greater London develops over the next 20 to 25 years. It is currently available in draft and is a material consideration in planning decisions. Policies related to flood risk and sustainable drainage are retained with some changes. A new policy 'Protecting London's Waterways' has been added, which amongst other things encourages deculverting and restoration of rivers.

London Regional Flood Risk Appraisal

2.3.5 The latest draft of the London Regional Flood Risk Appraisal (RFRA) was released for public consultation in December 2017, providing underpinning evidence to the New London Plan. The RFRA provides a broad overview of the different types of flood risk in London and addresses its probability and consequences. It also provides a spatial analysis of tidal, fluvial and surface water flood risk against major receptors of flood risk. For all identified areas, the RFRA includes potential mitigation measures and raises relevant flood risk issues to be addressed locally.

Thames Catchment Flood Management Plan

2.3.6 The Borough (and the wider Ravensbourne catchment) lies fully within the boundary of the Thames Catchment Flood Management Plan[14]. The plan was published by the EA in December 2009, and is one of the overarching flood risk management policy documents for the Thames River Basin. It provides an overview of flood risk within the catchment and presents the EA's key strategic policy for sustainable flood risk management over the next 50 to 100 years.

2.3.7 According to the Thames CFMP there are between 2,000 and 5,000 properties in the Borough at risk of flooding in a 1% AEP fluvial flood from the River Thames. Lewisham falls within Sub-area 9 of the Thames CFMP which is labelled 'London Catchments'. The preferred policy for this area of the catchment is Policy option 4: *'Areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change.'*

Thames Estuary 2100 Plan

2.3.8 The Environment Agency's Thames Estuary 2100 Plan (TE2100)[15] was last updated in March 2017, and is the overarching flood risk management policy document for the tidal River Thames and its associated floodplain. It provides a plan for improving the tidal flood defence system for the period 2005 to 2100, so that current standards of flood protection are maintained or improved taking account of sea level rise. The north-western part of the Borough is protected from tidal flooding by a system of tidal defences, which are within the TE2100 project area.

[12] Supplementary Planning Guidance for Sustainable Design and Construction; 2014; https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/supplementary-planning-guidance/sustainable-design-and
[13] The New London Plan; August 2018; https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/download-draft-london-plan-0
[14] Thames Catchment Flood Management Plan; December 2009; https://www.gov.uk/government/publications/thames-catchment-flood-management-plan
[15] Thames Estuary 2100 Plan; March 2017; https://www.gov.uk/government/publications/thames-estuary-2100-te2100

2.3.9 TE2100 indicates that the present system of flood risk management for tidal flooding can continue to afford an acceptable level of risk management until much later in the century, provided high standards of maintenance and operation are maintained. These include major repairs to flood defences that will come to the end of their design life during the period 2030 to 2060. The plan sets out recommendations and a timeline for these.

2.3.10 The defended tidal floodplain in the Borough is covered by TE2100 action zone 2 'Central London'. The recommended actions for this zone include:

- To use the Plan to inform the development and revision of local council SFRAs and flood plans;
- To agree a programme of floodplain management including plans for vulnerable key sites;
- To agree partnership arrangements and principles to ensure that new development in the tidal flood risk area is safe, and where possible applies the NPPF to reduce the consequences of flooding;
- To maintain, enhance or replace the river defence walls and active flood control structures;
- To implement a programme of defence raising through central London in 2065; and
- To agree a programme of managing flooding from other sources in the defended tidal floodplain.

2.3.11 Action zone 2 is further subdivided into policy units; the Borough falls within the Wandsworth to Deptford policy unit. TE2100 policy 5 applies to this policy unit: "to take further action to reduce the risk of flooding (now or in the future)". This policy advocates an increase in the level of flood protection from the current 1 in 1,000 year level to 1 in 10,000 year; justified by the unique commercial, economic and historic value of London, as well as the potential loss of life in the unlikely event of an extreme flood event.

Thames River Basin District Flood Risk Management Plan

2.3.12 Under the EU Floods Directive and UK Flood Risk Regulations, the EA is required to prepare FRMPs for all of England covering flooding from main rivers, the sea and reservoirs. The updated Thames River Basin District FRMP[16] was published by the EA in March 2016, setting out the proposed measures to manage flood risk within the District from 2015 to 2021 and beyond. The measures in the Thames FRMP have been formulated in line with agreed social, economic and environmental objectives and are grouped under 4 categories, summarised below.

- Preventing risk
  - Working with local planning authorities to ensure development takes place in the areas with the lowest risk of flooding;
  - Maintaining existing flood defences so that they continue to protect properties in future; and
  - Carrying out a prioritised programme of mapping and modelling to ensure flood risk information remains up to date and fit for purpose.
- Preparing for risk:
  - Working with communities to help them understand their risk and how to prepare effectively, improving emergency response; and
  - Continuing to invest in improving real-time data and information to provide a quality flood warning service.
- Protecting from risk:
  - Reducing the likelihood of flooding affecting people and property in specific locations or in locations that have flooded in the past; and

[16] Thames River Basin District Flood Risk Management Plan; March 2016; https://www.gov.uk/government/publications/thames-river-basin-district-flood-risk-management-plan

- Continuing to maintain watercourses that pose the most significant flood risk, responding quickly to incidents and clearing obstructions from screens and culverts during heavy rainfall.

- Recovery and review:
  - Continuing to carry out investigations after flooding, produce recommendation reports and help communities to recover from floods more quickly.

Thames River Basin Management Plan

2.3.13 The Thames River Basin District Management Plan[17] was updated in 2015, and has been prepared under the European Water Framework Directive. The plan describes the river basin district, the pressures impacting the state of the water environment, and proposed actions to address these. The Main Rivers within the Borough are covered by one catchment within the plan: the Ravensbourne catchment.

2.3.14 The plan highlights several water management issues across the Basin, including physical river modification, flow regulation, and a lack of natural river processes. This has led to a loss of habitat diversity, and barriers for fish migration throughout the catchment. Water quality is also a significant issue across the catchments, with pollution pressures due to increased surface water run-off, storm sewage overflows, misconnections and effluent discharge. Specifically in the Ravensbourne catchment, the priority management issues are the physical modifications made to the river, diffuse pollution from urban areas and point-source pollution of sewage.

2.3.15 The plan identifies a series of actions to assist in improving water body status by addressing the water management issues highlighted. The key flood and drainage management actions for the Ravensbourne catchment are:

- Reducing the flooding impact of heavy rain in the urbanised catchment along with improving water quality through a SuDS project funded by the EA.
- An EA investigation into the causes of urban diffuse pollution in the River Ravensbourne. There will also be a hotline number to the EA and Thames Water for reporting pollution, misconnections and incidents.
- The EA will work with partners to re-naturalise the River Ravensbourne, by removing or modifying weirs along its length.
- The plan will address the key pressures in the catchment, and those waters in the worst state will be prioritised.

2.3.16 The Thames River Basin Management Plan clearly states the responsibility for local government to consider the impact on water quality of new development during decisions on planning policies.

2.3.17 The overall status of the waterbodies within the Ravensbourne catchment can be found in Table 2.2. Under the WFD, the EA assigns waterbodies an overall rating of bad, poor, moderate, good or high, reflecting both their ecological and chemical status. The default objective of this Plan is for water bodies to achieve ‘good’ status by 2021. The objective for the Ravensbourne is to achieve a ‘good’ overall status by 2027.

[17] Thames River Basin District River Basin Management Plan; December 2015; https://www.gov.uk/government/publications/thames-river-basin-district-river-basin-management-plan

***Table 2-2** Overall water status for waterbodies in Ravensbourne Catchment*[18]

Water Body	Overall Status (2016)
Pool River	Moderate
Quaggy	Moderate
Water Body	**Overall Status (2016)**
Ravensbourne (Catford to Deptford)	Moderate
Ravensbourne (Keston to Catford)	Bad

2.4 Local Planning Policy and Flood Risk Strategies

New Local Plan

2.4.1 The Council is currently in the process of setting out the new Local Plan, which will set out the planning strategy for growth over the next 15 years (2018 to 2033). It will contain strategic as well as detailed policies to assess local planning applications together with a policies map and specific site allocations. Policies and site allocations are still being developed, with Council aiming to consult on the final version of the plan in the first quarter of 2019.

2.4.2 Several aspects of the initial consultation document for the new Local Plan[19],put forward for consultation in October 2015, address flood risks in the Borough:

- The varied network of open spaces and parks throughout Lewisham is important for flood protection and improving water quality; therefore, they should be protected.
- The new Local Plan will continue to ensure adequate protection and restoration of all watercourses in the Borough.
- The new Local Plan acknowledges that some parts of the Borough fall within areas of flood risk. Despite most of the Borough being protected by flood defences, other sources such as groundwater flooding and surface water flooding can put properties and infrastructures at risk. Therefore, the new Local Plan will ensure that risk of flooding is considered for new development and that opportunities to re-naturalise the Borough's watercourses are maximised.

2.4.3 As part of the adopted Local Development Framework, which will be replaced by the new Local Plan, supplementary planning documents have been produced including the **River Corridor Improvement Plan**[20] (RCIP). This plan has been informed by the Water Framework Directive (WFD) and other relevant European, national and local policies. Objectives of the RCIP relevant to this SFRA are:

- Protect and enhance the biodiversity and landscape value of the rivers in Lewisham;
- Provide coordinated guidance for development adjacent to the London Borough of Lewisham's rivers, promoting regeneration and ensuring design is responsive to and makes the most of opportunities to enhance the river environment;
- Promote the sustainable and efficient use of space by protecting and enhancing the multifunctional nature of the Ravensbourne, Quaggy and Pool Rivers, Deptford Creek and the River Thames; and
- Promote opportunities to manage flooding.

[18] Ravensbourne Operational Catchment; http://environment.data.gov.uk/catchment-planning/OperationalCatchment/3369

[20] River Corridor Improvement Plan; September 2015; https://www.lewisham.gov.uk/myservices/planning/policy/LDF/SPDs/Pages/River-corridor-improvement-plan.aspx

Local Flood Risk Management Strategy

2.4.4 As an LLFA, the Council has a statutory duty to develop, maintain, apply and monitor a strategy for local flood risk management. The Council has published a Local Flood Risk Management Strategy[21] (LFRMS), which provides guidance and information for residents, businesses and developers regarding managing flood risk. The document outlines the Council's responsibilities as an LLFA and also clarifies the role of other organisations in managing flooding across the Borough. The LFRMS further provides an overview of the sources of flood risk across the Borough and outlines options for dealing with flooding.

2.5 Other Local Studies

Lewisham Surface Water Management Plan

2.5.1 A Surface Water Management Plan (SWMP)[22] was produced for the Council as part of the Drain London Study in 2011, although was never officially published. This study undertook an assessment of flooding from sewers, drains, groundwater and runoff from land, small watercourses and ditches that occurs as a result of heavy rainfall. As part of the plan, local Critical Drainage Areas (LCDAs) were identified and surface water management recommendations were made for each area. The SWMP includes an Action Plan developed in conjunction with both the Council and other relevant Risk Management Authorities.

2.5.2 It is noted that the LCDAs identified in the SWMP do not meet the criteria to be recorded as a CDA by the Environment Agency.

2.5.3 The main outputs of the Lewisham SWMP have been considered in the preparation of this SFRA.

Preliminary Flood Risk Assessment

2.5.4 Under the Flood Risk Regulations, all LLFAs were required to prepare a Preliminary Flood Risk Assessment (PFRA). This study provides a high level summary of areas of significant flood risk, describing both the probability and consequences of past and future flooding.

2.5.5 The Lewisham Preliminary Flood Risk Assessment[23] was produced in July 2011 as part of the Drain London study, drawing upon the data and information available from the SWMP. The assessment gives an overview of all local sources of flood risk. The Council published an addendum[24] to this document in 2017, updating local flood risk information. It identified additional future flood risks in the Borough based on updated surface water mapping and revised climate change allowances.

[21] Lewisham Local Flood Risk Management Strategy; June 2015;
https://www.lewisham.gov.uk/mayorandcouncil/aboutthecouncil/strategies/Documents/Lewisham%20LFRM%20Strategy%20June%202015.pdf
[22] Lewisham Surface Water Management Plan; *Drain London*; May 2011;
http://councilmeetings.lewisham.gov.uk/documents/s3731/Appendix%202%20Surface%20Water%20Management%20Plan.pdf
[23] Lewisham Preliminary Flood Risk Assessment; *Drain London*; July 2011;
http://webarchive.nationalarchives.gov.uk/20140328171253/http:/cdn.environment-agency.gov.uk/flho1211bvkr-e-e.pdf
[24] Lewisham Preliminary Flood Risk Assessment Addendum; December 2017;
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/698650/PFRA_London_Borough_of_Lewisham_2017.pdf

3 Flood Risk in Lewisham

3.1 Overview

3.1.1 Fluvial flooding is the most prevalent risk across Lewisham due to the River Ravensbourne and its tributaries spanning most of the Borough. The proximity of the Borough to the River Thames also presents a residual risk of flooding in the event of a breach of flood defences.

3.1.2 The Borough is also at risk of flooding from other (non-river related) sources. Surface water flooding and sewer surcharge can both result from intense rainfall. Areas of the Borough are also susceptible to elevated groundwater levels, which may additionally interact with and exacerbate other sources of flood risk. It is expected that changing climate patterns will have a substantial impact of the level of flood risk from all sources within the Borough.

3.1.3 The various sources of flooding with the potential to affect the Borough are described in the following Chapter.

3.2 Historic Flooding

3.2.1 Information on known and recorded historic flooding events within Lewisham is shown in Maps 003a and 003b, Appendix A.

3.2.2 The EA holds the Historic Fluvial Flood Map, which includes past flood events in Lewisham. However, some of the recorded historical events might have been as a result of issues that have now been addressed and, therefore, an indication of historical flooding affecting a particular location does not necessarily mean that the locality affected remains prone to flooding.

3.2.3 For all other sources of flooding, there is limited availability of records across the Borough. This is likely due to a historical lack of centralised recording of such flood incidents across the UK, and should not be interpreted as indicating a low probability of future flooding. Nonetheless there are some records of previous flooding, based on local knowledge and reports from affected areas.

3.2.4 A site specific FRA will be required to confirm whether any historical issues have been addressed and development in previously flooded sites can take place.

Historic Flooding from Rivers

3.2.5 The EA historic flood maps show significant flooding in the 1960s across the Ravensbourne catchment. It should be noted that parts of the Ravensbourne and Quaggy now benefit from formal flood defences as illustrated on Map 009, Appendix A. Those defences did not exist during the aforementioned recorded events.

3.2.6 The November 1965 flood event only affected patches along the Ravensbourne and the Pool River. The extent was more significant south of Bellingham, in the London Borough of Bromley. The River Quaggy was also affected by this flood event; however, only a small area near Grove Park station experienced flooding within the Borough boundary.

3.2.7 The September 1968 flood extent was much more significant along the length of the Ravensbourne, the Pool River, and the Quaggy. This is particularly true around Lewisham Shopping Centre, Ladywell Fields and Lewisham University Hospital.

3.2.8 The EA historic flood maps also illustrate flooding from the Thames occurring in 1928. This only affected the northernmost tip of the Borough, with flooding being more significant on the opposite bank of the River Thames.

3.2.9 Many Ordinary Watercourses that had significant flooding issues have been designated as main rivers. The current Ordinary Watercourses therefore do not have any past significant flooding records.

3.2.10 More recently, flooding from the Ravensbourne River occurred in the Loampit Vale area near Lewisham Station in November 2014 and May 2016. Loampit Vale is a known low-point prone to flooding near Lewisham Town Centre. The November 2014 flood even followed heavy rainfall, and was precipitated by the presence of trash screens on the Ravensbourne which cause obstructions in the river when blocked up. Those have since been removed. The May 2016 event also occurred following heavy rainfall, and whilst construction work was being conducted alongside Loampit Vale. An investigation into the May 2016 event[25] was carried out by Council under Section 19 of the FWMA. This investigation identified that the flooding was due to an accumulation of debris from the adjacent construction site in the river bed.

Historic Flooding from Surface Water

3.2.11 Historically, several areas within the Borough have had report of surface water flooding. Recently, in June and July 2006, several high rainfall events led to widespread reports of flooding across the Borough. The main reason, as reported by residents, was blocked or insufficient gullies. In July 2007, several reports of drain surcharging following heavy rain were received by the Council, particularly around Hither Green area. It should also be noted that the public highways east of Forest Hill, have been identified by residents as regularly flooded during heavy and/or persistent rainfall.

3.2.12 The 2011 Lewisham PFRA[26] identified the following locations as having experienced repeated surface water flooding:

- Lewisham Town Centre due to its location at the confluence of railway lines that can act as a conduit to flood water in heavy rainfall. Additionally, it is a heavily developed area, with low permeability.
- The area of Deptford south of the A2 has historically experienced a lot of flooding to properties
- The area around Carholme Road experiences surface water flooding due to the under capacity of the sewers in the area.
- The Catford Bridge area in Catford easily floods in heavy rainfall due to a high water table and sewers under capacity.
- Hither Green is a low spot with the Ravensbourne catchment where surface runoff is constrained due to existing embankments and limited drainage capacity.

3.2.13 Lewisham Council holds a record of potential surface water flood incidents. Information from this record can be supplied on request where required to support site-specific FRAs. The record has been derived from historic reports made to the Council's Customer Service Centre and incidents were not verified at the time of occurrence; it is therefore not warranted complete or correct.

Historic Groundwater Flooding

3.2.14 No significant known issues with groundwater flooding have been identified across the Borough.

Historic Sewer Flooding

3.2.15 General information on sewer flooding history has been provided by TWUL, and is contained within Map 003b, Appendix A. This data indicates the total number of properties which have been impacted by sewer flooding (both externally and internally), per postcode area, over the previous decade. The dataset does not give exact locations of where flood incidents have occurred, only the numbers of properties affected in that area. The Thames Water DG5 dataset excludes severe weather events

[25] Report on the flooding incident at Loampit Vale on 11 May 2016; https://www.lewisham.gov.uk/inmyarea/publicsafety/emergencies/Preparing-for-an-emergency/flooding/Documents/ReportOnTheFloodingIncidentAtLoampitVale.pdf
[26] Lewisham Preliminary Flood Risk Assessment; *Drain London*; July 2011; http://webarchive.nationalarchives.gov.uk/20140328171253/http:/cdn.environment-agency.gov.uk/flho1211bvkr-e-e.pdf

(usually defined as a rainfall event with a 3.33% AEP (1 in 30 Year)). The map shows low and relatively uniform occurrence of sewer flooding across the Borough in the past decade, with the exception of the SE61 area where 55 incidents have been recorded over 10 years.

3.2.16 It should be noted that the flood records provided by Thames Water may not provide a complete and/or accurate account of flood events from this source in the Borough over the last 10 years. Some minor flooding incidents may go unreported, particularly if no property is affected. TWUL also undertakes network improvement projects, and such works may have improved sewer capacity since sewer flooding incidents were first reported.

Historic Flooding from Artificial Sources

3.2.17 There is no known history of flooding from artificial sources within the Borough.

3.3 Flood Risk from all Sources

Tidal and Fluvial

River Thames

3.3.1 The northern extent of the Borough is bounded by the lower reaches of the River Thames, draining a catchment of 5,000 square miles. Historically, the River Thames floodplain was substantially wider than it is today, with the dense urban area of London particularly constraining the downstream reaches of the river corridor. The River Thames is also tidally influenced in this area, with tidal flooding from this source presenting a significant residual risk to people and property within the Borough.

3.3.2 The greatest overall flood risk from the River Thames occurs when tidal surges coincide with particularly high tide levels or fluvial flooding in the upper reaches of the catchment.

3.3.3 The Thames Tidal Defence system, including the Thames Barrier and Thames River Walls provide the Borough with a significant Standard of Protection (SoP) from combined fluvial and tidal flooding up to the 1 in 1000 year event. The current and future River Thames Defences are described in further detail in Section 3.4.

3.3.4 Whilst these defences provide a significant SoP to the Borough, it is essential to appreciate that they are engineered structures which can only protect to a certain point, may malfunction and have a finite design life. There will always therefore be a residual risk of flooding from this source, associated with:

- Overtopping of the defences, during a larger event than has been planned for, or
- Breach of the defences, due to structural failure.

3.3.5 The likelihood of such residual risks are very small; however, the scale of consequences from rapid inundation and deep water in heavily urbanised areas mean that these residual risks must be considered, as further expanded below.

3.3.6 The Thames Tidal Defences provide a 1 in 1000 year level of protection. Overtopping occurs when flow exceeds the capacity of the channel to convey that flow, and water passes over a flood defence. Low levels of overtopping may arise even when the defence crest level is higher than the water level due to the actions of winds, wave and spray.

3.3.7 No assessment of risk associated with overtopping has been made as part of this study. Development proposals adjacent to the River Thames flood defences should include a consideration of overtopping risk within the site-specific FRA.

3.3.8 The floodplain areas within the Borough associated with the River Thames are classified as defended. Therefore, the associated flood risk with these areas is that of a residual nature, resulting from a failure or breach in the flood defences. To provide further detail on the variation of the residual risk,

hydraulic breach modelling was commissioned by the EA along the extent of the Tidal Thames frontage, from Teddington to Dartford Creek.

3.3.9 The breach modelling divides the full length of Thames tidal defences into discrete breach lengths (20 m for hard defences and 50 m for soft defences), in order to represent expected worst case scenarios. As such, the modelling did not take into account the conditions of the defences or the expected probability of breach.

3.3.10 The results at all breach locations were combined to provide a single maximum flood extent, depth, hazard and velocity outputs, which should be used for future planning in the affected areas. These are illustrated on Maps 012a, 012b, 012c and 012d in Appendix A.

3.3.11 For the 2005 epoch, the flood extent within the Borough is limited to the area directly adjacent to Deptford Creek, and to the area in-between the River Thames and the A200. The highest hazard (namely Danger for All) is limited to small outcrop directly along the River Thames and Deptford Creek. It then gradually reduces, with relatively high hazard mainly along the roadways, acting as water conduits. It should be noted that hazard is measured based on both flood depth and velocity outputs, which therefore show a similar distribution to the maximum hazard.

3.3.12 For the 2100 epoch, the flood extent becomes much greater, covering much of the northernmost tip of the Borough and extending further alongside Deptford Creek. The hazard, depth and velocity are therefore more significant, with large areas of the flooded zone considered a danger for all.

River Ravensbourne

3.3.13 Fluvial flooding occurs when water levels exceed the bank level of a watercourse, causing overtopping into adjacent areas. This can result from prolonged rainfall within the catchment, restrictions or blockages within the channels or high water levels preventing discharge at the outlet. This can also be impacted by saturated catchment conditions and high groundwater levels.

3.3.14 The Borough lies within the Ravensbourne catchment, which may be impacted by flooding associated with the River Ravensbourne, The River Pool, and the River Quaggy, all of which flow in a northerly direction towards the Thames. The River Pool and the River Quaggy both join the Ravensbourne within the Borough; the Ravensbourne then drains into the Thames through Deptford Creek.

3.3.15 The Environment Agency's Flood Map for Planning is illustrated in Map 004, Appendix A. This map delineates the probability of flooding into the Flood Zones, as defined in Table 2-1 (Section 2.2.10). Fluvial flood risk is prevalent across the Borough, with each main watercourse having some extent of Flood Zones 2 and 3 along its length.

3.3.16 The Environment Agency flood zones are defined based on an undefended scenario. Parts of the Main Rivers in the Borough have flood defences, as shown on Map 009, Appendix A. The areas of the Borough benefitting from flood defences are shown on the Flood Map for Planning (Map 004, Appendix A).

3.3.17 The main areas of Flood Zone 3b for the River Ravensbourne are in Ladywell, Fields, parts of Lewisham Town Centre, and along the railway line between those two locations.

3.3.18 Some extent of Flood Zone 3b is also present along the River Quaggy, notably along its tributary the Quaggy Hither Green. Flood Zone 3b is defined as land where water has to flow or be stored in times of flood. Therefore, the designated flood storage area around the Quaggy in the southeast of the Borough, known as the Chinbrook Meadows, is included in that definition.

3.3.19 Flood Zone 3a mapping predicts greater inundation in the northern half of the Borough along the Ravensbourne and its tributaries up to and including Deptford Creek. The areas around the tidal reach of the Ravensbourne, as well as some areas along the River Quaggy, do benefit from formal defences that would reduce the illustrated flooding extent. Flood Zone 2 is largely similar in extent to Flood Zone 3a in that northern half of the Borough.

3.3.20 Some areas in the southern half of the Borough are also within the Flood Zone 3a flooding extent. These include the area where the Spring Brook joins the Ravensbourne, the surroundings of Catford and Catford Bridge stations, and a small area downstream from Lower Sydenham station along the River Pool. Flood Zone 2 extends significantly further than Flood Zone 3a in the southern half of the Borough, especially along the Ravensbourne River south of Ladywell.

Ordinary Watercourses

3.3.21 It should be noted that limited information is available on the level of flood risk associated with any ordinary watercourses. To assess the risk of flooding from Ordinary Watercourses, developers should review the Risk of Flooding from Surface Water mapping (Map 005, Appendix A) as this illustrates runoff in topographic low points which often define the location of ordinary watercourses.

Flooding from Surface Water

3.3.22 The majority of the Borough is served by separate gravity surface water and foul drainage; systems; however, there are some combined systems to the north of the Borough near the River Thames. With the separate systems, the surface water drains operate via gravity with most of their outfalls discharging into localise watercourse. If the water level is high in these local watercourses, it becomes difficult for the surface water to discharge and sewers may back-up. This leads to localised surface water flooding until river levels recede.

3.3.23 Pluvial flooding occurs when high intensity rainfall generates runoff which flows over the surface of the ground and ponds in low lying areas, before the runoff enters any watercourse or sewer. It is usually associated with high intensity rainfall events and can be exacerbated when the soil is saturated and natural drainage channels or artificial drainage systems have insufficient capacity to cope with the flow. High intensity rainfall unable to discharge to ground, sewers or watercourses is the main mechanism of surface water flooding in the Borough; however, it can be exacerbated by lack of maintenance of assets owned by Risk Management Authorities (RMAs) and/or riparian owners. Furthermore, this source of flooding can be compounded when combined with impermeable sub-soils or vast areas of open grassland. In Lewisham, the significant urbanisation of the Borough and associated hard standing areas have increased volumes of runoff and can lead to the exceedance of the available pipe network capacity.

3.3.24 The Lewisham SWMP[27] undertook a comprehensive review of pluvial flood risk, including direct rainfall modelling and mapping across the Borough. It was identified that for short duration and medium size storms (about 30 mm rainfall depth), only shallow flooding would occur. Deep flooding and more significant damages are however expected for short duration and large size storms (about 100 to 150 mm rainfall depth). The LLFA needs to be concerned with the potential of these rain storm events and control development and manage highways accordingly. Flooding from highway drainage infrastructure often occurs as a result of limited inflow capacity of the road drains, which could be worsened by blockages.

3.3.25 As part of this study, the surface water flood risk was mapped and analysed. Local Flood Risk Zone (LFRZs) were then identified, defined as discrete areas likely to suffer from surface water flooding in the future. Prioritized areas include Lewisham Town Centre, Deptford area south of the A2, the Catford Bridge area, Carholme Road, and Hither Green.

3.3.26 The SWMP identified a total of 2,228 properties at definite risk of surface water flooding, 327 of which are at risk of flooding to a depth of 0.5 m or higher. Approximately 14% of those are basement dwellings. Furthermore, the report identifies 25 ‘Essential’, 2 ‘Highly Vulnerable’ and 6 ‘More Vulnerable’ infrastructure, such as hospitals, schools, post offices, etc. at definite risk of surface water flooding. These vulnerabilities are defined in accordance with the NPPF Vulnerability Classification Table (Table 4-2). The surface water flood risk across the Borough is shown on Map 005, Appendix A.

[27] Lewisham Surface Water Management Plan; *Drain London*; May 2011; http://councilmeetings.lewisham.gov.uk/documents/s3731/Appendix%202%20Surface%20Water%20Management%20Plan.pdf

Flooding from Groundwater

3.3.27 Groundwater flooding occurs as a result of the water table reaching the ground surface. This is most likely to occur in low-lying areas which are underlain by permeable rock (aquifers) and more likely to appear after periods of sustained rainfall. Groundwater flooding tends to occur sporadically in both location and time, and tends to last longer than fluvial, pluvial or sewer flooding. Groundwater flooding can also interact with other flood sources, exacerbating the risk of pluvial, fluvial or sewer flooding by reducing rainfall infiltration or discharge to sewers.

3.3.28 Within London, the primary mechanisms for elevated groundwater are associated with:

- Above average rainfall for a number of months in Chalk outcrop areas;
- Shorter period of above average rainfall in permeable superficial deposits;
- Permeable superficial deposits in hydraulic continuity with high river water levels;
- Interruption of groundwater flow paths; and
- Cessation of groundwater abstraction causing groundwater rebound.

3.3.29 Areas susceptible to groundwater flooding as defined by the British Geological Survey are illustrated in Map 007, Appendix A.

3.3.30 Most of the highly permeable superficial deposits are located along the centre of the Borough, following the flood plain of the River Ravensbourne and the River Quaggy. Those areas are generally qualified as susceptible to groundwater flooding at surface. Notably, the area surrounding Lewisham Town Centre, which is mostly underlain by Thanet Sands and Lambeth Group Formations, only has limited potential for groundwater flooding to occur.

3.3.31 In the north of the Borough around Deptford, some areas of elevated groundwater resulting from consolidate aquifers are identified in the SWMP. These have the potential to lead to some flooding of property situated below ground level.

3.3.32 Development in areas with a history of groundwater flood risk is likely to continue to be at risk since this is a particularly difficult source of flooding to prevent. Therefore a flood resilient building design is particularly important in these areas.

Flooding from Artificial Sources

3.3.33 Reservoirs, canals, water retention ponds and other artificial structures may have a potential flood risk associated with them. Generally, under normal circumstances, the flood risk posed is low; however, if a breach occurs, extensive flooding could be experienced.

3.3.34 There are no designated reservoirs located within Lewisham; however, some areas of the Borough are shown to be within the extent of flooding anticipated following breach of several different reservoirs and flood storage areas.

3.3.35 The Sutcliffe Park and Weigall Road Flood Storage Areas are part of the River Quaggy Flood Alleviation Scheme (FAS). They are designed to hold up to 150,000 m^3 of flood water during peak flows. The areas along the River Quaggy and the River Ravensbourne highlighted on Map 008, Appendix A would flood if this storage were to fail.

3.3.36 Failure of the Nunhead reservoir, which is a covered hill-top reservoir in the London Borough of Southwark, would result in flooding west of the Borough boundary. Areas near Brockley and New Cross within the Borough would also be affected. A breach of the Honor Oak covered reservoir, also located within Southwark, would lead to flooding in the north-western tip of the Borough, near South Bermondsey station.

3.3.37 It should be noted that reservoir flooding is considered extremely unlikely. The EA is the enforcement authority for the Reservoirs Act 1975 in England and is responsible for ensuring regular inspection and maintenance.

3.3.38 Areas at residual risk of flooding from reservoirs (during a breach event) within the Borough are illustrated within map 008 in Appendix A.

Other Artificial Sources

3.3.39 Numerous small local ponds and water features are also present across the Borough; however, very limited information currently exists with regards to their capacity and connectivity and therefore an assessment of the flood risk posed by them will need to be made at a site specific level.

Flooding from Sewers

3.3.40 As the foul water sewer network is mostly separate from the surface drainage network across the Borough, flooding from this source arises if there is a sewer blockage or if surface water enters the foul network, as a result of a misconnection, resulting in it overflowing. Furthermore, when there are high water levels in receiving watercourses there is potential for sewer outfalls to rivers to become submerged during high water levels. When this happens, water is unable to escape into the watercourse and flows back along the sewer. Once storage capacity within the sewer itself is exceeded, the water will overflow into streets and houses.

3.3.41 Under current Thames Water standards, sewer systems are typically designed and constructed to accommodate a 3.33% AEP (1 in 30 Year) rainfall event. Therefore, during rainfall events of greater than a 3.33% AEP event, the surface water drainage network may be susceptible to surcharge and flooding. Additionally, drainage systems across London are of varying age and capacity, with many parts of the system thought to be designed to accommodate a 6.67% AEP (1 in 15 Year) return period rainfall event or less.

3.3.42 Thames Water is responsible for investigating and resolving frequent sewer flooding. Any properties with flood incidents occurring more than once every ten years are documented on the DG5 register and Thames Water aims to protect them through investment in new sewerage systems through the water company's asset investment programmes. Any sewer flooding as a result of extreme events is excluded from the DG5 resister.

3.4 Flood Defences

3.4.1 There are two main categories of flood defences, formal and informal (de facto). Formal defences are specifically constructed to control floodwater. Informal defences include structures that have not necessarily been constructed for this purpose but do have an impact on retaining flood water, such as railway and road embankments or other linear infrastructure such as boundary walls and buildings.

3.4.2 As discussed in paragraph 3.3.4 there are some formal flood defences within the Borough, which are shown on Map 009, Appendix A. These include flood walls along the River Thames, The River Ravensbourne and the River Quaggy, embankments along the River Quaggy and the River Ravensbourne, and high ground/bunds following most of the Ravensbourne River and the River Pool.

3.4.3 In Lewisham, the informal flood defences are wharfs, embankments and walls built for other purposes (e.g. railways) but have the dual benefit of flood risk reduction. These assets are listed in Table 3-1.

Table 3-1 *List of Informal Flood Defences in Lewisham (source: AIMS)*

Type	Location
Wharfs	Along Deptford Creek
Embankment	At Deptford Environmental Centre
Walls	Several buildings and structures along Deptford Creek
Rail Embankments	In Lewisham Town Centre
Rail Embankments	Near Grove Park Cemetery and Sundridge Park

3.4.4 The EA and LLFA are responsible for the management of Main Rivers and Ordinary Watercourses respectively. The responsibility for operational maintenance lies with the Riparian Owner. Therefore it is important to ensure Riparian Owner are aware of their responsibilities and undertake the necessary maintenance work on any critical assets as failure to do so could result in flooding. The LLFA has the enforcement power to ensure all riparian landowners maintain any Ordinary Watercourses contained within their land.

Future Policy

TE2100

3.4.5 The EA has completed a comprehensive programme of study referred to as TE2100, to establish the best approaches to manage flood risk in the estuary throughout the 21th century, taking into consideration various Climate Change scenarios.

3.4.6 For the geographical area encompassing the Borough, the study indicates that further action is required in order to keep up with climate change and further manage and reduce both the likelihood and consequence of flooding. This advocates an increase in the level of flood protection from the current 1 in 1,000 year level to 1 in 10,000 year; justified by the unique commercial, economic and historic value of London, as well as the potential for loss of life in the unlikely event of a flood.

3.4.7 Under the TE2100 plan, the recommended measures for defences within Lewisham include:

- An ongoing programme of inspection, maintenance, repair and replacement of defences;
- Raising of all defences by up to 0.5 m by 2065;
- Raising of all defences by an additional 0.5 m by 2100. This allows for projected increases in sea level to 2135.

3.4.8 The actual dates of defence raising will depend on the rate of sea level rise and may be revised with ongoing updates of the TE2100 Plan. The drainage outfalls into the Thames may also require improvement as the sea level rises and storm rainfall increases. These may additionally be impacted by works associated with the proposed Thames Tideway Tunnel.

3.4.9 The TE2100 plan further highlights the requirement for safeguarding land corridors along the River and setting back development where possible, to allow for defence maintenance, repair and wider riverside enhancement. A recommended width of 10 metres is specified.

3.4.10 It should be noted that, in the future, climate change is anticipated to increase the frequency of closure of the Thames Barrier. Operational constraints, and the needs of the river and its users, may place restrictions on this. Consequently, other means of reducing the risk of fluvial flooding from the River Thames may have to be sought in future years.

Thames CFMP

3.4.11 The Thames CFMP includes the Ravensbourne catchment under the ‘London Catchments’ policy sub-area. The flood risk in this area is considered to be managed effectively; however additional works will be required to keep pace with climate change. Proposed actions to implement the policy include working through the planning system to seek to reduce flood risk through regeneration, maintaining and improving flood defences, and removing culverts and recreating river corridors to provide space for flood waters.

3.5 Impact of Climate Change

3.5.1 Climate change is anticipated to have a significant impact on temperature, rainfall and seasonal changes within London. The UK Climate Projections 2018 (UKCP18)[28] were released by the Met Office in November 2018. The latest predictions are for warmer and drier summers, and wetter winters, with appreciable changes anticipated by the 2020s. The EA is currently developing guidance as to how to incorporate the projections into flood risk assessments, and this guidance is likely to supersede the information in this section when released.

3.5.2 The expected impacts of Climate Change on various sources of flooding across the Borough are broadly described in Table 3-2 below.

Table 3-2 - *Anticipated Impact of Climate Change on Flood Risk within the Borough*

Source	Anticipated Impact within Lewisham
Groundwater Flooding	Increased frequency and intensity of rainfall events is anticipated, which could lead to further groundwater flooding in the Borough due to raised groundwater levels and associated spring flows
Surface Water and Sewer Flooding	Increased storm intensity, frequency and duration is anticipated to further exacerbate pressure on existing drainage and sewer systems, potentially leading to more frequent localised flooding incidents.
Fluvial Flooding	Changing rainfall patterns are likely to increase peak river flows, thereby resulting in higher levels of fluvial flood risk from the Main Rivers across the north of the Borough.

Climate Change Allowances

3.5.3 In February 2016, the EA updated national climate change allowances to be used in the assessment of future flood risk and support the NPPF risk based approach. The updated allowances covered the following aspects:

- Peak river flow by River Basin District;
- Peak rainfall intensity;
- Sea level rise; and
- Offshore wind speed and extreme wave height.

3.5.4 The range of allowances provided for river flow, rainfall intensity and sea levels are based on statistical percentiles, representing the range of possible climate change scenarios, which give rise to the central (50th percentile), higher central (70th percentile) and upper end (90th percentile) estimates of impacts.

3.5.5 The allowances provided are additionally based on a range of time periods, representing the anticipated impact over the next 100 years. The percentile and time period to be used are dependent on the proposed development location, vulnerability and design life. The range of different climate change scenarios should be considered in the analysis of flood risk.

3.5.6 The EA has provided detailed online guidance[29] on the use of these allowances for site specific flood risk assessments and reference should be made to this source for the most up to date guidance. Table 3-3 indicates the climate change allowances for peak river flow for the Thames Basin, which includes Lewisham.

[28] UK Climate Projections (2018) http://ukclimateprojections.metoffice.gov.uk/
[29] Climate change allowances for Flood Risk Assessment https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

***Table 3-3** Peak River Flow Allowances (use 1961 to 1990 baseline)*

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

3.5.7 Table 3-4 demonstrates which climate change allowance should be applied in each flood zone for each type of development.

***Table 3-4** Climate Change Allowances for Development Classifications in each Flood Zone*

NPPF Vulnerability Classification	Flood Zone 2	Flood Zone 3a	Flood Zone 3b
Essential Infrastructure	Higher Central	Upper End	Upper End
Highly Vulnerable	Higher Central	Not Permitted	Not Permitted
More Vulnerable	Central and Higher Central	Higher Central and Upper End	Not Permitted
Less Vulnerable	Central	Central and Higher Central	Not Permitted
Water Compatible	None	Central	Central

Climate Change in Lewisham

Ravensbourne Model

3.5.8 The impact of climate change has been taken into account as a part of the hydraulic modelling work undertaken for the Ravensbourne catchment by the EA. The model results have been provided for the 25% and 35% allowance for climate change, which corresponds to the Higher Central estimate for the 2050s and the Central estimate for the 2080s, as reflected in Map 013, Appendix A. These allowances have been modelled by the EA as they cover the majority of climate change scenarios outlined in Table 3-3.

Position Statement 1: Ravensbourne model to be run with the 70% climate change allowance (provided by the EA).

3.5.9 Where a development is required to consider the Upper End climate change as set out in Table 3-4 above, the developer will be required to consider flood levels for this climate change allowance in their site-specific flood risk assessment. The EA have a long term plan to update the Ravensbourne model; therefore they should be contacted during the preparation of site-specific flood risk assessments to obtain up to date model data from the River Ravensbourne. Where this data is not available from the EA, the developer will be required to determine the flood levels themselves.

3.5.10 Map 013, Appendix A, displays the flood extent with climate change allowances included. With an additional 25% allowance for climate change there is an increase in flood inundation around Deptford associated with Deptford Creek, and around Lewisham Shopping Centre, Catford and Beckenham

Place Park along the River Ravensbourne. With an additional 35% allowance, the extent increases slightly in Southend along the River Ravensbourne, and in Deptford around Deptford Creek.

4 Managing Flood Risk

4.1 Risk Based Approach to Planning

4.1.1 The NPPF 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.

4.1.2 Development is only permissible in areas at risk of flooding 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.

4.1.3 Building on these principles, the NPPF and Planning Practice 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 Planning Practice Guidance and shown in Table 4-1 below.

Table 4-1 - *Flood Risk Management Hierarchy and the SFRA Process*

Hierarchy

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
Exception Test at Site	Safe management of flood risk where avoidance is not possible
Control and Improvement	Through Design (e.g. SuDS)
Mitigate Remaining Risks	Flood Resilient Design and Construction

Applying the Sequential Test

4.1.4 As described in the NPPF, the aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. As such, development should not be permitted in areas of flood risk, where there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding. The Sequential Test should be carried out on all development sites and can be applied at all levels and scales of the planning process, both between and within Flood Zones.

4.1.5 The approach seeks to prevent the allocation of sites that are inappropriate on flood risk grounds by considering the vulnerability of the type of development proposed and how compatible the intended use is with the level of flood risk at the site. Five vulnerability classifications are defined; these are listed below and further defined in Table 4-2.

- Essential Infrastructure;
- Highly Vulnerable;
- More Vulnerable;
- Less Vulnerable, and
- Water Compatible.

Table 4-2 *Flood Risk Vulnerability Classifications (from Table 2 in the NPPF Planning Practice Guidance)*

Appropriate Use Classification	Examples of Classification
Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which has to be located in a flood risk area for operational reasons need to remain operational in times of flood. • Wind turbines.
Highly Vulnerable	• Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent.
More Vulnerable	• Hospitals. • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable	• Police, ambulance and fire stations which are not required to be operational during flooding. • Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non–residential institutions not included in "more vulnerable", and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works which do not need to remain operational during times of flood. • Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).
Water Compatible Development	• Flood control infrastructure. • Water and Sewage transmission infrastructure and pumping stations. • Sand and gravel working. • Docks, marinas and wharves. • Navigation facilities. • Ministry of Defence, defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

4.1.6 Table 4-3 illustrates the types of development that are considered as suitable within areas of varying perceived flood risk. This utilises the Flood Zones defined in Table 2-1 (Section 2.2.10), and delineated for the Borough in Map 004, Appendix A.

Table 4-3 - *Flood Zones and Development Compatibility (based on Table 3 in the NPPF Planning Practice Guidance)*

Flood Zone	Description	Annual probability of river or sea flooding	Appropriate uses
Zone 1	Low Probability	1 in 1,000 (<0.1% AEP)	• All uses
Zone 2	Medium Probability	1 in 100 – 1 in 1,000 (river) (1-0.1% AEP) 1 in 200 – 1 in 1,000 (sea) (0.5-0.1% AEP)	• Water Compatible • Less Vulnerable • More Vulnerable • Essential Infrastructure • Highly Vulnerable*
Zone 3a	High Probability	1 in 100 or greater (river) (>1% AEP) 1 in 200 or greater (sea) (>0.5% AEP)	• Water Compatible • Less Vulnerable • More Vulnerable* • Essential Infrastructure*
Zone 3b	The Functional Floodplain	1 in 20 or greater (5% AEP) or land which is designed to flood in an extreme (0.1% AEP) flood.	• Water Compatible • Essential Infrastructure*

Note: *only if Exception Test is passed

4.1.7 This SFRA provides the tools to undertake the Sequential Test by presenting information to identify the variation in flood risk across the Borough, allowing an area-wide comparison of future development sites with respect to flood risk considerations. The flow diagram presented as Figure 4-1 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.

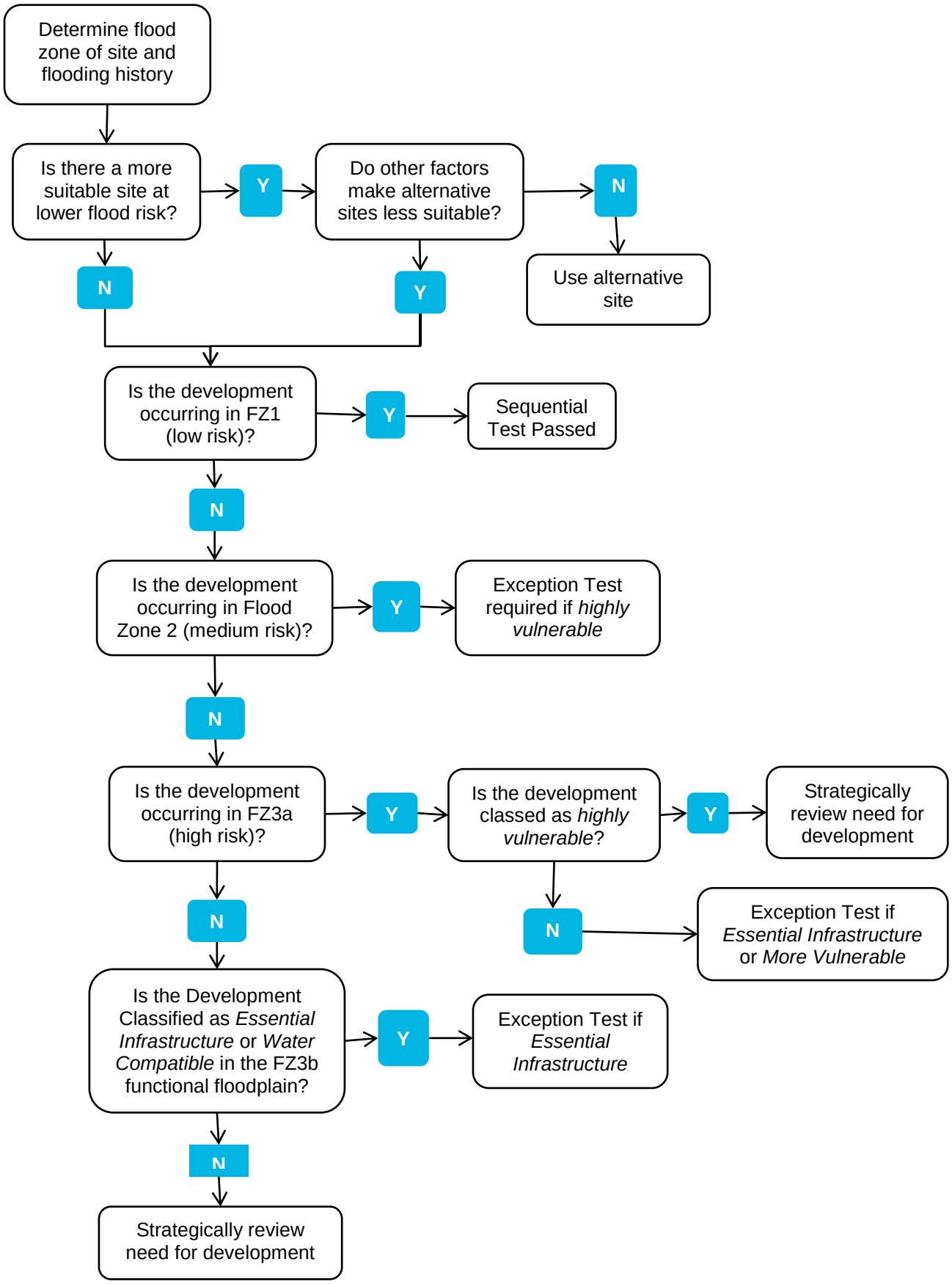


Figure 4-1: *Sequential Test Process - Schematic*

4.1.8 If, following the application of the Sequential Test, a proposed site allocation does not meet the criteria of acceptability, that site might qualify for the application of an Exception Test. This test considers both the development safety and the benefit of the site to the wider sustainability objectives of the Borough in order to establish whether the development can be deemed acceptable. This test is further described below.

4.1.9 It should be noted that, while the focus of the Sequential Test is on tidal and fluvial flood risk (through use of the NPPF Flood Zones), some areas of the Borough could be at risk of flooding from other sources. Consequently all sources of flooding must be considered in the location of new development. If the development is not deemed water compatible, and the site is found to be impacted by a recurrent flood source (other than fluvial), the site and flood sources should be investigated further irrespective of a requirement for the Exception Test.

Exception Test

4.1.10 The Exception Test is an additional test to be applied by decision-makers following application of the Sequential Test. The Exception Test has two elements as shown below, both of which must be satisfied for development in a flood risk area to be considered acceptable.

4.1.11 The Exception Test provides a method of managing flood risk while still allowing necessary sustainable development to occur. The test is only appropriate for use when there are large areas in Flood Zones 2, 3a and 3b, where the Sequential Test alone cannot deliver acceptable sites, but where some continuing development is necessary for wider sustainable development reasons. The flow chart presented in Figure 4-1 and Table 4-3 demonstrates the methodology to determine whether an Exception Test is required for proposed site allocations.

4.1.12 In order to pass the Exception Test, the NPPF Planning Practice Guidance identifies the following considerations that need to be demonstrated/fulfilled to the satisfaction of the LPA:

- That the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Sustainability Appraisal Report where one has been prepared; and
- 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.

4.1.13 Satisfying the Exception Test involves consideration of the reasons behind the selection of the site for development, from the sustainability appraisal, as well as consideration in planning and design, such that the site will remain safe and operational in the event of flooding. This may involve demonstrating:

- A sequential approach is taken to development site layout, such that 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;
- Buildings are designed to be appropriately flood resilient and resistant, with essential services remaining functional in the event of flooding, and quick recovery following a flood;
- Provision of safe means of access and egress during a flood event; and
- Emergency evacuation procedures are developed, to be utilised following receipt of a flood warning.

4.1.14 Further detail on undertaking site specific flood risk assessments, including measures to safely mitigate and manage flood risk, are provided in Chapter 5.1.

4.1.15 Both parts of the Exception test must be satisfied in order for the development to be considered acceptable in terms of flood risk. There must be robust evidence in support of every part of the test.

4.2 Recommendations for Policy and Practice

4.2.1 Adopting a holistic approach to flood risk management should help ensure that flooding is taken into account at all stages of the planning process. To aid this holistic approach, it is recommended that all key recommendations set out in this report are considered and incorporated into the emerging Lewisham Local Plan.

4.2.2 Redevelopment rates in areas of the Borough are high and may offer the opportunity to reduce the current risk. This includes making the urban environment more resilient and with a layout that offers added options for managing future flood risk and the impacts of climate change. As such, it is recommended that policy options are expanded to include greater emphasis on active floodplain management. This may include promoting more appropriate use of floodplain areas (Flood Zone 3), making space for water, improved flood preparedness and enhanced emergency planning and response measures.

4.2.3 Specific recommendations for the Council are detailed in the following sections.

Strategic Planning

4.2.4 When considering strategic spatial planning across the Borough, flood risk should be an early and primary consideration. A sequential approach should be taken to allocating strategic development areas in regions of lowest flood risk, taking into account vulnerability of land use. Consideration should also be given to strategic allocation of open space and preserving and expanding river corridors to create space for flooding to be managed effectively.

4.2.5 In particular, the following specific recommendations are made:

- Ensure the Sequential Test is undertaken for all strategic land allocations and check that the vulnerability classification of the proposed land use is appropriate to the Flood Zone classification;
- Pursue potential opportunities to move existing development from within the floodplain to areas with a lower risk of flooding. This should include consideration of the vulnerability of existing developments and whether there is potential for land swap with lower vulnerability uses.
- Encourage developments to create space for water through:
    - Maintaining/updating (as appropriate) the existing RCIP, under which developments should seek opportunities for river restoration, channel enhancements and deculverting. This will support the appropriate location, layout and design of development, in order to accommodate climate change and assist in managing future flood risk.
    - Identifying, allocating and safeguarding open space for storage. Equally, existing flood storage areas should be identified, conserved and protected against loss through redevelopment. As a minimum, and where the above approaches are not feasible, safeguarding existing corridors of land along the Main Rivers and their tributaries and promote the setting back of development to enable sustainable and cost effective flood risk management, including upgrading of river walls and embankments. As a minimum, an 8 m buffer strip should be maintained along fluvial corridors.
- Consider opportunities to improve the riverside frontage to provide amenity space and environmental enhancement. Floodplain management could reduce the impact of flooding to existing properties and other assets located in the floodable areas on the river side.
- The consultation and initial investigation associated with detailed site specific flood risk assessments should be undertaken at an early stage for major development locations to ensure opportunities to reduce flood risk are identified early and maximised wherever possible.
- Ensure that developments at risk of flooding are designed to be flood compatible and/or flood resilient and maximise the use of open spaces within these developments to make

space for water during times of flooding. Opportunities should be sought to identify a safe route for any exceedance flow of floodwaters and a suitable storage or discharge location, to avoid any risk to people.

- Strategic development allocations should specifically consider the issues of water supply and drainage infrastructure to service development proposed, taking into account regional constraints. An early and integrated approach should be taken to holistically assessing and planning for the flood risk, water supply and drainage requirements and constraints in these areas.
- All developments should incorporate SuDS unless there are practical reasons not to do so.
- The NPPF requirement for all Major Developments to submit a Sustainable Drainage Strategy for review by the LLFA should be extended to smaller developments within:
    - The local Critical Drainage Areas shown on map 005 in Appendix A. This will contribute to managing the surface water flood risk associated with the LCDAs, and should help mitigate any increases in surface water flood risk from climate change and infill development outside of targeted growth areas.
    - Areas served by surface water sewers shown in Map 006, Appendix A. Developments in these areas should be required to include SuDS measures that provide source control of pollutants as well as attenuation such as rainwater harvesting and reuse, bioretention systems and permeable paving. This will contribute to WFD objectives and is in line with the policies of the draft New London Plan.
- Standing advice for design of SuDS on smaller developments would help simplify the process for both developers and Council's development planners.

Development Control

4.2.6 In consulting on and determining development applications, the Council must ensure that all new developments have considered flood risk management from the planning stage. In general, this means that:

- Development is located in the lowest possible risk area from a flood risk perspective;
- New development is flood-proofed to a satisfactory level/standard and does not increase flood risk elsewhere; and
- Surface water is managed effectively on site using the SuDS hierarchy and the latest guidance and best practice.

4.2.7 When a proposed development is located within an area perceived to be at risk of flooding, then a suitably detailed FRA should determine the level of risk to the development and identify options to mitigate the flood risk to the development, site users and surrounding area. In particular, development located adjacent to flood assets is required to demonstrate that these will be maintained over the lifetime of the development. The requirements for site specific flood risk assessments and their contents are further detailed in Chapter 5. Planning applications should be considered and assessed in line with the sequential approach detailed in Section 4.1. Specific recommendations and considerations for development planning are provided below:

- If development is to be constructed with less vulnerable uses on the ground level, covenants need to be put in place to prevent future alteration of these areas to 'more vulnerable' uses without further consideration of the associated flood risk.
- Single storey residential development should not be considered in high flood risk areas as they offer no opportunity for safe refuge.
- NPPF does not permit self-contained basement dwellings to be located within Flood Zone 3a, and as such these should not be permitted in any areas at risk of flooding. This would include the excavation of basements under existing dwellings. Where a basement is proposed as part of a larger dwelling in Flood Zone 3a, covenants need to be put in place to prevent future alteration of the basement to 'more vulnerable' uses without further consideration of the associated flood risk.

- Flood risk should be managed through emergency planning, site design and protection measures.
- Where development within flood risk areas is necessary due to wider sustainability/regeneration objectives, flood resistance and resilience practices should be followed in the construction and operation of the buildings to minimise the impact of flooding.
- Finished floor levels of all residential accommodation should be raised above the 1% AEP (1 in 100 Year) plus Climate Change level, with an allowance for freeboard (300 mm). Potential access and egress routes should also be considered and recommendations made for emergency response by occupants in the event of a breach occurring.
- Flood risk from all sources should be considered when identifying the perceived level of flood risk affecting a site. Robust consideration of surface water flood risk is particularly important in certain regions of the Borough, particularly in the north in the vicinity of the existing river network.
- Opportunities should be taken to identify sites where developer contributions could be used to fund future flood risk management schemes, improvements to surface water drainage systems or flood assets in adjacent areas. However, it should be noted that developer installed defences should not wholly justify development in locations with inappropriate levels of flood risk.
- Existing flood storage areas within development areas should be identified, conserved and protected against loss through redevelopment.
- Development adjacent to a river should seek opportunities for river restoration as part of the development, in line with the RCIP. As a minimum, buffer strips should be maintained along river corridors (8 metres wide on fluvial rivers and 16 metres on tidal rivers), to ensure maintenance of the channel can be undertaken. As such, any new development should be avoided in existing buffer areas. A pragmatic approach should be adopted for existing development in these areas.
- For developments adjacent to Main Rivers, particular consideration should be given to facilitating the recommendations of the Thames CFMP and the North Kent Rivers CFMP in maintaining, enhancing and replacing flood assets, future flood risk management and safeguarding riverside land.

Flood Defences

4.2.8 The SFRA has explained the current extent of formal flood defences along the Borough river courses. The areas benefitting from those defences have been mapped and considered when assessing flood risks in the Borough. Local policy should continue to maintain and expand assets that are effective in managing current and future flood risks and promote wider sustainability.

4.2.9 The Thames CFMP considers the flood risk in this area to be managed effectively; however additional works will be required to keep pace with climate change. It proposes ‘to continue to maintain the existing flood defences and when redevelopment takes place, replace and improve them so that they are more effective against the impacts of climate change’.

Sustainable Drainage Systems

4.2.10 Sustainable Drainage Systems must be included in new developments as a way to manage surface water flood risk, improve water quality and increase amenity and biodiversity. This is significant in the Borough. SuDS policy should aim to manage surface water flood risk and water quality, prioritising SuDS measures with multiple benefits such as green/blue roofs, bioretention systems or permeable paving, over simple attenuation systems. Recommendations for this are set out in more detail in 4.2.5.

4.2.11 Runoff rates from new development must be restricted to greenfield runoff rates wherever possible. Robust justification must be provided for any sites where this is not achievable and an alternative discharge rate agreed with the Lewisham LLFA. Where appropriate, Lewisham should seek a planning contribution proportional to the difference in the volume of attenuation between that required to meet

the greenfield discharge rate and that proposed in the drainage strategy. This can be used to construct strategic attenuation systems to provide the balance of the attenuation volume. This approach has been pioneered in Southwark Council's Old Kent Road Area Action Plan.

4.2.12 Limiting the volume and rate of discharge, particularly for surface water entering the foul and combined surface water networks, is of critical importance within the Borough to help ensure the sewage network has the capacity to cater for population growth and the effects of climate change.

4.2.13 In line with the Sustainable Drainage Hierarchy, set out in Policy 5.13 of the London Plan (and repeated in Section 5.3), surface water runoff should be controlled at source wherever possible through rainwater harvesting and infiltration techniques. Managed discharge of surface water to adjacent surface water bodies should also be considered. However, controls would need to be implemented to avoid any adverse harm to biodiversity and ecological habitat within receiving waters. Sustainable drainage should be delivered in accordance with the London Plan, the Sustainable Design and Construction SPG, the London Sustainable Drainage Action Plan and CIRIA guidance C753.

4.2.14 Presently, there is a tendency for required attenuation volumes to be accommodated below ground. However, preference should be given to the installation of blue-green surface infrastructure wherever possible, as opposed to hardscape or underground solutions, due to the wider benefits for biodiversity, amenity and microclimate.

4.2.15 The underlying geology within certain areas in Lewisham is likely to impose constraints on the implementation of infiltration SuDS in many areas across the Borough, especially along the Ravensbourne. This is illustrated on Map 011, Appendix A. This is likely to necessitate the installation of lined systems to provide attenuation and reduction of runoff rates, requiring reuse of runoff or discharge to local surface water bodies or drainage systems. Site specific assessment of geological conditions should be undertaken as a part of the drainage strategy for new developments.

4.2.16 Greater detail and recommendations for SuDS within the Borough are contained in Section 5.3.

Emergency Planning

4.2.17 It is strongly recommended that emergency planning strategies are put in place in areas deemed at actual and/or residual risk of flooding to ensure adequate preparation and response during flood events. Where a new development or change of land use is proposed, flood evacuation plans should be developed through liaison with the emergency planners and the emergency services.

4.2.18 Additionally, following production of this SFRA, it is recommended that emergency planning strategies should be reviewed to determine the suitability of refuge centres and evacuation routes based on the updated flood risk mapping produced.

4.2.19 Emergency Planning can be broadly split into three phases, all of which should be considered in managing flood risk across the Borough:

- Before a flood – raising flood awareness, ensuring no inappropriate use of the floodplain/flow paths, preparing suitable flood emergency plans and communicating them to the wider community;
- During a flood – Flood alerts and communication, rescuing occupants, providing safe refuge and alternative accommodation; and
- After the flood – providing support to help people recover and return to their homes and businesses.

4.2.20 Consideration of emergency planning is even more critical when it relates to vulnerable sites and essential infrastructure, as further described below.

Vulnerable Sites

4.2.21 The Vulnerable sites (as defined by the National Receptors Database) in Lewisham are shown in Appendix A, Map 014. This map shows vulnerable site locations in relation to fluvial flood zones, risk of surface water flooding and groundwater vulnerability.

4.2.22 Emergency service authorities responsible for hospitals, ambulance, fire and police stations as well as prisons should ensure that emergency plans, in particular for facilities in flood risk areas, are in place and regularly reviewed so that they can cope in the event of a major flood. These plans should put in place cover arrangements through other suitable facilities, if deemed needed.

4.2.23 The NPPF classifies police stations, ambulance stations, fire stations and command centres as Highly Vulnerable buildings. It is essential that all establishments related to these services are located in the lowest flood risk zones to ensure that in the event of an emergency those services vital to the rescue operation are not impacted by flood water. Furthermore, development control policies should seek to locate more vulnerable uses such as schools and care homes in areas at the lowest risk of flooding to minimise the impact of a flood on their vulnerable users.

4.2.24 Allied to this, nominated rest and reception centres should also be identified within the study area and compared with the outputs of this SFRA to ensure that these centres are not at risk of flooding, so that evacuees will be safe during a flood event. Developments that would be suitable for such uses would include leisure centres, churches, schools and community centres.

4.2.25 On occasions where development of vulnerable sites within flood risk areas is unavoidable, necessary measures should be implemented to ensure the site is as safe as possible.

Critical Infrastructure

4.2.26 In the event of a flood incident, it is essential that the evacuation and rescue routes to and from any proposed development remain safe. Essential infrastructure located in Flood Zone 3a or 3b must be operational during a flood event to assist in the emergency evacuation process.

4.2.27 Relevant transport authorities and operators should examine and regularly review their infrastructure including their networks, stations, and depots, for potential flooding locations and to identify the need for any flood risk reduction measures. For large stations and depots, solutions should be sought to store or disperse rainwater from heavy storms in a sustainable manner.

Water Environment

4.2.28 It is recommended that Council take a holistic approach to flood risk management across the Borough within the wider context of the water cycle and local environment. Within Lewisham, a large extent of waterbodies are designated as heavily modified (as defined by the Water Framework Directive), with an absence of natural river processes leading to lost habitat diversity and poor water quality.

4.2.29 Additionally, it is anticipated that growing population numbers and changing climate patterns will place increased pressure on already stressed water resources across Greater London. New development can assist in alleviating this water scarcity by incorporating water efficiency measures such as grey water recycling, rainwater harvesting and water use minimisation technologies. This will also have a substantial benefit on the sewer system which will receive less wastewater from properties, potentially freeing up capacity during flood events.

4.2.30 Consideration should be given to maximising the benefits of surface water management infrastructure, enhance the urban environment for the benefit of communities and biodiversity. Through high quality design and installation, such infrastructure can contribute to multi-functional benefit in the following areas:

- Provision of habitat and biodiversity - when adequately planned, the delivery of diverse, high quality green spaces can provide valuable habitat to a range of flora and fauna.

- Recreation and community - provision of space for recreation and contribution to community health, wellbeing and social cohesion. Water features can create a sense of place.
- Microclimate adaptation - Reducing the impact of the urban heat island effect by providing shading to protect against radiations, reducing local temperatures through evapotranspiration and reducing heat absorbed and then released by surfaces.
- Public realm - street greening and the delivery of effectively landscaped open spaces can substantially improve the amenity value of neighbourhoods.

Consultation and Coordination

4.2.31 For future flood risk management within the Borough to be successful, it is essential that relevant partners and stakeholders, who have responsibility for flood risk management assets, work collaboratively to reduce flood risk.

4.2.32 In particular, the Council should continue to work with the EA and others to ensure ongoing maintenance and improvement of watercourses. This will include ensuring that the recommendations of the CFMPs and London Plan are implemented in new and existing developments, to keep communities safe from flooding in a changing climate and improving the local environment.

4.2.33 Similarly, opportunities should be sought to reduce the risk of flooding from surface water and sewer surcharge through consultation with Thames Water, to determine key areas for maintenance and locations that would benefit from flood alleviation schemes.

4.2.34 It is further recommended that the Council continues to collaborate with stakeholders to maintain and expand upon the existing understanding of flood risk across the Borough and, in particular, to confirm the impact of revised climate change allowances on understanding of fluvial flood risk.

5 Guidance for Developers

5.1 Site Specific Flood Risk Assessment

5.1.1 The aim of a site specific Flood Risk Assessment (FRA) is to assess the flood risk to and from a proposed development, and demonstrate that it will not be at risk of flooding during the design event during the lifetime of the development. This includes assessment of mitigation measures required to safely manage flood risk and demonstration that the proposed development will not increase flood risk elsewhere. All sources of flood risk will need to be considered.

5.1.2 This section presents the recommendations for site specific FRAs prepared for submission with planning applications to the Council, following the approach recommended by:

- The EA, particularly its flood risk standing advice[30];
- NPPF and Technical Guidance[31];
- CIRIA C753 The SuDS Manual[32];
- CIRIA report 624, Development and Flood Risk: Guidance for the construction industry[33]; and
- Council's Validation Guidance and Local Information Requirements for Planning Applications[34].

5.1.3 Comprehensive guidance on FRAs are provided on the Government website[35] by DEFRA and the EA and should be used by developer when preparing planning applications.

5.1.4 FRA reports are usually undertaken by the developer and submitted as part of the planning application process. However, there are instances where a LPA might wish to commission a detailed, site-specific FRA to further understand the level of risk associated with a strategic site, and to inform decision making. An example of this would be where new flood defences or improved Standard of Protection (SoP) to existing assets is considered for a site, and the resultant flood reduction benefits, loss of floodplain storage and downstream implications need to be understood.

5.1.5 A site specific flood risk assessment is required in the following circumstances:

- Proposals of 1 hectare or greater in Flood Zone 1;
- Proposals for new development (including minor development and change of use) in Flood Zones 2 and 3;
- Proposals for new development (including minor development and change of use) in any critical drainage areas (as designated by the EA or the LLFA); and
- Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.

5.1.6 A FRA should demonstrate that the proposed development is safe from flooding from all sources, including the provision of safe access and egress, and that the development does not increase flood risk elsewhere. The flood risk assessment should consider the latest climate change guidance and allowances.

[30] Flood risk assessment: standing advice; April 2012; https://www.gov.uk/guidance/flood-risk-assessment-standing-advice
[31] The NPPF; 2018; https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/740441/National_Planning_Policy_Framework_web_accessible_version.pdf
[32] The SuDS Manual (C753); 2007; https://www.ciria.org/Resources/Free_publications/SuDS_manual_C753.aspx
[33] Development and flood risk – guidance for the construction industry (C624D); October 2004; http://www.ciria.org/ItemDetail?iProductCode=C624D&Category=DOWNLOAD
[34] Planning validation requirements; 2018; https://www.lewisham.gov.uk/myservices/planning/apply-for-planning-permission/Pages/How-to-submit-a-valid-planning-application.aspx
[35] Flood risk assessment for planning applications, 2017, https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications

5.1.7 Proposals for the sustainable management of surface water should also be presented through a suitable drainage strategy incorporating SuDS techniques and demonstrating betterment in terms of runoff rates, amenity and biodiversity, as further described in Section 5.3.

5.1.8 If a detailed FRA is required, it must be undertaken by a suitably qualified professional. Assessments should be on a site by site basis making use of local knowledge. However, an initial assessment of flood risk can be made by consulting the mapping section of this SFRA.

5.1.9 FRAs should also be appropriate to the scale, nature and location of the development. Table 5-1 presents the different levels of site-specific FRA (as defined in CIRIA publication C624) and identifies typical sources of information that can be used.

Table 5-1 - *Levels of Site Specific Flood Risk Assessment (CIRIA C624)*

Level	Requirements	Typical Sources of Information
Level 1 Screening Study	The Level 1 FRA should 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.	Typical sources of information include: • Lewisham SFRA, SWMP and PFRA; • Flood Map for Planning (Rivers and Sea); • Local flood risk policy documentation (such as Flood Risk Management Plan, Catchment Flood Risk Management Plan and Local Flood Risk Management Strategy); • EA Standing Advice; and • NPPF Tables 1, 2 and 3.
Level 2 Scoping study	The Level 2 FRA should 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: • An appraisal of the availability and adequacy of existing information; • A qualitative appraisal of the flood risk posed to the site, and potential impact of the development on flood risk elsewhere; and • An appraisal of the scope of possible measures to reduce flood risk to acceptable levels. 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.	Typical sources of information include those listed above, plus: • Local policy statements or guidance, Local Flood Risk Management Strategy; • Catchment Flood Management Plan; • 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; • Consultation with EA/Council/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; • Historic maps; • Interviews with local people and community groups; • Walkover survey to assess potential sources of flooding, likely routes for floodwaters, the key features on the site including flood defences, their condition; and • Site survey to determine general ground levels across the site, levels of any formal or informal flood defences.
Level 3 Detailed study	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: • Quantitative appraisal of the potential flood risk to the development; • Quantitative appraisal of the potential impact of the development site on flood risk elsewhere; and • Quantitative demonstration of the effectiveness of any proposed mitigations measures.	Typical sources of information include those listed above, plus: • Detailed topographical survey; • Detailed hydrographic survey; • Site-specific hydrological and hydraulic modelling studies which should include the effects of the proposed development; • Monitoring to assist with model calibration/verification; and • Continued consultation with the Council, EA and other flood risk consultees.

Flood Risk Assessments for Flood Zone 1

5.1.10 Site specific flood risk assessments are required in Flood Zone 1, if a proposed development is:

- 1 hectare or greater in size;
- Within a Critical Drainage Area (as designated by the EA); or
- Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.

5.1.11 The following recommendations are made for site specific FRAs in Flood Zone 1.

- The developer should check whether the site has been identified as at risk from other (non-river related) flood sources by referring to the relevant maps within this SFRA. If so, a more detailed assessment of this risk over the lifetime of the development must be made.
- Assess the flood risk from all sources, including an assessment of the effects of climate change over the lifetime of the development.
- A drainage impact assessment must be carried out by a suitable professional to identify the impact of the proposed development on surface water drainage and recommend the approach to controlling runoff to the required discharge rates, through the use of SuDS. Where possible, runoff should be reduced to Greenfield Rates, in accordance with the recommendations of the London Plan. If the development is adjacent to a river, it must be set back an appropriate distance from the watercourse and development must enhance the river form and habitat. If culverted, the development should not build over the culvert and the developer should seek opportunities to de-culvert the watercourse as part of the development.
- The FRA must show that flood risk will be reduced overall.

5.1.12 The NPPF Technical Guidance (Table 3) confirms that all types of development are deemed suitable in Flood Zone 1.

5.1.13 If the site is on a ‘dry island’, surrounded by Flood Zone 2 or 3, the developer must also show that safe access and egress will be possible during a flood event.

Flood Risk Assessments for Flood Zones 2 and 3

5.1.14 A FRA must be undertaken for any proposed developments in flood zones 2 and 3. It is strongly recommended that the Sequential Test, and, depending on the vulnerability of the development (refer to Table 4-2), the first part of the Exception Test, be satisfied before the FRA is commenced.

5.1.15 If the development is within Flood Zone 2 or 3, the flood risk will be greater, and therefore the following recommendations and comments are made in addition to those that apply to sites in Flood Zone 1.

- Demonstrate, through the application of the Sequential Test, that there are no other suitable alternative sites in Flood Zone 1 for development.
- Show that flood risk will be reduced, and that suitable methods of mitigation will protect the development against the following (whichever are applicable):
    - 1% AEP fluvial event plus climate change over the lifetime of the development.
    - 0.5% AEP tidal event plus climate change over the lifetime of the development.
- Show that safe access can be provided to an appropriate level for the type of development.
- Show that flow routes are preserved and floodplain storage capacity is not reduced.
- The residents and occupiers of commercial buildings should be made aware their home / business is located in an area of flood risk, and should be encouraged to sign up to the EA Floodline Warnings Direct service (if available in this location).

- Any future development which includes or is immediately adjacent to a flood defence must additionally demonstrate that the flood defence will be fit for the lifetime of the development. This may require a survey of defences, proposals for required remedial works and / or complete replacement of defences.

5.1.16 If in Flood Zone 3, the Flood risk assessment must also confirm whether the development is located in Flood Zone 3a or 3b. It should be noted that only planning applications for essential infrastructure or water compatible development will be considered in Flood Zone 3b. Within Flood Zone 3b it must additionally be demonstrated that the development will:

- Remain operational and safe for users in times of flood;
- Result in no net loss of floodplain storage;
- Not impede water flows; and
- Not exacerbate flood risk elsewhere.

5.2 Reducing Residual Flood Risk

5.2.1 The minimum acceptable standard of protection against flooding for new property within flood risk areas is 1% AEP for fluvial flooding, with allowance for climate change over the lifetime of the development. The measures chosen will depend on the nature of the flood risk. Some of the more common measures are broadly outlined in this section.

Reducing Flood Risk through Site Layout and Design

5.2.2 Flood risk should be considered at an early stage in determining the layout and design of a development, providing an opportunity to reduce flood risk within the site. The NPPF and Technical Guidance state that a sequential, risk-based approach should be applied in order to locate more vulnerable land uses (such as residential use) to higher ground, while more flood-compatible development (e.g. parking, recreational space) can be located in areas at the highest risk of flooding within the site.

5.2.3 Low-lying waterside areas, or areas along known surface water flow routes, can be used for recreation, amenity and environmental purposes, allowing the preservation of flow routes and flood storage, and at the same time providing valuable social and environmental benefits contributing to other sustainability objectives. Landscaping should ensure safe access to higher ground from these areas, while avoiding the creation of isolated islands as water levels rise.

Modification of Ground Levels

5.2.4 Modifying ground levels to raise land above the required flood levels may be a potential means of reducing flood risk at certain sites, particularly where the risk is entirely from tidal flooding and the land does not provide conveyance for flood waters. However, in most areas of fluvial flood risk, conveyance or flood storage would be reduced by raising land above the floodplain, thereby adversely impacting on flood risk downstream. As such, compensatory flood storage must be provided to account for any land raising in the floodplain. Where the site is entirely within the floodplain it is not possible to provide compensatory storage at the maximum flood level so this will not be a viable mitigation option.

5.2.5 For proposed sites shown to be at risk of flooding from the 1 in 100 year plus Climate Change event, localised topography raising must be balanced with suitable floodplain compensation storage at another location (to be agreed with the EA). Such locations need to be sited in areas that currently do not flood (i.e. not part of the floodplain) and ideally within the redline application boundary.

5.2.6 Hydraulic modelling is likely to be required to demonstrate that the floodplain compensation design is technically robust, that there is no increase in flood risk off-site and that flood flow paths are not altered in such a way as to cause increase of flooding elsewhere. Consideration should also be given to surface water ponding, which may be increased due to changes in local topography.

Raised Defences

5.2.7 Construction of raised floodwalls or embankments can divert floodwaters away from new development or reduce the rate of flood inundation following a residual event. However, this should not be regarded as a preferred option for new development, as a residual risk of flooding will remain. Additionally, it is essential to ensure that diversion of flood waters does not increase flood risk to people or properties in other areas. Compensatory storage must be provided where raised defences remove storage from the floodplain. Temporary or demountable defences are not acceptable flood protection for new development unless flood risk is residual only.

Upstream Flood Storage

5.2.8 Flood storage areas can be an effective way of attenuating floodwater for management of flood risk in surrounding areas. The basic function of these techniques is increased flood storage, through installation of features including pools, ponds, ditches and river restoration schemes. These features can provide habitat for local wildlife, contributing to local ecology and biodiversity, while additionally providing open space for recreational and amenity benefit. It is important that ongoing maintenance of flood storage areas is considered at an early stage to avoid future exacerbation of flood risk to surrounding areas as a result of poor upkeep.

Developer Contributions to Flood Defences and Risk Management Infrastructure

5.2.9 Riparian developments are required to renew or otherwise adequately maintain flood defences to the required standard of protection, over the lifetime of the development, accounting for the effects of climate change. In some cases, it may be necessary for the developer to make a contribution to the improvement of flood defences, or flood alleviation schemes for the benefit of both the development and the local community. Developers should also assess other existing assets (e.g. bridges, culverts, embankments) and renew them to last (as a minimum) the lifetime of the development.

5.2.10 Proposed developments which are adjacent to main rivers must demonstrate that sufficient access is provided to existing river assets to enable ongoing maintenance and, where appropriate, improvement has been considered. Where possible, development should be set back from the edge of main rivers and watercourses to enable future sustainable and cost effective flood risk management, including upgrade of river walls and embankments.

Building Design and Finished Floor Levels

5.2.11 Where developing in flood risk areas is unavoidable, the most common method of mitigating flood risk to occupants is to ensure that habitable floor levels are raised above the estimated design flood level, with an allowance for freeboard. This significantly minimises the risk of damage to the building interior, furnishings and electrical installations during flood events. Floor levels should ideally be set a minimum of 300 mm above the 1% AEP event plus climate change water level in areas at fluvial flood risk.

5.2.12 This additional height that the floor level is raised is referred to as the ‘freeboard’.

5.2.13 Making the ground floor use of a building water compatible (for example a garage), may also provide an effective means of raising living space above likely flood levels.

5.2.14 Constructing a building on stilts is not considered an acceptable means of flood mitigation for new development as underfloor voids are prone to catching debris and litter, silting up, and colonisation by vermin. However, this may be considered in special circumstances if replacing an existing solid building, as it can improve flow routes. In these cases, safe access and egress must be provided and covenants established to ensure the ground floor use is not changed at a later stage.

Flood Resistance and Resilience

5.2.15 There may be certain circumstances under which flood risk to a development is unavoidable, for example:

- Proposed water compatible uses;
- Alterations to existing buildings;
- Where building floor levels have been raised but there is still a remaining risk under the 0.1% AEP event.

5.2.16 In such cases (and for existing development in the floodplain), additional measures may be implemented to reduce damage during a flood and increase the speed of recovery. These measures should not be relied on as the only mitigation method.

5.2.17 Flood resistance measures aim to prevent floodwater from entering a property and causing damage. These measures may be temporary, such as demountable flood barriers and door flood guards for individual properties. If installed correctly and in advance of a flood event, these measures can provide effective protection. On a smaller scale, temporary snap-on covers for airbricks and vents can also be fitted to prevent entry of flood water. However complications can arise regarding the time for transportation and installation of defences and therefore a reasonable duration between flood warning and onset of flooding is generally required. This may be mitigated by the use of automatic barriers that do not require manual assembly.

5.2.18 The use of temporary resistance measures is considered appropriate for existing properties when the use of the building is not changing to a more vulnerable use type. It is also not recommended for new development. This is because most temporary measures require intervention to function effectively, along with continued maintenance, which cannot be guaranteed. Permanent flood resistance measures, such as the use of low permeability materials to prevent water ingress are therefore recommended for new development.

5.2.19 Flood resilience measures aim to reduce the consequences of flooding events and ensure that buildings can be swiftly returned to normal use. This means that design provision is made for conveyance of flood waters through the building, avoiding the risk of structural damage and allowing rapid re-occupancy.

5.2.20 This includes interior design to reduce damage caused by flooding and may include:

- Designing structural capability to handle levels of water pressure associated with anticipated depths of flooding.
- Use of appropriate construction materials for surfaces, walls and floors which retain structural integrity during flooding and have good drying and cleaning properties. This may include vinyl and ceramic tiles, pressure treated timber, glass block, or metal. Alternatively sacrificial materials can be used for internal and external finishes (such as gypsum plasterboard which may be removed and replaced following flooding).
- Consideration given for appropriate water entry points into properties including doors, windows and air bricks.
- Placement of electrical circuitry and appliances above predicted levels of flooding with power cables carried down from the ceiling (not up from the floor level).
- Appropriate design of plumbing fittings, including toilets, with non-return valves to minimise the risk of contamination of floodwaters.

5.2.21 Flood resilience measures are most appropriate for less vulnerable uses where temporary disruption is acceptable and suitable flood warning is received.

5.2.22 The measures implemented should be specific to the nature of flood risk and the type of development proposed and, as such, will be informed and determined by the FRA. Further detailed guidance on

flood resilient construction techniques is provided within readily available publications from CIRIA (2010)[36] and DCLG (2007)[37].

5.3 Sustainable Drainage Systems (SuDS)

5.3.1 Implementing SuDS aims to recreate more natural drainage systems within the urban environment. These features celebrate the presence of water, enriching the urban environment, while providing valuable function for flood alleviation and biodiversity enhancement. Within developments, SuDS measures look to maximise permeable surfaces in an effort to increase the amount of water that is attenuated, treated and processed within the natural hydrological cycle.

5.3.2 Incorporating SuDS features will assist in absorbing runoff generated within development sites, reducing flooding, improving water quality, providing irrigation for vegetation and improve amenity. Such features can also contribute to a range of wider benefits, including provision of habitat for biodiversity, recreational opportunities, improved air quality and amelioration of the urban heat effect. All new developments within the Borough must incorporate SuDS to provide attenuation and management of rainfall runoff unless there is a valid reason to justify that they are not suitable. SuDS features are also suitable for retrofit on many sites. Sustainable drainage should be delivered in accordance with the SuDS Hierarchy, below:

- Store rainwater for later use;
- Use infiltration techniques, such as porous surfaces in non-clay areas;
- Attenuate rainwater in ponds or open water features for gradual release;
- Attenuate rainwater by storing in tanks or sealed water features for gradual release;
- Discharge rainwater direct to a watercourse;
- Discharge rainwater to a surface water sewer/drain;
- Discharge rainwater to the combined sewer.

5.3.3 Within Lewisham, sewer capacity is constrained in certain areas, and minimising the volume and rate of discharge entering the foul and combined surface water networks is of critical importance to help ensure ongoing capacity to cater for population growth and the effects of climate change. Where infiltration is not achievable, managed discharge of surface water to adjacent surface water bodies should also be considered. However, controls would need to be implemented to avoid any adverse harm to biodiversity and ecological habitat within receiving waters.

5.3.4 Runoff rates from new development should be restricted to greenfield runoff rates wherever possible. Where this is not achievable, robust justification will be required, and an alternative reduction in runoff agreed through consultation with the Lewisham LLFA.

5.3.5 SuDS schemes should be in accordance with the London Plan and associated Sustainable Design and Construction SPG and the London Sustainable Drainage Action Plan.

5.3.6 Appendix C provides a brief summary of the main SuDS techniques that could be suitable for implementation within Lewisham. Detailed guidance on the selection, design, construction and maintenance of SuDS is provided in the CIRIA SuDS Manual[38]. However, it should additionally be noted that the field of sustainable drainage is rapidly developing; therefore reference should be made to the latest guidance and best practice in developing site drainage strategies.

5.3.7 The selected SuDS scheme will be dependent on various factors including (but not limited to) topography, geology (soil permeability), and available area. This should be based on a comprehensive understanding of the catchment hydrological processes (i.e. nature and capacity of the existing drainage system). The design, construction and maintenance regime of such a scheme must be

[36] Flood resilience and resistance for critical infrastructure (C688); 2010; http://www.ciria.org/Resources/Free_publications/Flood_resilience.aspx
[37] Improving the Flood Performance of New Buildings - Flood Resilient Construction; 2007; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7730/flood_performance.pdf
[38] The SuDS Manual (C753); 2007; https://www.ciria.org/Resources/Free_publications/SuDS_manual_C753.aspx

carefully defined, including the need and responsibility for ongoing inspection and maintenance to avoid future exacerbation of flood risk as a result of poor upkeep.

5.3.8 Many SuDS measures are designed to promote infiltration of runoff into the ground beneath, promoting recharge of the water table and reducing runoff. However, implementation of infiltration SuDS within Lewisham may be constrained by geological conditions, including contaminated land. Site specific assessment of geological conditions should be undertaken to confirm that infiltration SuDS are suitable. Where sites lie within or close to source protection zones further restrictions may apply, and guidance should be sought from the EA.

5.3.9 Map 011, Appendix A contains information on the likely suitability of infiltration SuDS across the Borough. This map delineates four subsurface categories across the Borough, in which infiltration is likely to be of varying suitability, based upon a range of hydrogeological indicators. Further detail on the four categories is included in Table 5-2 below.

Table 5-2 - *SuDS Infiltration Suitability category descriptors*

Category	Description
Highly suitable	The subsurface is likely to be suitable for free-draining infiltration SuDS.
Probably suitable	The subsurface is probably suitable for infiltration SuDS although the design may be influenced by the ground conditions.
Potentially suitable for bespoke designs	The subsurface is potentially suitable for infiltration SuDS although the design will be influenced by the ground conditions.
Unlikely to be suitable	There is a very significant potential for one or more geo-hazards associated with infiltration.

5.3.10 If subsurface conditions are not suitable to facilitate infiltration in a certain area, selected SuDS features will need to be focused on surface water storage and attenuation, and appropriately lined so as to transport water to an area where it can be safely disposed.

5.4 Managing Flood Risk from Other Sources

Surface Water and Sewer Flooding

5.4.1 New development should seek to improve on-site drainage infrastructure to reduce flood risk. The site flood risk assessment and drainage strategy should demonstrate that the development will not increase flood risk elsewhere, and that the Lewisham LLFA's drainage requirements regarding runoff rates and SuDS are met. SuDS are a highly effective way of managing surface water flood risk, as described in Section 5.3 and Appendix C, and should be incorporated on all development sites.

5.4.2 When the redevelopment of existing buildings does not result in a higher flood vulnerability category, the installation of some flood-proofing and resilience measures can be used to protect against both surface water and sewer flooding. Non-return valves prevent water entering the property from drains and sewers. These valves can be installed within gravity sewers or drains, within the property's private sewer, upstream of the public sewer system. These need to be carefully installed and must be regularly maintained.

Groundwater

5.4.3 Groundwater flooding has a unique flooding mechanism, as it may emerge from below ground level and for this reason many conventional flood defence and mitigation methods are not suitable. Flood risk may be reduced through building design, by ensuring that floor levels are raised sufficiently above

the water table. Site design would also need to preserve any flow routes followed by the groundwater overland and make sure flood risk is not increased downstream. Proposed basement areas are likely to be particularly susceptible to groundwater flooding in certain areas. This may be mitigated through waterproof construction; however, consideration should be given to the potential impact on subterranean flow or water tables. When redeveloping existing buildings, it may be acceptable to install pumps in basements as a resilience measure. However, for new development this is unlikely to be considered an acceptable solution.

5.4.4 Site specific ground investigation is also likely to be required in locations where below ground development is proposed or there is known groundwater flood risk.

Artificial Sources

5.4.5 The flooding mechanism associated with flood risk from artificial sources is primarily related to breach or failure of structures (reservoir, lake, canal, flood storage areas, etc.). Due to the nature of this mechanism, it is difficult to foresee the location or extent of these problems and therefore it is important that the site specific FRA takes into consideration the integrity and history any relevant artificial structures and makes recommendations/provisions aimed at reducing the level of risk from these sources where applicable.

5.5 Making Development Safe

Safe Access and Egress

5.5.1 Emergency access and egress is required for developments during times of flooding to enable the evacuation of occupants and facilitate the emergency response. An emergency access and egress route is a path that is ‘safe’ for use by occupiers without the intervention of emergency services or others. A route can only be completely ‘safe’ in flood risk terms if it is dry at all times.

5.5.2 The FD2320/21 Defra/EA Flood Risks to People Report provides requirements for maximum flood depth and velocity to quantify whether an evacuation route should be deemed safe, where the requirements for safe access and egress from new developments are 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) is low and should not cause risk to people; and
- If a dry route for vehicles is not possible, a route for vehicles where the flood hazard (in terms of depth and velocity) is low to permit access for emergency vehicles.

5.5.3 Provision of safe access and egress may involve raising access routes to a suitable level above flood levels. As with land raising, it is imperative that any assessment takes into consideration the volume of floodwater potentially displaced.

Flood Warning and Evacuation

5.5.4 Emergency and evacuation plans should be in place for all properties at residual risk of flooding. Those developments which house vulnerable people (i.e. care homes and schools) will require more detailed plans.

5.5.5 Advice should be sought from the Council’s Emergency Planning Team when producing an emergency evacuation plan for developments as part of an FRA. Those preparing detailed emergency evacuation plans for vulnerable developments should undertake consultation not only with Council‘s Emergency Planning team but also the emergency services, so they know what is expected of them in the event of an emergency.

5.5.6 The EA operates a flood warning service in certain areas at risk of both fluvial and tidal flooding. The Flood warning system helps residents in these areas to prepare for flooding to minimise its potential consequences.

5.5.7 All homes and businesses within Flood Zone 2 and 3 are eligible for the EA's Floodline Warnings Direct (FWD) service, and should be encouraged to sign up to it. It is recommended that the developers make new owners of the property aware of this so they can sign up to the service.

5.5.8 Areas of the Borough which are subject to flood warnings and alerts are illustrated in Map 010, Appendix A.

5.6 Making Space for Water

Opportunities for River Restoration and Enhancement

5.6.1 This section outlines current best practice for river restoration and enhancement. Council's existing River Corridor Improvement Plan already provides a framework for managing development along Lewisham's river corridors in a way that contributes to flood risk management and public amenity. The approach set out in the RCIP should be maintained and enhanced where possible.

5.6.2 All new development close to watercourses should consider the opportunity to improve and enhance the water environment. Developments should look at particular opportunities for river restoration and enhancement. Restoration can take place on various scales, from small enhancement measures to full river restoration. Options include backwater creation, de-silting, in-channel habitat enhancement, removal of in-stream structures (e.g. weirs), and restoration of banks among others.

5.6.3 These measures have the potential of reducing the costs of any hard engineering structures, reducing flood risk, improving water quality and increasing biodiversity. Social benefits are also gained by increasing green space and access to the river.

5.6.4 In particular, there should be a presumption against further culverting of watercourses and constructing over culverts. All new developments with culverts running through their site should seek opportunities to de-culvert rivers, for flood risk management and conservation benefit.

5.6.5 These measures are supported by the WFD, a comprehensive river basin management planning system which aims to protect and improve the ecological health of waterbodies across Europe. In the UK, the EA is the authority charged with implementation of the Directive, and must meet certain targets aimed at restoring water bodies towards good condition. In line with the objectives of the directive, opportunities for waterbody improvement must be considered across all development proposals incorporating watercourses.

Buffer Strips

5.6.6 Developers must aim to set back development from the edge of adjacent waterways in accordance with the RCIP, in order to provide a 'space for water' and allow additional capacity to accommodate the effects of climate change.

5.6.7 This is also necessary in areas where flood defences or other engineered structures are present in order to provide a corridor for maintenance and improvement works. The minimum flood defence setbacks (from the bank line) are:

- 5 metres from ordinary watercourses;
- 8 metres from fluvial main rivers; and
- 16 metres from tidal main rivers

5.6.8 An Environmental Permit will be required from the EA for all works within 8 metres of fluvial main rivers or 16 metres of tidal main rivers and for erecting any temporary or permanent structure in, over or under a main river.

Designing for Exceedance

5.6.9 The capacity of existing drainage systems is limited, and can be overwhelmed by rainfall events of intensity above the design capacity, possibly leading to surcharge and flooding. In order to manage and minimise the impacts of such events, developers should seek opportunities to identify a safe route path for any exceedance flow and suitable storage or discharge location, so that this does not put people or property at risk.

5.6.10 As exceedance is expected to occur infrequently, such measures should ideally provide other benefits. An example of this is blue-green urban corridors, which provide ecological, recreational and functional benefits under the small rainfall events, whilst offering an effective and safe means of managing extreme events when these do occur.

5.6.11 CIRIA publication C635 ‘Designing for exceedance in urban drainage – good practice’ provides additional guidance.

6 Summary

6.1 Overview

6.1.1 The NPPF and accompanying Guidance emphasise the responsibility of LPAs to ensure that flood risk is understood and managed effectively and sustainably throughout all stages of the planning process. This SFRA aims to facilitate this process by identifying the spatial variation in flood risk across the Borough, allowing an area-wide comparison of future development sites with respect to flood risk considerations.

6.1.2 The Borough is dissected by four Main Rivers: the Pool River, the River Ravensbourne, the River Quaggy, and Deptford Creek. All are part of the wider Ravensbourne system. Some of those benefit from formal flood defences; formalisation of river channels and alterations to the watercourses over the years also resulted in reduced flood risk. Nonetheless, there are still considerable areas at fluvial flood risk within the Borough. The proximity of the Thames River and its associated flood risks and flood defences is also significant for planning in the north of the Borough.

6.1.3 A potential risk of flooding from other (non-river related) sources exists throughout the Borough, including sewer surcharge, and surface water flooding as a result of heavy rainfall and limited capacity of drainage infrastructure. This is particularly known to be an issue where groundwater levels are already high due to the location of permeable aquifers beneath the surface. It is expected that changing climate patterns will have a substantial impact on the level of flood risk from all sources within the Borough.

6.1.4 This SFRA identifies the floodplain areas associated with the Main Rivers and presents Flood Zone Maps that delineate the flood zones outlined in the NPPF. These maps provide the necessary information to facilitate the NPPF risk-based approach to planning. This process determines the compatibility of various types of development within each flood zone, subject to the application of the Sequential Test and the Exception Test when required.

6.2 Key Recommendations and Next Steps

6.2.1 Adopting a holistic approach to flood risk management should help ensure that flooding is taken into account at all stages of the planning process. To aid this holistic approach, it is recommended that all key recommendations set out in this report are considered and incorporated into the emerging Lewisham Local Plan.

6.2.2 Given the extent of Main Rivers in the Borough, development in this region must be considerate of flood risk and undertake measures to ensure its level is not increased. The proximity to the River Thames should also be considered. It is recommended that policy options are expanded to include greater emphasis on floodplain management to promote appropriate use of the floodplain and making space for water. Existing corridors of land along the river frontage should be safeguarded and opportunities taken to set back development to enable sustainable and cost effective flood risk management, including upgrading of river walls and embankments. Flood awareness and robust emergency planning and response will additionally be critical to sustainable ongoing flood risk management.

6.2.3 In the future, climate change is anticipated to have an impact on all sources of flood risk within the Borough. It is important that planning decisions recognise the potential risk that increased runoff poses to property and plan development accordingly so that future sustainability can be assured.

6.2.4 This Level 1 SFRA report will be complemented by further detailed assessment of the allocated development sites within the Borough, during the Level 2 SFRA. It is further recommended that this

report and mapping is updated to reflect revised fluvial modelling, expected to be completed in the future.

6.3 Maintenance of this SFRA

6.3.1 In order for this SFRA to serve as a practical planning tool now and in the future, it is imperative that the SFRA is adopted as a 'living document' and is reviewed periodically in light of emerging policy directives and an improving understanding of flood risk within the Borough.

6.3.2 Appendix D lists a series of recommendations ensuring that the SFRA is kept up-to-date and maintained. This will allow the SFRA to follow emerging best practice and developments in policy and climate change predictions.

References

TfL; Bakerloo Line Extension; https://tfl.gov.uk/corporate/about-tfl/how-we-work/planning-for-the-future/bakerloo-line-extension

BGS; Online Geology Viewer; https://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html

CIRIA; Development and flood risk – guidance for the construction industry (C624D); October 2004; http://www.ciria.org/ItemDetail?iProductCode=C624D&Category=DOWNLOAD

CIRIA; Designing for exceedance in urban drainage – good practice (C635); 2006; https://www.ciria.org/Resources/Free_publications/Designing_exceedance_drainage.aspx

CIRIA; Flood resilience and resistance for critical infrastructure (C688); 2010; http://www.ciria.org/Resources/Free_publications/Flood_resilience.aspx

CIRIA; The SuDS Manual (C753); 2015; https://www.ciria.org/Resources/Free_publications/SuDS_manual_C753.aspx

DEFRA/Environment Agency; Thames river basin district river basin management plan; February 2016; Accessible at: https://www.gov.uk/government/publications/thames-river-basin-district-river-basin-management-plan

Environment Agency; Climate change allowances for Flood Risk Assessment https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Environment Agency; Flood risk assessment: standing advice; April 2012; https://www.gov.uk/guidance/flood-risk-assessment-standing-advice

Environment Agency; Thames Catchment Flood Management Plan; December 2009; https://www.gov.uk/government/publications/thames-catchment-flood-management-plan

Environment Agency; Thames River Basin District Flood Risk Management Plan; March 2016; https://www.gov.uk/government/publications/thames-river-basin-district-flood-risk-management-plan

Environment Agency; Thames River Basin District River Basin Management Plan; December 2015; https://www.gov.uk/government/publications/thames-river-basin-district-river-basin-management-plan

Flood and Water Management Act; 2010; http://www.legislation.gov.uk/ukpga/2010/29/contents

Flood Risk Regulations; 2009; http://www.legislation.gov.uk/uksi/2009/3042/contents/made

Improving the Flood Performance of New Buildings - Flood Resilient Construction; 2007; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7730/flood_performance.pdf

Lewisham Local Flood Risk Management Strategy; June 2015; https://www.lewisham.gov.uk/mayorandcouncil/aboutthecouncil/strategies/Documents/Lewisham%20LFRM%20Strategy%20June%202015.pdf

Lewisham Local Plan – Consultation on main issues; October 2015; https://www.lewisham.gov.uk/myservices/planning/policy/Planning/Pages/Lewisham-Local-Plan-consultation-on-main-issues.aspx

Lewisham Planning validation requirements; 2018; https://www.lewisham.gov.uk/myservices/planning/apply-for-planning-permission/Pages/How-to-submit-a-valid-planning-application.aspx

Lewisham Preliminary Flood Risk Assessment; *Drain London*; July 2011; http://webarchive.nationalarchives.gov.uk/20140328171253/http:/cdn.environment-agency.gov.uk/flho1211bvkr-e-e.pdf

Lewisham Preliminary Flood Risk Assessment Addendum; December 2017; https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/698650/PFRA_London_Borough_of_Lewisham_2017.pdf

Lewisham River Corridor Improvement Plan; September 2015; https://www.lewisham.gov.uk/myservices/planning/policy/LDF/SPDs/Pages/River-corridor-improvement-plan.aspx

Lewisham Surface Water Management Plan; *Drain London*; May 2011; http://councilmeetings.lewisham.gov.uk/documents/s3731/Appendix%202%20Surface%20Water%20Management%20Plan.pdf

London Plan (current); 2016; https://www.london.gov.uk/what-we-do/planning/london-plan/current-london-plan

London Plan (new); August 2018; https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/download-draft-london-plan-0

London Plan; Supplementary Planning Guidance for Sustainable Design and Construction; 2014; https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/supplementary-planning-guidance/sustainable-design-and

Met Office, UK Climate Projections (2009) http://ukclimateprojections.metoffice.gov.uk/

National Flood and Coastal Erosion Risk Management Strategy for England; May 2011; https://www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england

NPPF; 2012; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf

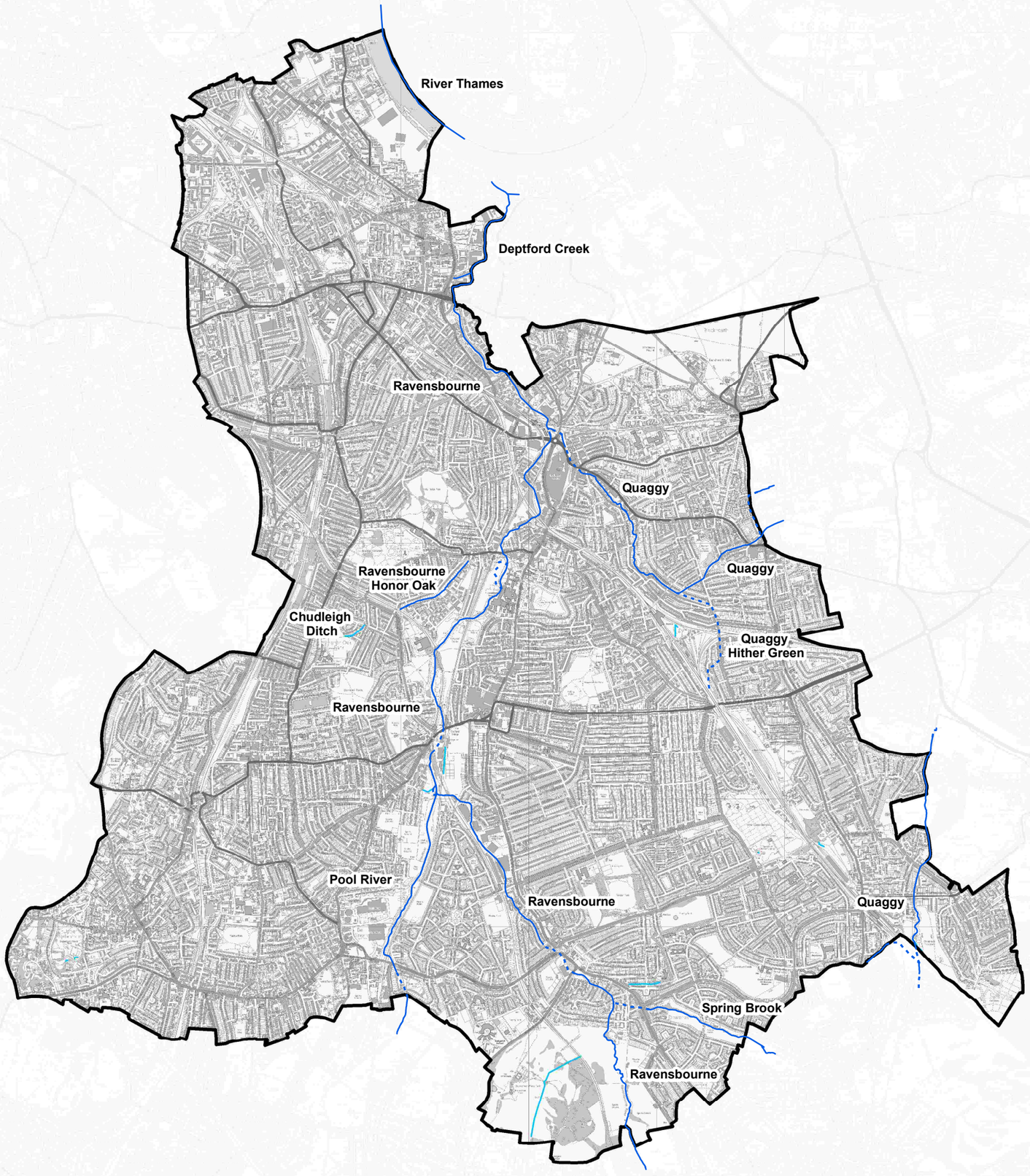
ONS; Census Data for Population; 2011; Accessible at: https://www.ons.gov.uk/census/2011census

PPG; 2012; https://www.gov.uk/government/collections/planning-practice-guidance

Thames Estuary 2100 Plan; March 2017; https://www.gov.uk/government/publications/thames-estuary-2100-te2100

Appendix A - Mapping

List of Maps



THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT

Legend

- Lewisham Borough Boundary
- Main River - Culvert
- Main River
- Ordinary Watercourse

Purpose of Issue: Final

Client: Lewisham Council

Project Title: Lewisham SFRA

Drawing Title: Detailed River Network

Drawn	Checked	Approved	Date
FVV	SM	GP	08/03/2019

AECOM Internal Project No.	Scale @ A3
60580647	1:35,000

AECOM
Sunley House
4 Bedford Park
Croydon, CR0 2AP
Telephone 020 8639 3500

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Drawing Number	Rev
Map 001	1

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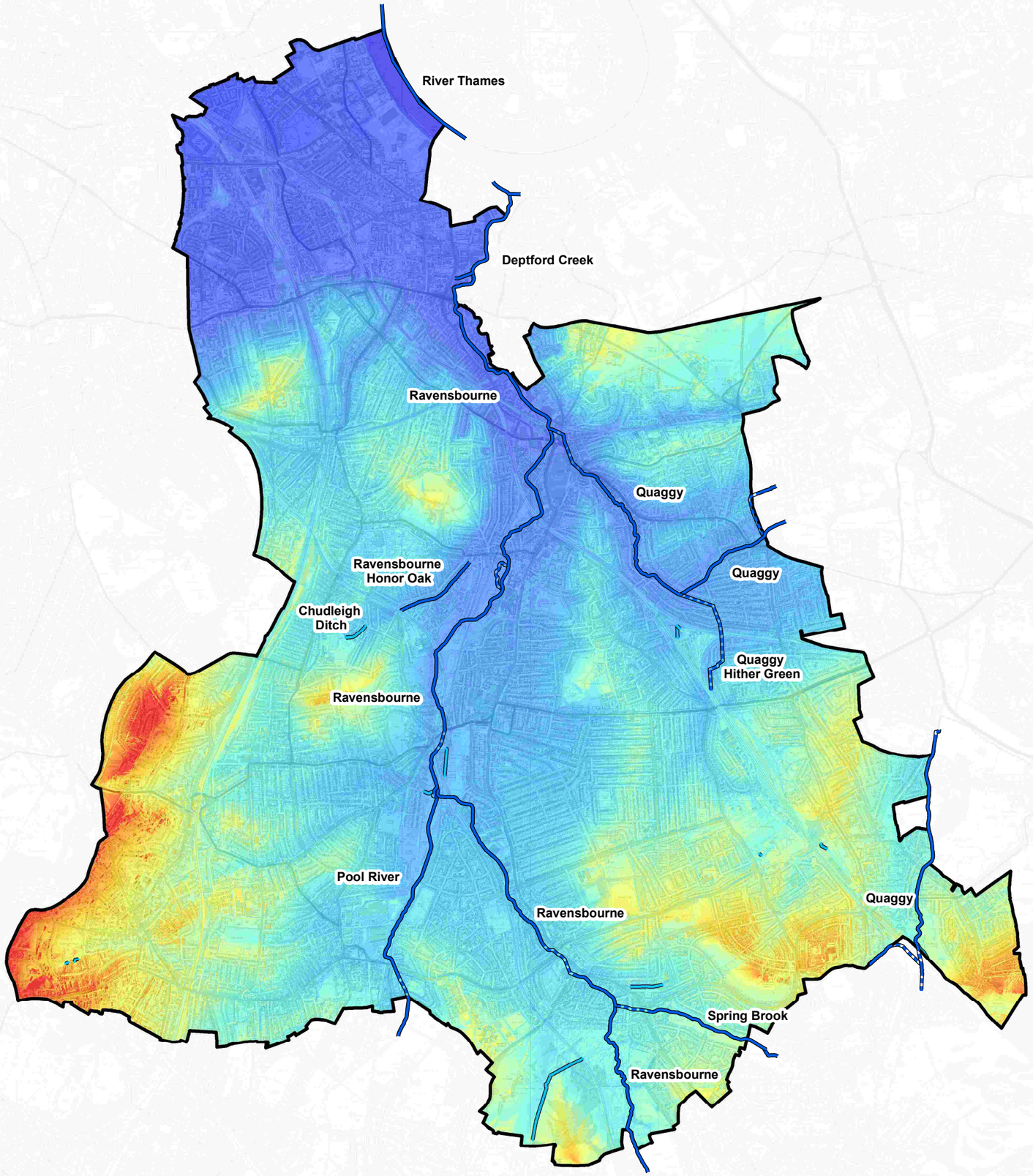

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Legend

- Lewisham Borough Boundary
- Main River - Culvert
- Main River
- Ordinary Watercourse

Ground Elevation (LiDAR m AOD)

High : 115
100
85
70
55
40
25
10
Low : -5

N

Purpose of Issue: Final

Client: Lewisham Council

Project Title: Lewisham SFRA

Drawing Title: Topography

Drawn	Checked	Approved	Date
FVV	SM	GP	23/10/2018

AECOM Internal Project No.: 60580647

Scale @ A3: 1:35,000

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Drawing Number: **Map 002**

Rev: **1**

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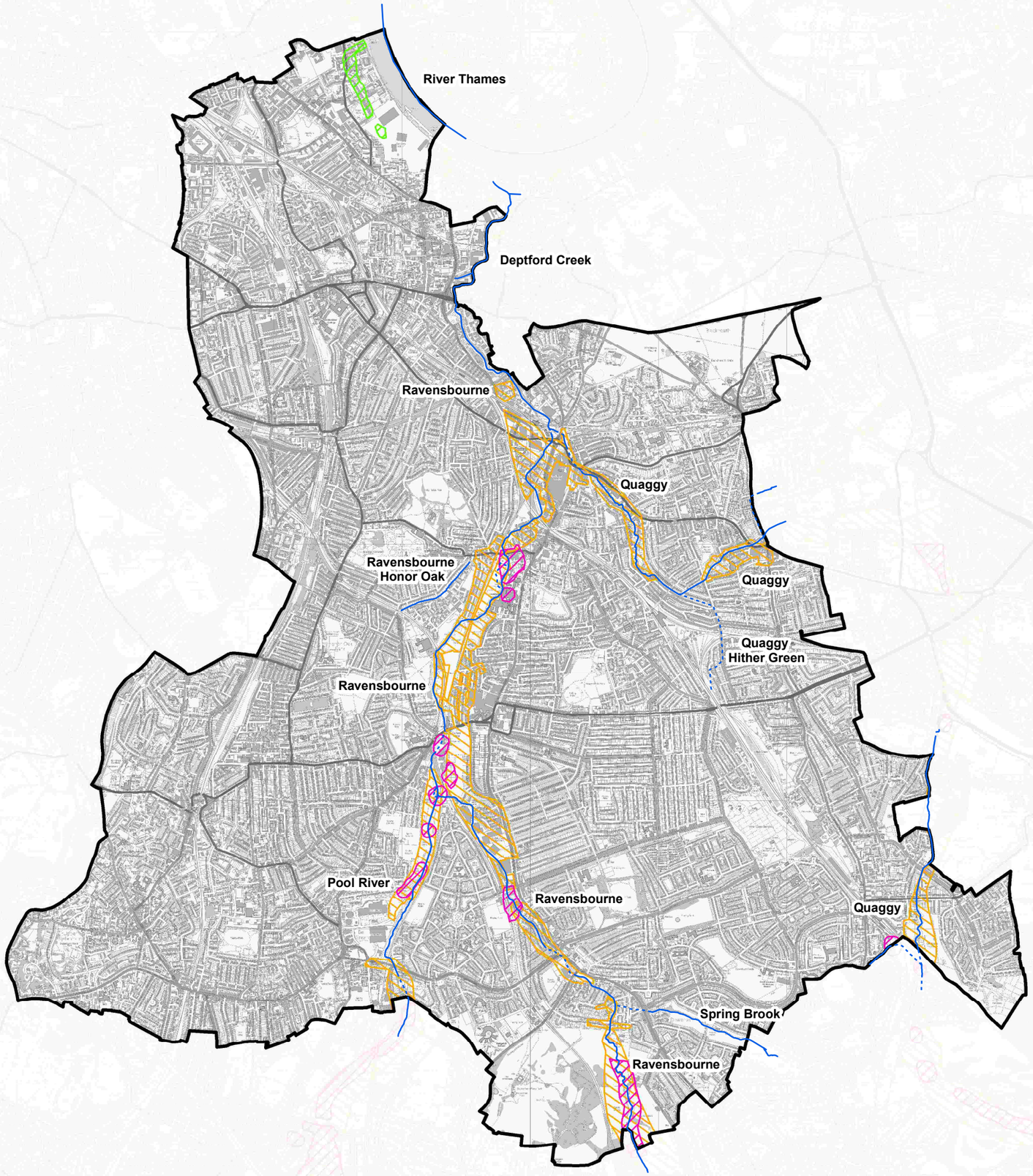

THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT

Legend

- Lewisham Borough Boundary
- Main River - Culvert
- Main River

Flooding History

- 1928 Flood Extent
- November 1965 Flood Extent
- September 1968 Flood Extent

Purpose of Issue

Final

Client

Lewisham Council

Project Title

Lewisham SFRA

Drawing Title

Historic Fluvial Flood Map

Drawn	Checked	Approved	Date
FVV	SM	GP	08/03/2019

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60580647	1:35,000

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Drawing Number	Rev
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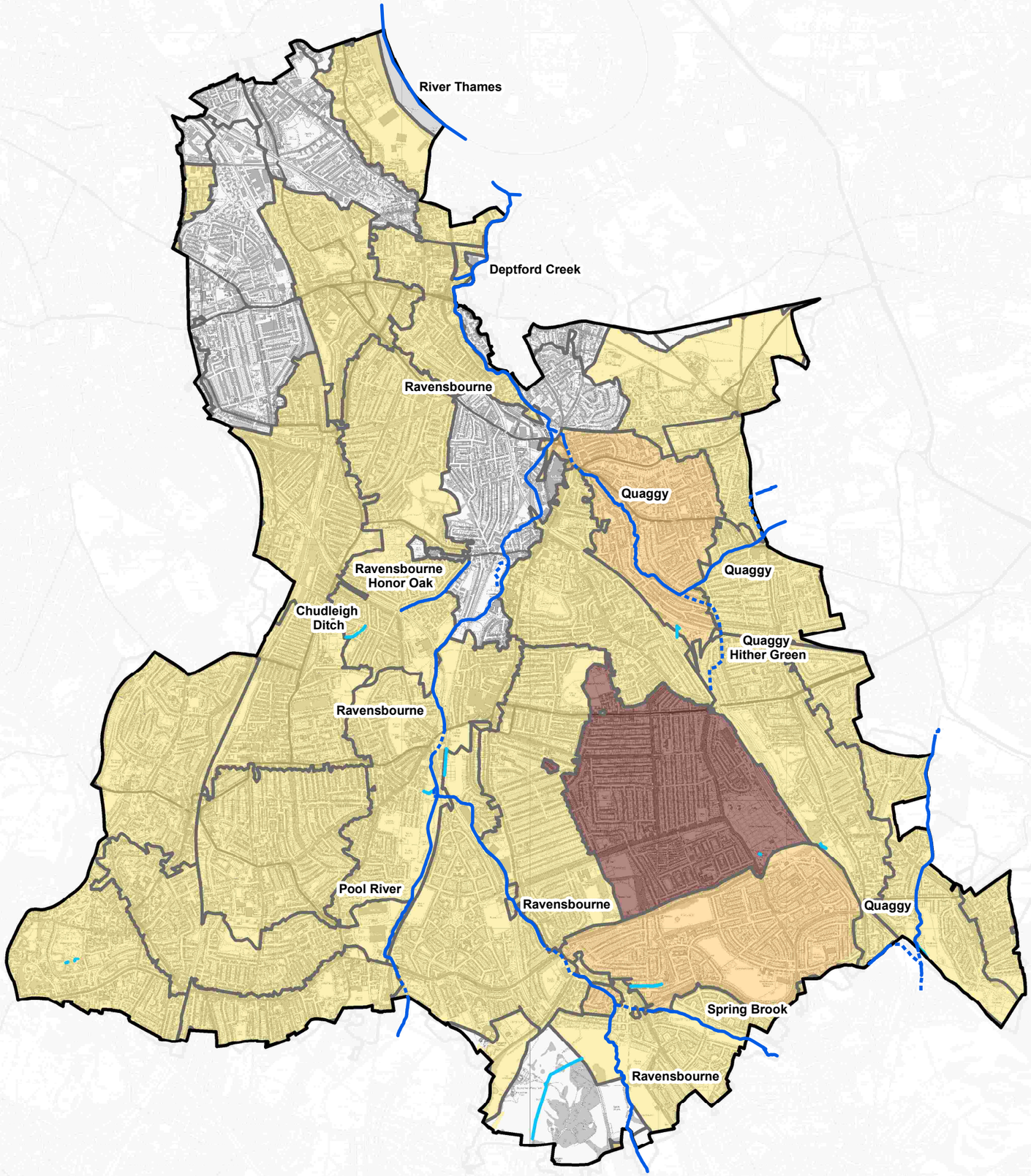

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Legend

- Main River - Culvert
- Main River
- Lewisham Borough Boundary
- Ordinary Watercourse

Sewer flooding incidents per postcode

- 0
- 1 to 10
- 11 to 20
- 21 to 30
- 31 to 40
- 41 to 50
- 51 to 60

Purpose of Issue: Final

Client: Lewisham Council

Project Title: Lewisham SFRA

Drawing Title: Records of Sewer Flooding

Drawn	Checked	Approved	Date
FVV	SM	GP	18/10/2018

AECOM Internal Project No.	Scale @ A3
60580647	1:35,000

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Drawing Number	Rev
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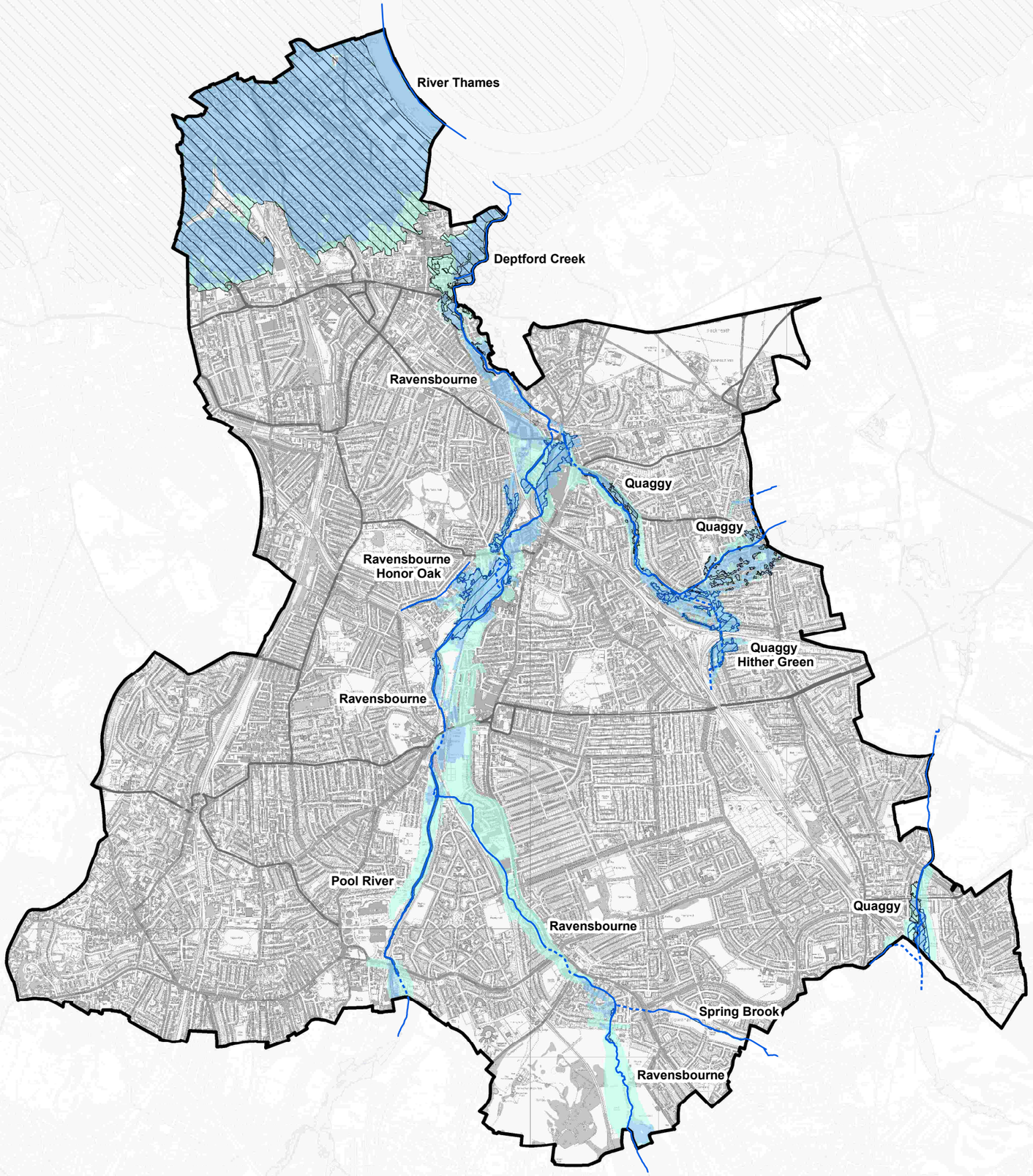

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Legend

- Lewisham Borough Boundary
- Main River - Culvert
- Main River
- Areas benefiting from Flood Defences

Flood Zones

- Flood Zone 3b
- Flood Zone 3
- Flood Zone 2

Purpose of Issue: Final

Client: Lewisham Council

Project Title: Lewisham SFRA

Drawing Title: Flood Map for Planning

Drawn	Checked	Approved	Date
FVV	SM	GP	08/03/2019

AECOM Internal Project No.	Scale @ A3
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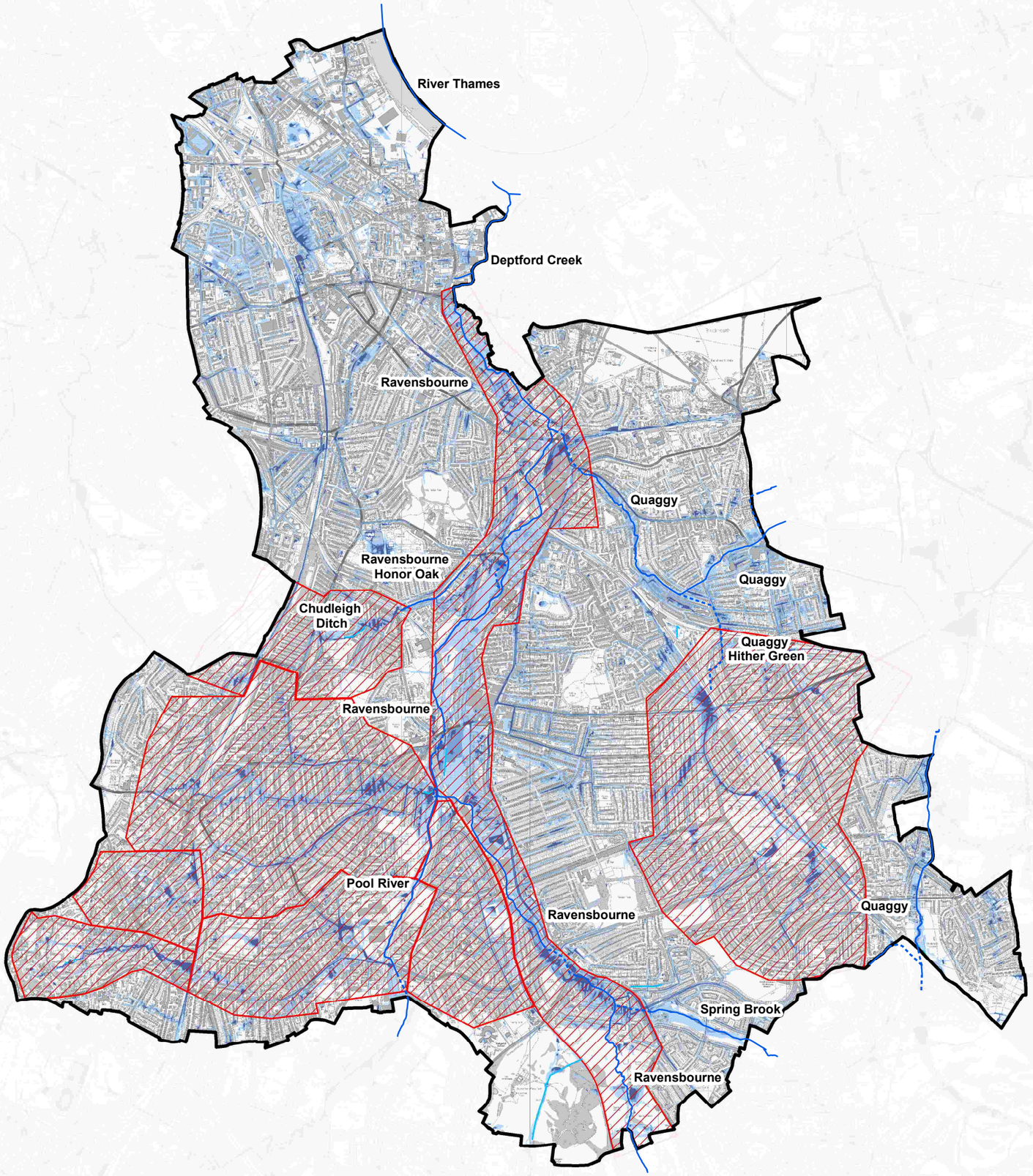

THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT

Legend

- Lewisham Borough Boundary
- Main River - Culvert
- Main River
- Ordinary Watercourse
- Local Critical Drainage

Surface water flood extents

- 3.33% AEP
- 1% AEP
- 0.1% AEP

Purpose of Issue

Final

Client

Lewisham Council

Project Title

Lewisham SFRA

Drawing Title

Flood Map for Surface Water

Drawn	Checked	Approved	Date
FVV	SM	GP	08/03/2019

AECOM Internal Project No.	Scale @ A3
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Drawing Number	Rev
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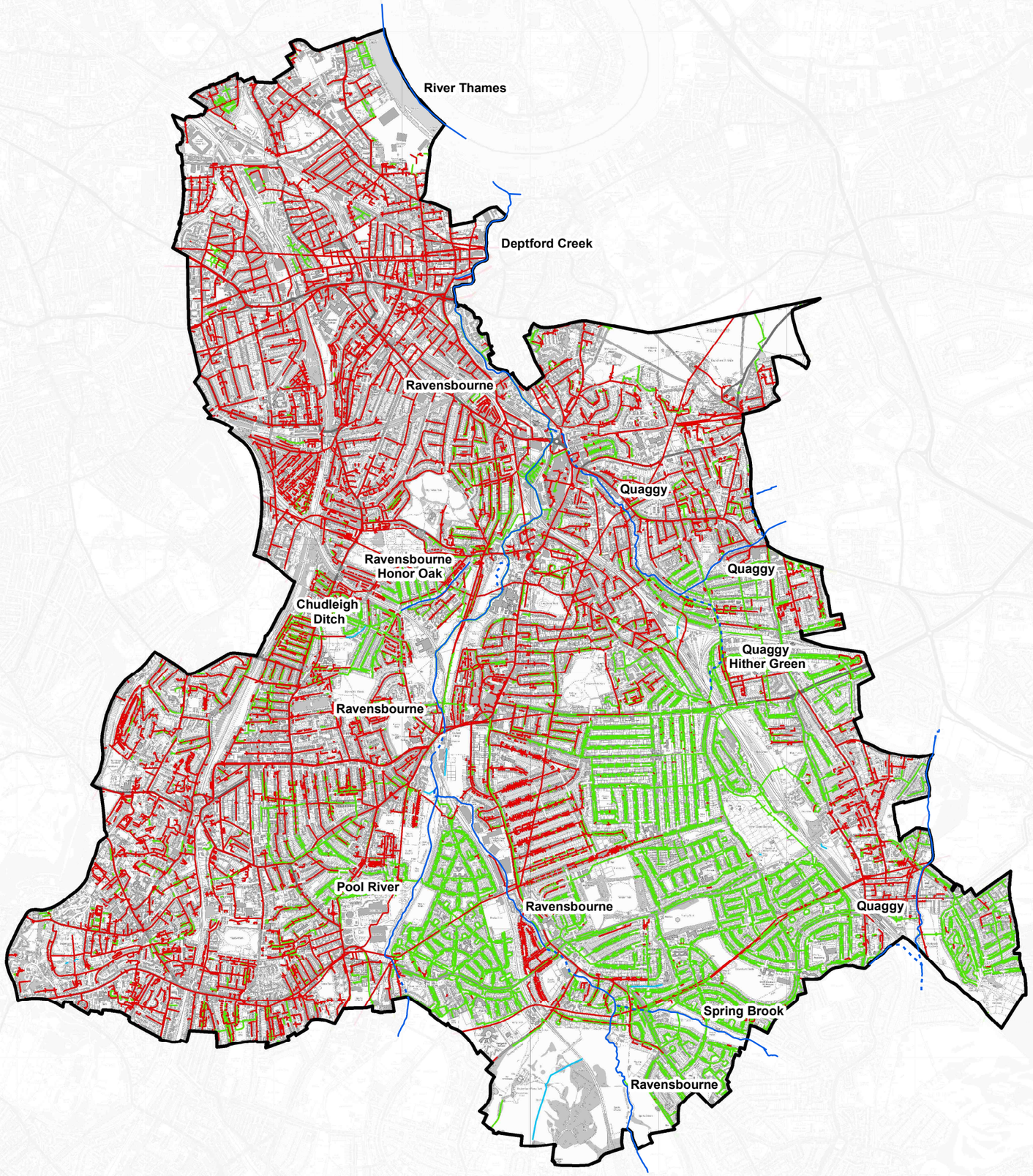

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Legend

- Lewisham Borough Boundary
- Main River - Culvert
- Main River
- Ordinary Watercourse

Sewer Network

- Combined Sewers
- Surface Water Sewers

Purpose of Issue: Final

Client: Lewisham Council

Project Title: Lewisham SFRA

Drawing Title: Sewer Network

Drawn	Checked	Approved	Date
FVV	SM	GP	08/04/2019

AECOM Internal Project No.	Scale @ A3
60580647	1:35,000

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Drawing Number	Rev
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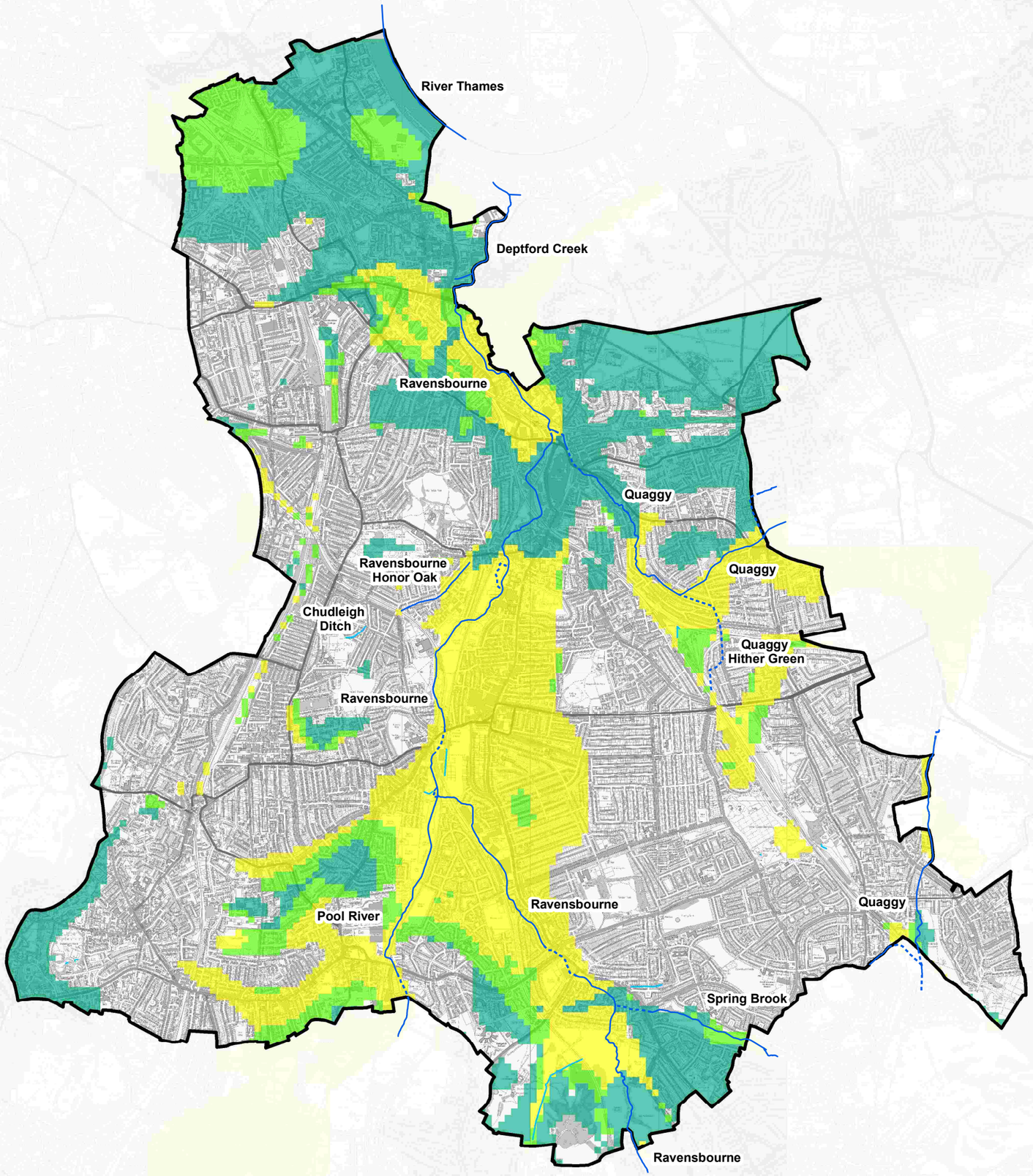

THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT

Legend

- Lewisham Borough Boundary
- Main River - Culvert
- Main River
- Ordinary Watercourse

Risk of Groundwater Flooding

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

Purpose of Issue

Final

Client

Lewisham Council

Project Title

Lewisham SFRA

Drawing Title

Susceptibility to Groundwater Flooding

Drawn	Checked	Approved	Date
FVV	SM	GP	08/03/2019

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Drawing Number	Rev
Map 007	1

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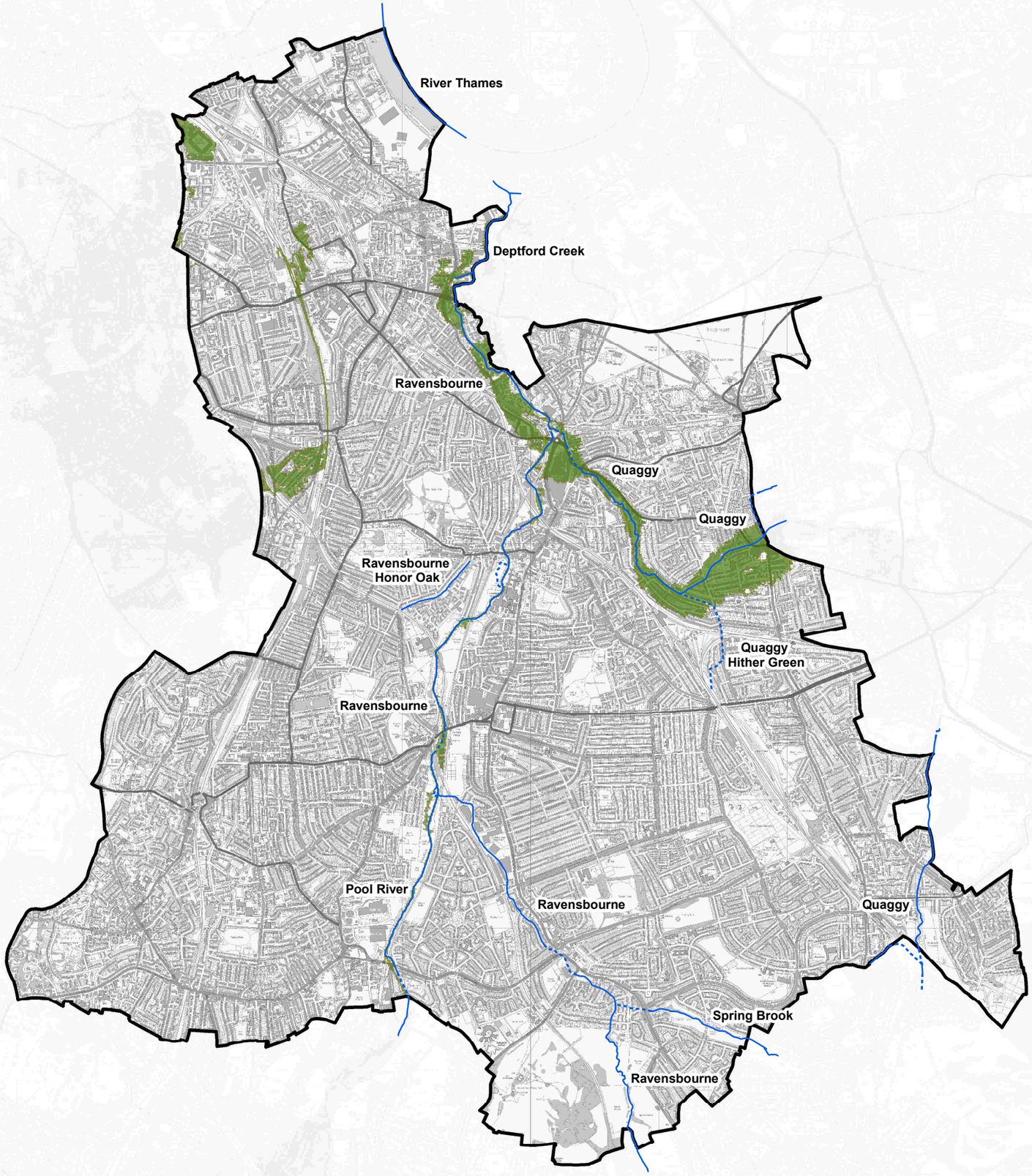

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Legend

- Lewisham Borough Boundary
- Main River - Culvert
- Main River
- Reservoir Flood Extents

Purpose of Issue: Final

Client: Lewisham Council

Project Title: Lewisham SFRA

Drawing Title: Flood Risk from Reservoirs

Drawn	Checked	Approved	Date
FVV	SM	GP	08/03/2019

AECOM Internal Project No.	Scale @ A3
60580647	1:35,000

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Drawing Number: **Map 008**

Rev: **1**

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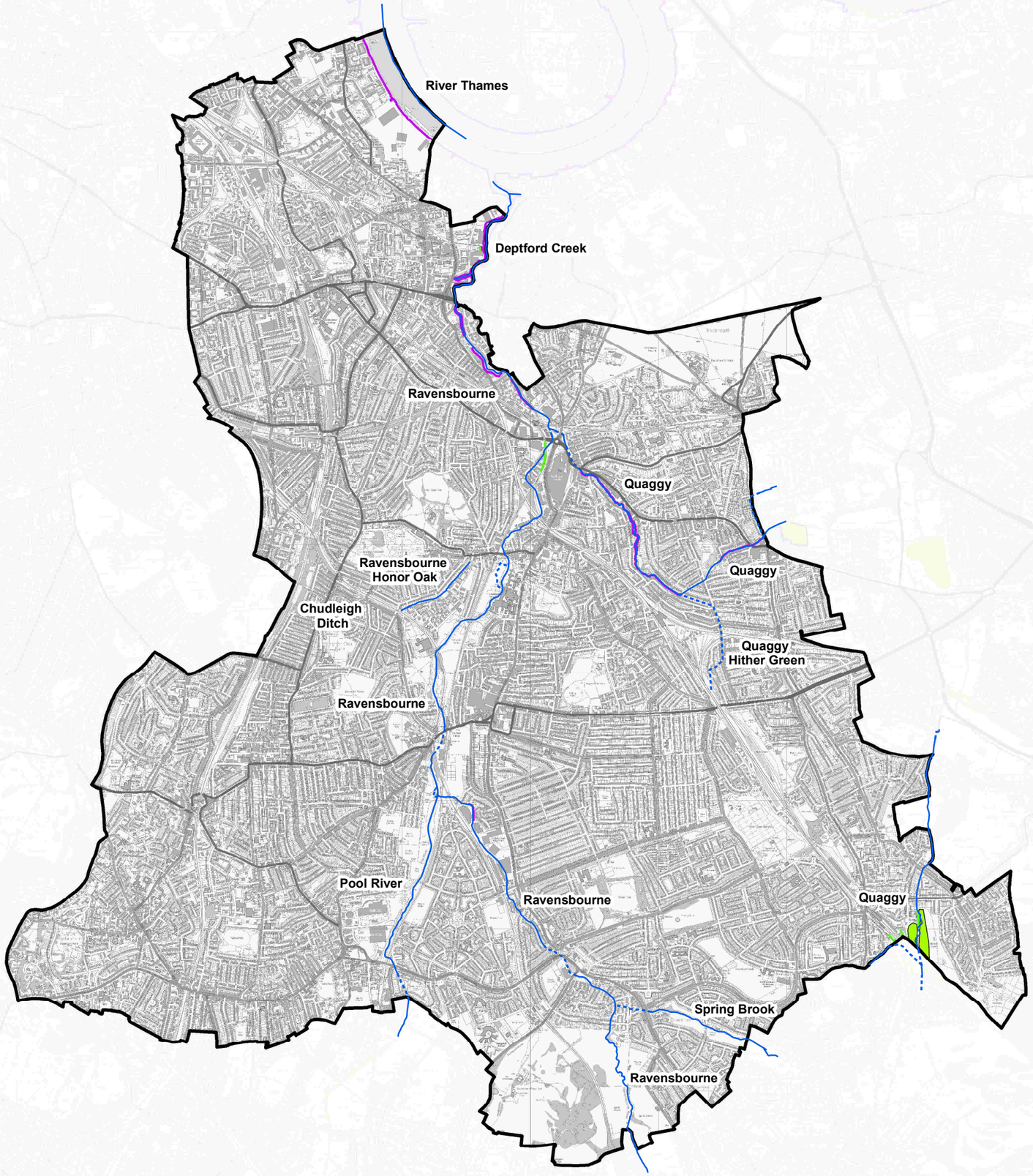

THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT

Legend

- Lewisham Borough Boundary
- Main River - Culvert
- Main River
- Flood Storage Areas

Flood defence - asset types

- Embankment
- Wall

Purpose of Issue

Final

Client

Lewisham Council

Project Title

Lewisham SFRA

Drawing Title

Flood Risk Management Infrastructure

Drawn	Checked	Approved	Date
FVV	SM	GP	08/03/2019

AECOM Internal Project No.	Scale @ A3
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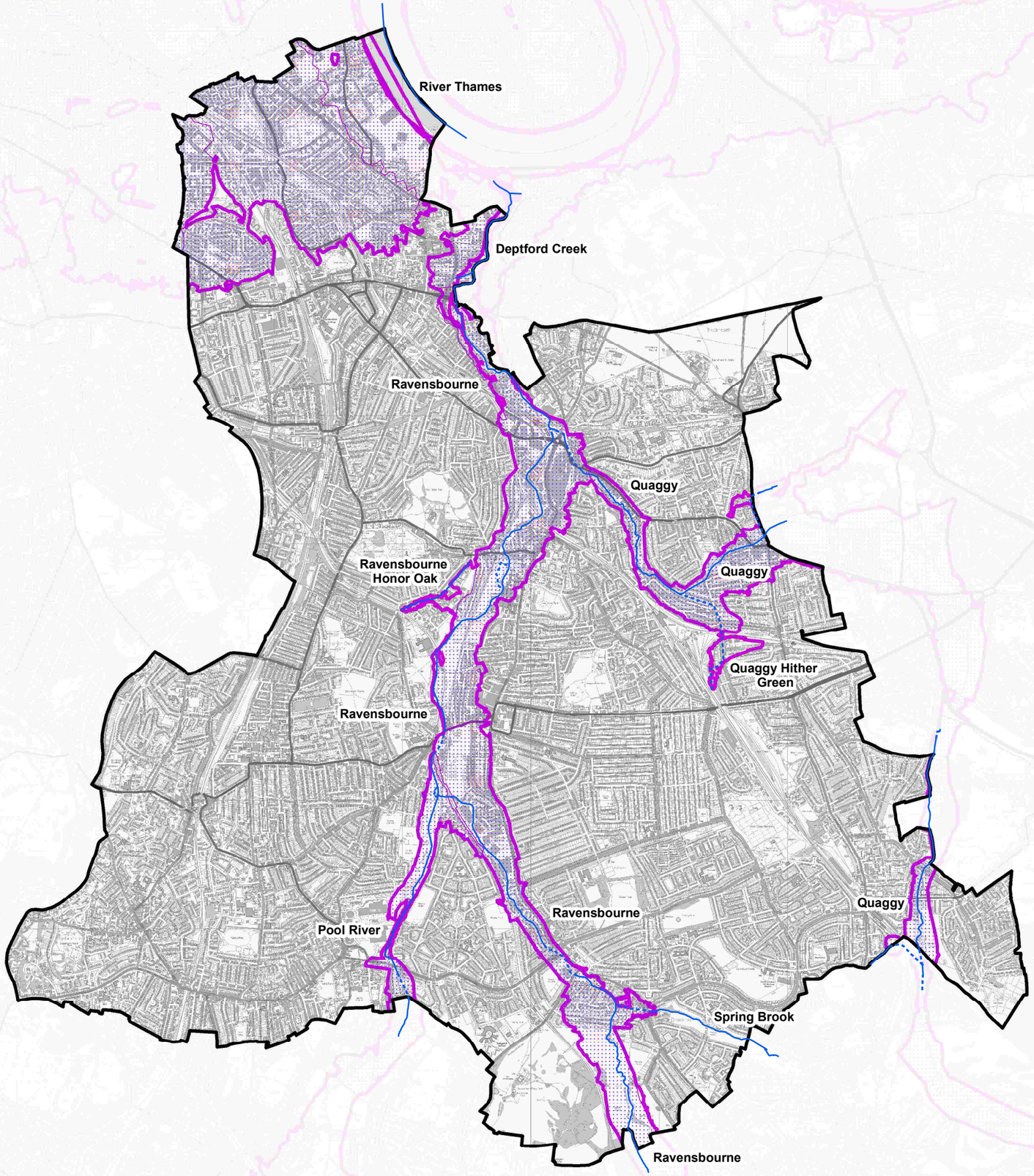
Drawing Number	Rev
Map 009	**1**

File Name:\\Eu.aecomnet.com\emia\UK\UKCRD1\Jobs\PR-311959_Lewisham_SFRA_Update\900_CAD_GIS\940_GIS\6.1Maps\Map009_Flood Risk Management Infrastructure.mxd



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Legend

- Lewisham Borough Boundary
- Main River - Culvert
- Main River
- Flood Warning Area
- Flood Alert Area

Purpose of Issue

Final

Client

Lewisham Council

Project Title

Lewisham SFRA

Drawing Title

Flood Alert and Warning Areas

Drawn	Checked	Approved	Date
FVV	SM	GP	14/03/2019

AECOM Internal Project No.	Scale @ A3
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Drawing Number

Map 010

Rev

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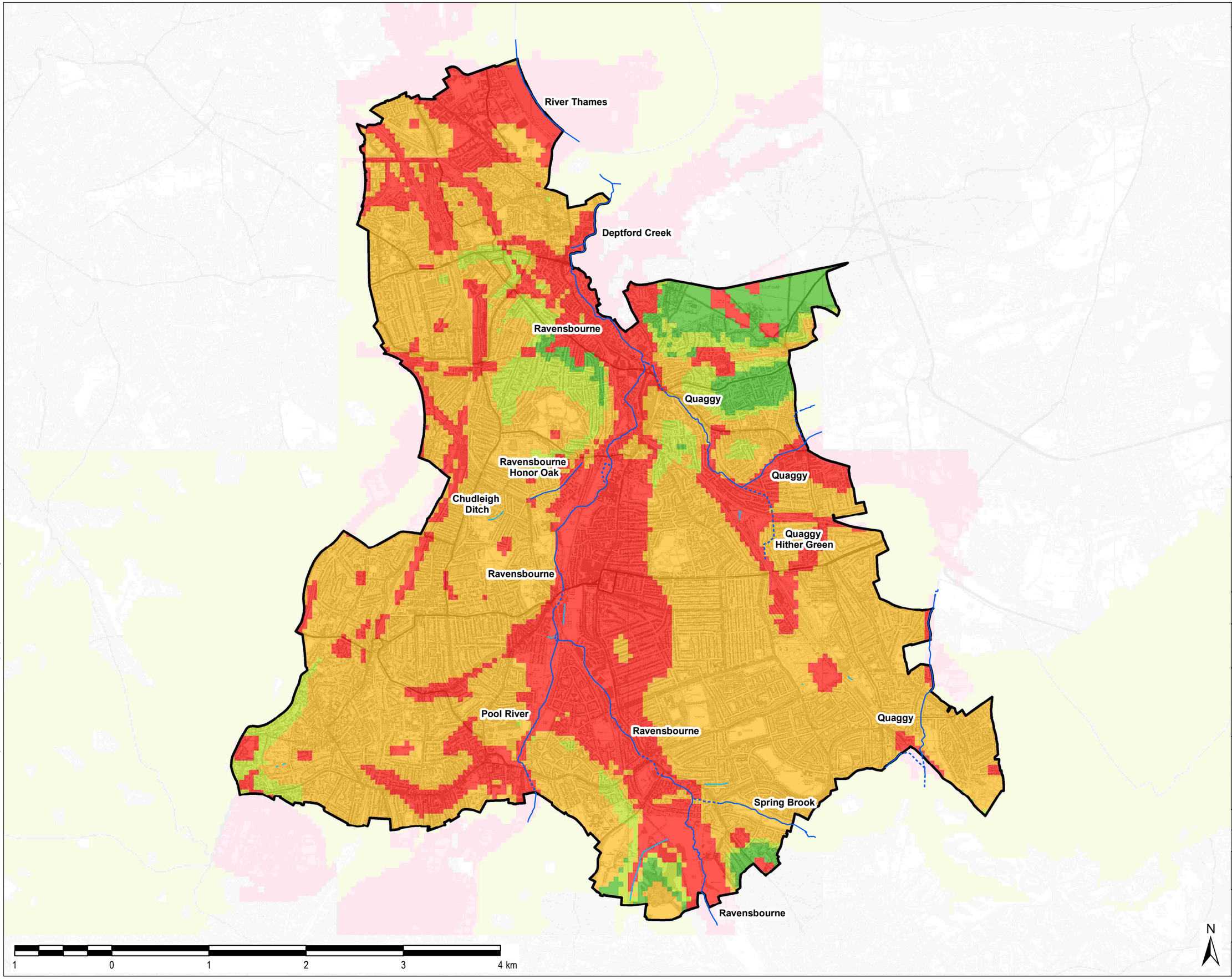

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Legend

- Lewisham Borough Boundary
- Main River - Culvert
- Main River
- Ordinary Watercourse

SuDS Infiltration Suitability

- Highly compatible
- Probably compatible
- Potentially suitable for bespoke design
- Very significant constraints indicated

Purpose of Issue: Final

Client: Lewisham Council

Project Title: Lewisham SFRA

Drawing Title: SuDS Infiltration Suitability

Drawn	Checked	Approved	Date
FVV	SM	GP	08/03/2019

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Drawing Number	Rev
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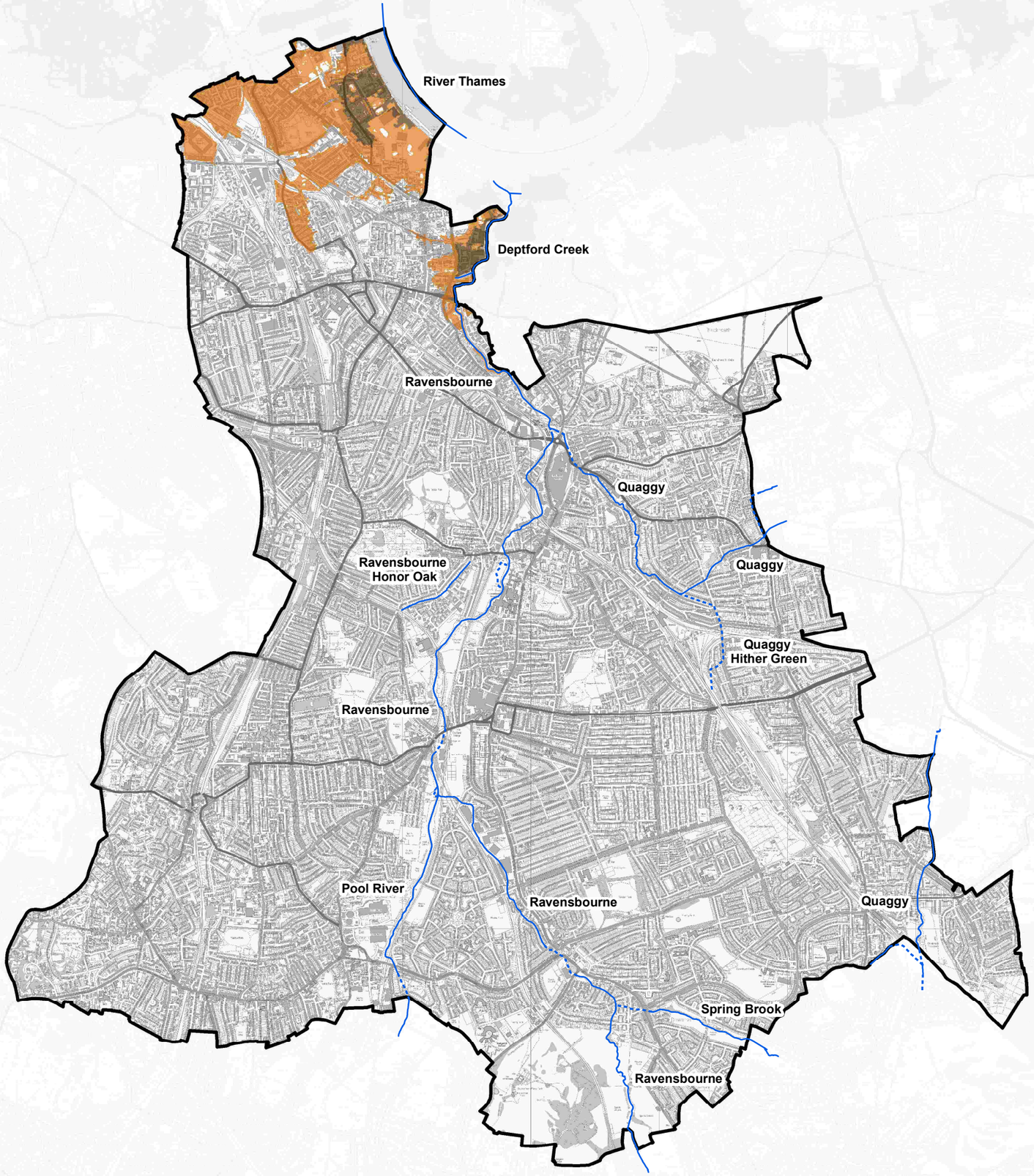

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Legend

- Lewisham Borough Boundary
- Main River - Culvert
- Main River

Tidal Breach Flood Extent

- 2005
- 2100

Purpose of Issue

Final

Client

Lewisham Borough Council

Project Title

Lewisham SFRA

Drawing Title

Thames Tidal Upriver Breach Inundation 2017 Flood Extents

Drawn	Checked	Approved	Date
FVV	SM	GP	06/03/2019

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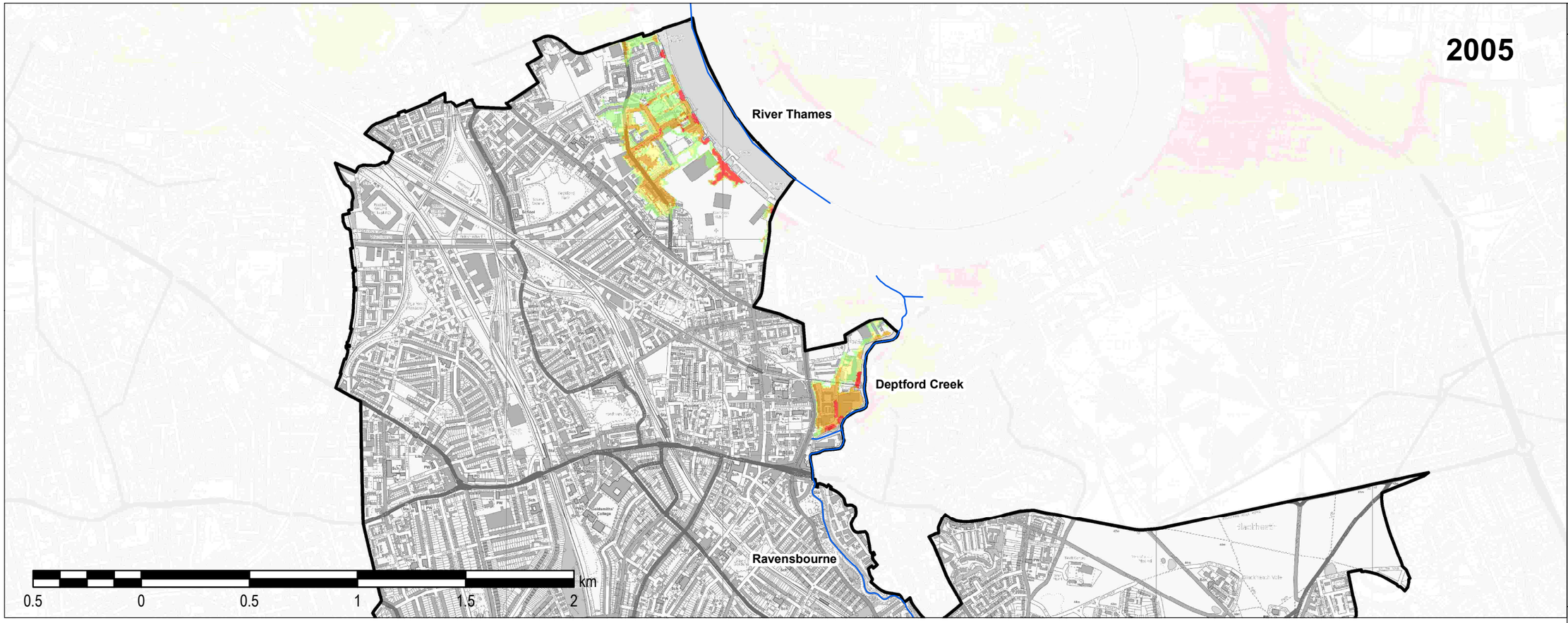

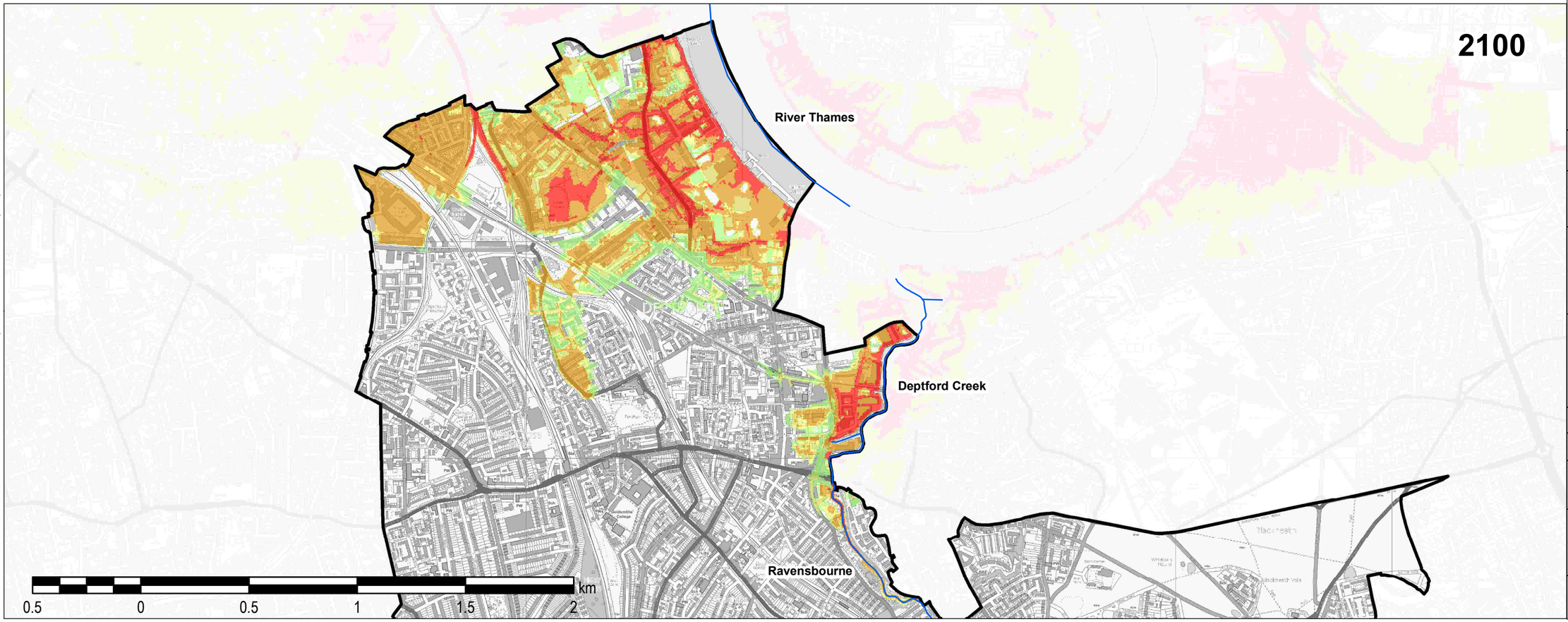

THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT

Legend

- Lewisham Borough Boundary
- Main River - Culvert
- Main River

Maximum Hazard

- Less than 0.75 (Low Hazard)
- Between 0.75 and 1.25 (Danger for Some)
- Between 1.25 and 2.00 (Danger for Most)
- Greater than 2.00 (Danger for All)

Purpose of Issue: Final

Client: Lewisham Council

Project Title: Lewisham SFRA

Drawing Title: Thames Tidal Upriver Breach Inundation 2017 Flood Hazard

Drawn	Checked	Approved	Date
FVV	SM	GP	08/03/2019

AECOM Internal Project No.	Scale @ A3
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Drawing Number	Rev
Map 012b	1

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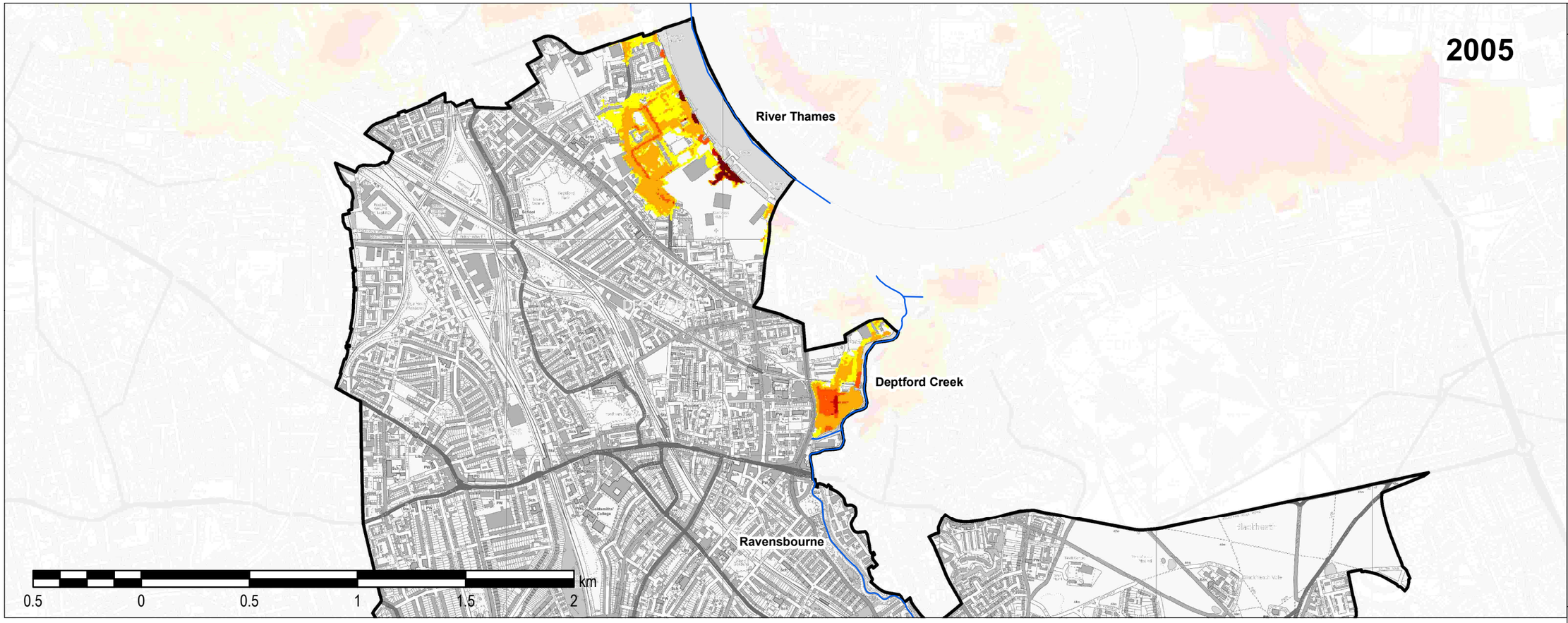

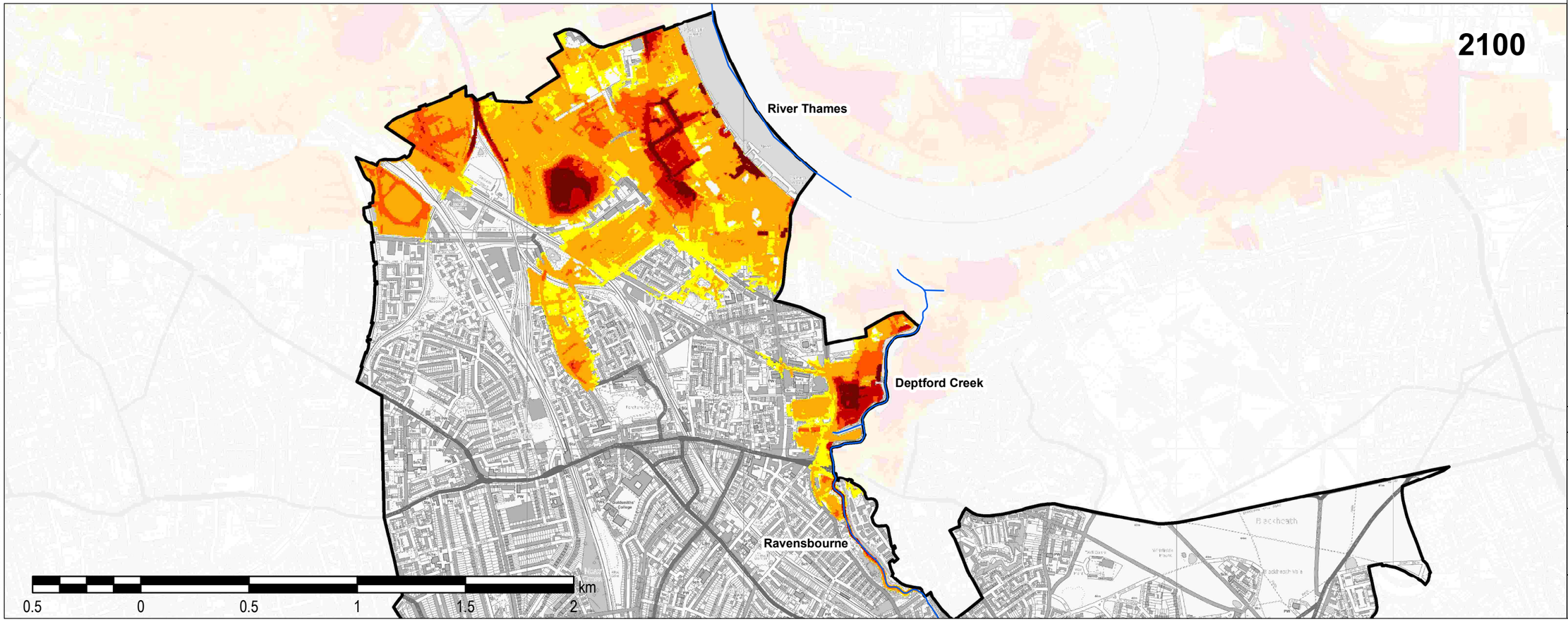

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Legend

- Lewisham Borough Boundary
- Main River - Culvert
- Main River

Flood Depth (m)

- 0 - 0.25
- 0.25 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

Purpose of Issue

Final

Client

Lewisham Council

Project Title

Lewisham SFRA

Drawing Title

Thames Tidal Upriver Breach Inundation 2017 Flood Depth

Drawn	Checked	Approved	Date
FVV	SM	GP	08/03/2019

AECOM Internal Project No.	Scale @ A3
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Map 012c	1

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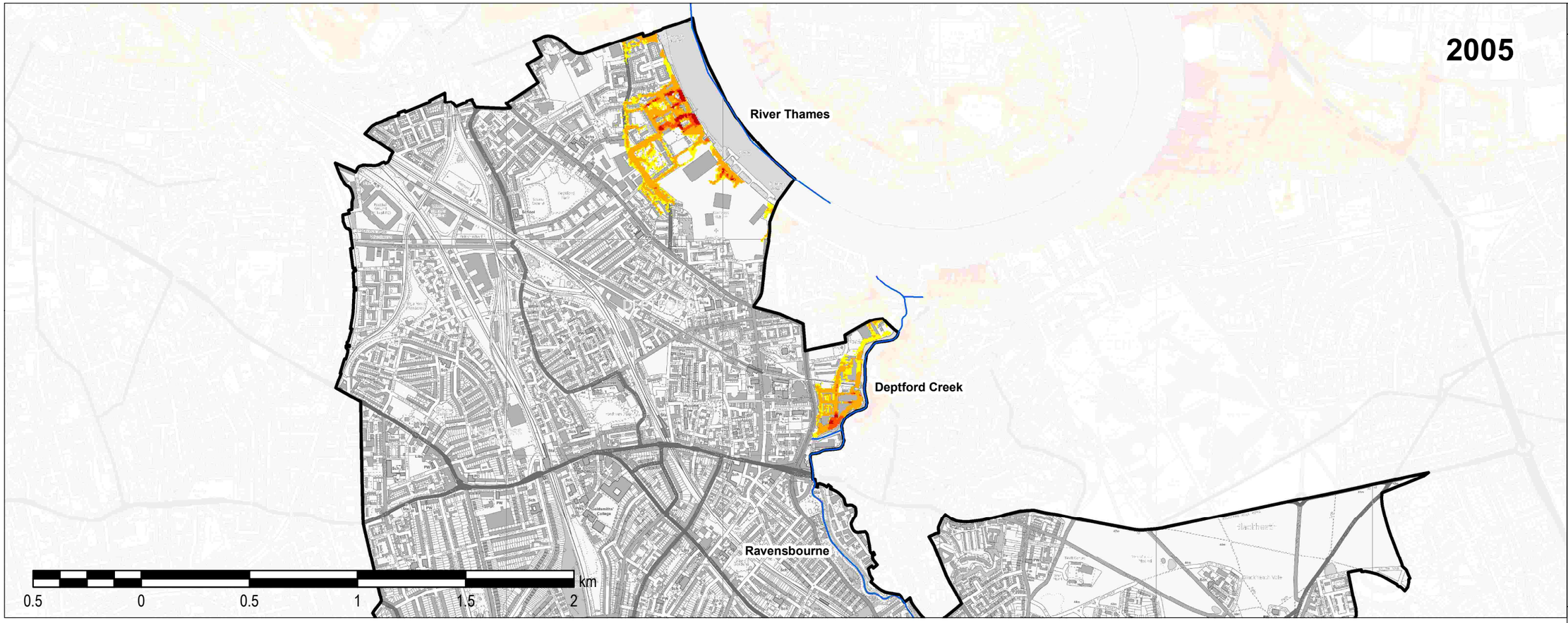

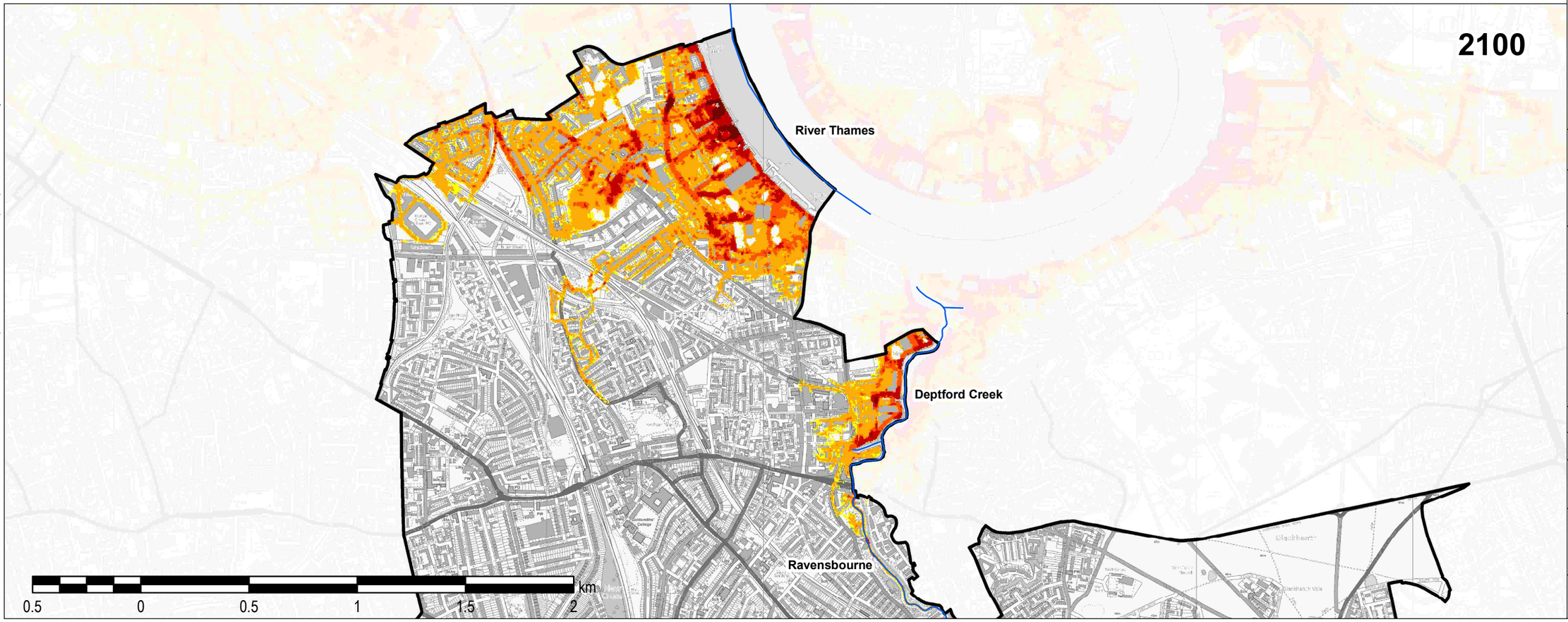

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Legend

- Lewisham Borough Boundary
- Main River - Culvert
- Main River

Velocity (m/s)

- 0 - 0.3
- 0.3 - 1.0
- 1.0 - 1.5
- 1.5 - 2.5
- > 2.5

Purpose of Issue: Final

Client: Lewisham Council

Project Title: Lewisham SFRA

Drawing Title: Thames Tidal Upriver Breach Inundation 2017 Flood Velocity

Drawn	Checked	Approved	Date
FVV	SM	GP	08/03/2019

AECOM Internal Project No.	Scale @ A3
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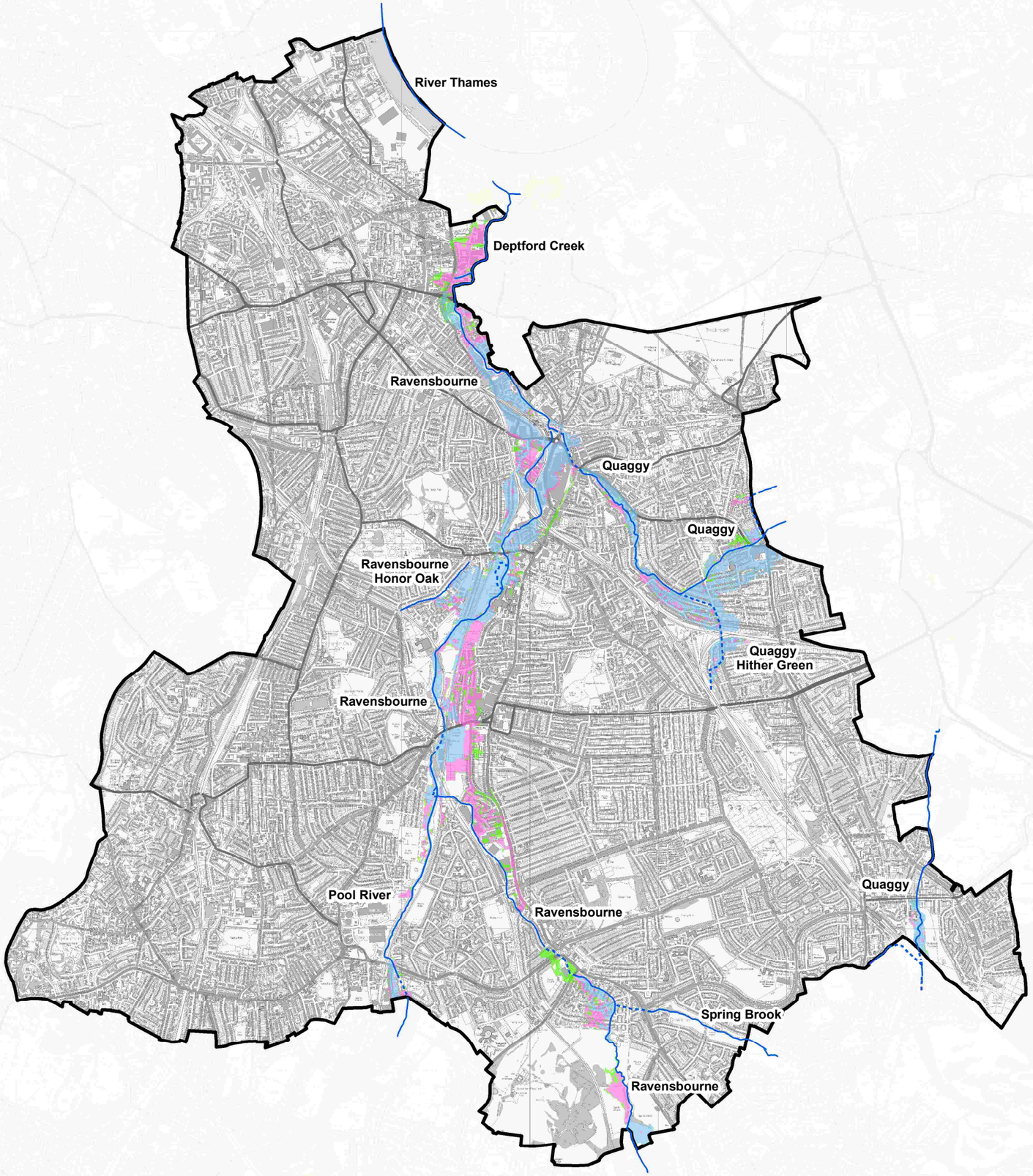

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Legend

- Lewisham Borough Boundary
- Main River - Culvert
- Main River

1% AEP with an allowance for Climate Change

- 1% AEP Modelled Flood Extent (Flood Zone 3)
- 25% increase in Peak River Flow
- 35% increase in Peak River Flow

Purpose of Issue: Final

Client: Lewisham Council

Project Title: Lewisham SFRA

Drawing Title: Fluvial Flooding Extents with an allowance for Climate Change

Drawn	Checked	Approved	Date
FVV	SM	GP	08/03/2019

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Drawing Number	Rev
Map 013	**1**

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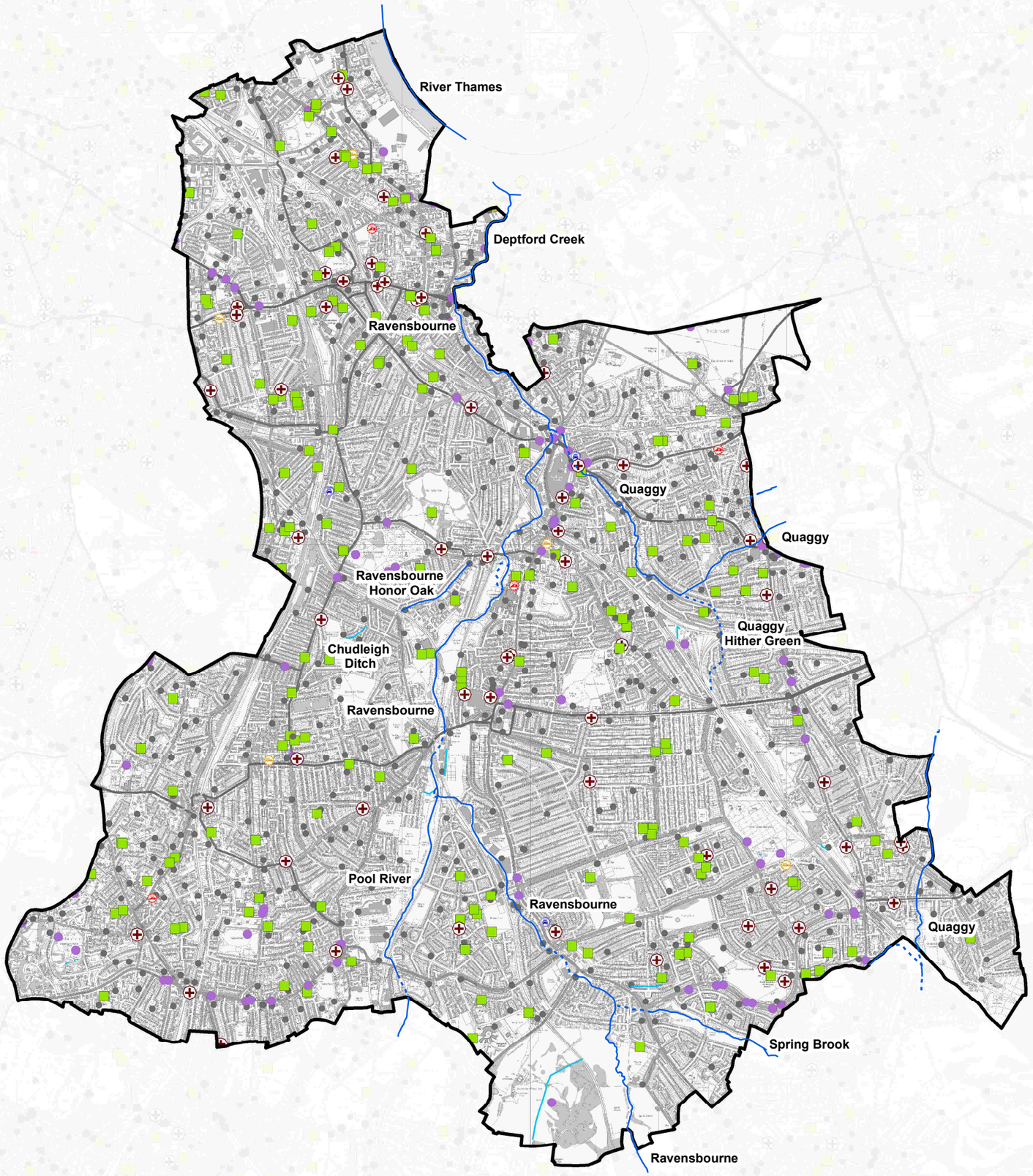

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Legend

- Lewisham Borough Boundary
- Main River - Culvert
- Main River
- Ordinary Watercourse

National Receptor Database

- Emergency / Rescue Service
- Public Transport Stations
- Education Facility
- Gas and Electric Infrastructure
- Fire Station
- Medical Facility
- Police Station

Purpose of Issue: Final

Client: Lewisham Council

Project Title: Lewisham SFRA

Drawing Title: Vulnerable Sites

Drawn	Checked	Approved	Date
FVV	SM	GP	08/03/2019

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Drawing Number	Rev
Map 014	**1**

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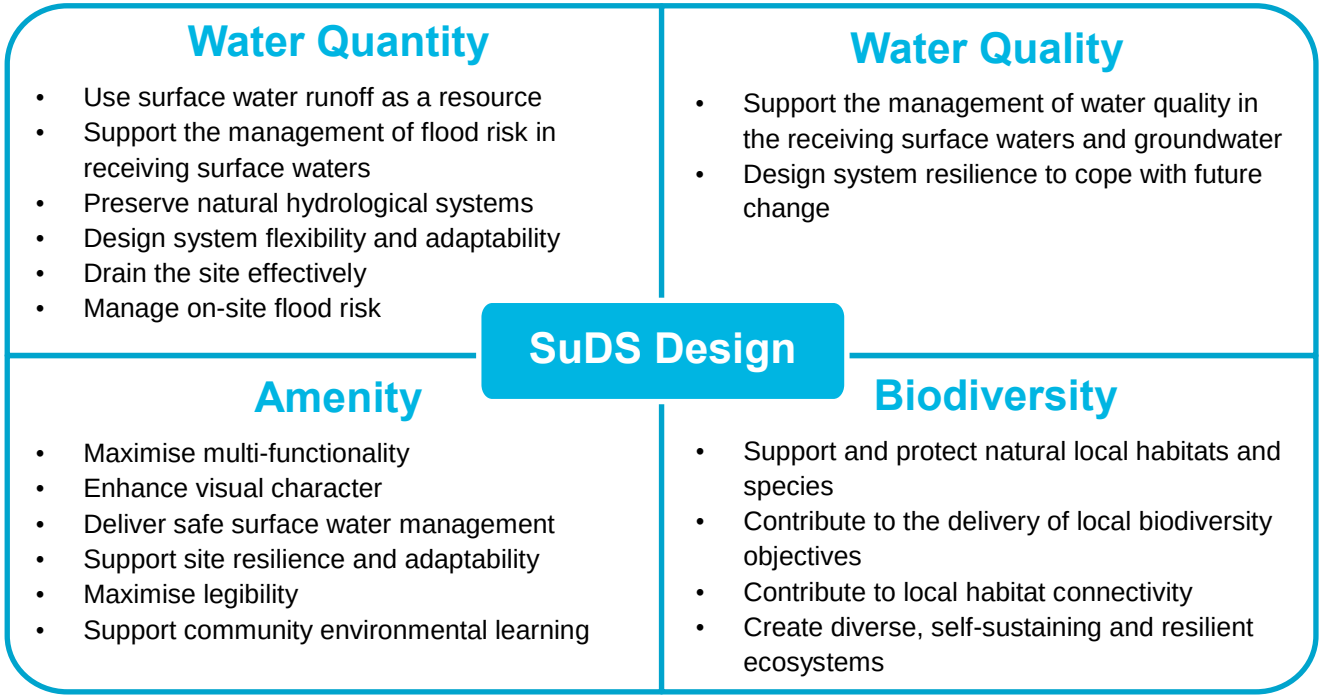
Appendix B - SuDS Guidance

Guidance for SuDS in Lewisham

Introduction

Sustainable Drainage Systems (SuDS) are designed to maximise the opportunities and benefits of surface water management. This is particularly important in increasingly urban areas where there is less permeable ground available for natural infiltration and evapotranspiration, leading to increased rainfall runoff from impermeable surfaces and contributing to flooding, pollution and erosion. SuDS can counteract these impacts on the water cycle and additionally enhance urban spaces by making them more vibrant, attractive, sustainable and resilient, with improved air and water quality, microclimate and amenity.

There are four main categories of benefits which can be achieved through high quality SuDS design, as summarised below:



The installation of high quality and multi-functional SuDS is most likely to be achieved through early and multi-disciplinary consideration of surface water management. Ideally this should be integrated within the overall site planning and design, including early consultation with relevant stakeholders and consideration of ongoing operational and maintenance responsibilities.

SuDS design should be based around the general principles of:

- Harnessing surface water runoff as a resource;
- Managing rainfall close to where it falls;
- Managing runoff on the surface;
- Promoting infiltration of rainwater into the ground;
- Encouraging evapotranspiration;
- Attenuating runoff to mimic natural flow characteristics;
- Reducing contamination of runoff through pollution prevention and controlling the runoff at source; and
- Treating runoff to reduce the risk of urban contaminants causing environmental pollution.

The following sections provide an overview of common types of SuDS measures, which may be suitable for installation within the Borough. Generally, SuDS should not be thought of as isolated features, but delivered as an interconnected sequential train of surface water management and treatment.

Developers within Lewisham should make reference to the Council's Validation Guidance and Local Information Requirements for Planning Applications, which provides local advice regarding SuDS and summarises the local approval process.

Further information on the philosophy of SuDS and detailed guidance on design, installation and maintenance, is provided in the CIRIA SuDS Manual (2015) and other sources described at the end of this document.

Swale

Swales are vegetated shallow depressions designed to convey and filter water. These can be 'wet' where water gathers above the surface, or 'dry' where water gathers in a gravel layer beneath the ground level. They have the ability to remove pollutants and can be used to channel surface water to the next stage of a treatment train. Check dams can be constructed along their route to control flow velocities, and promote infiltration and sediment deposition.

Advantages	Disadvantages
• Encourages evapotranspiration and infiltration of runoff • Provides attenuation to reduce peak run-off rates • Relatively simple to incorporate into landscaping • Effective removal of urban pollutants • Minimal maintenance requirements • Aesthetically pleasing • Good community acceptability	• Careful consideration of location and design is required to reduce potential health and safety hazards • May limit opportunities to use trees in landscaping • Blockages can occur in connecting pipe work • Retrofitting opportunities are limited

Effective Locations	Ineffective Locations
• Residential and commercial areas • Contaminated sites • Sites above vulnerable groundwater • Alongside roadways • Linear street garden areas • Field boundaries	• High density areas • Steeply sloping areas

Performance Criteria	Rating
Ecological Advantages	Medium
Peak Flow Reduction	Medium
Amenity Potential	Medium
Water Quality Treatment Potential	High
Surface Water Volume Reduction	Medium

In the Community

Swales can be used to replace conventional drainage systems and are particularly effective when installed adjacent roadsides or transport links, to capture and re-route surface water. They are also suitable for residential and commercial areas and may be integrated with areas of open space and landscaping, or used to create informal barriers.

Design

Example

Filter Strip or Drain

Filter strips and drains can be used to manage runoff from impermeable areas, providing conveyance and filtration. Filter Strips allow water to flow across grass or dense vegetation; whereas filter drains are hardscape systems where runoff is temporarily stored in a shallow trench filled with stone or gravel.

Advantages	Disadvantages
• Simple to design and can be incorporated into site landscaping for aesthetic benefit • Minimal public safety risks • Encourages evaporation and infiltration • Important hydraulic and water quality benefits can be achieved • Can be retrofitted into a site with ease • Low construction cost	• Vegetation must be light and can get damaged • Loose gravel can be removed • Drains relatively small catchments • High cost to replace filter materials

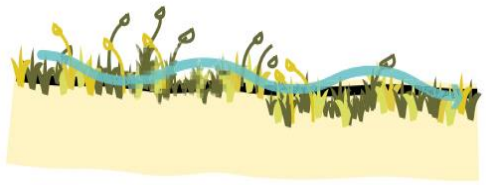
Effective Locations	Ineffective Location
• Residential and commercial areas • Between hard standing surfaces and grassland • High density areas • Contaminated sites • Sites above vulnerable ground water	• Steeply sloping areas

Performance Criteria	Rating
Ecological Advantages	Low
Peak Flow Reduction	Medium
Amenity Potential	Low
Water Quality Treatment Potential	High
Surface Water Volume Reduction	Low

In the Community

Filter strips or filter drains are a suitable retrofitting option for heavily trafficked or spatially constrained areas as they cause no safety hazards and can be implemented into small spaces with ease. They can be simply implemented along the edges of pathways or pavements or integrated within site landscaping.

Design



Example

Bio-Retention Areas or Rain Gardens

Bio-retention areas or rain gardens are vegetated depressions with gravel and sand layers below, designed to collect, channel, filter and cleanse water vertically. Water can infiltrate into the ground or enter a piped drainage system. These systems can be integrated with site landscaping, including tree pits, planter areas or gardens. Treatment performance can be improved through engineered soils and enhanced vegetation.

Advantages	Disadvantages
• Provides initial water treatment • Aesthetically pleasing • Provides ecological benefits • Capability to be retrofitted in heavily paved areas or existing vegetation • Effective pollutant removal • Minimal ground take with spatially flexible layout	• May be susceptible to clogging or blockage due to surrounding landscape • Regular inspection and maintenance is required to maintain effectiveness

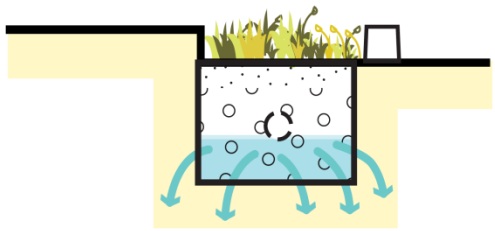
Effective Locations	Ineffective Locations
• Residential and Commercial areas • Contaminated sites • Sites above vulnerable groundwater • Seating areas • Impermeable areas • High density areas	• Steeply sloping areas

Performance Criteria	Rating
Ecological Advantages	Medium
Peak Flow Reduction	Medium
Amenity Potential	Good
Water Quality Treatment Potential	High
Surface Water Volume Reduction	Medium

In the Community

Rain gardens and bio-retention systems can be planned as aesthetically pleasing landscaped features, providing critical green space within the urban areas. These measures can be retro-fitted around existing street infrastructure, such as seating areas, and incorporated within both paved and vegetated areas.

Design



Example

Rainwater Harvesting

Rainwater harvesting involves capturing rainwater and reusing it for purposes such as irrigation or toilet flushing. Rainwater is collected from building rooftops or other paved surfaces and stored in tanks for treatment and reuse locally.

Advantages	Disadvantages
• Water can be used for variety of non-potable uses, such as toilet flushing and irrigation • Reduces potable water demand • Provides source control of storm-water run-off • Rooftop or underground tanks can minimise land take and visual impact • Can be retrofitted to existing buildings	• Potentially complex installation and high capital cost, particularly for retrofit • Ongoing energy requirement for pumping, if below ground storage is used • Careful management required to manage any health risks associated with water reuse • Above ground storage can be visually intrusive • Regular maintenance is required

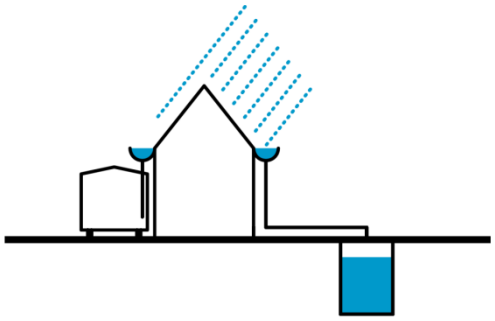
Effective Locations	Ineffective Locations
• Residential and Commercial areas • High density areas • Contaminated sites • Sites above vulnerable groundwater	• Fields or large open space

Performance Criteria	Rating
Ecological Advantages	Low
Peak Flow Reduction	High
Amenity Potential	Low
Water Quality Treatment Potential	Low
Surface Water Volume Reduction	High

In the Community

Rain-water harvesting can be implemented on a variety of scales; however, is particularly suitable for implementation in buildings with large rooftop areas, significant water consumption and defined ownership and maintenance responsibilities. Installation is generally easier when integrated into the design of new buildings; however, water butts can provide a simple means of retrofit.

Design



Example

Ponds and Basins

Ponds or Basins can be used to store and to treat water. 'Wet' (retention) ponds have a constant body of water and run-off water is additional to this, whilst 'dry' (detention) ponds are empty during periods without rainfall. Ponds can be designed to allow infiltration through its base to ground or to store water for a period of time, before it is discharged via a soakaway to ground. They can support emergent and submerged vegetation, enhancing both treatment and biodiversity.

Advantages	Disadvantages
• Pollutant removal through sedimentation and biological treatment mechanisms • Effective accommodate of large storm events • Good community acceptability • Potential for biodiversity improvement • Relatively simple construction • Has the potential for supply of irrigation to other amenities • Aesthetically pleasing • Potential recreational benefit	• Requires infiltration to achieve significant reduction in surface water runoff volumes • Significant spatial requirements • Requires control measures to prevent migration of invasive species • Consideration of public safety may require control measures in certain settings • Careful design is required to manage undesirable impacts associated with eutrophication and fluctuating water levels

Effective Locations	Ineffective Locations
• Residential and Commercial areas • Fields • Parks or areas of open space • Areas with feature requirements	• High density areas • Locations with vulnerable people

Performance Criteria	Rating
Ecological Advantages	High
Peak Flow Reduction	High
Amenity Potential	High
Water Quality Treatment Potential	High
Surface Water Volume Reduction	Low

In the Community

Ponds can be aesthetically pleasing, and can be used to support urban amenity, recreation and ecology. They can provide central features within areas of community space. However, careful design consideration is required to ensure they do not pose a health and safety risk to the public.

Design

Example

Soakaway

Soakaways and other infiltration systems collect and store runoff, allowing it to rapidly soak into permeable layers of soil. Constructed like a dry well, an underground pit is dug and then filled with gravel and rubble, or specially designed structures. Surface water can be directed into a soakaway using a number of above or below ground methods, with overlying vegetation and underlying soils providing treatment benefits.

Advantages	Disadvantages
• Minimal land take • Provides recharge of natural ground water levels • Good storm volume reduction and peak flow attenuation • Simple operation and maintenance • Relatively simple to construct • Effective retrofitting solution • Good community acceptability	• Not always practicable near to structural foundations • Long term performance is uncertain and difficult to guarantee if property owner is responsible for maintenance • Requires good subsurface drainage • Infiltration rates need to be investigated

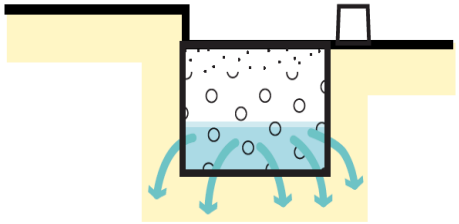
Effective Locations	Ineffective Locations
• Residential and commercial areas • High density areas • Fields • Small grassed/planted areas	• Contaminated sites • Sites above vulnerable groundwater • Sites with shallow groundwater • Sites underlain by impermeable ground

Performance Criteria	Rating
Ecological Advantages	Low
Peak Flow Reduction	High
Amenity Potential	Low
Water Quality Treatment Potential	Medium
Surface Water Volume Reduction	High

In the Community

Soakaways are effective in areas with good infiltration potential and where the water table is relatively low. Soakaways can be covered over by suitable permeable materials and be used for a variety of purposes at ground level. Caution should be taken when implementing these techniques in tightly constrained areas as they should not be built within a close proximity to structural foundations.

Design



Example

Living Roofs

A planted soil layer is constructed on the roof of a building to create a living medium. Following rainfall, water is stored in the soil layer and absorbed by planted vegetation. They may be designed to be accessible and landscaped to provide biodiversity and amenity benefit. Blue roofs can also be used to store water, without the use of vegetation.

Advantages	Disadvantages
• High potential to reduce surface run off • Suitable for high density development • Can deliver building insulation and sound proofing • Inaccessible to general public • Can provide biodiversity benefits to the local area • Improved air quality • Assists in amelioration of the urban heat island effect • Can be retrofitted	• Additional structural loading to roof (compared with most traditional rooftops) • Irrigation may be required during drought • Replacement and maintenance of plants is required on a regular basis

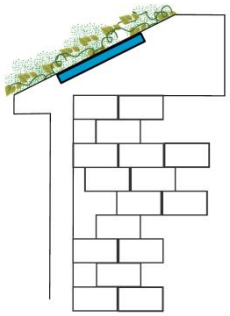
Effective Locations	Ineffective Locations
• Residential and Commercial areas • High density areas • Contaminated sites • Sports centres	• Roofs with inadequate access • Steep pitched roofs • Rooftops with inadequate structural support

Performance Criteria	Rating
Ecological Advantages	High
Peak Flow Reduction	Medium
Amenity Potential	High
Water Quality Treatment Potential	High
Surface Water Volume Reduction	Medium

In the Community

Living roofs provide an opportunity to attenuate and store rainwater in spatially constrained areas, while providing potential benefits for local biodiversity, air quality, microclimate and amenity. They have controlled access, which means the associated risk of misuse or vandalism is low.

Design



Example

Permeable / Porous Paving

This is paving which allows water to soak into the underlying ground. It can be in the form of paving blocks with gaps in between or porous mediums where water filters through the paving itself. Water can be stored in the sub-base beneath or be allowed to infiltrate into the ground below.

Advantages	Disadvantages
• Good potential for water quality treatment • High potential for surface water run off • Very efficient • Good community acceptability • Requires minimal maintenance • Effectively requires no space, as it allows for a dual usage • It can remove the need for manholes or gully pots	• Requires closure of surfaced areas whilst SuDS are constructed • Cannot be used where high sediment loads are likely to be washed across the surface • Requires vegetation maintenance • Regular inspection of the surfaces required to ensure effectiveness • Can deflect if subject to heavy vehicular loads

Effective Locations	Ineffective Locations
• Residential and Commercial areas • Car Parks • Low speed roads (below 30 mph) • Pathways • Residential pavements • Hard courts	• High speed roads

Performance Criteria	Rating
Ecological Advantages	Low
Peak Flow Reduction	High
Amenity Potential	Low
Water Quality Treatment Potential	High
Surface Water Volume Reduction	High

In the Community

Permeable surfaces offer effective drainage solutions that integrate within residential environments. Porous paving is effective at managing runoff from paved surfaces, and this low maintenance method is particularly useful in built up environments, including city centres. Replacing hard standing with permeable surfaces could improve drainage across a site whilst creating more aesthetically pleasing environments.

Design

Example

References

For detailed information on the design and delivery of SuDS, reference should be made to the CIRIA *SuDS Manual* C753 (2015), which is freely available online at www.ciria.org.

A range of further resources on SuDS, including case studies, videos, presentations, fact sheets and links to research can be found on the Susdrain website at http://www.susdrain.org.

Additional supporting information is available from DEFRA (www.defra.gov.uk) and the Environment Agency (www.environment-agency.gov.uk).

Appendix C - Mapping and Dataset Summary

Mapping and Dataset Summary

A series of maps and a geodatabase have been produced to accompany this study and assist the assessment of sites by the London Borough of Lewisham as part of their decision making process. A GIS based mapping system using the software package 'ArcGIS' was implemented to enable this. A summary of the figures created and the GIS layers used for each of the maps is included in the Table D1 below.

Table D1 *- Summary of Maps Created*

Map Number	Figure Title	Layers Used
Map 001	River Network	• Ordnance Survey Base-mapping (10k)* • Borough Boundary* • Lewisham Mapped Rivers* • Ordinary Watercourse (DRN)*
Map 002	Topography	• Lidar (Elevation Data)
Map 003a	Historic Fluvial Flood Map	• EA fluvial flood records
Map 003b	Record of Sewer Flooding	• DG5 dataset provided by Thames Water • Lewisham postcode boundaries
Map 004	Flood Maps for Planning	• Flood Zone 2 • Flood Zone 3 • Flood Zone 3b (from EA Ravensbourne Model combined with Flood Storage Areas) • Areas benefitting from Flood Defences
Map 005	Flood Map for Surface Water	• Flood Map for Surface Water 30 year extent • Flood Map for Surface Water 100 year extent • Flood Map for Surface Water 1000 year extent • Local Critical Drainage Areas
Map 006	Sewer Network	• TWUL Waste Water Data
Map 007	Susceptibility to Groundwater Flooding	• BGS dataset for Groundwater Vulnerability
Map 008	Flood Risk from Reservoirs	• EA designated reservoir flood extents
Map 009	Flood Risk Management Infrastructure	• Flood Defences

Map Number	Figure Title	Layers Used
Map 010	Flood Alert and Warning Areas	• EA designated Flood Warning Areas • EA designated Flood Alert Areas
Map 011	SuDS Infiltration Suitability	• BGS dataset for SuDS Suitability
Map 012a	Thames Tidal Upriver Breach Inundation 2017 - Flood Extents	• Thames Tidal Upriver Breach Inundation 2017 Maximum Flood Extents for 2005 and 2100
Map 012b	Thames Tidal Upriver Breach Inundation 2017 - Flood Hazard	• Thames Tidal Upriver Breach Inundation 2017 Maximum Hazard for 2005 and 2100
Map 012c	Thames Tidal Upriver Breach Inundation 2017 - Flood Depth	• Thames Tidal Upriver Breach Inundation 2017 Maximum Flood Depth for 2005 model 2100
Map 012d	Thames Tidal Upriver Breach Inundation 2017 - Flood Velocity	• Thames Tidal Upriver Breach Inundation 2017 Maximum Flood Velocity for 2005 model and 2100
Map 013	Fluvial Flooding Extents with an allowance for Climate Change	• Ravensbourne Model 2015 outline for 1 in 100 year flood • Ravensbourne Model 2015 outline with 25% and 35% allowance for climate change
Map 014	Vulnerable Sites	• National Receptor Database

Notes:*Included in all maps

ArcGIS uses multiple datasets with associated attribution to present geo-located features from multiple sources. An overview of the information provided for mapping purposes by the various key stakeholders is shown below.

Table D2 *- Description of GIS Layers used to inform the assessment*

	Dataset	Source	Format	Layer Description
Fluvial and Tidal	Detailed River Network	Environment Agency	GIS shapefile	Identification of the river network including main rivers and ordinary Watercourses.
	Lewisham Mapped Rivers	London Borough of Lewisham	GIS shapefile	Dataset showing all watercourses (main rivers and others) in the LBL, with information on culverts.
	Flood Map for Planning (Rivers and Sea) Flood Zones 2 and 3	Environment Agency Geostore	GIS shapefile	Shows areas at varying risk of flooding from rivers and the sea.
	Recorded Flood Outlines	Environment Agency Geostore	GIS shapefile	Single GIS layer showing the extent of fluvial historic flood events.
	Asset Information Management System (AIMS)	Environment Agency	ASRI Geodatabase	Shows where existing river assets (embankments, walls, culverts, etc.) are located and contain additional information about owner, type, and condition.
	Ravensbourne Catchment Model	Environment Agency	GIS shapefile	Report and GIS outputs summarising the flood modelling of The Beck River, River Ravensbourne and Kyd Brook, completed in 2015.
	Flood Warning and Alert Areas	Environment Agency Geostore	GIS shapefile	Shows areas benefitting from fluvial flood warning schemes in the Borough.
	Areas Benefitting from Flood Defences	Environment Agency Geostore	GIS shapefile	Shows areas that would benefit from defences in a 1 in 100 year fluvial flood, or 1 in 200 year tidal flood.

	Dataset	Source	Format	Layer Description
	Thames Tidal Upriver Inundation 2017 Model	Environment Agency	GIS shapefile & Raster file (.tiff)	Report and GIS outputs summarising the flood modelling of the London Thames Breach Assessment.
	Spatial Flood Defences	Environment Agency Geostore	GIS shapefile	Shows flood defences currently owned, managed or inspected by the EA
	Flood Storage Areas	Environment Agency Geostore	GIS shapefile	Shows areas that act as a balancing reservoir, storage basin or balancing pond, which can attenuate incoming flood peak.
Pluvial	Infiltration SuDS Summary Map	British Geological Society	GIS shapefile	Dataset produced by BGS illustrating the likely suitability of the utilisation of infiltration SuDS techniques across the Borough.
	Risk of Flooding from Surface Water	Environment Agency Geostore	GIS shapefile	Provides an indication of the broad areas likely to be at risk of surface water flooding during a 1 in 30 year, 1 in 100 year and 1 in 100 year return period event.
	Local Critical Drainage Areas	London Borough of Lewisham	GIS shapefile	Outlines the areas designated as critical drainage areas by the Lewisham SWMP.
Groundwater	Susceptibility to Groundwater Flooding	British Geological Society	GIS shapefile	Dataset produced by BGS illustrating the likely suitability to groundwater flooding, based on geological indicators.

	Dataset	Source	Format	Layer Description
Sewer	DG5 Register of sewer flooding incidents, by post code area	Thames Water	PDF	Indicates post code areas that have experienced sewer flooding in the past 10 years and the amount of recorded incidents.
	Post Code Boundaries	London Borough of Lewisham	GIS shapefile	Delineates Post Code Boundaries for the Borough, enabling mapping of Thames Water datasets.
Reservoir	Area Deemed at of Risk of Flooding from Reservoirs	Environment Agency	GIS shapefile	Outlines the areas at risk of flooding from EA managed reservoirs would a breach occur.
General	Ordnance Survey 10k Background	London Borough of Lewisham	Raster file (.tiff)	Provides background mapping and indicates important features and street names in detail.
	National Receptor Database	Environment Agency	GIS shapefile	Shows all possible flood receptors within the Borough.
	LiDAR Data	Environment Agency	Raster file (.tiff)	Provides a useful basis for understanding local topography and the surface water flood risk in the area.

Appendix D - SFRA Management Guide

SFRA Management Guide

NPPF highlights the importance of maintaining Strategic Flood Risk Assessments current to ensure the decision making process by the Local Planning Authorities is based on the most up to date information and understanding of flood risk within the Borough. A summary of the key aspects to be considered to ensure that the SFRA is kept up-to-date and maintained is provided in the table below.

Table F1 *- Summary of main aspects to be considered during maintenance of the SFRA*

Area Covered	Source of Information	Provider	Comments	Next Review
Flood Zones	Hydraulic modelling of main rivers	EA	Should new Flood Zone information become available, the data should be digitised and georeferenced within the GIS system.	When further modelling is carried out and/or outlines reviewed by EA
Climate Change Scenarios	Environment Agency Guidance and Modelling	EA	The hydraulic modelling results considered as a part of this SFRA were based on the latest available modelling of the River Ravensbourne. The 25% and 35% climate outlines were mapped for the Ravensbourne model; however, the 70% climate model was not available during the timescales of this project. The EA should be contacted to assess the 'Upper End' allowance for climate change in the Ravensbourne catchment. Updating of this modelling is understood to be a long-term plan of the EA, and it is strongly recommended that this revised modelling be incorporated within the SFRA upon completion	When updated hydraulic modelling for the 70% climate model for the Ravensbourne becomes available and during the next general review of the SFRA

Area Covered	Source of Information	Provider	Comments	Next Review
Surface Water Flood Outlines	EA Dataset	EA	The EA have provided the Risk of Flooding from Surface Water. Any site-specific modelling of surface water flood risk carried out in the Borough in future should be added to this dataset.	When new relevant information becomes available
Flooding History	Stakeholders records	EA, LBL	When new flooding incidents are reported, these should be added as a new point to the relevant GIS layer, including metadata.	Next general review of SFRA
Local Plan Information	Lewisham Local Plan	LBL	The updated Lewisham Local Plan was under consultation at the time of producing this SFRA. It is intended that detailed assessment of the proposed allocated development sites is undertaken as a further phase of this SFRA, once this plan and proposed development sites, are finalised.	Finalisation of Local Plan and allocated development sites
Geology	Geology	EA	No Geology Datasets were provided during the production of the SFRA. Would any dataset be made available, their information should be compared to the currently described information in this SFRA.	When geology datasets are made available
Groundwater Flood Risk	Groundwater Vulnerability and SuDS suitability	BGS	BGS has provided Borough specific information on Groundwater Vulnerability and the Suitability of SuDS. This dataset is used at a higher resolution than the freely available EA dataset ‘Areas Susceptible to Groundwater Flooding’ thus provides greater accuracy when designating groundwater flood risk areas. Any emerging local knowledge on groundwater flood incidents in future should be updated incorporated into the SFRA.	When information is available and in next general review of SFRA

Area Covered	Source of Information	Provider	Comments	Next Review
Sewer Flood Risk	Thames Water Utilities Ltd	TWUL	TW provided the DG5 register and the network capacity information for the Borough. Should updated information on sewer flood risk and network capacity become available, it is recommended that this is incorporated within the SFRA.	When information is available
OS Background Mapping	Ordinance Survey	LBL	The SFRA has made use of OS 1:10,000 digital mapping. Periodically these maps are updated. Updated maps are unlikely to alter the findings of the SFRA but should be reviewed as part of the SFRA maintenance.	Next General review of SFRA
Flood Risk Policy	NPPF, NPPG, London Plan, etc.	Various	This SFRA was created using guidance that was current in October 2018, principally the NPPF and the accompanying Planning Practice Guidance. Should new flooding policy be adopted nationally, regionally or locally, the SFRA should be checked to ensure it is still relevant and updates made if necessary.	When changes to relevant planning policy are adopted

It should be noted that, prior to any data being updated within the SFRA, it is important that the licensing information is also updated to ensure that the data used is not in breach of copyright. The principal licensing bodies relevant to the SFRA at the time of publishing were the Environment Agency, Ordnance Survey and British Geological Survey. Updated or new data may be based on datasets from other licensing authorities and may require additional licenses. Generally, when updating the GIS information associated with this SFRA, it is important that the meta-data is updated in the process. This is the additional information that lies behind the GIS polygons, lines and points.

It is recommended that an interim review of the SFRA is undertaken on an annual basis, in liaison with the Environment Agency, to assess any maintenance or update work required. In particular, this would include incorporation of any major changes in terms of flood management infrastructure and any recorded flooding incidents. An overall general review of the SFRA is recommended every 3 years, to re-evaluate flood risk and planning policies according to latest legislation.

Should Council decide any significant changes are necessary; the SFRA should be updated and re-issued. It is essential that any reviews and updates of the SFRA are recorded in a structured manner. To facilitate this task, the following register has been created:

STRATEGIC FLOOD RISK ASSESSMENT REVIEW				
Type of Review	Scheduled ☐	Interim ☐	**Date of Review:**	
Reviewer Name:			**Organisation:**	
Area Reviewed	**Source of Information**	**Provider**	**Maps Modified**	**Comments**

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