Strategic Flood Risk Assessment
Update 2015

On behalf of **London Borough of Lewisham**

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Glossary

AEP	Annual Exceedance Probability e.g. 1% AEP is equivalent to 1% probability of a flood of a given magnitude being exceeded in any one year (or, on average, once in every 100 years)
Spatial (Core) Strategy	The Development Plan Document within the Council's Local Development Framework, which sets the long-term vision and objectives for the area. It contains a set of strategic policies that are required to deliver the vision including the broad approach to development.
DCLG	Department of Community and Local Government
Defra	Department of Environment, Food and Rural Affairs
Development	The carrying out of building, engineering, mining or other operations, in, on, over or under land, or the making of any material change in the use of a building or other land.
Development Plan Document (DPD)	A spatial planning document within the Council's Local Development Framework, which set out policies for development and the use of land. Together with the Regional Spatial Strategy, they form the development plan for the area. They are subject to independent examination.
EA	Environment Agency
Flood Zone Map	Nationally consistent delineation of *'high'* and *'medium'* flood risk, published on a quarterly basis by the Environment Agency
Formal Flood Defence	A structure built and maintained specifically for flood defence purposes
Informal Flood Defence	A structure that provides a flood defence function, however has not been built and/or maintained for this purpose (e.g. boundary wall)
Local Development Framework (LDF)	Consists of a number of documents which together form the spatial strategy for development and the use of land
National Planning Policy Framework	The **National Planning Policy Framework** is the overarching UK planning policy document. It replaces over two dozen previously issued Planning Policy Statements (PPS) and Planning Policy Guidance Notes (PPG) for use in England.
Planning Policy Statement (PPS)	A series of statements issues by the Government, setting out policy guidance on different aspects of planning. They replace Planning Policy Guidance Notes
NPPG	The National Planning Practice Guidance: a web based resource launched by DCLG which brings together planning practice guidance for England
PPS25	Planning Policy Statement 25: Development and Flood Risk. Department of Community & Local Government, 2006. Now superseded by the NPPF.
Residual Risk	A measure of the outstanding flood risks and uncertainties that have not been explicitly quantified and/or accounted for as part of the review process
SEA	Strategic Environmental Assessment
SuDS	Sustainable Drainage Systems
Supplementary Planning Document (SPD)	Provides supplementary guidance to policies and proposals contained within Development Plan Documents. They do not form part of the development plan, nor are they subject to independent examination.

Sustainability Appraisal (SA)	Appraisal of plans, strategies and proposals to test them against broad sustainability objectives.
Sustainable Development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs (The World Commission on Environment and Development, 1987).
Zone 1 Low Probability	NPPF Flood Zone, defined as areas not at risk from a 0.1% annual probability fluvial or tidal event. (Refer to Paragraph: 065 Reference ID: 7-065-20140306 of NPPG).
Zone 2 Medium Probability	NPPF Flood Zone, defined as areas at risk of flooding in events that are greater than a 1% annual probability (1 in 100 year) event for rivers or the 0.5% annual probability (1 in 200 year) design event from the sea, and less than the 0.1% annual probability (1 in 1000 year) design event. (Refer to Paragraph: 065 Reference ID: 7-065-20140306 of NPPG).
Zone 3a High Probability	NPPF Flood Zone, defined as areas at risk of flooding in the1% annual probability (1 in 100 year) design event from rivers, or the 0.5% annual probability (1 in 200 year) event from the sea. (Refer to Paragraph: 065 Reference ID: 7-065-20140306 of NPPG).
Zone 3b Functional Floodplain	NPPF Flood Zone, defined as areas at risk of flooding in the 5% annual probability (1 in 20 year) design event taking account of existing flood defences. (Refer to Paragraph: 065 Reference ID: 7-065-20140306 of NPPG).

Executive Summary

The London Borough of Lewisham lies to the south east of the centre of London. The Borough fronts onto the River Thames for approximately 1km in the north and extends approximately 8km south from here. It falls within most of the catchment of the River Ravensbourne and its tributaries, which outfalls into the Thames at Deptford Creek. The Borough covers an area of approximately 35 square kilometres and has a population of 248,922in 116,000 households (2011 Census).

It is important to recognise that some of those areas that are at risk of flooding in the Borough are under pressure from future development. It is essential therefore that the Council are in a position to take informed decisions, providing a careful balance between the risk of flooding and other unrelated planning constraints that may place pressure upon *'at risk'* areas. The Lewisham Borough SFRA Update (2014) endeavours to provide specific advice to assist the Council in this regard.

This report (and the supporting mapping) represents the Level 1 SFRA Update (2015), and should be used by the Council to inform the application of the Sequential Test. Following the application of the Sequential Test, it may be necessary to develop a Level 2 SFRA should it be shown that proposed allocations fall within a flood affected area of the Borough. The Level 2 SFRA should consider the risk of flooding in greater detail within a local context to ensure that the site can be developed in a safe and sustainable manner.

Outcomes of the Lewisham Borough SFRA

The London Borough of Lewisham has been delineated into zones of low, medium and high probability of fluvial and tidal flooding (refer to Section 5.1), based largely upon existing available information provided by the Environment Agency (EA). A further assessment of flood hazard within defended areas adjoining the River Thames has also been carried out for planning purposes (refer to Section 5.2). The spatial variation in fluvial (river) flood risk across the Borough has been delineated in the following manner:

Zone 3b (Functional Floodplain)

The National Planning Practice Guidance (NPPG) website[1] defines Flood Zone 3b as *'land where water* has *to flow or be stored in times of flood'* (Paragraph 65).

For the purposes of the Lewisham SFRA, Greenfield land subject to flooding in the 5% annual probability (1 in 20 year) flood extent, taking account of existing flood alleviation measures fall under the designation of Functional Floodplain.

It is important to recognise that these areas are subject to relatively frequent flooding, and may be subject to fast flowing and/or deep water. Very careful consideration must be given to future sustainability and safety issues within this area.

The Functional Floodplain also includes areas that are specifically defined to flood in extreme events.

Appropriate uses within this zone are presented in Table 3 of the NPPG (Paragraph 67).

Zone 3a High Probability

Areas subject to flooding in the 1% annual probability (1 in 100 year) design event have been delineated as Zone 3a High Probability. Development within these areas may only be considered following application of the Sequential Test, and *'more vulnerable'* development should be avoided wherever possible. Appropriate uses within this zone are presented in Table 3 of the NPPG.

[1]http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/flood-zone-and-flood-risk-tables/table-1-flood-zones/

The SFRA has outlined specific development management recommendations that should be placed upon development within Zone 3a High Probability to minimise the damage to property, the risk to life in case of flooding, and the need for sustainable drainage techniques (SuDS). It is essential that the applicant carries out a detailed Flood Risk Assessment to consider the site-based constraints that flooding may place upon the proposed development.

Zone 2 Medium Probability

Areas subject to flooding in events exceeding the 1% annual probability (1 in 100 year) event, and up to (and including) the 0.1% annual probability (1 in 1000 year) event have been delineated as Zone 2 Medium Probability. As set out in Table 3 of the NPPG, *'Highly Vulnerable Development'*, for example emergency services in this zone must pass the exception test.. There are generally no other restrictions placed upon land use in these areas, however it is important to ensure that the applicant takes account of possible climate change impacts to avoid a possible increase in the risk of flooding in future years (achieved through completion of a Flood Risk Assessment).

Zone 1 Low Probability

Areas not affected by the 0.1% annual probability (1 in 1000 year) event. There are no restrictions placed on land use within Zone 1 Low Probability (i.e. all remaining areas of the Borough) by the NPPF. It is essential however that consideration is given to the potential risk of flooding from other sources (outlined in *'Localised Flooding Issues'* below), ensuring that future development is not inadvertently placed at risk. It is also essential to ensure that future development does not exacerbate the current risk posed to existing homes and businesses.

Localised Flooding Issues

Properties and infrastructure within the London Borough of Lewisham are also at risk of flooding from other sources. These include groundwater flooding, the surcharging of the underground sewer system, the blockage of culverts and gullies (which results in overland flow), and surface water flooding. Evidence of localised flooding of this nature has been captured through consultation with local authorities, Thames Water and the EA, and is provided in Figure 4[2].

The NPPF does not address issues of this nature within its delineation of flood zones and what development is acceptable within them. Incidents of this nature can often be addressed through the design process, and therefore will not generally affect decision making with respect to the allocation (or otherwise) of sites within the Borough. Widespread flooding throughout England in 2007 highlights that this is certainly not always the case however, and uncontrolled flooding as a result of particularly heavy rains can create significant damage and disruption.

The NPPG advocates the application of a sequential approach when allocating land, taking into consideration *all* sources of flooding. From a spatial planning perspective, with the exception of areas known to be susceptible to regular (and problematic) groundwater or flash flooding, it is widely considered generally unreasonable to restrict future development within areas that may have suffered a localised flooding incident in years past.

It is essential however not to overlook the potential risk of localised flooding during the design process. Whilst the incidents that have been identified will typically not result in widespread damage or disruption, a proactive approach to risk reduction through design can mitigate the potential for damage, both to the development itself and elsewhere. Specific development management recommendations have been provided accordingly (refer to Section 7.4).

As a minimum, the implementation of sustainable drainage systems (SuDS) must be ensured and overland flow routes during events which exceed a site's drainage capacity must be carefully considered as part of the site design.

[2] Detailed mapping of areas within the River Ravensbourne catchment that are potentially at risk of surface water flooding is held by the council.

There are eight Critical Drainage Areas in the Borough. Within these areas there are specific requirements for drainage systems. Details are obtainable through the EA.

A Proactive Approach – Reduction in Flood Risk

It is crucial to recognise that the NPPF considers not only the risk of flooding posed to new development, but that it also seeks to positively reduce the risk of flooding posed to existing properties within the Borough. It is strongly recommended that this principle be adopted as the underlying *'goal'* for developers and Council development management teams within Lewisham Borough.

Developers should be encouraged to demonstrate that their proposal will deliver a positive reduction in flood risk to the Borough, whether that be by reducing the frequency or severity of flooding (for example, through the introduction of SuDS), or by reducing the impact that flooding may have on the community (for example, through a reduction in the number of people within the site that may be at risk). This should be reflected through the inclusion of a positive statement within the detailed FRA that clearly and concisely summarised how this reduction in flood risk will be delivered.

The Way Forward

Planning policy needs to be informed about the risk posed by flooding. A collation of potential sources of flood risk has been carried out in accordance with the NPPF, developed in consultation with both the Council and the EA. The Borough has been broken down into zones of *'high', 'medium'* and *'low'* probability of flooding in accordance with the NPPF, providing the basis for the application of the Sequential Test.

A **planning solution** to flood risk management should be sought wherever possible, steering vulnerable development away from areas affected by flooding in accordance with the Sequential Test. Specific planning recommendations have been provided for all urban centres within the Borough (refer to Section 7.4).

Where other planning considerations must guide the allocation of sites and the Sequential Test cannot be satisfied, specific recommendations have been provided to assist the Council and the developer to meet the Exception Test. These should be applied as **development management** conditions for all future development (refer to Section 7.4).

Council policy is essential to ensure that the recommended development management conditions can be imposed consistently at the planning application stage. This is essential to achieve future sustainability within the Borough with respect to flood risk management.

Emergency planning is imperative to minimise the risk to life posed by flooding within the Borough. It is recommended that the Council advises the local Resilience Forum of the risks raised in light of the Lewisham SFRA, ensuring that the planning for future emergency response can be reviewed accordingly.

A Living Document

This document is an update to the original SFRA, produced in 2008. It reflects updates to understanding of flood risk within the Borough and to planning policy and associated guidance building on the ongoing research in flood risk management.

As there are continual developments in flood risk management guidance and policy a periodic review of the Lewisham SFRA is imperative. It is recommended that the Lewisham SFRA is reviewed on a regular basis, and a number of key questions to be addressed as part of the SFRA review process (i.e. triggering whether or not a comprehensive review is required) are provided in Section 9.

1 Introduction

1.1 Overview

1.1.1 The London Borough of Lewisham lies to the south east of the centre of London. The Borough fronts onto the River Thames for approximately 1km in the north and extends approximately 8km south from here. It falls within the catchment of the River Ravensbourne and its tributaries, including the Quaggy, the Pool and Kyd Brook, which outfalls into the Thames at Deptford Creek. The Borough is third largest in Inner London in area and population. It covers an area of approximately 35 square kilometres and has a population of 275,900 in 116,000 households (2011 Census). A location plan is presented as Figure 1.

1.1.2 The National Flood Risk Assessment (NaFRA)[3] covering the whole of England and Wales is a method for flood risk assessment that uses a risk-based approach to factor in the location, type, condition and effects of flood defences. According to this assessment, properties in Lewisham fall in the categories shown in **Table 1** below. All of the properties in the flood risk area adjacent to the Thames fall within the low risk category, while those in the River Ravensbourne catchment fall in the moderate or significant risk category.

Risk Category	Number of Properties at Risk (Residential and Non-residential)
Low 0.5% (1 in 200) chance of flooding each year or less	17,047
Moderate 1.3% (1 in 75) chance or less but greater than 0.5% (1 in 200) chance of flooding in any year	991
Significant greater than 1.3% (1 in 75) chance of flooding in any year	3420
Total number of properties at risk	**21,458**

Table 1: National Flood Risk Assessment (NaFRA) statistics for the London Borough of Lewisham

1.1.3 The River Thames has posed a risk of flooding to London for millennia, and as the city grew, the river became more and more constrained by urban development. The natural floodplain of the River Thames within London is now almost fully developed, and the northern proportion of the Borough of Lewisham (adjoining the River Thames) is heavily dependent upon manmade flood defences to protect against the risk of flooding. Substantial investment has been committed to the protection of London, both now and into the future, as set out by the TE2100 Strategy (EA).

1.1.4 As highlighted above however, the River Ravensbourne and River Quaggy are also key features of the Borough, flowing in a northerly direction through the heart of the Borough, and representing a potential risk of flooding to property and infrastructure. Investment has been made in flood risk management along the River Ravensbourne, both by the EA and the Council. This has included the construction of raised flood defences within Lewisham, and the development of dedicated landscaped areas for flood storage as part of ongoing regeneration within the Borough.

[3] EA Flood Risk Data Report (March 2007 - based on information from April 2006)

1.1.5 The EA published the Thames Catchment Flood Management Plan in December 2009. Lewisham falls under Sub-area 8 '*Heavily populated floodplain*', where the preferred method of managing flood risk is Policy option 5:

'Areas of moderate to high flood risk where we can generally take further action to reduce flood risk'. (Thames CFMP, p 24)

1.1.6 As is the case in many areas of England, an ever increasing *'squeeze'* is evident through competing needs for government funding for flood defence, and an increasing potential risk of flooding due to pressure for future development and climate change. **For this reason, a key focus of the strategy is the need to proactively deliver a reduction in flood risk through the planning process – in simple terms, guiding vulnerable development away from areas that are most at risk, and adopting sustainable design techniques.**

> *'In all of these areas, but especially in those areas where major flood defences are not a realistic option in the foreseeable future, the most sustainable way of reducing flood risk will be through floodplain management. In areas of redevelopment; resilience and resistance measures can be incorporated into new buildings'*. (Thames CFMP, p 24)

1.1.7 This philosophy is also clearly evident within other strategic studies being developed by the EA relating more widely to the River Thames[4], in particular the TE2100 Strategy. The Council embrace these core principles of sustainability, and these have underpinned the development of the Lewisham Borough SFRA.

1.1.8 Peter Brett Associates was commissioned to update the Lewisham Borough Strategic Flood Risk Assessment (SFRA). The SFRA forms part of the Local Development Framework which replaced the Unitary Development Plan in 2014. The SFRA should be used to inform the sustainability appraisal of new local plans.

1.2 Future Development in Lewisham Borough

1.2.1 Lewisham is an inner London Borough located in south east London. It has a short stretch of frontage to the River Thames and is also characterised by Deptford Creek, where the River Ravensbourne, having joined the River Quaggy just north of Lewisham, meets the Thames. The Borough is mainly built up although there are significant areas of open space throughout the borough. The main urban centres are Lewisham and Catford. New Cross and Deptford also have local shopping facilities. There are significant rail routes crossing the borough, as well as the A2 and A20 taking coastal traffic to the channel ports.

1.2.2 Like other boroughs of inner east London, Lewisham is keen to take advantage of any opportunities for regeneration that arise. A number of regeneration areas have been identified by the Council, and are described in the Core Strategy which details the spatial strategy for the borough that will guide development and accommodate growth and regeneration within the borough to 2026. The preferred option for growth is to support borough-wide regeneration and growth and includes several former business/industrial sites (services and manufacturing) in north Deptford as appropriate for regeneration and growth and the provision of new jobs and homes, along with intensifying mixed use development in the Lewisham and Catford town centres.

[4] Refer to Section 7.3

2 SFRA Approach

2.1.1 The primary objective of the SFRA was to inform the revision of flooding policies, including the allocation of land for future development, within the emerging Local Development Framework (LDF). The SFRA has a broader purpose however, and refining the depiction of flood risk across the Borough in the 2014 update can:

- Inform the development of Council policy that will underpin decision making within the Borough, particularly within areas that are affected by (and/or may adversely impact upon) flooding;
- Assist the development management process by providing a more informed response to development proposals affected by flooding, influencing the design of future development within the Borough;
- Help to identify and implement strategic solutions to flood risk, providing the basis for possible future flood attenuation works;
- Support and inform the Council's emergency planning response to flooding.

2.1.2 The Government provides no specific methodology for the SFRA process. Therefore, to meet these broader objectives, the SFRA was developed in a pragmatic manner in close consultation with both the Council and the EA.

2.1.3 A considerable amount of knowledge exists with respect to flood risk within the Borough, including information relating both to historical flooding, and the predicted extent of flooding under extreme weather conditions (i.e. as an outcome of detailed flood risk modelling carried out by the EA). The SFRA has built upon this existing knowledge, underpinning the delineation of the Borough into zones of 'high', 'medium' and 'low' probability of flooding, in accordance with the NPPF. Collectively these flood zones will be used to provide a robust and transparent evidence base for the development of flooding related policy, and the allocation of sites for future housing and employment uses.

2.1.4 A summary of the adopted SFRA process is provided in the figure below, outlining the specific tasks undertaken.

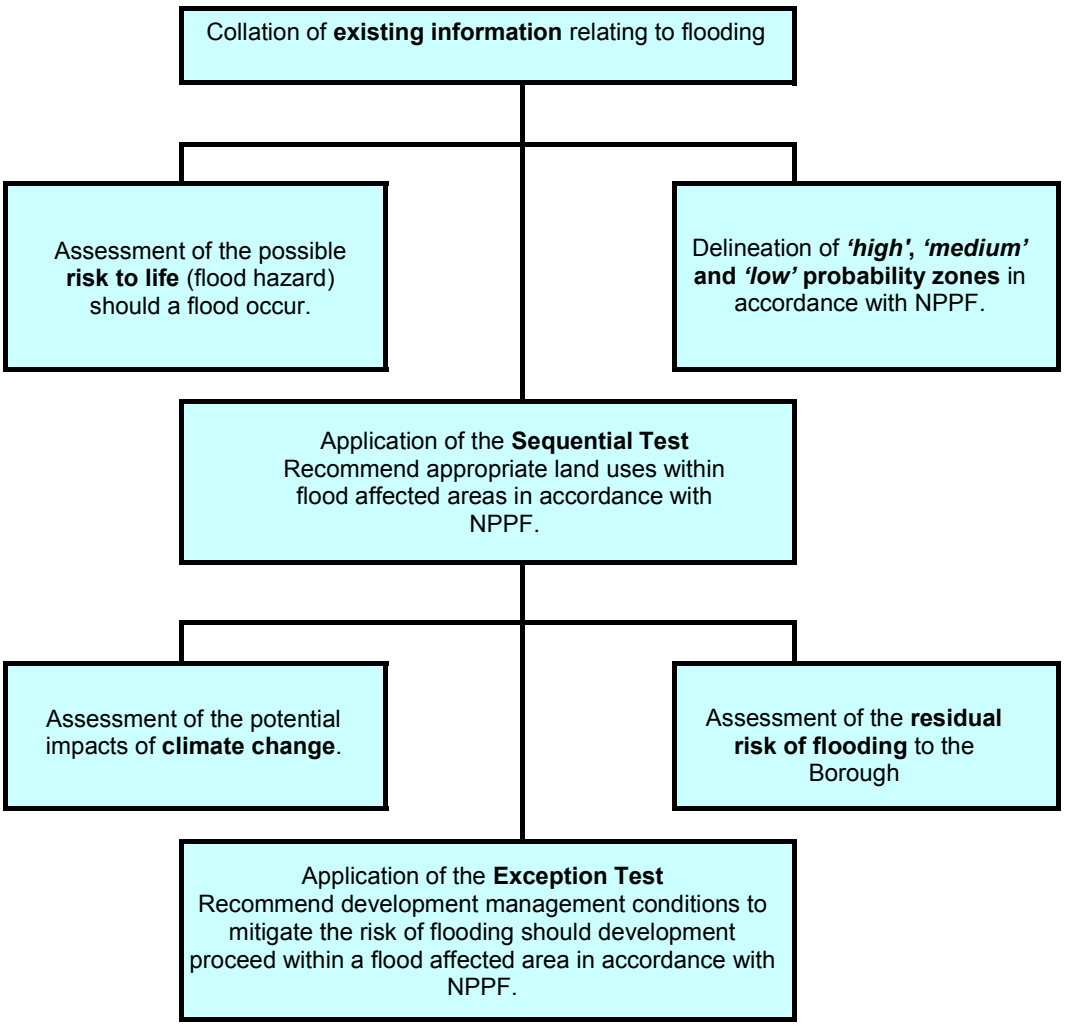

Figure 1: Summary of the Adopted SFRA Process

2.1.5 The River Thames catchment encompasses a large number of boroughs within the Greater London area, and future development within the region could severely influence the risk of flooding posed to neighbouring areas if not carefully managed. All the local authorities have produced SFRAs in consultation with the EA. Consequently all local authorities should clearly understand the core issues that flood risk raises within their respective boroughs, and adapt their decision making accordingly. They must be aware of the impact that careless planning may have, not only locally, but upon adjoining Boroughs.

3 Policy Framework

3.1 Introduction

3.1.1 This section provides a brief overview of the strategy and policy context relevant to flood risk in the Borough.

3.1.2 The success of the SFRA is heavily dependent upon the Council's ability to implement the recommendations put forward for future sustainable flood risk management, both with respect to planning decisions and development management recommendations (refer to Section 7.4). A framework of national and regional policy is in place, providing guidance and direction to local planning authorities. Ultimately however, it is the responsibility of the Council to establish robust policies that will ensure future sustainability with respect to flood risk.

3.2 National Policy and Legislation

Introduction

3.2.1 This section provides a brief overview of planning policy relating to Lewisham in terms of flood risk. The SFRA is a key point of reference to the Council in developing their flood risk policies, and this part of the document is designed to facilitate policy development.

3.2.2 At the time of the original SFRA the two key pieces of national policy were Planning Policy Statement 25: Development and Flood Risk[5] and Planning Policy Statement: Planning and Climate Change[6].

3.2.3 In March 2012, the Department for Communities and Local Government published the National Planning Policy Framework (NPPF)[7]. It sets out the Government's planning policies for England and, in conjunction with the National Planning Practice Guidance (NPPG)[8], how they are expected to be applied. It supersedes Planning Policy Statement 25: Development and Flood Risk and Planning Policy Statement: Planning and Climate Change.

3.2.4 Since the original SFRA was published, two key pieces of legislation have been introduced. In December 2009 the Flood Risk Regulations were introduced and in April 2010 the Flood and Water Management Act was introduced.

National Planning Policy Framework

3.2.5 The contents of the NPPF and the NPPG set out the planning objectives for flood risk management. It states that all forms of flooding and their impacts are material planning considerations, which gives much weight to the issue of flooding. The aim of NPPF is to ensure that flood risk is taken into account at all stages of the planning process in order to prevent inappropriate development in *'at risk'* areas.

3.2.6 The key objectives for planning are appraising, managing and reducing flood risk. To *appraise* the risk it is stated that flood risk areas need to be identified, and that the level of risk needs to be identified. To facilitate this, NPPF indicates that Regional Flood Risk Appraisals (RFRA) and Strategic Flood Risk Assessments should be prepared. The London RFRA (2009) is discussed in Section 3.3.

5 Communities and Local Government (2006) Planning Policy Statement 25: Development and Flood Risk

6 Communities and Local Government (2007) Planning Policy Statement: Planning and Climate Change: Supplement to Planning Policy Statement 1

7 Communities and Local Government (2012) National Planning Policy Framework

8 http://planningguidance.planningportal.gov.uk/

3.2.7 To *manage* the risk, Local Planning Authorities (LPAs) need to develop Local Plans. These plans *'should be supported by Strategic Flood Risk Assessments and develop policies to manage flood risk from all sources, taking account of advice from the EA and other relevant flood risk management bodies, such as lead local flood authorities and internal drainage boards. Local Plans should apply a sequential, risk-based approach to the location of development to avoid where possible flood risk to people and property and manage any residual risk, taking account of the impacts of climate change'.*

3.2.8 The main planning tools for *reducing flood* risk are set out in paragraph 100 of the NPPF:

- applying the Sequential Test;
- if necessary, applying the Exception Test;
- safeguarding land from development that is required for current and future flood management;
- using opportunities offered by new development to reduce the causes and impacts of flooding; and
- where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to facilitate the relocation of development, including housing, to more sustainable locations.

3.2.9 The future impacts of climate change are highlighted in the NPPF and associated guidance, as climate change will lead to increased flood risk in many places in the years ahead. When developing planning policy, LPAs need to consider if it is necessary to encourage the relocation of existing development to locations at less of a risk from flooding in order to prevent future impacts of flooding.

3.2.10 The NPPF and associated guidance also give specific advice for determining planning applications, which needs to be considered when developing policy. LPAs should ensure that flood risk assessments (FRAs) are submitted with planning applications where this is appropriate; they should apply the sequential approach (defined in the NPPF) which ensures that lower risk areas are considered in preference to higher risk areas; priority should be given to the use of SUDS for managing site drainage; new development should be designed to be resilient to flooding as appropriate; and they should ensure that residual risks can be safely managed.

Flood and Water Management Act

3.2.11 The Flood and Water Management Act (FWMA) (2010) was enacted in 2010 to improve the management of flood risk and water supply issues in the UK. It was intended to implement the recommendations of the *Pitt Review, Lessons learned from the 2007 floods* (2008), which were largely caused by poor drainage and surface water runoff.

3.2.12 The Act sets out the roles and responsibilities for various bodies with regards to managing flood risk. It gives the EA an overview role of all flood and coastal erosion risk management. It also incorporates the designation of Lead Local Flood Authority (LLFA) making county councils and unitary authorities the responsibility for managing local flood risk, where local flood risk is defined as that arising from ordinary watercourses (including lakes and ponds) and surface water.

3.2.13 Under the Act, Lewisham Council, as Lead Local Flood Authority, is responsible for developing, maintaining and applying a strategy for local flood risk management in its area and for maintaining a register of flood risk assets. It also has responsibility for managing the

risk of flooding from surface water, groundwater and ordinary watercourses (further details are provided in Section 7.2).

3.2.14 The Act is also anticipated to introduce new responsibilities for the LLFAs and Highways Agency to assess drainage proposals in accordance with a National Standard for SuDS (further details are provided in Sections 7.2, 7.4 and 7.6)

Flood Risk Regulations

3.2.15 The Flood Risk Regulations (2009) were introduced to incorporate the requirements of the Floods Directive into national law in England and Wales. The Floods Directive was written as a response to major flooding in Europe.

3.2.16 The Flood Risk Regulations (FRRs) are concerned with identifying and taking action in relation to areas with the most significant flood risks. They advocate that local flood risk be managed at the local level and that reporting is at the River Basin District Level.

3.2.17 The key requirements of the FRRs are:

- Preliminary Flood Risk assessment reports (PFRA) leading to the identification of flood risk areas by 22 December 2011;
- Flood hazard maps and flood risk maps for flood risk areas taking account of climate change by 22 December 2013;
- Flood risk management plans for flood risk areas by 22 December 2015;

3.2.18 The FRRs also set out the roles and responsibilities of various bodies. These are consistent with those set out in the Flood and Water Management Act.

3.3 Regional Planning Policy

The London Plan[9]

3.3.1 The London Plan is the adopted regional spatial strategy relevant to the London Borough of Lewisham. This document includes a number of policies relevant to flood risk in the Lewisham area. The key policies relate to flood plains; flood defences and sustainable drainage. All these policies are contained within Chapter 5, London's Response to Climate Change.

3.3.2 Policies 7.24-7.28 set out the policy for the Blue Ribbon Network, which includes the Thames, the canal network, the other tributaries, rivers and streams within London and London's open water spaces such as docks, reservoirs and lakes. The River Thames and London's canals and other rivers and water spaces have their own policies 7.29 and 7.30 respectively.

3.3.3 Paragraph 5.54 of the London Plan identifies that the management of flood risk is critical to London's future. Consequently the Plan seeks to ensure that all future development minimises the risk of flooding within the Capital. The Regional Flood Risk Appraisal investigates flood risk in more detail and identifies the range of sources of flood risk.

3.3.4 Policy 5.12 *'Flooding Risk Management'* is particularly relevant stating that Boroughs preparing LDFs utilise SFRAs to develop actions and approaches to reduce risk, particularly through redevelopment of sites at risk of flooding and identifying specific opportunities for flood risk management measures. It also states that proposals must have regard to measures proposed in the Thames Estuary 2100 and Catchment Flood Management Plans.

[9] Mayor of London (2011) The London Plan: Spatial Development Strategy for Greater London

3.3.5 Policy 5.12 also highlights the need to set back permanent development from flood defences to allow for replacement or repair of the defences. This is an issue for Lewisham as there are a number of flood defences located in the borough, such as the Thames Tidal Defences. The London Borough of Lewisham will need to ensure that any new development near to the defences is set back from them, and that any new development does not undermine or breach the defences.

3.3.6 Policy 5.13 *'Sustainable Drainage'* seeks to ensure that surface water run-off is managed close to its source and recommends that sustainable urban drainage systems (SuDS) are promoted for new developments unless there are practical reasons for not doing so. It sets out a drainage hierarchy and states that drainage should deliver other objectives of the London Plan such as water use efficiency, water quality, biodiversity, amenity and recreation, Furthermore, it highlights the contribution that green roofs (Policy 5.11) can make to the reduction in runoff during rainfall events. It is important that local planning policy provides clear guidance relating to sustainable drainage within emerging development areas in Lewisham.

3.3.7 The Region's housing targets over the plan period are given in policy 3.3 *'Increasing Housing Supply'* and subsequent Table 3A.1. These state that the Mayor will seek a minimum ten year target (2011-2021) of 322,100 additional homes across London. Within the Borough of Lewisham the ten year target is 11,105 additional houses with an annual monitoring target of 1,105. The policies mentioned above will need to be considered when the borough is considering how to allocate land, in particular, in order to meet development pressures such as the need for additional housing.

Regional Flood Risk Appraisal for Greater London [10]

3.3.8 One of the key elements of PPS25 was to introduce a hierarchy of Flood Risk Appraisal and the requirement for Regional Planning bodies to produce a Regional Flood Risk Assessment (RFRA) to accompany Regional Spatial Strategies, this hierarchy is retained in the NPPF. The RFRA for Greater London (2009) was undertaken with the assistance of the EA and responses elicited through the informal consultation stage.

3.3.9 The RFRA is a strategic overview of flood risk across London. It does not represent a detailed analysis of flood risk in relation to any particular areas or sites. It contains a series of recommendations which are either region wide or applicable to boroughs in undertaking their SFRA to accompany emerging Local Development Documents. The RFRA will remain a live document with regular updates to reflect the changing position in relation to both climate change and development pressure and policy responses. The RFRA should be useful to spatial planners, developers, infrastructure and utility operators and emergency planners. It is a specific aim of the RFRA to bring spatial planners and emergency planners into closer communication.

3.3.10 The Regional Flood Risk Appraisal (RFRA) provides the following recommendations of specific relevance to the London Borough of Lewisham:

i. **Recommendation No. 1** - All Thames-side planning authorities should consider in their SFRAs and put in place DPD policies to promote the setting back of development from the edge of the Thames and tidal tributaries to enable sustainable and cost effective upgrade of river wall/embankment in line with Policy 5.12, CFMPs and TE2100;

ii. **Recommendation No. 4** – Boroughs at confluences of tributary rivers with the River Thames should pay particular attention to the interaction of fluvial and tidal flood risks;

[10] London Regional Flood Risk Appraisal , October 2009

iii. **Recommendation No. 5** - Developments all across London should reduce surface water discharge in line with the Sustainable Drainage Hierarchy set out in Policy 5.13 of the draft replacement London Plan[11].;

iv. **Recommendation No. 6** - Regeneration and redevelopment of London's fluvial river corridors offer a crucial opportunity to reduce flood risk. Strategic Flood Risk Assessments and policies should focus on making the most of this opportunity through appropriate location, layout and design of development as set out in PPS25[12] and the Thames Catchment Flood Management Plan (CFMP)[13]. In particular opportunities should be sought to:

- Set back of development from the river edge to enable sustainable and cost effective flood risk management options
- Ensure that the buildings with residual flood risk are designed to be flood compatible or flood resilient
- Use open spaces within developments which have a residual flood risk to act as flood storage areas

v. **Recommendation No. 8** – Organisations responsible for development with large roof areas should investigate providing additional surface water runoff storage;

vi. **Recommendation No. 10** – That groundwater flood risk is kept under review;

vii. **Recommendation No. 16** – University Hospital of Lewisham should examine how it may cope in the event of a major flood.

3.3.11 The RFRA deliberately crosses the boundary between land use planning and emergency planning, which has been done to stimulate greater links between these disciplines. The London Resilience Team published its *'Strategic Emergency Plan Version 6.0'* (March 2010) which contains the London Flood Response Strategic Plan. . These plans seek to co-ordinate emergency services and emergency planners across London in the event of a major flood. It will be important to foster links between the RFRA and the Strategic Emergency Plan.

Supplementary Planning Guidance – Sustainable Design and Construction[14]

3.3.12 The Draft Supplementary Planning Guidance (SPG) – Sustainable Design and Construction was published in July 2013 for public consultation. The SPG aims to provide guidance for developers, local planning authorities and neighbourhoods on how to effectively implement Policy 5.3 (Sustainable Design and Construction) of the London Plan and builds on policies set out in the NPPF.

3.3.13 Section 3.4 of the SPG provides guidance on the following areas:

- surface water flooding;
- sustainable drainage;
- flooding and the resilience and resistance of buildings;

[11] Now the London Plan 2011, refer to Section 3.1.1

[12] Now superseded by the NPPF

[13] In particular, the River Ravensbourne policy unit (refer to Section 6.1)

[14] Mayor of London (May 2013)

- safety;
- flooding and basement developments;
- flood defences;
- flood risk management from tidal and
- fluvial flooding; and
- other sources of flooding.

3.3.14 The standards contained within this document have informed the development management recommendations established as part of this SFRA. Refer to Section 7.4 and 7.6 for further details.

Mayor's Water Strategy: Securing London's Water Future (October 2011)

3.3.15 The Water Strategy states: *'Most people in London expect to turn on the tap and get water without having to think about where it comes from. Equally, people want to be able to pull out the plug and let water run away without having to worry about what happens to it afterwards. However, changes are going on around us that mean that Londoners will have to pay more attention to where water comes from and goes to'*.

3.3.16 London's demand for water will increase in the future as London's population grows and the trend of people living in smaller households continues. Furthermore, higher seasonal rainfall and hotter summers will mean that the availability of water will decrease when we need it most. There will also be questions about whether we will be able to capture and store the additional water that wetter winters will bring. This means London's already tenuous supply-demand balance will become increasingly unsustainable – we therefore need to act to balance supply and demand.

3.3.17 London is a dynamic, growing city and, like other world cities, is facing the effects of a changing climate. Together these pressures will aggravate the stress on existing systems by creating:

- *'greater demand for water from the mains network, and therefore from the environment;*
- *increased flows to, and discharges from, the sewage treatment works*
- *greater risks of surface flooding as rainwater runs off new houses, driveways and roads; and*
- *increased risks of storms and tidal surges.*

All in all, this means we will need increasingly to plan and co-ordinate all aspects of water management than in the past'.

3.3.18 To address these issues, the Water Strategy sets out specific proposals for future management of water and wastewater within Greater London. These are outlined below.

Chapter 5 – Managing Rainwater (Action 18)

'The Mayor will work with partners through the Drain London Forum to manage surface water flood risk and ensure a consistent approach across London. This will include:

- *identifying flood risk hotspots and working with partners to determine who is best placed to manage these*
- *developing a Community Flood Plan Programme to support communities that wish to* increase their resilience to flooding
- *developing at least three demonstration projects to show how urban greening measures can help to manage surface water flood risk'.*

'As part of this strategy each London Borough as a Lead Local Flood Authority (LLFA) will have to produce, consult and adopt a Local Floor Risk Management Strategy and Plan over the next few years, these will be based on the Drain London SWMPs'.

Chapter 5 of The Water Strategy also reiterates the drainage hierarchy as set out in the London Plan.

Chapter 6 – Disposal of Wastewater in London (Action 19)

'The Mayor will work with Thames Water and other partners to support the construction of the Thames and Lee Tunnels, as a means of greatly reducing storm discharges from the combined sewer system and improving the quality of the water in the River Thames. The Mayor will ensure cost effectiveness and reduced disruption at all individual locations by continuing to lobby Thames Water on local issues'.

3.4 Local Planning Policy

The Local Development Framework

3.4.1 The Local Development Framework (LDF) is the name given to the planning documents which collectively deliver the planning strategy and policies for Lewisham. The policy documents which make up Lewisham's LDF are at different stages of production. This collection of documents replaced the Unitary Development Plan in 2014. The Local Development Framework includes the Core Strategy, the Development Management Local Plan, the Site Allocations Local Plan and the Lewisham town centre Local Plan.

London Borough of Lewisham Core Strategy[15]

3.4.2 The Lewisham Core Strategy was adopted in June 2011. The Core Strategy is the key Local Development Framework (LDF) document. In relation to Objective 6 of the Core Strategy which deals with flood risk and water management:

3.4.3 *'The Council with its partners will take action to protect the borough from the risk of flooding and reduce the effects of flooding from all sources, including the Thames, Ravensbourne, Quaggy and Pool rivers, and manage improved water quality by:*

- *using the PPS25 sequential and exception tests to allocate land for development;*
- *requiring river restoration and appropriate flood defences as part of development proposals, where appropriate;*
- *ensuring appropriate local flood defences are maintained and provided for; and*
- *requiring sustainable urban drainage systems in new development, wherever feasible'.*

[15] London Borough of Lewisham Core Strategy Development Plan Document (June 2011)

3.4.4 Policy 10 within the Core Strategy policy relates to managing and reducing the risk of flooding with reference to the London Plan, the SFRA and PPS25 (now superseded by NPPF). The policy aims to:

- *'sequentially allocate land to guide development into areas least at risk from flooding;*
- *prevent new development from adding to the risk of localised flooding;*
- *reduce the flood risk to people and the built environment and to the development itself and elsewhere by ensuring the highest design standards contributing to flood reduction and mitigation;*
- *demonstrate that the most sustainable urban drainage system that is reasonably practical is being incorporated to reduce flood risk, improve water quality and achieve amenity and habitat benefits; and*
- *conserve water resources by using water saving devices and rainwater harvesting systems'.*

3.4.5 The Core Strategy also discusses the importance of considering climate change:

'those properties (and areas) that are currently at risk of flooding may be susceptible to more frequent, more severe flooding in future years. It is essential therefore that the development management process (influencing the design of future development within the borough) carefully mitigates against the potential impact that climate change may have on the risk of flooding to property'.

3.4.6 The Core Strategy recognises that as a consequence of limited land availability within the Borough a large proportion of the spatial strategy area is within Flood Zone 3a.

'In order to meet housing targets, regenerate the local area and meet sustainability objectives it will be necessary to develop these sites, subject to adequate mitigation to reduce flood risk. In consultation with the EA, the Council's Strategic Flood Risk Assessment and the Sequential Test have been used to ensure suitable land uses and will be used to guide development. This area is also generally the most sustainable location for development within the borough given higher levels of public transport accessibility and the existing mix in land uses'.

Ravensbourne River Corridor Improvement Plan

3.4.7 The Ravensbourne River Corridor Improvement Plan (2010) was co-authored by the EA and the London Borough of Lewisham. It provides guidance for the enhancing the natural, urban and suburban qualities through opportunities provided by regeneration and positive planning to:

'Bring the Ravensbourne River back to the heart of Lewisham, becoming a distinctive and attractive focal point that brings together not only wildlife but also local communities promoting healthy living whilst reducing flood risk and the impacts of climate change'.

3.4.8 With specific regard to flood risk management and dealing with climate change the plan aims to:

- Raise awareness of the expected increased risk of flooding and extreme weather conditions.
- Encourage appropriate adaptation and mitigation measures.

- Maximise opportunities from regeneration to reconsider the location, layout and design of riverside.

3.4.9 The document includes design guidance, management guidance and good practice examples to aid the achievement of the vision.

3.4.10 The Council is currently preparing a River Corridor Improvement Plan to provide development guidance in relation to all rivers in the borough. This document will draw on the content of the Ravensbourne River Corridor Improvement Plan but update and expand it in the form of a Supplementary Planning Document.

4 Data Collection

4.1 Overview

4.1.1 A considerable amount of knowledge has been collated to inform the analysis (and delineation) of flood risk throughout the Borough, including (but not limited to):

- Historical river flooding information.
- Information relating to localised flooding issues (surface water, groundwater and/or sewer related), collated in consultation with the Council and the EA.
- Detailed flood modelling for the River Ravensbourne.
- Locality of raised flood defences.
- EA Flood Zone Maps.
- Topography (LiDAR).

4.1.2 This data has been sourced from key stakeholders, as highlighted below. The interpretation of this data to inform the delineation of zones of *'high', 'medium'* and *'low'* probability of flooding in accordance with NPPF is explained in Section 5, and the findings of this interpretation is outlined in Section 6. The formulation of planning and development management recommendations is provided in Section 7.

4.1.3 As part of the SFRA update (2014) the latest flood risk information and relevant policy and guidance has been retrieved from the EA and other bodies. The key updates with regards to assessing flood risk across the Borough are:

- Latest EA flood zones
- Reservoir Inundation Maps
- Bermondsey Embayment outputs from The Thames Tidal Breach Modelling Study.
- Thames Estuary Extreme Water Levels
- Outputs from The Ravensbourne Catchment Areas Benefiting From Defences Study
- Revised flood alert and flood warning areas
- The latest historical flood maps
- Areas susceptible to groundwater flooding

4.2 Consultation

4.2.1 Consultation formed a key part of the data collation phase for the Lewisham Borough SFRA. The following key stakeholders were comprehensively consulted to inform the original SFRA document i:

London Borough of Lewisham

4.2.2 **Planning:** Consulted to identify areas under pressure from development and/or regeneration.

4.2.3 **Highways:** Consulted to identify areas potentially at risk from surface water flooding.

4.2.4 **Emergency Planning:** Consulted to discuss the Borough's existing emergency response to flooding.

Environment Agency (EA)

4.2.5 The EA has been consulted to source specific flood risk information to inform the development of the SFRA. In addition, the EA is a statutory consultee under NPPF and therefore must be satisfied with the findings and recommendations for sustainable flood risk management into the future. For this reason, the EA has been consulted during the development of the SFRA to discuss potential flood risk mitigation measures and planning recommendations.

Thames Water

4.2.6 Thames Water is responsible for the management of urban drainage (surface water) and sewerage within the Borough. Thames Water was consulted to discuss the risk of localised flooding associated with the existing drainage/sewer system.

London Fire Brigade

4.2.7 Anecdotal information relating to observed flooding within the Borough was sought from the London Fire Brigade; however no information was made available for the study.

4.2.8 As part of the SFRA update (2014) the EA has been consulted further on technical issues, specifically on the presentation of tidal breach outputs and delineation of Flood Zone 3b.

EA Flood Zone Maps

4.2.9 The EA's Flood Map shows the natural floodplain, ignoring the presence of defences, and therefore areas potentially at risk of flooding from rivers or the sea. The Flood Map shows the area that is susceptible to a 1 in 100 (1% annual exceedance probability (AEP)) chance of flooding from rivers, and a 1 in 200 (0.5% AEP) chance of tidal flooding, in any one year (Flood Zone 3). It also indicates the area that has a 1 in 1000 (0.1% AEP) chance of flooding from rivers and/or the sea in any given year (Flood Zone 2). This is also known as the Extreme Flood Outline.

4.2.10 The Flood Map outlines have been produced from a combination of a national generalised computer model, more detailed local modelling (if available), and some historic flood event outlines. Within the tidal reaches of the River Thames (including the London Borough of Lewisham) the Flood Map has been developed on the basis of detailed two dimensional modelling. The EA's Flood Map provides a consistent picture of flood risk for England and Wales.

4.2.11 The EA's knowledge of the floodplain is continuously being improved by a variety of studies, detailed models, data from river flow and level monitoring stations, and actual flooding information. They have an ongoing programme of improvement, and updates are made on a quarterly basis where more accurate information is available.

4.3 Historical Flooding

4.3.1 Discussions have been held with the Council to identify those areas within the Borough that are known to have been exposed to flooding in recent years, and these have been highlighted in the adjoining flood risk maps (and are summarised in Section 6.2 below). Data on historic flooding has also been retrieved from the EA and Thames Water.

4.3.2 It is important to recognise that the incidents listed are events in which areas have been affected not only by flooding from the River Ravensbourne and the River Thames, but also from surcharging of the underground sewer system, blockage of culverts and gullies, and/or surface water runoff or groundwater.

4.3.3 It is important to recognise that often the *cause* of observed flooding is difficult to ascertain, particularly after the floodwaters have passed. Finally, whilst prescriptive information relating to the precise location and depth of flooding is not always available, anecdotal information highlights the importance of careful and informed decision making when locating future development within a Borough.

4.4 Detailed Hydraulic Modelling

4.4.1 Detailed modelling of the Ravensbourne Catchment was carried out as part of The Ravensbourne Catchment Areas Benefiting from Defences Study (2010). A dynamically linked 1D-2D model was developed for the River Ravensbourne and the River Quaggy and their tributaries.

4.4.2 The study simulated flood events with a range of probabilities for both the defended and undefended scenarios and used the results to determine the areas benefitting from defences.

4.4.3 The model outputs have been used to define the EA Flood Zones (as presented in Figure 2 and Figure 5) and the areas benefitting from defences are shown in Figure 3.

4.4.4 It should be noted that the detailed hydraulic models developed on behalf of the EA assume *'typical'* conditions within the respective river systems that are being analysed. The predicted water levels may change if the operating regimes of the rivers involved are altered (e.g. engineering works which may be implemented in the future), if culverts become blocked, or if the condition of the river channel is allowed to deteriorate.

4.4.5 The EA has also undertaken the Thames Estuary 2100 (TE2100) project, which investigated the risks of flooding at a more detailed level to inform the flood risk management strategy for the area up to the year 2100.

4.4.6 The outputs from this modelling have been incorporated into the EA's flood zones. The project also involved modelling numerous individual breaches in the raised defences alongside the River Thames. The outputs from the breach modelling are presented in Figure C.

4.5 Flood Defences

4.5.1 Flood defences are typically raised structures that alter natural flow patterns and prevent floodwater from entering property in times of flooding. They are generally categorised as either *'formal'* or *'informal'* defences. A *'formal'* flood defence is a structure that was built specifically for the purpose of flood defence, and is maintained by its respective owner, which could be the EA, Local Authority, or an individual. An *'informal'* flood defence is a structure that has not been specifically built to retain floodwater, and is not maintained for this specific purpose, but may afford some protection against flooding. These can include boundary walls, industrial buildings, railway embankments and road embankments situated immediately adjacent to rivers. Within the London Borough of Lewisham, protection is also provided against flooding by the River Thames Barrier.

4.5.2 Formal raised flood defences within the Borough have been identified in consultation with the EA, providing protection against tidal and fluvial flooding from the River Thames. These are indicated in Figure 3. The height of the River Thames defence walls (along the northern boundary of the Borough) is set by an Act of Parliament[16]. These were raised in the mid-

[16] Thames River Prevention of Floods Acts (1879 – 1962)

1970s as interim protection measures in conjunction with the construction of the Thames Barrier. With completion of the barrier, the walls at their original heights provide a standard of defence against a combined fluvial and tidal event of 0.1% (1 in 1000) chance of occurring in any year. Within the River Ravensbourne catchment, as part of a major flood alleviation scheme undertaken between 1964 and 1974, many of the channels in the catchment were culverted or converted to concrete channels, which provided a standard of protection against flood events with a return period of up to 1 in 30 years. There have been a number of flood mitigation schemes carried out within the River Ravensbourne and River Quaggy catchment since the works carried out in the 1970s, and these are summarised in **Table 2** below.

Reach/Location	Details
Brookmill Park (re-alignment)	A 450m diversion as part of the Docklands Light Rail (DLR) extension in 1998 on the Ravensbourne at Deptford.
Bell Green Gas Works (re-alignment)	A 650m diversion of original channel on the River Pool as part of the gas works redevelopment in 1995, Standard of Protection (SoP) increased to 50 years.
Former Glaxo Wellcome Site, Langley Park (re-alignment)	Diversion and opening up of culverts on the East Beck, carried out during a large housing development at this site.
River Quaggy FAS from Sutcliffe Park to confluence with Ravensbourne (storage areas, raised defences and channel restoration)	The Quaggy FAS was completed in December 2006. The project provides two flood storage areas, raised defences and some channel restoration through Greenwich and Lewisham. The standard of protection is 100 years for the storage area at Sutcliffe Park however it is 70 years for the rest of the scheme.
Chinbrook Meadows (channel re-alignment and flood storage)	River restoration works carried out in 2002 for the creation of a natural meandering channel and flood storage, giving a standard of protection of 100 years.
Sundermead Estate, Elmira Street, Lewisham (channel re-profiling)	Channel re-profiling, bridge replacement and bridge raising have taken place as part of a housing development.
Lewisham, the new Town Centre Open Space (channel re-profiling)	Channel re-profiling has taken place as part of an urban re-generation programme by the Lewisham Council.
Sundridge Park Golf Course on Kyd Brook/Quaggy (channel re-alignment)	Channel re-alignment 1995-1996 (outside the Borough)
Chislehurst Railway Culvert (culvert renovation)	A culvert beneath the Chislehurst railway embankment, downstream of Woodlands Road, has been renovated (reduced in size to a 1.2m diameter pipe) as part of the Channel Tunnel Rail Link project. (outside the Borough)
Ladywell Fields (re-meander through the park)	A 200m meander was created through the centre of the park, diverting around half of the river's flow.
Cornmill Gardens (removal of concrete channel)	Around 100m of the river was removed from its concrete banks and a new public space created.

Table 2: Flood Mitigation Schemes

4.5.3 No particular informal raised flood defences providing protection from flooding have been identified in Lewisham as part of the SFRA process. It is important to recognise however that

local roads and/or rail lines that have been constructed on raised embankments may alter overland flow routes, and as such may have a localised effect upon the risk of flooding. This should be carefully reviewed in a local context as part of the detailed site based Flood Risk Assessment.

4.6 Topography & Geology

4.6.1 Detailed topographic information has been provided by the EA (2013) to allow representation of the topography of the Borough, see Figure Geological information has been retrieved from the British Geological Society (BGS), providing an overview of soils and substrate (see Figures B1 and B2).

5 Data Interpretation

5.1 Introduction

5.1.1 The data captured from key sources to inform the development of the Lewisham SFRA is outlined in Section 4 above. This section provides an overview of how this data was interpreted to meet the requirements of NPPF. The findings of these analyses are presented in Section 6 below.

5.2 Delineation of the NPPF Flood Zones (Fluvial & Tidal Flooding)

5.2.1 To inform the planning process, it is necessary to review flood risk across the Borough, categorising the area in terms of the likelihood (or probability) that flooding will occur.

5.2.2 The definitions of these flood zones within NPPF are presented below.

Zone 3b The Functional Floodplain

5.2.3 This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the EA. (Not separately distinguished from Zone 3a on the Flood Map).

Zone 3a High Probability

5.2.4 Land having a 1 in 100 or greater annual probability of river flooding or Land having a 1 in 200 or greater annual probability of sea flooding.. (Land shown in dark blue on the Flood Map).

Zone 2 Medium Probability

5.2.5 Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map).

Zone 1 Low Probability

5.2.6 Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as *'clear'* on the Flood Map – all land outside Zones 2 and 3). Delineation of Zone 3b Functional Floodplain.

5.2.7 Zone 3b Functional Floodplain is defined as those areas in which *'water has to flow or be stored in times of flood'*. Within the Lewisham Borough Flood Zone 3b is defined as:

> *'Areas which are designed to store or convey flood waters during times of flood and Greenfield areas at risk from the 5% annual probability (1 in 20 year) flood extent, taking into consideration the presence of existing flood alleviation measures'.*

5.2.8 The northern areas of the London Borough of Lewisham are defended against flooding from the River Thames. In these areas, Zone 3b Functional Floodplain is restricted to land on the river side of the defences. Throughout the remainder of the Borough, areas of natural floodplain adjoining the River Ravensbourne and the River Quaggy (i.e. that have a 5% annual probability (20 year) chance of flooding in any year) also fall within Zone 3b Functional Floodplain.

5.2.9 The detailed modelling outputs developed by the EA (refer to Section 4.4) have been adopted to aid in the delineation of Zone 3b Functional Floodplain within the Borough of Lewisham. The 5% annual probability (1 in 20 year) event outline, taking into account defences, is presented on Figure 3.

Delineation of Zone 3a High Probability

5.2.10 Zone 3a High Probability is defined as those areas of the Borough that are situated within the 1% annual probability (1 in 100 year) fluvial event or 0.5% annual probability (1 in 200 year) tidal event (whichever is greater) flood extent. For planning purposes, the EA has issued a series of Flood Zone Maps. The outlines, dated December 2013, have been adopted to define Zone 3a High Probability within the London Borough of Lewisham SFRA.

5.2.11 The Fluvial Flood Zone 3a is based on the 1% annual probability (1 in 100 year) undefended event flood outline from the River Ravensbourne Study (provided by the EA) which accounts for flooding from the River Quaggy and the River Thames.

Delineation of Zone 2 Medium Probability

5.2.12 Zone 2 Medium Probability is defined as those areas of the Borough have between a 1% annual probability (1 in 100 year) event and 0.1% annual probability (1 in 1000 year) event of river flooding in any year, or between a 0.5% annual probability (1 in 200 year) event and a 0.1% annual probability (1 in 100 year) event of flooding from the sea in any year. Zone 2 Medium Probability is defined on the basis of the EA Flood Zone Map. The EA Flood Zone 2 has been created by combining the 0.1% annual probability (1 in 1000 year) undefended event outline from the Ravensbourne Modelling Study with the historic flood outlines held by the EA. These outlines have been adopted unmodified for the SFRA.

Delineation of Zone 1 Low Probability

5.2.13 Zone 1 Low Probability is defined as those areas of the Borough that are situated above (or outside of) the 0.1% annual probability (1 in 1000 year) event flood extents. For SFRA purposes, this incorporates all land that is outside of the shaded Zone 2 and Zone 3 flood risk areas (as defined above).

5.3 Local Drainage Issues

5.3.1 The risk of flooding from other (non-river related) sources is an important consideration. The flooding that affected England, and particularly the South East, in August 2007 highlighted the potential risk that groundwater, surface water runoff and sewer flooding can have upon an area. Newbury (West Berkshire), Sheffield and Hull all suffered severe flooding from other sources.

5.3.2 Within Lewisham, information has been provided by the Council relating to anecdotal observations of localised flood risk problems that have occurred within the Borough. These are generally as a result of blocked culverts and gullies, surface water runoff, and failures of the underground sewer system during particularly intense rainfall. Some very general information has also been provided by Thames Water, providing a simple overview (per post code area) of the number of properties that have been affected by sewer flooding over the past decade. The EA have also provided outlines showing the extents of past flood events, some of which may have been caused by local drainage issues.

5.3.3 Of course this information only relates to localised problems *once they have occurred*. NPPF strongly advocates the prediction (where possible) of potential flood risk, seeking an avoidance strategy that guides development away from these areas wherever possible.

5.3.4 Detailed modelling of surface water risks within the Ravensbourne catchment (encompassing the boroughs of Lewisham, Bromley and Greenwich) is being carried out as part of Drain London, a study which is designed to deliver a PFRA (preliminary flood risk assessment) and Surface Water Management Plan (SWMP) for each London Borough.

5.3.5 The report presents the outputs of broadscale surface water mapping. Unfortunately these have not been made available for the purposes of the SFRA and not generally available to the public. The assessment presumes that the drainage system can cope with 6mm/hr in all areas and does not explicitly consider the capacity of the watercourses in the study area. The report also identifies critical drainage areas within the Borough.

5.3.6 Areas in which the soils are highly impermeable (reducing the capacity of infiltration into the ground during periods of wet weather) and localised *'sags'* in the topography (where ponding is likely to occur) can be considered locations within which the potential risk of localised flooding should be taken into account as part of the design process. The local geology also provides an indication of the likely presence (or otherwise) of a susceptibility to groundwater flooding. For example, areas of highly permeable gravel geology situated near a river may be at risk of groundwater flooding as the local water table rises following a rainfall event.

5.3.7 More generally however, development can fundamentally alter drainage patterns, obstructing overland flow routes, and altering the volume and speed of runoff. The SFRA has therefore captured all readily available information relating to localised flooding in an effort to inform future detailed FRAs. It is essential to highlight however that this should not be considered a comprehensive representation of all localised flood risks as indeed not all observed incidents may have been reported (and the blockage of culverts and gullies can happen anywhere).

5.4 Potential Impacts of Climate Change upon Flood Risk

5.4.1 A considerable amount of research is being carried out worldwide in an endeavour to quantify the impacts that climate change is likely to have on flooding in future years. Climate change is perceived to represent an increasing risk to low lying areas of England, and it is anticipated that the frequency and severity of flooding will change measurably within our lifetime. The EA has published Climate Change to Planners – Guidance to support the National Planning Policy Framework (EA, 2013). It states that a 10% increase in the 1% AEP (100 year) river flow should be considered for the 1990-2025 timeframe and that an increase of 20% should be considered for the 2025-2115 timeframe. These impacts should be considered when reviewing the potential risk of flooding in future years within the River Ravensbourne catchment. In tidally affected areas within the east of England, including London, an increasing rate of change in predicted sea levels is to be assumed with time as summarised in **Table 3** below.

1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
4.0mm/year	8.5mm/year	12.0mm/year	15.0mm/year

Table 3: Recommended Contingency Allowances for Net Sea Level Rise in London[17] (relative to 1990 base sea level)

5.4.2 Within the northern proportion of the London Borough of Lewisham, at risk of flooding from the River Thames, the potential impact that climate change may have upon peak design river levels within the Thames is complicated to a large degree by the operation of the Thames Tidal Defences (TTD). As part of the TE2100 Strategy, a detailed review of the TTD design and operation into future years has been undertaken by the EA. Currently the impacts of climate change can be mitigated by making space for water, and reducing reliance upon the barrier.

[17] Climate Change to Planners – Guidance to support the National Planning Policy Framework (EA, 2013)

5.4.3 Clearly future investment in the TTD over the coming century cannot be assured today however, and therefore it is essential that planning policy takes a proactive stance when considering the potential impact of climate change. For this reason, developers working within this area should consult with the EA as part of the design process to seek advice on the appropriate climate change related design level to use for design purposes.

5.4.4 It is essential that developers consider the possible change in flood risk over *the lifetime of the development* as a result of climate change. The likely increase in flow and/or tide level over the lifetime of the development should be assessed proportionally to government guidance as outlined above. For design purposes, the EA recommend that the *'lifetime of development'* is adopted as 60 years and 100 years for commercial and residential development respectively.

5.4.5 It is important to remember however that the potential impacts of climate change will affect not only the risk of flooding posed to property as a result of river and/or tidal flooding, but it will also potentially increase the frequency and intensity of localised storms over the Borough. This may exacerbate localised drainage problems, and it is essential therefore that the detailed FRA considers the potential impacts of climate change upon localised flood risks, as well as the risks of river related flooding. The Climate Change to Planners – Guidance to support the National Planning Policy Framework (EA, 2013) provides guidance as to the anticipated increase in rainfall intensity that should be considered for design purposes. This is reproduced in **Table 4** below.

1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
+5%	+10%	+20%	+30%

Table 4: Recommended national precautionary sensitivity ranges for peak rainfall intensities[18]

[18] Climate Change to Planners – Guidance to support the National Planning Policy Framework (EA, 2013)

6 Flood Risk in the London Borough of Lewisham

6.1 Overview

River Thames

6.1.1 The northern proportion of the London Borough of Lewisham is situated immediately adjacent to the River Thames. Whilst the Thames poses a potential risk of flooding to properties within the this area of river frontage, property is currently protected from flooding by the River Thames Tidal Defences (TTD) up to the 0.1% annual probability (1 in 1000 year) event.

6.1.2 This degree of protection is effective provided that the River Thames Barrier is operated to protect against storm surges from the North Sea and that there is a sufficient storage pool behind the barrier to accommodate the River Thames when it is shut during extreme fluvial events at high tides. The Thames Estuary 2100 sets out the strategy for managing tidal flood risk from the Thames over the next 100 years.

River Ravensbourne & River Quaggy

6.1.3 The River Ravensbourne and the River Quaggy are key features of the Borough of Lewisham, and properties within the vicinity of the river corridors are subject to a potential risk of fluvial (river) flooding. Investment has been placed into flood defence to reduce the risk of flooding, particularly within Lewisham town centre, however fluvial flooding remains a threat to property (and potentially life) within the Borough. Both the Council and the EA are encouraging a more sustainable planning-led approach to further reducing flood risk in the future, and this is discussed further in Section 7 below.

Localised Flood Risk

6.1.4 A potential risk of flooding from other (non-river related) sources exists throughout the Borough, including possible sewer surcharging, and surface water flooding as a result heavy rainfall and/or blocked gullies (see Figures 2 and 4). With changing climate patterns, it is expected that intense storms of this nature will become increasingly common. It is vitally important therefore that planning decisions recognise the potential risk that increased runoff poses to property and plan development accordingly so that future sustainability can be assured.

6.1.5 The overloading of the sewer system due to inflows exceeding the underground system capacity (i.e. resulting in surcharging) is a potential problem in any urban area. It is important to recognise that surface water networks are typically designed to cater for events up to a 1 in 30 year. Surface water flooding will occur when the sewer system is overloaded and/or a system blockage occurs.

6.1.6 The potential sources of flood risk within the Borough are explained more fully below.

6.2 Historical Flooding

6.2.1 Severe flooding affected the Boroughs along the River Thames, including Lewisham, on 6th January 1928 when the defences along the river were breached. Amongst other disaster locations, failure of a 25 metre stretch of embankment near Lambeth Bridge resulted in the death by drowning of fourteen people within basements. Four thousand people were made homeless as a direct result of this flooding event.

6.2.2 The last major flood in the Ravensbourne catchment was in September 1968, which was considered to have a return period of 100 years and caused flooding of residential and

commercial properties. Flooding was observed within the Borough in 1977, however this was limited to the Quaggy and its tributaries. Flooding was also observed in 1992 and 1993, although this was largely confined once again to the Quaggy with relatively limited property flooding within the Ravensbourne catchment. There has been no tidal flooding of the Ravensbourne catchment since 1968, and is now protected by the Thames Barrier.

6.2.3 Figure 4 presents the extent of recorded historical flooding within the Borough (retrieved from the EA (November 2013).

6.2.4 Since 2000 Lewisham have been recording reported flooding incidents within the Borough in a Flooding Hotspots database. The data presented in Appendix D, is banded into 5 significance bands based on the frequency of occurrence and the severity of the events recorded at the location.

6.2.5 The following statistics have been obtained from the EA work currently underway within the Ravensbourne catchment[19]:

- Fluvial flooding has not reached property threshold levels since 1993;
- In most tributaries of the Ravensbourne there has been flooding of properties (since 2001) from surface water flooding. This has been the result of insufficient capacity of urban drainage systems and/or backwater effects on urban drains from high water levels in the watercourses. Partial culvert blockages may have also contributed to the flooding;
- There is little evidence that groundwater flooding has affected properties apart from a limited number of house cellars and property gardens in the lower part of the catchment. It is also unclear if the source of flooding is the result of a high water table or if it originates from other sources (e.g. seepage from a nearby watercourse or from surface drainage).

6.2.6 Relatively few flooding incidents have occurred in more recent years. Anecdotal evidence provided by Thames Water in 2007 noted that there were 26 occurrences of properties flooded by combined overloaded sewers in the last ten years in the BR 1 postcode area. However, this area extends outside of the borough boundary and may not provide an accurate assessment of flooding from this source within the Borough.

6.2.7 Data retrieved from Thames Water in 2014 shows that there have been 128 internal flooding incidents within the last 20 years. The data, based on postcode sector, is presented in Figure 4 and Appendix C.

6.3 Fluvial Flood Risk

River Thames

6.3.1 The London Borough of Lewisham is bounded to the north by the River Thames. The Borough is situated within the lowermost reaches of the River Thames system, draining a catchment area of almost 5000 square miles. Historically the River Thames floodplain was substantially wider than it is today, and indeed the dense urban area of Greater London (including Lewisham) heavily constrains the passage of the river corridor as it winds its way towards the sea. Not surprisingly therefore, fluvial flooding from the River Thames does pose a risk to areas of London. High river levels within the lower reaches of the Thames are most likely to be evident when prolonged rainfall falls within the upper reaches of the catchment, affecting counties to the west of Greater London, as occurred during the summer of 2007.

[19] Ravensbourne Flood Risk Management Strategy September 2005 Inception Report

6.3.2 The River Thames has been heavily modified over time with the growth of London, including the construction of raised defences along much of its length (within London). As a result, the direct risk to the London Borough of Lewisham as a result of fluvial flooding alone from the River Thames is virtually negligible. Should a fluvial flooding event within the upper catchment coincide with a particularly high tide in the lower reaches of the River Thames however, the London Borough of Lewisham is at risk. This is discussed further in the section below.

River Ravensbourne & River Quaggy

6.3.3 The risk of fluvial flooding through much of the Borough of Lewisham is dominated by the River Ravensbourne and River Quaggy. The river corridors are heavily constrained by urban development along much of their respective lengths, and (not surprisingly therefore) a risk of flooding is evident.

6.3.4 Considerable modifications have been made to the river channels. In decades past, these improvements were often made in an attempt to increase land availability within town centres, canalising and/or culverting the rivers to get water away more quickly and more efficiently. As time passed however, it became increasingly evident that this was not a sustainable approach, particularly as flooding began to pose an ever increasing risk to property and livelihood.

6.3.5 A change in *'philosophy'* was adopted, and rivers were once again seen as a resource to be protected, rather than simply part of the wider drainage system. This is particularly evident within the River Ravensbourne catchment where both the EA and the Borough of Lewisham are now working to seek sustainable, planning led solutions to risk reduction, including (for example) Chinbrook Meadows. The Ravensbourne River Corridor Improvement Plan seeks a design-led spatial improvement plan to ensure the principles of *'Making Space for Water'* and the Blue Ribbon network are maximised, and proposed future developments (including regeneration) fit into a spatial improvement plan.

6.3.6 The potential risk of fluvial flooding from the Rivers Quaggy and Ravensbourne, delineated in accordance with the NPPF flood zone definitions, is presented in Figure 2. A number of properties are potentially at risk of river flooding throughout the Borough, and the regeneration of these areas will require very careful consideration to ensure sustainability in future years.

6.4 Tidal Flood Risk

6.4.1 The primary risk to property and life from flooding within the northern portion of the London Borough of Lewisham (adjoining the River Thames) is as a result of tidal activity. Considerable investment has been made in the provision of the Thames Tidal Defences (TTD) to protect Greater London (including Lewisham) from tidal flooding. It is essential to appreciate however that the flood defences are engineered structures that can only ever protect up to a point, they may malfunction, and they have a finite structural life. There will always therefore be a residual risk of flooding within the Borough, and this is explained further in the section below.

6.4.2 As highlighted earlier, the London Borough of Lewisham is situated in the lower reaches of the River Thames catchment, and the river is tidally influenced at this location. The primary risk of flooding within the London is as a result of a surge tide. A surge occurs when a weather system within the North Sea creates gale force winds that blow in a southerly direction through the narrow stretch of sea between Great Britain and the continent. A *'wedge'* of water is created, increasing in depth as it progresses through the narrowing gap between the land masses towards the English Channel. Large tidally influenced river estuaries, particularly within the South East of England (including the River Thames), are susceptible to relatively large and rapid increases in river levels as the wave passes. Should this *'surge'* coincide with a particularly high tide and/or fluvial flooding in the upper reaches of the catchment, the River Thames within London becomes in effect a *'basin'* with water approaching in both directions.

6.4.3 The Thames Tidal Barrier was constructed specifically to prevent the tidal surge passing upstream into the built up areas of London. Not only does this (in conjunction with the raised River Thames flood defences) protect London from unusually high river levels as a result of a surge tide, but it also ensures that there is capacity in the river channel to safely store fluvial floodwaters that are travelling downstream from the upper catchment.

6.4.4 The future sustainability of London is clearly dependant to a large degree upon the retention of the River Thames Tidal Defences (TTD) in the longer term. Decisions surrounding investment of this nature in future years cannot be predicted with any certainty, and therefore it is imperative that planning decisions are taken with a clear understanding of the potential risks posed to property and life should things ultimately go wrong. This is the primary purpose of the following sections of the SFRA.

6.5 Flood Risk due to Reservoir (or Water Storage) Failure

6.5.1 Paragraph 014 of NPPF states:

> *'The failure of a reservoir has the potential to cause catastrophic damage due to the sudden release of large volumes of water. The local planning authority will need to evaluate the potential damage to buildings or loss of life in the event of dam failure, compared to other risks, when considering development downstream of a reservoir. Local planning authorities will also need to evaluate in Strategic Flood Risk Assessments (and when applying the Sequential Test) how an impounding reservoir will modify existing flood risk in the event of a flood in the catchment it is located within, and/or whether emergency draw-down of the reservoir will add to the extent of flooding'.*

6.5.2 As part of the SFRA update, flood outlines from the Reservoir Inundation Mapping Study were retrieved from the EA. This study assumed a worst-case scenario; that a breach occurs for the full height and width of the impounding structure when the water level is near the crest. It did not make any assessment of the probability of such an event occurring. Unfortunately, the data does not include any information about depths or velocities of flooding and so no assessment of the hazard can be made. In the absence of this data it can be assumed that any areas within watercourses and with well-defined valleys will present a risk to life.

6.5.3 The flood outlines derived as part of the Reservoir Inundation Mapping Study are presented in Figure E.

6.6 Risk to Life from Flooding (Flood Hazard)

6.6.1 In 2006 Defra and the EA published a document entitled *'Flood Risk to People'* (FD2321/TR2). This provides guidance to aid in the assessment of flood hazard within the UK. The risk to life (as a result of flooding) within the Borough of Lewisham has been assessed to accordingly inform the allocation of land within the Borough for future development. A brief summary of the findings is presented below:

Flood Hazard due to Flood Defence Failure

6.6.2 Flood defences are typically raised structures that alter natural flow patterns and divert floodwater away from areas of habitation in times of flooding. Raised defences exist along the Thames frontage, providing protection against tidal flooding, and along the River Ravensbourne and River Quaggy. The areas that benefit from existing defences, as determined by the Ravensbourne Modelling Study are presented in Figure 3.

6.6.3 A failure of a raised flood defence could result in rapid inundation into the Borough, posing a potential risk to residents, pedestrians and property that may be in the path of the floodwaters. Deep, fast flowing water may threaten life, and this must be considered when planning future

development. The accumulation of standing water as a result of breaching or overtopping also needs consideration. This can lead to flood risks associated with, for example:

- safe access and exit to properties through flood water;
- interference with essential services and infrastructure; and/or
- the inundation (without warning) of basement dwellings.

6.6.4 As part of the original SFRA, hydraulic modelling was carried out to consider the velocity, depth and path of flood water should a failure of the defences occur (at any point along its length). However, this information has been supplanted by outputs of the Thames Tidal Breach Modelling Study (Figure C). The figure shows the combined output of 5 individual simulated breaches. Sites some distance from these breaches may need to carry out modelling to determine the risk from Tidal Breach. The embayment modelling *'areas at risk of tidal breach'* should be used as a guide to determine whether this work is necessary.

Sub-delineation of Zone 3a High Probability for Planning Purposes (River Thames)[20]

6.6.5 The northern portion of the London Borough of Lewisham is situated within Zone 3a High Probability, defended against flooding from the River Thames. There remains a residual risk of failure of these defences, and therefore it is essential that planning decisions are taken with due consideration to the scale (and variability) of this risk.

6.6.6 These decisions should take account of the breach outlines presented in Figure C and also the TE2100 information presented Appendix E.

River Ravensbourne & River Quaggy Defences

6.6.7 As part of the original SFRA a site walkover was carried out to identify those defences along the River Ravensbourne and River Quaggy that could potentially pose a direct risk to life should a sudden breach failure occur.

6.6.8 It was concluded that all raised defences along the Ravensbourne and the Quaggy are relatively short in stature (less than 1m in height), and therefore unlikely to collapse in a catastrophic manner, resulting in a sudden wave that may wash pedestrians off their feet. Consequently no dedicated breach modelling of this defence system has been carried out as part of the SFRA.

6.6.9 **It is imperative that any proposed development within close proximity of the defences consider the potential risk of breach failure and/or overtopping within a localised context as an integral part of the detailed Flood Risk Assessment**. The location of the River Ravensbourne and River Quaggy defences is shown on Figure 3.

Structural Integrity of Flood Defences

6.6.10 Finally, it is highlighted that the structural integrity of the existing flood defences is integral to the sustainability of development. It is recognised however that this will vary with time and proximity along the river frontage. Consequently it is essential that the detailed site based Flood Risk Assessment for all potential future development within defended areas of the Borough considers both the likelihood and consequence of defence failure near the proposed site.

6.7 Localised Risk of Flooding

Local Drainage Issues (Observed Flooding Incidents)

6.7.1 As discussed earlier, consultation has been carried out with a number of stakeholders to identify known and/or perceived problem areas. These problems are generally attributed to inundation resulting from (for example) culvert blockages and/or surface water flooding. Properties and infrastructure within the Borough have been subject to flooding in the recent past, as indicated in Figure 4.

6.7.2 Given the heavily urbanised character of much of the Borough, it is inevitable that localised flooding problems arising from under capacity drainage and/or sewer systems will occur, particularly given the mounting pressure placed upon ageing systems as a result of climate change. Furthermore, sewer systems are generally designed (in accordance with current Government guidance) to cater for the 1 in 30 year storm, and highway soakaways are generally designed for only 1 in 10 year storms. Storms over and above these design events will exceed the drainage system, resulting in overland flow, often in an uncontrolled manner (resulting in localised flooding). Input has been sought from Thames Water to pinpoint known and/or perceived problem areas relating to the sewer system; however the information provided is very general.

6.7.3 The EA have produced a national dataset called Flood Maps for Surface Water (FMfSW). The maps present depth banding for 1 in 30 year and 1 in 200 year rainfall events and are available on the EA website. Maps centred on a particular location can be requested from the EA through the external relations team.

6.7.4 As part of the Drain London Study a detailed assessment of the risk of surface water flooding in River Ravensbourne catchment was carried out.

6.7.5 Incidents of historical flooding have been identified, however any location within the Borough may be susceptible to localised flooding, irrespective of whether or not they have flooded in the past. An overview of the geology and topography has been provided in Figures A and B, and these may be used as a tool to consider whether the proposed development site is (for example) situated within a local *'sink'* that may be susceptible to localised ponding.

6.7.6 Surface water flooding is considered to be the source of most frequent flooding within the Borough (when accounting for the tidal defences) and is expected to worsen as intense rainfall events become more frequent. It is essential, therefore, that planning decisions are informed by an assessment of surface water flooding (carried out in a local context) commensurate with the perceived risk, as indicated by broad scale mapping, flood history and the opinion of local flood risk managers.

Groundwater Flooding

6.7.7 A proportion of the Borough of Lewisham, away from the River Thames, overlays London Clay and consequently the risk of groundwater flooding will typically be very low. Areas adjoining the River Thames and River Ravensbourne corridors however are characterised by alluvium and *'river terrace deposits'*. These are referred to as *'Thames Gravels'* and there is evidence within adjoining Boroughs of groundwater flooding occurring some distance from the river as a result of water finding a pathway through the gravels during high river levels.

6.7.8 The EA's *'Areas at Risk of Groundwater Flooding'* is presented in Figure 4. At times however, incidents of groundwater flooding can be mistaken for flooding from other sources (or vice versa). The risk of groundwater flooding is highly variable and heavily dependent upon local conditions at any particular time however, and therefore it is not possible to sensibly develop a strategic map of *'groundwater risk'* as part of the SFRA process. It is important to recognise that historical flooding is *not* a robust measure of the risk of flooding in future years.

6.7.9 Due to the high degree of variability when considering groundwater flooding, it is important to ensure that the potential risk of groundwater flooding to a property is considered within a local context. This is most appropriate at the development application stage (i.e. as part of the detailed Flood Risk Assessment).

6.8 Topography

6.8.1 The topography London Borough of Lewisham falls gradually from north to south towards the River Thames. The River Ravensbourne traverses through the centre of the Borough in a relatively well defined river valley with land gently sloping towards the river corridor.

6.8.2 To the south of New Cross and St John, there are no distinct local low-lying areas that may be particularly susceptible to localised ponding during periods of heavy rainfall. Within Deptford however (to the north of New Cross and St John) the area adjoining the River Thames is relatively low lying. Local *'sags'* in the topography are evident, particularly Deptford Park and the Football Ground on Stockholm Road. Residential areas to the north of the railway line (around Reculver Road) are also low lying however, and may be susceptible to localised ponding should the underground drainage system be exceeded.

6.8.3 The topography of the London Borough of Lewisham is provided in Figure A.

6.9 Geology

6.9.1 The geology of the London Borough of Lewisham is characterised by London Clay to the south, and river terrace deposits (Thames Gravels) to the north, and adjoining the River Ravensbourne. The impermeable nature of the soils within the south of the Borough (away from the river corridors) can increase the susceptibility of the area to surface water (or flash) flooding following periods of heavy rainfall. Immediately adjoining the River Thames, the deposits of gravel can lead to localised incidents of groundwater flooding. A lens of chalk is evident within the low lying area of Deptford, and this too may indicate a slightly higher susceptibility to possible groundwater flooding.

6.9.2 The geology of the Borough will heavily influence the design of Sustainable Drainage (SuDS) techniques, and should be carefully considered as part of the design process. In simple terms, infiltration techniques including for example soakaways are unlikely to operate efficiently in areas overlaying impermeable soils. To the south of the Borough therefore, away from the river corridors, engineered solutions (including tanked on-site storage) may be more suitable.

6.9.3 An overview of the geology of the London Borough of Lewisham is provided in Figures B1 and B2.

6.10 Impacts of Climate Change upon Flood Risk

6.10.1 Detailed modelling of the tidal and fluvial flood risk has been carried out; no outputs for climate change adjusted flows have been provided for the Ravensbourne and Quaggy model or for the Thames model. For planning purposes Zone 2 Medium Probability is often assumed to be a reasonable approximation of the likely extent of Zone 3 High Probability in 100 years as a result of climate change. Although this is a questionable approach, it provides some basis on which to assess the possible impacts of climate change.

6.10.2 If Flood Zone 2 is taken as a reasonable approximation of the future Flood Zone 3, then the extent of river flooding will increase significantly over the next 100 years. Although Flood Zone 2 has been created by combining the model outputs with historical flood outlines, this only significantly increases the extent of Flood Zone 2 at the confluence of the Pool River and the River Ravensbourne and slightly further upstream on both these watercourses

6.10.3 It is important to recognise that **those properties (and areas) that are currently at risk of flooding will be susceptible to more frequent, more severe flooding in future years**. It is essential therefore that the development management process (influencing the design of future development within the Borough) carefully mitigates against the potential impact that climate change may have upon the risk of flooding to the property.

6.10.4 The tidal impacts include expected rises in mean sea level, peak surge tide level, and wave heights.

6.10.5 For this reason, all of the development management recommendations set out below require all floor levels, access routes, drainage systems, infrastructure and flood mitigation measures to be designed *with an allowance for climate change*[21]. This provides a robust and sustainable approach to the potential impacts that climate change may have upon the Borough over the next 100 years, ensuring that future development is considered in light of the possible increases in flood risk over time.

6.10.6 Once again, it is emphasised that the potential impacts of climate change will affect not only the risk of flooding posed to property as a result of river flooding, but it will also potentially increase the frequency and intensity of localised storms over the Borough. This may exacerbate localised drainage problems

6.11 Residual Risk of Flooding

6.11.1 It is essential that the risk of flooding is minimised over the lifetime of the development in all instances. It is important to recognise however that flood risk can never be fully mitigated, and there will always be a residual risk of flooding. This residual risk is associated with a number of potential risk factors including (but not limited to):

- a flooding event that exceeds that for which the local drainage system has been designed;
- the residual danger posed to property and life as a result of flood defence failure; and
- general uncertainties inherent in the prediction of flooding.

6.11.2 The modelling of flood flows and flood levels is not an exact science; therefore there are inherent uncertainties in the prediction of flood levels used in the assessment of flood risk. The adopted flood zones underpinning the Borough of Lewisham are largely based upon detailed river and/or breach modelling within the area. Whilst these provide a robust depiction of flood risk from a strategic perspective, all detailed modelling requires the making of core assumptions and the use of empirical estimations. The broadscale nature of the models means that small scale features that may impact on overland flow pathways are not necessarily represented.

6.11.3 Taking a conservative approach for planning purposes therefore, the EA advises that finished floor levels are raised to 300mm above the 0.5% annual probability (1 in 200 year) peak design flood level (including climate change) when advising developers.

[21] All elements of design must account for the potential impact of climate change in predicted peak design water levels, as highlighted in Section 7.4. The impacts of climate change should be assessed over the lifetime of the proposed development, and calculated in accordance with Climate change allowances for planners – Guidance to support the National Planning Policy Framework (EA, 2013).

7 Sustainable Management of Flood Risk

7.1 Overview

7.1.1 An ability to demonstrate *'sustainability'* is a primary government objective for future development within the UK. The definition of *'sustainability'* encompasses a number of important issues ranging broadly from the environment (i.e. minimising the impact upon the natural environment) to energy consumption (i.e. seeking alternative sources of energy to avoid the depletion of natural resources). Of particular importance however is sustainable develop ment within flood affected areas.

7.1.2 Recent history has shown the devastating impacts that flooding can have on lives, homes and businesses. A considerable number of people live and work within areas that are susceptible to flooding, and ideally development should be moved away from these areas over time. It is recognised however that this is often not a practicable solution. For this reason, careful consideration must be taken of the measures that can be put into place to minimise the risk to property and life posed by flooding. These should address the flood risk not only in the short term, but throughout the lifetime of the proposed development. This is a requirement of the NPPF.

7.1.3 The primary purpose of the SFRA is to inform decision making as part of the planning and development management process, taking due consideration of the scale and nature of flood risk affecting the Borough. Responsibility for flood risk management resides with all tiers of government, and indeed individual landowners, as outlined below.

7.2 Responsibility for Flood Risk Management

7.2.1 There is no statutory requirement for the Government to protect property against the risk of flooding. Notwithstanding this however, the Government recognise the importance of safeguarding the wider community, and in doing so the economic and social wellbeing of the nation. An overview of key responsibilities with respect to flood risk management is provided below.

7.2.2 The Greater London Authority (GLA) should consider flood risk when reviewing strategic planning decisions including, for example, the provision of future housing and transport infrastructure. The GLA authored the Regional Flood Risk Appraisal for Greater London (see Section 3.3) to inform the development (and distribution) of housing targets for Boroughs throughout the Greater London area and to provide overarching policy regarding flood risk management.

7.2.3 The EA has a statutory responsibility for flood management and defence in England and Wales. It assists the planning and development management process through the provision of information and advice regarding flood risk and flooding related issues.

7.2.4 As the Lead Local Flood Authority, Lewisham Borough are required to develop, maintain, apply and monitor a strategy for local flood risk management (local flood risk includes ordinary watercourses, surface water and groundwater). In order to allow co-ordinated approaches, it is required that the London Borough of Lewisham forges effective partnerships with the adjacent LLFAs and the EA as well as other key stakeholders – Thames Water, Network Rail, Transport for London and the Highways Agency, as carried out during the Drain London Study. They also have a responsibility to manage future input into the planning process to ensure suitable SuDS have been included as part of planning proposals (see Section 7.6).

7.2.5 The main responsibilities are to:

- take the lead in managing local flood risk and bring together all the relevant bodies to help manage it effectively ;
- prepare a local flood risk management strategy;
- investigate and report on flooding incidents;
- maintain a register of flood prevention assets; and
- following the implementation of Schedule 3 of the FWMA (see Sections 3.2 and 7.6), it is anticipated that Lewisham Borough will act as statutory consultee with regard to surface water drainage for developments.

7.2.6 The **Local Planning Authority** is responsible for carrying out a Strategic Flood Risk Assessment. The SFRA should consider the risk of flooding throughout the Borough and should inform the allocation of land for future development, development management policies and sustainability appraisals. Local Planning Authorities have a responsibility to consult with the EA when making planning decisions.

7.2.7 **Landowners and Developers** have the primary responsibility for protecting their land against the risk of flooding. They are also responsible for managing the drainage of their land such that they do not adversely impact upon adjoining properties.

7.2.8 The EA has developed a guide entitled *'Living on the Edge'* (4th Edition, 2013) that provides specific advice regarding the rights and responsibilities of property owners, the EA and other bodies. The guide is targeted at owners of land situated alongside rivers or other watercourses, and is a useful reference point outlining who is responsible for flood defence, and what this means in practical terms. It also discusses how stakeholders can work collaboratively to protect and enhance the natural environment of our rivers and streams. This guide can be found on the EA's website at *www.environment-agency.gov.uk.*

7.3 Strategic Flood Risk Management - The EA

Overview

7.3.1 With the progressive development of urban areas along river corridors, particularly during the industrial era, a reactive approach to flood risk management evolved. As flooding occurred, walls or embankments were built to prevent inundation to developing areas, often without consideration as to the effect that such limiters had on the ability of the watercourse to redistribute the risk of flooding elsewhere.

7.3.2 The EA in more recent years has taken a strategic approach to flood risk management. The assessment and management of flood risk is carried out on a *'whole of catchment'* basis. This enables the EA to review the impact that proposed defence works at a particular location may have upon flooding at other locations throughout the catchment.

7.3.3 A number of flood risk management strategies have been undertaken within the region, encompassing the large river systems that influence flood risk within the Borough of Lewisham. A brief overview of these investigations is provided below.

Thames Catchment Flood Management Plan (CFMP)

7.3.4 The EA published the Thames Catchment Flood Management Plan in December 2009.

7.3.5 Key messages for the future direction of flood risk management are:

- Flood defences cannot be built to protect everything.

- Climate change will be the major cause of increased flood risk in the future.
- The floodplain is our most important asset in managing flood risk.
- Development and urban regeneration provide a crucial opportunity to manage the risk.
- More frequent, short duration, intense storms in summer causing more widespread and regular *'flash flooding'* from overwhelmed drainage systems and some river.

7.3.6 With regards to the impact of climate change the following key trends have been assumed in production of the CFMP:

- *'Milder, wetter winters resulting in increase in peak river flows of 20%. This will mean that flooding will happen more often and large scale severe flooding will be more likely to happen.*
- *More frequent, short duration, intense storms un summer causing more widespread and regular 'flash flooding' from overwhelmed drainage systems and some river'*.

7.3.7 Using broad-scale modelling the CFMP estimates that the number of properties at a 1% annual risk of flooding from rivers in the Thames Catchment will increase by approximately 20% as a result of climate change. It also highlights the opportunity for risk reduction within London by ensuring new developments have far better layout and design that recognises the current and future flood risk.

7.3.8 Lewisham falls under Sub-area 8 '*Heavily populated floodplain*', where the preferred method of managing flood risk is Policy option 5:

> *'Areas of moderate to high flood risk where we can generally take further action to reduce flood risk'* (Thames CFMP, p 24)

7.3.9 As is the case in many areas of England, an ever increasing *'squeeze'* is evident through competing needs for government funding for flood defence, and an increasing potential risk of flooding due to pressure for future development and climate change. **For this reason, a key focus of the strategy is the need to proactively deliver a reduction in flood risk through the planning process – in simple terms, guiding vulnerable development away from areas that are most at risk, and adopting sustainable design techniques**.

> *'In all of these areas, but especially in those areas where major flood defences are not a realistic option in the foreseeable future, the most sustainable way of reducing flood risk will be through floodplain management. In areas of redevelopment; resilience and resistance measures can be incorporated into new buildings'*. (Thames CFMP, p 24).

7.3.10 With regards to climate change the CFMP reports that:

> *'More recent investigations show that in the Lower Thames the number of properties at risk from flooding could increase by 50% as a consequence of climate change'*.

7.3.11 Lewisham is covered by the Ravensbourne Policy unit action plan. The overarching policy for the Ravensbourne is to *'accept the risk – but in the long term take action to ensure that risk does not increase from the current level'*. Key messages from the CFMP include:

Short term:

- Seek commitments in land use planning documents to retain the remaining floodplain for flood risk management compatible uses.

- Encourage the Local Authority to adopt and apply policies that ensure that all new properties built in the floodplain are resistant and resilient to flooding.

Long term:

- Encourage refurbishment of existing buildings that increases resilience and resistance to flooding.
- Identify opportunities to recreate river corridors and wetland habitats in urban areas. Encourage new development and any redevelopment of these areas to acknowledge these opportunities in their site layouts and set development back, allowing space for water, habitat, wildlife and recreation.
- Removing obstructions to flow and naturalising watercourses so there is a reduced risk of blockages.
- Increasing the available storage within the river corridor.
- Encourage partners to assess the viability of future land swapping opportunities in those areas where there is a risk of flooding.

Optimising attenuation and conveyance within the catchment in the long-term:

- Conveyance maintained where we have to, but in a more natural state.
- Greater attenuation in the catchment.
- A re-established and enhanced river corridor.
- Reduce future legacy costs by identification of redundant asset structures.

7.3.12 The full set of recommendations is contained within the Ravensbourne Policy Unit document contained within Appendix F.

7.3.13 It was intended that the recommendations for the Ravensbourne would be used to draw up a Ravensbourne Delivery Plan. This did not come to fruition. Instead the EA drew up the Lewisham and Catford FAS (see Section 7.3.2).

7.3.14 These policies succinctly reinforce the over-arching objectives of national policy, i.e. it is important that Local Authorities seek to restrict development within flood affected areas, protecting the natural floodplain wherever possible.

Thames 2100 Strategy (TE2100)

7.3.15 The EA's Thames Estuary 2100 (TE2100) project (November 2012) is the strategic plan for managing flood risk in the River Thames estuary to the year 2100. It covers the areas bordering the River Thames from the estuary upstream to Teddington Lock (Richmond upon Thames) where the tidal influence ends. The Plan primarily looks at tidal flooding, though other sources of flooding including high river flows as a result of heavy rainfall and surface water flooding are considered.

7.3.16 The overarching estuary wide (Action Zone 0) recommendations of the short, medium and long term are present below:

- *'2010-2035 – continue to maintain the current flood defence system including planned improvements; ensure effective floodplain management (emergency and spatial planning) is in place across the estuary: safeguard areas that will be required for future changes to*

the flood defences; and, monitor change indicators including sea level rise and climate change (to continue through to end of century) and review plan as required'.

- *'2035-2050 - raise, refurbish or replace many of the existing walls, embankments and smaller barriers; these major projects provide an opportunity to reshape our riverside environment through working with spatial planners, developers, designers, environmental groups and those who live and work in the estuary area'*.

- *'2050-2100 - decide on the 'end of the century' option at the start of this period. Plan and prepare for implementation; implement agreed 'end of century' option which may include the construction of a new Thames Barrier at Long Reach to be operational by ~ 2070; raise and adapt defences, where required, to keep new Barrier closures within operational constraints'*.

7.3.17 Beyond the estuary wide recommendations the area is subdivided in to 9 *'Action Zones'*. The London Borough of Lewisham falls within Action Zone 2. The policy selected for this Action Zone is P5 – Take further action to reduce the risk of flooding (now or in the future). The document states that:

'The commercial, economic and historic value of London, as well as the potential for loss of life in the unlikely event of a flood, justifies an increased standard of protection from the current 1:1000 year level to 1:10,000'.

7.3.18 Pages 107-114 set out 10 recommendations for Action Zone 2 during this century. The document can be accessed through the EA's website at http://www.environment-agency.gov.uk/homeandleisure/floods/125045.aspx.

7.3.19 The document also includes a risk map which delineates areas on the basis tidal risk; this is reproduced in Appendix E.

Lewisham and Catford Flood Alleviation Scheme

7.3.20 The EA have undertaken a detailed assessment of options to alleviate flood risk with the River Ravensbourne catchment. Their preferred option will reduce flood risk between Beckenham Place Park to the south and Deptford Creek to the north, including the urban centres of Catford and Lewisham. The scheme comprises three elements:

- Creation of floodwater storage at Beckenham Place Park, Beckenham.

- Some localised works to existing river walls through Lewisham.

- Works on the Honor Oak Stream in Ladywell.

7.3.21 The proposed scheme would protect 400 homes, 31,000m^2 of business floor space several critical roads, two railways lines and 9 electrical substations. It is thought that £5 million needs to be found through local partners in order to progress the scheme. A decision on whether or not this scheme will be constructed is expected in Spring 2015. Further details are available at http://www.beckenhamplaceparkfriends.org.uk/FloodschemeBriefing%20note_FINALv2.pdf.

7.4 Planning & Development Management – London Borough of Lewisham

Planning Solutions to Flood Risk Management

7.4.1 The risk of flooding is most effectively addressed through *avoidance*, which in very simple terms equates to guiding future development away from areas at risk. Development that is sustainable for future generations is imperative, and it is widely recognised that the risk of flooding cannot be considered in isolation. There are many tests and measures of *'sustainability'* that must be weighed in the balance when locating and designing future development.

7.4.2 NPPF endeavours to guide Local Planning Authorities in this decision making process, and the Sequential and Exception tests underpin the method by which flood risk should be taken into consideration as part of the planning process. The application of these tests within the London Borough of Lewisham (by the Council) is outlined below.

The Sequential Test

7.4.3 Historically urbanisation has evolved along river corridors, the rivers providing a critical source of water, food and energy. This leaves many areas of England with a legacy of key urban centres that, due largely to their close proximity to rivers, are at risk of flooding.

7.4.4 The ideal solution to effective and sustainable flood risk management is a planning led one, i.e. steer urban development away from areas that are susceptible to flooding. NPPF advocates a sequential approach that will guide the planning decision making process (i.e. the allocation of sites).

7.4.5 In simple terms, this requires planners to seek to allocate sites for future development within areas of lowest flood risk in the initial instance. Only if it can be demonstrated that there are no suitable sites at the lowest risk of flooding within these areas should alternative sites (i.e. within areas that may potentially be at risk of flooding) be considered (refer to paragraph 101 of the NPPF).

It is absolutely imperative to highlight that the SFRA does not attempt, and indeed cannot, fully address the requirements of the NPPF Sequential Test. As highlighted in the NPPG), it is necessary for the Council to demonstrate that sites for future development have been sought within the lowest flood risk zone (i.e. Zone 1 Low Probability). Only if it can be shown that suitable sites are not available within this zone can alternative sites be considered within the areas that are at greater risk of possible flooding (i.e. Zone 2, and finally Zone 3).

7.4.6 It is important to recognise that the principles of the sequential approach are applicable throughout the planning cycle, and refer equally to the forward planning process (delivered by Council as part of the LDF) as they do to the assessment of windfall sites. Where windfall sites come forward for consideration, it is essential that the developer to consider the planning *'need'* for the proposed site (adopting a sequential approach in accordance with NPPF). The Council will assist where possible with supporting information. The detailed FRA will be required to demonstrate the careful and measured consideration of whether indeed there is an alternative site available within an area of lesser flood risk, in accordance with the NPPF Sequential Test.

> *'The Sequential Test ensures that a sequential approach is followed to steer new development to areas with the lowest probability of flooding. The flood zones as refined in the Strategic Flood Risk Assessment for the area provide the basis for applying the Test. The aim is to steer new development to Flood Zone 1 (areas with a low probability of river or sea flooding). Where there are no reasonably available sites in Flood Zone 1,*

local planning authorities in their decision making should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2 (areas with a medium probability of river or sea flooding), applying the Exception Test if required'. NPPF, Paragraph 019.

7.4.7 **Further guidance on applying the sequential test at the Local Plan level and the site level is provided in NPPF paragraphs 20 and 33 respectively.**

7.4.8 Table 2 of the NPPG sets out the vulnerability of various development types ranging from *'highly vulnerable'* to *'water compatible'*. In order to avoid exposing certain types of development to inappropriate levels of risk, Table 3 of the NPPG sets out which types of development are acceptable within each of the Flood Zones and identifies which combinations of risk and vulnerability are only permissible following application of the exception test.

7.4.9 Wherever possible, the Council should restrict development to the permissible land uses summarised in Table 3 of the NPPG. These are reproduced in Appendix B of this report for ease of reference. This may involve seeking opportunities to *'swap'* more vulnerable allocations at risk of flooding with areas of lesser vulnerability that are situated on higher ground.

The Exception Test

7.4.10 A proportion of the Borough of Lewisham is situated within NPPF Zone 3. This is a particularly vibrant part of London and future investment and regeneration is paramount. Prohibiting future residential development in these areas is likely to have a detrimental impact upon the economic and social welfare of the existing community, and consequently there are clearly other non-flooding related planning *'needs'* that warrant further consideration of these areas. Given that this is the case, following the application of the Sequential Test, the Council and potential future developers are required to work through the **Exception Test** (paragraph 102 of the NPPF) where applicable. For the Exception Test to be passed:

- *'It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared; and*
- *a site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, elsewhere, and where possible, will reduce flood risk overall'*.

7.4.11 The Lewisham SFRA has been developed to inform the Sequential Test. It will be the responsibility of the Council to apply the Sequential Test on the basis of this information, allocating potential sites for future development accordingly. Furthermore, the developer will be required to demonstrate within the detailed Flood Risk Assessment that the Sequential Test has been applied both in terms of site location and in terms of development within a site, and (where appropriate) that the risk of flooding has been adequately addressed in accordance with NPPF.

7.4.12 The ongoing management of flood risk that affect the site under consideration must be assured should development be permitted to proceed, addressing the third critical element of the Exception Test. The SFRA has provided specific recommendations that ultimately should be adopted as design features, with evidence provided of how they will be fulfilled prior to permission being granted for all future development. It is the responsibility of the prospective developer to build upon these recommendations as part of a detailed Flood Risk Assessment to ensure that the specific requirements of NPPF can be met.

7.4.13 An overview of flood risk throughout the Borough has been provided in Section 6 and the adjoining flood risk maps. **Future planning decisions should consider the spatial**

variation in flood risk across the Borough, as defined by the delineated flood zone that applies at the specified site location, and apply the recommendations provided below accordingly. It is reiterated that NPPF applies equally to both allocated sites identified within the emerging LDF and future windfall sites.

A Proactive Approach – Positive Reduction of Flood Risk through Development

7.4.14 It is crucial to reiterate that NPPF considers not only the risk of flooding posed to new development. It also seeks to positively reduce the risk of flooding posed to existing properties within the Borough. It is strongly recommended that this principle be adopted as the underlying *'goal'* for developers and Council development management teams within the Borough.

7.4.15 Developers should be encouraged to demonstrate that their proposal will deliver a positive reduction in flood risk to the Borough, whether that be by reducing the frequency or severity of flooding (for example, through the introduction of SuDS), or by reducing the impact that flooding may have on the community (for example, through a reduction in the number of people within the site that may be at risk). This should not be seen as an onerous requirement, and indeed if integrated into the design at the conceptual stage, will place no added demands upon the development and/or planning application process.

7.4.16 Possible risk reduction measures for consideration may include the following:

- The integration of SuDS to reduce the runoff rate from the site.
- A change in land use to reduce the vulnerability of the proposed development.
- A reduction in the building platform area.
- The raising of internal floor levels and flood proofing (within existing buildings) to reduce potential flood damage.
- The rearrangement of buildings within the site to remove obstructions to overland flow paths.
- The placement of buildings to higher areas within the site to limit the risk of flood damage.
- The integration of landscaping for flood storage and flood resilience.

7.4.17 It is recommended that a clear statement is requested within each and every detailed FRA that concisely summarises how a reduction in flood risk has been achieved within the proposed (re)development. This may be specified as (for example) a reduction in flow from the site, a reduction in water levels within (or adjacent to) the site, or a reduction in the consequences of flooding.

Localised Flood Risk within the Planning Process

7.4.18 The NPPG advocates the application of a sequential approach when allocating land, taking into consideration *all* sources of flooding. The local drainage related problems identified within the Lewisham SFRA are generally localised, and relate to historical incidents, the source of which is often somewhat uncertain. It is important to recognise therefore that these cannot be adopted as a measure of *'risk'* of future localised flooding, but rather problems that have occurred due to a particular set of local circumstances in the past (for example, the blockage of a local gully inlet). These may or may not reoccur. More importantly however, areas that have not flooded previously can certainly not assume that (for this reason alone) they will not be affected in future years.

7.4.19 From a spatial planning perspective therefore, it is considered unreasonable to restrict future development within areas that may have suffered a localised flooding incident in years past. It is essential however not to overlook the potential risk of localised flooding during the design process. Whilst the incidents that have been identified will typically not result in widespread damage or disruption, a proactive approach to risk reduction through design can mitigate the potential for damage, both to the development itself and elsewhere. Specific development management recommendations have been provided accordingly.

Policy Response	NPPF Flood Zone						
	Zone 3b Functional Floodplain (see Section 5.2 for explanation)		Zone 3a High Probability			Zone 2 Medium Probability	Zone 1 Low Probability
			River Ravensbourne and River Quaggy (refer Figure 2)		River Thames Breach (refer Figure C)		
	Developed	Undeveloped	Undefended	Defended			
Spatial Planning Recommendations							
Important considerations	Future development within Zone 3b Functional Floodplain (Undeveloped) can only be considered following application of the Sequential Test		Future development within Zone 3a High Probability can only be considered following application of the Sequential Test		Future development within Zone 3a High Probability can only be considered following application of the Sequential Test	Future development within Zone 2 Medium Probability can only be considered following application of the Sequential Test	It is important to recognise that sites within Zone 1 may be susceptible to flooding from other sources. Development may contribute to an increase in flood risk elsewhere if not carefully mitigated
						Areas of Zone 2 and Zone 1 that may be surrounded by flooding in case of a breach (e.g. Deptford) must ensure site specific emergency evacuation procedures are in place to ensure that the risk to life is minimised should a flood occur. Coordination with the emergency services will be required in the event of a flooding emergency.	
Land Use (refer to Section 7.4)	Land use should be restricted to Water Compatible development. Essential Infrastructure may only be considered if the Exception Test can be passed.		Land use should be restricted to Water Compatible or Less Vulnerable development. Essential Infrastructure and More Vulnerable development may only be considered if the Exception Test can be passed		Land use should be restricted to Water Compatible or Less Vulnerable development. Essential Infrastructure and More Vulnerable development may only be considered if the Exception Test can be passed	Land use should be restricted to Water Compatible, Less Vulnerable or More Vulnerable development. Highly Vulnerable development may only be considered if the Exception Test can be passed	No restrictions
Development Management Recommendations							
Detailed Flood Risk Assessment (FRA)	Required	Required	Required	Required	Required	Required	Required for all sites > 1ha area

Policy Response		NPPF Flood Zone						
		Zone 3b Functional Floodplain (see Section 5.2 for explanation)		Zone 3a High Probability			Zone 2 Medium Probability	Zone 1 Low Probability
				River Ravensbourne and River Quaggy (refer Figure 2)		River Thames Breach (refer Figure C)		
		Developed	Undeveloped	Undefended	Defended			
Development Management Recommendations (Contd)								
Floor Level (refer to Section 7.6)	More Vulnerable Development	N/A	N/A	Floor levels are to be situated a minimum of 300mm above the Q100 flood level, including climate change.	Floor levels are to be situated a minimum of 300mm above the Q100 flood level, including climate change, assuming a breach of the river defences.	No residential development is permitted at ground floor level Ground floor levels should be situated 300mm above the Q200 plus Climate Change flood level, assuming a breach of the River Thames defences	Flood resilient design techniques should be adopted to mitigate the potential damage to property in case of flooding.	No minimum level stipulated
	Less Vulnerable Development					Flood resilient design techniques should be adopted to mitigate the potential damage to property in case of flooding		
Site Access & Egress	More Vulnerable Development	Refer SFRA Appendix A. For residential property, dry access is to be provided above the Q100 flood level, including climate change. For commercial property, access must be *'safe'* in accordance with Defra *'Flood Risk to People'* (FD2320 & FD2321)	N/A	Refer SFRA Appendix B. For residential property, dry access is to be provided above the Q100 flood level, including climate change. For commercial property, access must be *'safe'* in accordance with Defra *'Flood Risk to People'* (FD2320 & FD2321)	Refer SFRA Appendix B. For residential property, dry access is to be provided above the Q100 flood level, including climate change, assuming a breach of the defences. For commercial property, access must be *'safe'* in accordance with Defra *'Flood Risk to People'* (FD2320 & FD2321)	Access and egress routes should be designed to meet EA Agency defined criteria, as set out in Appendix B. Only where this is not feasible, a dedicated *'safe haven'* must be provided above the Q200 plus Climate Change flood level (assuming breach failure) to enable rapid escape should a failure of the defences occur. This may be provided in the form of a sheltered communal space within the building, accessed via internal stairs. It will be necessary to ensure that the safe haven is sufficient in size to safely house all residents. It is essential to ensure that the nominated evacuation route does not divert evacuees onto a '*dry island'* upon which essential supplies (i.e. food, shelter and medical treatment) will not be available for the duration of the flood event.	Site specific emergency evacuation procedures must be in place to ensure that the risk to life is minimised should a breach of the River Thames defences occur. Coordination with the emergency services will be required in the event of a flooding emergency	No minimum level stipulated by NPPF
	Less Vulnerable Development		N/A			Site specific emergency evacuation procedures must be in place to ensure that the risk to life is minimised should a breach of the River Thames defences occur. Coordination with the emergency services will be required in the event of a flooding emergency.		

Policy Response	NPPF Flood Zone						
	Zone 3b Functional Floodplain (see Section 5.2 for explanation)		Zone 3a High Probability			Zone 2 Medium Probability	Zone 1 Low Probability
			River Ravensbourne and River Quaggy (refer Figure 2)		River Thames Breach (refer Figure C)		
	Developed	Undeveloped	Undefended	Defended			
Development Management Recommendations (Contd)							
Basements	No basements are permitted within Zone 3b Functional Floodplain	N/A	Basements must be restricted solely to non-residential uses within Zone 3a High Probability, with an internal access to above the Q100 plus climate change flood level. Flood resilient design techniques must be adopted.	Basements must be restricted solely to non-residential uses within Zone 3a High Probability, with an internal access to above the Q100 plus climate change flood level, assuming a breach in the river defences. Flood resilient design techniques must be used for all basements (refer to Section 7.7).	No basement accommodation will be permitted within these areas. In the absence of more detailed information, the At risk in Wandsworth to Deptford policy unit drawing from the TE2100 study should be used as a starting point for determining appropriate use. No basements permitted within the area shown as *'Priority Evacuation or Take Refuge'* areas. Within the '*Building Resistance'* and '*Building Resilience*' areas basements must be flood resilient and have an internal access to above the Q200 plus climate change flood level, assuming a breach of the River Thames defences. Flood resistance measures should be put in place where appropriate. Accommodation is not permitted at basement level. If the applicant proposes something that does not conform with these requirements, detailed breach modelling will be required to determine the rate of inundation and maximum hazard at the site. Generally, basements will not be permitted if inundated in less than 6 hours or if subjected to flooding of maximum hazard within 12 hours of a breach. Where the assessment shows the site to be at risk of flooding, basements must be flood resilient and have an internal access to above the Q200 plus climate change flood level, assuming a breach of the River Thames defences. Flood resistance measures should be put in place where appropriate.	Basements must be flood resistant, and must have an internal access to a higher floor (situated 300mm above the Q200 plus climate change flood level, assuming breach failure). Flood resilient design techniques must be used for all basements (refer to Section 7.7).	No restrictions

Policy Response	NPPF Flood Zone						
	Zone 3b Functional Floodplain (see Section 5.2 for explanation)		Zone 3a High Probability			Zone 2 Medium Probability	Zone 1 Low Probability
			River Ravensbourne and River Quaggy (refer Figure 2)		River Thames Breach (refer Figure C)		
	Developed	Undeveloped	Undefended	Defended			
Development Management Recommendations (Contd)							
Site Runoff (refer to Sections 6.7 & 7.6)	Implement SuDS to ensure that a reduction in site runoff is achieved, reducing run-off rates by at least 50% over current levels. Any SuDS design must take due account of groundwater and geological conditions. Some infiltration techniques (including, for example, soakaways) are unlikely to be effective within areas overlying London Clay.						
Buffer Zone	A minimum buffer zone should be provided to *'top of bank'* within sites immediately adjoining the River Thames. Advice must be sought from the EA at an early stage.						

7.5 SFRA Interpretation

7.5.1 The spatial variation in flood risk across the Borough is depicted in the adjoining maps, and described below. The Lewisham SFRA should be used by both the Council and prospective developers to meet their obligations under NPPF throughout the planning cycle. Instructions for use are provided below:

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7.5.2 Figure 2 provides an overview of the spatial variation in fluvial flood risk throughout much of the Borough, originating from the River Ravensbourne, the River Quaggy and the River Thames. It is necessary to adopt a sequential approach when considering where land should be allocated for future development, and this is described in Section 7.4. This figure should be used to inform this sequential approach. Furthermore, the NPPF provides guidance on permissible land use within areas potentially at risk from flooding, and this too is discussed in Section 7.4.

7.5.3 A proportion of the Borough of Lewisham (situated adjacent to the River Thames) is defended however, and therefore the primary risk of flooding within these areas, where not affected by surface water flood risk, is a residual risk (i.e. to be realised only should there be a failure of the River Thames defences). Given that this is the case therefore, it is important that a more robust assessment of the *'real'* risk to property and life is considered, and the planning decisions taken accordingly. For areas at high risk of flooding, planning applications should make an assessment of the hazard in accordance with FD2320 Framework and Guidance for Assessing and Managing Flood Risk for New Development – Phase 2, or otherwise presume extreme hazard. The Council should exercise a sequential approach within Zone 3a High Probability, steering more vulnerable development away from areas of highest hazard. Section 7.4 provides further advice in this regard.

7.5.4 Whilst there is no particular constraint placed upon land use within areas of Zone 1 Low Probability within the Borough, it is strongly recommended that the Council takes due consideration of flooding from other sources (i.e. non fluvial). Areas that have previously flooded from localised and non-fluvial sources are depicted in Figure 4 and presented in Appendices C and D. Many of these localised sources of flooding within Lewisham can be effectively managed through the design process, however it is recommended that advice is taken from the EA to ensure that the severity of the local issue that may affect (or be exacerbated by) the proposed allocation is fully appreciated.

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7.5.5 It is important that the potential risk of flooding is considered as an integral part of all proposed development within the Borough. Figure 2 (fluvial flooding from the Ravensbourne and Quaggy) and tidal flooding from the River Thames) provides a measure of the severity of flooding within the proposed development site. Figure C presents the results of breach modelling undertaken by the EA which delineates areas potentially at risk of rapid and severe flooding. More detailed descriptions of flood risk in a more localised context are provided in Appendices C and D. These should be used to trigger a more detailed assessment of flood risk related issues within the site, as described in Section 7.4 and Section 7.6. Within defended areas[22], a detailed assessment of the potential impact of breach failure and/or defence overtopping will also be required.

[22] The EA has prepared a dedicated map layer referred to as *'Areas Benefitting from Defence'* as depicted in *www.environment-agency.gov.uk*. This relates purely to areas defended from flooding from the River Thames however, and does not include the River Ravensbourne and/or River Quaggy defences. Areas benefitting from defences on the River Ravensbourne can be seen by referring to Figure 3. Early advice should be taken from the EA as to whether or not a breach assessment is required

7.5.6 The assessment of localised flooding related issues is imperative for all proposed development, irrespective of its location and/or scale within the Borough, and the SFRA provides some helpful tools to assist in this regard:

- **Figure 4** provides an indication of areas that have been susceptible to localised flooding historically. This is not a comprehensive record of flooding, and relies upon community reports of flooding made to the Council(s). It is a good indication of areas that may be susceptible however, and reiterates the importance of considering flood risk related issues in areas that are outside of the designated flood zones.

- **Figures A, B1 and B2** provide an overview of the topography and geology of the Borough. The detailed FRA should use this information to assess (in a site based context) the potential risk of localised ponding, flash flooding and/or inundation from groundwater.

7.6 Detailed Flood Risk Assessment (FRA) – The Developer

Scope of the Detailed Flood Risk Assessment

7.6.1 As highlighted above, the SFRA is a strategic document that provides an overview of flood risk throughout the area. It is imperative that a site-specific Flood Risk Assessment (FRA) is carried out by the developer for all proposed developments within Flood Zones 2 and 3 and for all developments greater than 1 hectare in Flood Zone 1, and this should be submitted as an integral part of the planning application.

7.6.2 The FRA should be commensurate with the risk of flooding to the proposed development. For example, where the risk of flooding to the site is negligible (e.g. Zone 1 Low Probability), there is little benefit to be gained in assessing the potential risk to life and/or property as a result of flooding. Rather, emphasis should be placed on ensuring that runoff from the site does not exacerbate flooding lower in the catchment. The particular requirements for FRAs within each delineated flood zone are outlined below.

Proposed Development within Zone 3a High Probability & Zone 3b Functional Floodplain (existing developed areas)

7.6.3 All FRAs supporting proposed development within Zone 3b Functional Floodplain (existing developed areas only) and Zone 3a High Probability should include an assessment of the following:

- The vulnerability of the development to flooding from other sources (e.g. surface water drainage, groundwater) as well as from river flooding. This will involve discussion with the Council and the EA to confirm whether a localised risk of flooding exists at the proposed site.

- The vulnerability of the development to flooding over the lifetime of the development (including the potential impacts of climate change), i.e. maximum water levels, flow paths and flood extents within the property and surrounding area. *Within defended areas of the Borough[23], flood levels (underpinning the design of a development) should be determined assuming a breach of the raised flood defences.* Two dimensional hydraulic modelling by suitably qualified engineers will typically be required to determine the risk of flooding to

[23] The EA has prepared a dedicated map layer referred to as *'Areas Benefitting from Defence'* as depicted in *www.environment-agency.gov.uk*. This relates purely to areas defended from flooding from the River Thames however, and does not include the River Ravensbourne and/or River Quaggy defences. Areas benefitting from defences on the River Ravensbourne can be seen by referring to Figure C. Early advice should be taken from the EA as to whether or not a breach assessment is required.

the site. This should be discussed with the EA at the earliest possible stage. The risk to property and life should be considered in accordance with FD2320 (Defra)[24].

- The potential of the development to increase flood risk elsewhere through the addition of hard surfaces, the effect of the new development on surface water runoff and groundwater flow routes, and the effect of the new development on depth and speed of flooding to adjacent and surrounding property. This will require a detailed assessment, to be carried out by a suitably qualified engineer.

- A demonstration that residual risks of flooding (after existing and proposed flood management and mitigation measures are taken into account) are acceptable. Measures may include flood resistant and resilient design, escape/evacuation, effective flood warning and emergency planning (refer to Sections 7.7 and 7.8). Within defended areas, the structural integrity of the existing flood defences should be considered. It will be necessary to demonstrate that the structural conditions of the defences can be assured over the lifetime of the development.

- Details of existing site levels, proposed site levels and proposed ground floor levels. All levels should be stated relevant to Ordnance Datum.

- Details of proposed sustainable drainage systems (SuDS) that will be implemented to mitigate any increase in runoff from the site as a result of future development. Any SuDS design must take due account of groundwater and geological conditions. Some infiltration techniques (including, for example, soakaways) are unlikely to be effective within areas overlying London Clay.

- The developer must provide a clear and concise statement summarising how the proposed (re)development has contributed to a positive reduction in flood risk within the Borough. It should include, how the SuDS drainage hierarchy and the Mayor's hierarchy have been applied and provide justification for divergence from the standards set out in Securing London's Water Future (Section 7.6).

Proposed Development within Zone 2 Medium Probability

7.6.4 For all sites within Zone 2 Medium Probability, a high level FRA commensurate with the level of risk posed to the site should be prepared based upon readily available existing flooding information, sourced from the EA. It will be necessary to demonstrate that the residual risk of flooding to the property is effectively managed in accordance with the requirements set out in Section 7.4. **Within the defended areas[25] of the Borough, flood levels (underpinning the design of a development) should be determined assuming a breach of the raised flood defences.**

7.6.5 The risk of alternative sources of flooding (e.g. urban drainage and/or groundwater) must be considered, and sustainable drainage techniques must be employed to ensure no worsening to existing flooding problems elsewhere within the area.

7.6.6 Details of proposed sustainable drainage systems (SuDS) that will be implemented to ensure that runoff from the site (post redevelopment) does not exceed greenfield runoff rates. Any SuDS design must take due account of groundwater and geological conditions. Some infiltration techniques (including, for example, soakaways) are unlikely to be effective within areas overlying London Clay.

[24] A 'debris factor' of 1 should be assumed within the urban environment

[25] The EA has prepared a dedicated map layer referred to as *'Areas Benefitting from Defence'* as depicted on *www.environment-agency.gov.uk*. This relates purely to areas defended from flooding from the River Thames however, and does not include the River Ravensbourne and/or River Quaggy defences. Areas benefitting from defences on the River Ravensbourne can be seen by referring to Figure C. Early advice should be taken from the EA as to whether or not a breach assessment is required.

7.6.7 The developer must provide a clear and concise statement summarising how the proposed (re)development has contributed to a positive reduction in flood risk within the Borough. It should include how the SuDS drainage hierarchy and the Mayor's hierarchy have been applied and provide justification for divergence from the standards set out in Securing London's Water Future (Section 7.6).

Proposed Development within Zone 1 Low Probability

7.6.8 For all sites greater than 1ha in area, a Flood Risk Assessment must be prepared.

7.6.9 The risk of alternative sources of flooding (e.g. urban drainage, and groundwater) must be considered.

7.6.10 Details of proposed sustainable drainage systems (SUDS) that will be implemented to ensure that runoff from the site (post redevelopment) does not exceed greenfield runoff rates. Any SUDS design must take due account of groundwater and geological conditions. Some infiltration techniques (including, for example, soakaways) are unlikely to be effective within areas overlying London Clay.

7.6.11 The developer must provide a clear and concise statement summarising how the proposed (re)development has contributed to a positive reduction in flood risk within the Borough. It should include how the SuDS drainage hierarchy and the Mayor's hierarchy have been applied and provide justification for divergence from the standards set out in Securing London's Water Future (Section 7.6).

Liaison with the EA

7.6.12 To assist local planning authorities, the EA has produced standing advice to inform on their requirements regarding the consultation process for planning applications on flood risk matters. Full details of their Flood Risk Standing Advice (FRSA) for local planning authorities can be reached through the EA's website at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/399651/LIT_9002.pdfhttps://www.gov.uk/government/uploads/system/uploads/attachment_data/file/399651/LIT_9002.pdf.

7.6.13 The EA is an excellent source of information to inform the development of the detailed FRA. The external relations team should be contacted as early as possible to source information relating to (for example) historical flooding, hydraulic modelling and topography (LiDAR). It is emphasised that the information provided within the SFRA is the best available at the time of writing. More up-to-date information may be available, and contact should always be made with the EA at an early stage to ensure that the detailed site based FRA is using the most current datasets, avoiding unnecessary re-work.

7.6.14 The EA can be consulted for advice prior to submission of a Planning Application.

Raised Floor Levels (Freeboard)

7.6.15 The raising of floor levels within the highest risk areas of the Borough will ensure that the risk to life, and damage to property, is minimised. Where stipulated within Section 7.4 above, floor levels should be situated a minimum of 300mm above the predicted 1% (100 year) design flood level (plus climate change) for areas at risk of fluvial flooding and the 0.5% annual probability (1 in 200 year) design flood level (plus climate change) for areas at risk of tidal flooding. Within defended areas adjoining the River Thames (refer to Figure 3), this should be taken as the 0.5% (200 year) design flood level (plus climate change) calculated assuming a breach of the raised flood defences. Specific advice should be sought in this regard from the EA prior to the commencement of any modelling. The height that the floor level is raised

above flood level is referred to as the *'freeboard'*, and is determined as a measure of the residual risks.

Basements

7.6.16 It is reiterated that basements within areas of the London Borough of Lewisham that fall within Zone 3a High Probability and/or Zone 2 Medium Probability must have a point of access that is situated above the 1% annual probability (1 in 100 year) fluvial or 0.5% annual probability (1 in 200 year) tidal flood level, plus climate change, for the Rivers Ravensbourne & Quaggy, and the River Thames respectively. Specific development management requirements for basements are set out in Section 7.4.

7.6.17 It is particularly important to ensure that basements within areas situated within the *'extreme'* and *'significant'* hazard zones are provided within a *'continuous secondary fixed flood defence'*. In practical terms, this may be a raised wall incorporated into the landscaping that will withstand the ponding of water (i.e. following a breach failure), and will prevent water surging into the basement area with little or no warning.

Sustainable Drainage Systems (SuDS)

7.6.18 SuDS is a term used to describe the various approaches that can be used to manage surface water drainage in a way that mimics the natural environment. The management of rainfall (surface water) is considered an essential element of reducing future flood risk to both the site and its surroundings. Indeed reducing the rate of discharge from urban sites to greenfield runoff rates is one of the most effective ways of reducing and managing flood risk within the Borough. The integration of sustainable drainage systems into a site design can also provide broader benefits, including an improvement in the quality of runoff discharged from the site, the capture and re-use of site runoff for irrigation and/or non-potable uses, and the provision of greenspace areas offering recreation and/or aesthetic benefits. If planned properly at the outset, SuDS need not cost any more than *'conventional'* drainage scheme.

7.6.19 SuDS may improve the sustainable management of water for a site by[26]:

- reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;
- reducing volumes and the frequency of water flowing directly to watercourses or sewers from developed sites;
- improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
- reducing potable water demand through rainwater harvesting;
- improving amenity through the provision of public open space and wildlife habitat; and
- replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

7.6.20 Designs should, wherever possible, include landscaping for flood storage and flood resilience.

7.6.21 In catchment terms, any reduction in the amount of water that originates from any given site is likely to be small. But if applied across the catchment in a consistent way, the cumulative effect of a number of sites could be significant.

[26] Interim Code of Practice for Sustainable Drainage Systems National SUDS Working Group, 2004

7.6.22 There are numerous different ways that SuDS can be incorporated into a development and the most commonly found components of a SuDS system are described in the following **Table 5**[27]. The appropriate application of a SuDS scheme to a specific development is heavily dependent upon the topography and geology of the site (and its surrounds). Careful consideration of the site characteristics must be assured to ensure the future sustainability of the adopted drainage system.

Pervious surfaces	Surfaces that allow inflow of rainwater into the underlying construction or soil.
Green roofs	Vegetated roofs that reduce the volume and rate of runoff and remove pollution.
Filter drain	Linear drains consisting of trenches filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage, to store and conduct water; they may also permit infiltration.
Filter strips	Vegetated areas of gently sloping ground designed to drain water evenly off impermeable areas and to filter out silt and other particulates.
Swales	Shallow vegetated channels that conduct and retain water, and may also permit infiltration; the vegetation filters particulate matter.
Basins, ponds and wetlands	Areas that may be utilised for surface runoff storage.
Infiltration Devices	Sub-surface structures to promote the infiltration of surface water to ground. They can be trenches, basins or soakaways.
Bioretention areas	Vegetated areas designed to collect and treat water before discharge via a piped system or infiltration to the ground

Table 5: Common Components of a SuDS System

7.6.23 For more guidance on SUDS, the following documents and websites are recommended as a starting point:

- Draft National Standards for Sustainable Drainage Systems, Defra (2011)
- Planning for SuDS (C687), CIRA (2010)
- The SUDS Manual (C697), CIRIA (2007)
- Interim Code of Practice for Sustainable Drainage Systems, National SUDS Working Group (2004)
- www.ciria.org.uk/SUDS/
- http://www.susdrain.org/resources/

7.6.24 Additionally, the EA (Thames Region) has issued best practice guidance for Sustainable Drainage Systems (October 2006), available from the EA external relations teams. This provides a clear hierarchy for SuDS, reflecting the degree of sustainability offered by the SuDS application as captured in **Table 6** below.

[27] Interim Code of Practice for Sustainable Drainage Systems National SUDS Working Group, 2004

	SuDS Technique	Flood Reduction	Water Quality Improve-ment	Landscape & Wildlife Benefit
Most Sustainable	Living roofs	✔	✔	✔
	Basins and ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✔	✔	✔
	Filter strips and swales	✔	✔	✔
	Infiltration devices - soakaways - infiltration trenches and basins	✔	✔	✔
	Permeable surfaces and filter drains - gravelled areas - solid paving blocks - porous paving	✔	✔	
Least Sustainable	Tanked systems - over-sized pipes/tanks - storms cells	✔		

Table 6: SuDS Hierarchy

7.6.25 Finally, *'Securing London's Water Future'*, the Mayor's Water Strategy (Rainwater in London) sets out a hierarchy for management of urban runoff as below:

'The Mayor proposes the following hierarchy for the drainage of rainwater:

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

7.6.26 Table 5.1 of Securing London's Water Future sets out supplementary essential and preferred standards for site drainage.

- **Essential Standards:** Use sustainable drainage systems (SuDS) measures wherever practical; and, achieve 50% attenuation of the undeveloped site's surface water runoff at peak times.

- **Preferred Standard:** Achieve 100% attenuation of the undeveloped site's surface water runoff at peak times.

7.6.27 Following the introduction of the Flood and Water Management Act (FWMA) 2010, the Council will have further responsibilities under their role of LLFA regarding SuDS. At the time of this report, Defra are consulting on proposed changes to the planning process to implement the Council's requirements with respect to SuDS.

7.6.28 It is recommended that the Borough determine what the requirements of any SuDS applications should be well in advance of the timetabled implementation of Schedule 3 in order to allow a consultation period to elicit the comments of developers, planners and drainage specialists.

7.6.29 Developers should check to see whether SuDS guidance has been published by the Borough in order to determine what the requirements for surface water drainage systems will be.

7.7 Local Community Actions to Reduce Flood Damage

7.7.1 There will always be a residual risk of flooding, whether that be (for example) from an event that is more extreme than that considered, or whether as a result of a flood defence system that fails unexpectedly. Flood resistance and flood resilience may need to be incorporated into the design of buildings for this reason.

7.7.2 It is estimated that several hundred homes within the Borough are at risk of flooding. It is essential therefore to ensure a broad awareness with respect to flood risk, providing the community with the knowledge (and tools) that will enable them to help themselves should a flood event occur.

7.7.3 The following *'community based measures'* are cost effective solutions that local communities may introduce to minimise the damage sustained to their own homes in the case of flooding. Further guidance is provided by the EA, Defra and CLG[28] (refer the National Flood Forum (*www. floodforum.gov.uk*).

7.7.4 In all areas at risk of flooding, a basic level of flood resistance and resilience will be achieved by following good building practice and complying with the requirements of the Building Regulations 2000[29]. The difference between *'resilience'* and *'resistance'* is explained below:

- *Flood resistance,* or *'dry proofing'*, where flood water is prevented from entering the building.

- Flood resilience, or *'wet proofing'*, is focused on minimizing the work required to clean up after a flood event.

7.7.5 Flood resistance techniques include: demountable flood barriers across property boundaries or doorways; permanent flood proof doors and windows; and, installing non-return valves and flood proof airbricks.

7.7.6 Flood resilience techniques include: utilising materials that are easy to remove/clean after flooding (waterproof finishes); installing pumps to address basement flooding; raising services

[28] Improving the Flood Performance of New Buildings – Flood Resilient Construction (May 2007)

[29] Office of Deputy Prime Minister (ODPM) – now Communities & Local Government (CLG)

and white goods above the maximum flood level or even using hydraulic platforms for placement of heavy vulnerable equipment, allowing them to be raised in the event of a flood.

7.7.7 Examples of both flood-resistant and flood resilient design are given in Improving the Flood Performance of New Buildings (Flood Resilient Construction), CLG (2007). CIRIA also has a number of advice sheets for improving the flood resilience of buildings (http://www.ciria.org.uk/flooding/advice_sheets.html).

7.7.8 It is recommended that the Local Authority seek to proactively raise awareness within the community with respect to flooding (and indeed *'self-help'* flood risk reduction opportunities) through, for example, the circulation of a targeted newsletter to affected residents. This could be particularly affective when properties are flooded as it provides an opportunity to retrofit materials and products to reduce the effects of future flooding, especially with flood resilience techniques.

7.8 Emergency Planning

7.8.1 The Council is designated as a Category 1 Responder under the Civil Contingencies Act 2004. As such, the Council has defined responsibilities to assess risk, and respond appropriately in case of an emergency, including (for example) a major flooding event. The Council's primary responsibilities are[30]:

- From time to time assess the risk of an emergency occurring.
- From time to time assess the risk of an emergency making it necessary or expedient for the person or body to perform any of his or its functions.
- Maintain plans for the purpose of ensuring that, so far as is reasonably practicable, if an emergency occurs the person or body is able to continue to perform his or its functions.
- Maintain plans for the purpose of ensuring that if an emergency occurs or is likely to occur the person or body is able to perform his or its functions so far as necessary or desirable for the purpose of:
  - preventing the emergency;
  - reducing, controlling or mitigating its effects; or
  - taking other action in connection with it.

7.8.2 The FWMA also puts responsibility on LLFAs to take a lead in response to flooding events with an emphasis on co-operation with adjoining authorities, emergency services, utility providers and the EA.

7.8.3 The SFRA provides a concise summary of the possible sources of flooding within the Borough, and may be used to inform the assessment of flood risk in response to the requirements of the Act.

7.8.4 The EA monitors river levels within the River Thames and the River Ravensbourne (refer to Figure D). Based upon weather predictions provided by The Met Office, the Agency makes an assessment of the anticipated maximum water level that is likely to be reached within the proceeding hours (and/or days). Where these predicted water levels are expected to result in the inundation of populated areas[31], the EA will issue a series of flood warnings within defined

[30] Civil Contingencies Act 2004

[31] Restricted to those urban areas situated within EA flood warning zones

flood warning areas, encouraging residents that are signed up to the service to take action to avoid damage to property in the first instance.

7.8.5 The EA advises that people and key infrastructure may be vulnerable at different stages of flooding:

- **Before** – lack of preparedness – ensure people are aware (sign up to Flood Warnings Direct) infrastructure is protected or resilient.
- **During** - property and infrastructure is flood-resistant, escape and access is appropriate, refuge areas are provided.
- **After** – recovery is maximised - ensure emergency services can reach those most at risk/affected, no basement-only properties in areas if most flood risk, ensuring properties are properly flood-resilient.

7.8.6 As water levels rise and begin to pose a risk to life and/or livelihood, it is the responsibility of the emergency services to coordinate the evacuation of residents. This evacuation will be supported by the Council. It is essential that a robust plan is in place that clearly sets out (as a minimum):

- Roles and responsibilities.
- Paths of communication.
- Evacuation routes.
- Community centres to house evacuated residents.
- Contingency plans in case of loss of power and/or communication.

7.8.7 Co-ordination with the emergency services and the EA is imperative to ensure the safety of residents in time of flood. A relatively small proportion of the Borough is at risk of river flooding (as indicated by the shaded flood risk zones in Figure 2). Flooding of this nature will typically occur following relatively long duration rainfall events, and consequently forewarning will generally be provided to encourage preparation in an effort to minimise property damage and risk to life. It is worth highlighting however that the benefits of flood warning are often compromised to a large degree by the lack of *'take up'* within the local community. This emphasises the extreme importance of raising local awareness with respect to the potential risks of flooding.

7.8.8 Areas suffering from localised flooding issues will tend to be at greater risk. These areas are susceptible to *'flash'* flooding, associated with storm cells that pass over the Borough resulting in high intensity, often relatively localised, rainfall. It is anticipated that events of this nature will occur more often as a result of possible climate change over the coming decades. Events of this nature are difficult to predict accurately, and the rapid runoff that follows will often result in flooding that cannot be sensibly forewarned. All urbanised areas are potentially at some degree risk of localised flooding due to heavy rainfall. The blockage of gullies and culverts as a result of litter and/or leaves is commonplace, and this will inevitably lead to localised problems that can only realistically be addressed by reactive maintenance.

7.8.9 To support the emergency planning process, Figure 5 depicts the locations of vulnerable sites and emergency services, and Figure C delineates areas which are likely to experience rapid inundation in the event of a breach of the River Thames defences. The emergency planning team (and indeed prospective developers) should use this information in combination with the outputs of surface water flood modelling to identify routes that may be susceptible to flooding.

Emergency planning should also take account of the tidal risk zones reproduced from the TE2100 study (Appendix E).

7.8.10 Floodplain management and emergency response activities must have a focus on key infrastructure such as the underground network and other properties that are below sea level. Emergency planning would include refuge areas in vulnerable areas, and aim to increase the number of people who sign up to Flood Warnings Direct[32]. Key challenges include instilling a culture of flood preparedness in the resident and visitor population without damaging confidence in London.

7.8.11 It is important to reiterate that flood risk can be reduced by reducing both the probability and the *consequences* of flooding. If the probability is uncertain, the consequences can still be reduced by increasing flood awareness and flood preparedness, assisting members of the community to help themselves in case of flooding by providing forewarning of a flood event. Those at flood risk should be encouraged to sign up to the EA's Flood Warnings Direct.

7.8.12 It is recommended that the Council advises the local Resilience Forum of the risks raised in light of the Lewisham SFRA, ensuring that the planning for future emergency response can be reviewed accordingly.

7.9 Insurance

7.9.1 Many residents and business owners perceive insurance to be a final safeguard should damages be sustained as a result of a natural disaster such as flooding. Considerable media interest followed the widespread flooding of 2000 when it became clear that the insurance industry were rigorously reviewing their approach to providing insurance protection to homes and businesses situated within flood affected areas. Not surprisingly, the recent widespread flooding of July 2007 has further exacerbated the discussion surrounding the future of insurance for householders and business owners situated within flood affected areas.

7.9.2 The following quotations are an extract from the Association of British Insurers (ABI) website, dated August 2007:

> *'The UK is unique in offering flood cover as a standard feature of household and most business policies. Unlike much of Europe and worldwide, cover is widely available to the UK's 23.5 million householders.*
>
> *In the long term, this situation could worsen, unless we take action to reduce flood risk to people and property. Climate change will increase winter rainfall, the frequency of heavy rainfall, and sea levels and storm surge heights. With no change in Government policies or spending, climate change could increase the number of properties at risk of flooding to 3.5 million. Furthermore, continued pressure on land could mean even more new developments being situated in floodplains.*
>
> *By spreading the risk across policy holders, insurance enables householders and businesses to minimize the financial cost of damage from flooding. In the modern competitive insurance market, premiums reflect the risks that customers face. This enables insurance to be offered at very competitive prices to customers living in low flood risk areas.*
>
> *In 2003 ABI members agreed to extend their commitment to provide flood insurance to the vast majority of UK customers. The result of discussions between Government and insurers was a Statement of Principles, which aims to provide reassurance to the overwhelming majority of insurance customers living in the floodplain about the continued availability of insurance in future.*

[32] EA flood warning service

Individual property owners can do much to increase the resistance and resilience of their properties to flood damage - further information is available. ABI has issued a factsheet for property owners on a range of measures that could be taken by a homeowner to improve the resilience of their property to flood damage'.

7.9.3 Since 2000 the *'Statement of Principles'* agreement between the ABI and the government has been in place to safeguard the availability of flood insurance in flood prone areas. On 27 June 2013, the ABI and the Government agreed a Memorandum of Understanding (MoU) on how to develop a new model to ensure the affordability and availability of flood insurance. Until this new arrangement is in place the ABI members will continue to meet the commitments under the Statement of Principles agreement.

7.9.4 The introduction of this new model, known as *'Flood Re'*, is anticipated to be in summer 2015. Flood Re, a not-for-profit flood fund, has been developed with the aim of ensuring that residential properties deemed to be at a high risk of flooding can still obtain affordable flood insurance. Under the scheme, flood risk premiums will be calculated based on council tax banding and capped according to the council tax band. . The money for the fund will come from a levy on all home insurance policies, anticipated to be about £10 per household per year.

7.9.5 Flood Re is designed to be a mid-term solution (20-25 years), to allow time for flood risk to be reduced following investments in flood defences, and house prices to adjust accordingly. It is worth noting that the Flood Re scheme will only be made available to properties built before 1st January 2009, so as not to incentivise inappropriate development in high flood risk areas. Flood Re will be designed to fully deal with at least 99.5% of years. In years of exceptional flood, Flood Re will cover losses up to those expected in a 1% annual probability (1 in 100 year) event, with the remainder being the primary responsibility of government who will work with the insurance industry and Flood Re to distribute any available resources to Flood Re policyholders.

7.9.6 In summary, for the time being, residents and business owners can be assured that insurance for buildings constructed before January 2009 will be available to assist in recovery following a flood event. However the future availability of flood insurance within the UK is likely to be heavily dependent upon commitment from the government to reduce the risk of flooding over time, particularly given the anticipated impacts of climate change. Investment is required in flood defence and improving the capacity of sewage and drainage infrastructure, however it is also essential to ensure that spatial planning decisions do not place property within areas at risk of flooding.

8 Summary

8.1 Risk of Flooding

8.1.1 A number of properties within the Borough of Lewisham are at risk of flooding. The risk of flooding posed to properties within the Borough arises from a number of sources including river flooding, localised runoff and sewer flooding.

8.2 Strategic Flood Risk Management (EA)

8.2.1 The EA's TE2100 strategy for the Thames Estuary for the next 100 years includes the London Borough of Lewisham and highlights the following key messages:

- The present system of flood risk management provides a very high standard of protection.
- The current flood defence system will be maintained until 2035.
- Measures to maintain or reduce overall flood risk include raising defences (where possible), setting defences back from the river to make space for water and reducing the consequences of flooding. This may be achieved by increasing flood resilience and resistance of development and infrastructure, siting development in locations that are appropriate to the flood risk, raising flood awareness and preparedness, ensuring that emergency planning measures have been considered (including safe access and egress during a flood), and finally ensuring that the development is safe.
- Land Use Planning and floodplain management have a fundamental role to play to prevent the build-up of risk into the future.

8.2.2 The EA's Thames Catchment Flood Management Plan (CFMP) goes on to highlight the important links between planning and flood risk management. In the Ravensbourne catchment:

- Options to reduce the probability of flooding are highly constrained in these catchments. There is significant flood risk from a variety of sources and the rivers have been significantly altered.
- We need to change the character of the urban footprint through re-development so that the consequences of flooding are reduced by better layout and a greater resilience to flooding.
- In most areas we need to change the character of the urban area through re-development before we can introduce measures to reduce the probability of flooding that will be sustainable. For example, re-creating river corridors so that there is space for the river to flow and flood more naturally.
- The most effective and sustainable approach to managing risk in the long-term is to change the character of the urban floodplain. In the long-term this provides the opportunity to link our management of the watercourse (channel, structures), floodplain (open space) to the redevelopment of the urban river corridor.
- The EA has invested heavily in assessing and addressing (at a strategic level) the risk of flooding within the Ravensbourne catchment. The TE2100 strategy for the Thames Estuary has established a preferred policy for the area encompassing the Borough of Lewisham, namely (Policy 5) *'Take further flood risk management action to reduce the*

risk now and into the future, taking account of land use and climate change'. A number of options have been identified to deliver this policy, and these rely heavily upon the engagement of key stakeholders, including the Council. These options are outlined in Appendix A.

8.3 Planning Response to Flood Risk (Lewisham Borough Council)

8.3.1 Planning policy needs to be informed about the risk posed by flooding. A collation of potential sources of flood risk has been carried out in accordance with the NPPF, developed in close consultation with both the Council and the EA. The Borough has been broken down into zones of *'high', 'medium'* and *'low'* probability of flooding providing the basis for the application of the flooding element of the Sequential Test.

8.3.2 A **planning solution** to flood risk management should be sought wherever possible, steering vulnerable development away from areas affected by flooding in accordance with the Sequential Test.

8.3.3 Where other planning considerations must guide the allocation of sites and the Sequential Test cannot be satisfied, specific recommendations have been provided to assist the Council and the developer to meet the Exception Test. These should be applied as **development management** conditions for all future development (refer to Section 7.4).

8.3.4 **Council policy** is essential to ensure that the recommended development management conditions can be imposed consistently at the planning application stage. This is essential to achieve future sustainability within the Borough with respect to flood risk management.

8.3.5 **Emergency planning** is imperative to minimise the risk to life posed by flooding within the Borough. It is recommended that the Council advises the local Resilience Forum of the risks raised in light of the Lewisham SFRA, ensuring that the planning for future emergency response can be reviewed accordingly.

8.3.6 The EA's Catchment Flood Management Plan also provides strategic messages for the River Ravensbourne (which can be found in Appendix F)[33] . These include:

- All redevelopment adjacent to watercourses must be set back from the river.
- All redevelopment in the floodplain must be resilient to flooding and not rely on human intervention.
- All redevelopment must reduce the maintenance burden in the future by removing unnecessary structures and naturalise the river where practical by removing culverts, trash screens, artificial channel and bank lining where possible.

8.3.7 Open space will continue to have flood compatible uses e.g. recreation so that as funding levels change, or the basis for allocating resources changes in the future, the opportunity to store water will still be there.

[33] Ravensbourne Policy Unit, Draft, July 2007

9 A Living Document

The SFRA has been developed building heavily upon existing knowledge with respect to flood risk within the Borough. However, flood mapping is regularly being updated. This, in addition to observed flooding that may occur throughout a year, will improve the current knowledge of flood risk within the Borough and may marginally alter predicted flood extents within Lewisham. Furthermore, the planned enactment of Schedule 3 of the Flood and Water Management Act 2010 will change the way the planning system deals with the issue of the management of surface drainage.

Given that this is the case, a periodic review of the Lewisham SFRA is imperative. It is recommended that the Lewisham SFRA is reviewed on a regular basis, and a number of key questions to be addressed as part of the SFRA review process (i.e. triggering whether or not a comprehensive review is required) are provided below.

Question 1: Has any flooding been observed within the Borough since the previous review?

If so, the following information should be captured as an addendum to the SFRA:

- What was the mapped extent of the flooding?
- On what date did the flooding occur?
- What was the perceived cause of the flooding?
- If possible, what was the indicative statistical probability of the observed flooding event? (i.e. how often, on average, would an event of that magnitude be observed within the Borough?)
- If the flooding was caused by overtopping of the riverbanks, are the observed flood extents situated outside of the current Zone 3a? If it is estimated that the frequency of flooding does not exceed 1% (1 in 100) then the flooded areas (from the river) should be incorporated into Zone 3a to inform future planning decision making.

Question 2: Have any amendments to the NPPF or associated guidance been implemented?

If so, the following key questions should be tested:

- Does the revision to the policy guidance alter the definition of the NPPF, Flood Zones presented within the SFRA?
- Does the revision to the policy guidance alter the decision making process required to satisfy the Sequential Test?
- Does the revision to the policy guidance alter the application of the Exception Test?
- Does the revision to the policy guidance alter the categorisation of land use vulnerability, presented within Table 2 of NPPG?

If the answer to any of these core questions is *'yes'* then a review of the SFRA recommendations in light of the identified policy change should be carried out.

Question 3: Has the EA issued any amendments to their flood risk mapping and/or standing guidance since the previous policy review?

If so:

- Has any further detailed flood risk mapping been completed within the Borough, resulting in a change to the 20 year, 100 year or 1000 year flood outline? If yes, then the Zone 3b and Zone 3a flood outlines should be updated accordingly.

- Has the assessment of the impacts that climate change may have upon rainfall and/or river flows over time altered? If yes, then a review of the impacts that climate change may have upon the Borough is required.

- Do the development management recommendations provided in Section 6.4 of the SFRA in any way contradict emerging EA advice with respect to (for example) the provision of emergency access, the setting of floor levels and the integration of sustainable drainage techniques? If yes, then a discussion with the EA is required to ensure an agreed suite of development management requirements are in place.

It is highlighted that the EA review the Flood Zone Map on a quarterly basis. If this has been revised within the Borough, the updated Flood Zones will be automatically forwarded to the Council for their reference. *It is recommended that only those areas that have been amended by the EA since the previous SFRA review are reflected in Zone 3 and Zone 2 of the SFRA flood maps.* This ensures that the more rigorous analyses carried out as part of the SFRA process are not inadvertently lost by a simple global replacement of the SFRA flood maps with the Flood Zone Maps.

Question 4: Has the implementation of the SFRA within the spatial planning and/or development management functions of the Council raised any particular issues or concerns that need to be reviewed as part of the SFRA process?

Appendix A Safe Access & Egress Design Requirements (EA, June 2007)

***'Safe'* access and egress** is to be designed to meet the following strict criteria:

- Developments within Zone 3a High Probability and Zone 2 Medium Probability, and are **not** offered protection from flood defences:
  - Dry escape, above the 100 year flood level taking into account climate change, should be provided for all *'more vulnerable'* (including residential) and *'highly vulnerable'* development;
  - *'Safe'* should preferably be dry (above Q100 plus climate change) for all other uses such as educational establishments, hotels and *'less vulnerable'* land use classifications.
- Developments within Zone 3a High Probability and Zone 2 Medium Probability, and **are** offered protection from flood defences:
  - *'Safe'* access should preferably be dry for *'highly vulnerable'* uses, situated above the Q200 plus climate change flood level, assuming a breach failure of the River Thames or River Ravensbourne defences.
  - For all development, *'safe'* access should incorporate the ability to escape (un-aided, and without passing through floodwaters) to a safe haven that is situated above the Q200 plus climate change water level, assuming a breach of the River Thames or River Ravensbourne defences.

In all instances, it will be necessary to ensure that the London Borough of Lewisham Emergency Planning Team, and the emergency services (consulted via the Emergency Planning Team), accept the proposals.

For major *'highly vulnerable'* development, *'safety'* will also need to be ensured through the development of a robust evacuation plan. This should clearly define routes to dry (i.e. *'unflooded'*) land. This may include routes through flood waters, providing the depth and speed of flow across the evacuation route are below the risk defined by the *'some'* threshold in *'Flood Risk to People'* (Defra, FD2320)[34].

For infrastructure development, *'safety'* will also need to be ensured through the development of a robust evacuation plan. This should clearly define dry escape routes (above the 100 year plus climate change flood level) to dry (i.e. *'unflooded'*) land.

In exceptional circumstances, dry access (above the 100 year plus climate change flood level) for *'more vulnerable'* and/or *'highly vulnerable'* development may not be achievable. In these exceptional circumstances, liaison must be sought with the EA and the London Borough of Lewisham Emergency Planning Team to ensure that the safety of site tenants can be satisfactorily resolved.

[34] Refer Defra Research Paper FD2320 *'Flood Risks to People'*

Appendix B NPPG Tables 2 & 3

Essential Infrastructure

- Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk.
- Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood.
- Wind turbines.

Highly Vulnerable

- Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding.
- Emergency dispersal points.
- Basement dwellings.
- Caravans, mobile homes and park homes intended for permanent residential use.
- Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure').

More Vulnerable

- 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, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'More Vulnerable' class; and assembly and leisure.
- Land and buildings used for agriculture and forestry.
- Waste treatment (except landfill* and hazardous waste facilities).
- Minerals working and processing (except for sand and gravel working).
- Water treatment works which do not need to remain operational during times of flood.
- Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place.

Water-Compatible Development

- Flood control infrastructure.
- Water transmission infrastructure and pumping stations.
- Sewage transmission infrastructure and pumping stations.
- Sand and gravel working.
- Docks, marinas and wharves.
- Navigation facilities.
- 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 and essential facilities such as changing rooms.
- Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

* Landfill is as defined in Schedule 10 to the Environmental Permitting (England and Wales) Regulations 2010.

Table 2 - Flood Risk Vulnerability Classification

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	✗	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	✗	✗	✗	✓*

Table 3: Flood Risk Vulnerability and Flood Zone 'Compatibility'

Appendix C Thames Water DG5 Sewer Flooding Records by Postal Sector

Thames Water DG5 Sewer Flooding Records by Postal Sector - Provided by Thames Water March 2014

		Internal Flooding				External Flooding				
Post Code	Locale	2 or more in 10 years	1 in 10 years	1 in 10 to 20 years	Total	2 or more in 10 years	1 in 10 years	1 in 10 to 20 years	Total	Grand Total
BR1 4	Bromley	0	0	6	6	0	0	4	4	10
BR1 5	Catford	0	0	14	14	0	0	4	4	18
BR3 1	Beckenham	0	0	1	1	0	0	0	0	1
SE3 0	Blackheath	0	0	0	0	0	0	2	2	2
SE3 9	Blackheath	0	0	0	0	0	1	0	1	1
SE4 1	Lewisham	0	10	4	14	0	0	1	1	15
SE4 2	Lewisham	0	1	0	1	0	0	1	1	2
SE6 1	Catford	5	1	26	32	3	1	24	28	60
SE6 2	Catford	0	0	3	3	0	1	0	1	4
SE6 3	Catford	0	0	2	2	0	0	0	0	2
SE6 4	Catford	0	0	2	2	0	0	0	0	2
SE8 3	Deptford	0	0	1	1	0	0	0	0	1
SE8 4	Deptford	0	0	1	1	0	0	0	0	1
SE9 4	Chislehurst	0	0	2	2	0	0	2	2	4
SE12 0	Catford	0	0	0	0	0	0	2	2	2
SE12 8	Lewisham	0	0	0	0	0	0	0	0	0
SE12 9	Catford	0	0	0	0	0	1	2	3	3
SE13 5	Lewisham	1	6	8	15	0	0	0	0	15
SE13 6	Lewisham	0	2	0	2	0	1	0	1	3
SE14 6	Deptford	0	0	3	3	0	0	0	0	3
SE15 1	Peckham	2	1	0	3	0	0	0	0	3
SE15 2	Peckham	0	0	0	0	0	0	0	0	0
SE22 8	Dulwich	0	0	0	0	0	0	0	0	0
SE23 1	Forest Hill	0	0	4	4	0	2	0	2	6
SE23 2	Forest Hill	0	1	8	9	0	0	2	2	11
SE23 3	Forest Hill	1	1	0	2	0	3	0	3	5
SE26 4	Sydenham	0	0	4	4	0	1	0	1	5
SE26 5	Sydenham	0	0	1	1	0	0	0	0	1
SE26 6	Sydenham	0	0	0	0	0	0	2	2	2
BR3 5	Beckenham	0	0	0	0	0	0	0	0	0
SE8 5	Deptford	0	0	0	0	0	0	0	0	0
SE10 8	Greenwich	0	0	0	0	0	0	0	0	0
SE13 7	Lewisham	0	0	0	0	0	0	0	0	0
SE14 5	Deptford	0	0	0	0	0	0	0	0	0
SE16 2	Surrey Quays	0	0	0	0	0	0	0	0	0
SE16 3	Bermondsey	0	0	0	0	0	0	0	0	0

Appendix D Lewisham Borough Flood Records 2000-2013

Data collection: 2013 - 2000

Significant?	Location/road	Problem	Cause	Tally	Recurrent	Time span (year/s of flooding)	No. years	No. of years since 1st occurrence	Mean tally per year (within time span)	Mean tally per year (from 1st occurrence to November 2014)	Avg tally overall (%)	Statistical significance	Responsibility
	Avignon road	C, I, B, P, H	L, T, B	13	Yes	2012 - 2009	4	4	3.3	3.3	3.3	High	Lewisham council
	Baring road	B, V, P, H, R, D	B, W, T, L, D, N	3	Yes	2012, 2009	4	4	0.8	0.8	0.8	Low	Lewisham council
	Leyland road	B, V, C, R	B, O, L, T	3	Yes	2012, 2010, 2009	4	4	0.8	0.8	0.8	Low	Lewisham council
	Bromley road	R, H, P, B, I, C	B, G, N, T, I, L	2	Yes	2010, 2002	9	11	0.2	0.2	0.2	Low	Red route network - TFL
	Surrey Canal road	H, I, P, B, R	L, O, G, T, N, D	8	Yes	2010 - 2008	3	5	2.7	1.6	2.1	High	Lewisham council
	Collins street	C, V, P, H, B, R	L, O, T, B, D, I	2	Yes	2010 - 2009	2	4	1.0	0.5	0.8	Low	Lewisham council
	Evelyn street	H, P, R, I, B	D, B, T, L, I	4	Yes	2009, 2008, 2002	8	11	0.5	0.4	0.4	Low	Lewisham council
	Frendsbury road	H, B, R, D, E	L, T, I, W	2	Yes	2009 - 2008	2	5	1.0	0.4	0.7	Low	Lewisham council
Yes	Algernon road [J/w Ellerdale Street]	P, I, V, R, H, X, B(+)	L, D, T, N, W, I, M, O^	6	Yes	2013, 2011, 2010	4	3	1.5	2.0	1.8	High	Lewisham council / Thames Water / Environmental Health
	Hare & Billet heath	R, V, I, H, P, E	L, B, T, N	3	Yes	2009, 2008, 2005	5	8	0.6	0.4	0.5	Low	Lewisham council
	Hither green lane	C, R, P, B, H, D, E	L, T, O, I, N	4	Yes	2013, 2008 - 2006	8	7	0.5	0.6	0.5	Low	Lewisham council
Yes	Amroth Close	C(#), R, B	T, O, N	1	No	2012	1	1	1.0	1.0	1.0	Low	Lewisham council
	Burnt Ash road	H, B, R, I, P, A, E	L, T, B, O, W	4	Yes	2013, 2012, 2007, 2006	8	7	0.5	0.6	0.5	Low	Lewisham council / Thames water
	Thorpewood avenue	B, V, R, C, H	T, B, L, O, N	3	Yes	2013, 2012, 2006	8	7	0.4	0.4	0.4	Low	Lewisham council
	Quaggy River (near Clarendon Rise bridge)	Q, B(+)	U*, D	1	Yes	2013	1	0	1.0	n/a	n/a	n/a	Environment agency / Thames Water
	Bolina road	H, B, R, I, D	N, D, T	1	Yes	2011	1	2	1.0	0.5	0.8	Low	Lewisham council
	Lawn Terrace	H, R, B(+), I	T, B, U*, O^, N	2	Yes	2011-2010	2	3	1.0	0.7	0.8	Low	Lewisham council / Thames Water / Environmental Health
	South Row (Blackheath)	P, H, B, R, D, I, A	B, O, W, I, D, N	2	Yes	2013	1	0	2.0	n/a	n/a	n/a	Lewisham council / Thames Water
	Deptford high street	R, D, G, H, P, B(+)	B, T, O, N, U*, I	3	Yes	2013, 2010 - 2009	5	4	0.6	0.8	0.7	Low	Lewisham council
	Cold blow lane	P, H, B, R	L, T, I, N	2	Yes	2010, 2008	3	5	0.7	0.4	0.5	Low	Lewisham council
	Musgrove road	I, C, H	O, T, B	2	yes	2010, 2008	3	5	0.7	0.4	0.5	Low	Lewisham council
	Abinger Grove (Flats)	L, C, B	W	1	No	2012	1	1	1.0	1.0	1.0	Low	Lewisham Homes
	Agnew road	P, H, R, B, D	L, T, I, N, B	2	Yes	2010 - 2009	2	4	1.0	0.5	0.8	Low	Lewisham council
	Holbeach road	B, R, P	T, G, L	2	Yes	2009 - 2008	2	5	1.0	0.4	0.7	Low	Lewisham council
Yes	Carholme road	P, H, R, I, D, V, L, X	T, B, O, D, G, N	2	Yes	2007, 2009	3	4	0.7	0.5	0.6	Low	Lewisham council / Thames Water
	Horsmonden Road	C(#), I, B(+)	O^, N	1	No	2008	1	5	1.0	0.2	0.6	Low	Thames Water / Environmental health
	Stondon Park	H, R, V, B	L, W	2	Yes	2008 - 2007	2	6	1.0	0.3	0.7	Low	Lewisham council
	Longhurst road	G, B, H, R, F	T, B, O^, L, D	5	Yes	2008 - 2006	3	7	1.7	0.7	1.2	Moderate	Lewisham council / Thames water
	MillMark Grove	C(#), B(+)	T, O^, D	1	No	2007	1	6	1.0	0.2	0.6	Low	Thames Water
Yes	Derby hill crescent	C, B, R, V	O, L, T	3	Yes	2007 - 2006	2	7	1.5	0.4	1.0	Low	Lewisham council
	Ackroyd road	P, B, R	T, B	2	Yes	2005 - 2004	2	9	1.0	0.2	0.6	Low	Lewisham council
	Sangley Road	P, H, B	M, T, B, L	1	No	2013	1	0	1.0	n/a	n/a	n/a	Lewisham council
	Dartmouth Road J/w London Road	V	W, N	1	No	2013	1	0	1.0	n/a	n/a	n/a	Thames Water / TFL
	Watermead Road	P, H	T, N, I	1	Yes	2013	1	0	1.0	n/a	n/a	n/a	Lewisham council
	Catford Hill	P, H, R, V, D	T, W, N, I	3	Yes	2013, 2012	2	1	1.5	3.0	2.3	High	Lewisham council / Thames Water
	Marvels Lane	X	W, N	1	No	2013	1	0	1.0	n/a	n/a	n/a	Thames Water
	Sedgehill Road	H, D, X	N, T, L	1	No	2013	1	0	1.0	n/a	n/a	n/a	Lewisham council / Private Land owner
	Stanstead road	G, H, B	R, L, T, D	2	Yes	2012, 2010	3	3	0.7	0.7	0.7	Low	Red route network - TFL
	Westwood park	G, P, H, R, A	O, T, W, N	3	Yes	2013, 2009, 2006	8	7	0.4	0.4	0.4	Low	Lewisham council
	Aspinall road	C	T	1	No	2012	1	1	1.0	1.0	1.0	Low	Lewisham council
	Halifax street	R, B	L, B, D	2	Yes	2012, 2010	3	3	0.7	0.7	0.7	Low	Lewisham council
	New Cross road	B, R, P, H, I	L, B, O, D, T, N	2	Yes	2012, 2006	7	7	0.3	0.3	0.3	Low	Lewisham Council
	Wemyss road	H, R, I	T, L, N	1	No	2012	1	1	1.0	1.0	1.0	Low	Lewisham council
	Torridon road	G, H	D, L	1	No	2012	1	1	1.0	1.0	1.0	Low	Lewisham council
	Ravensbourne park	B, P, H, I	T, B, L, R, O	2	Yes	2012, 2010	3	3	0.7	0.7	0.7	Low	Lewisham council
	Bankhurst road	H, B, D	N, I, W	1	No	2012	1	1	1.0	1.0	1.0	Low	Lewisham council
	Winchfield road	P, B, H, V	T, B, I, N	1	No	2012	1	1	1.0	1.0	1.0	Low	Lewisham council
	Sketchley gardens	H, P	L, T, I, N, D	2	Yes	2013 - 2012	2	1	1.0	2.0	1.5	High	Lewisham council
	Churchdown Road	P, H	T, I, N	1	Yes	2012	1	1	1.0	1.0	1.0	Low	Lewisham council
	Further Green Road [J/w Verdant lane]	B, H, P	I	1	No	2012	1	1	1.0	1.0	1.0	Low	Lewisham council
	Pomeroy street	P, I, H	B, T, N, O	1	No	2011	1	2	1.0	0.5	0.8	Low	Lewisham council
	Whitefoot lane	P, H, B, R	T, B, N	1	Yes	2011	1	2	1.0	0.5	0.8	Low	Lewisham council
	Dunkery road	P, H, R, E, V, D	L, T, B, N, I	2	Yes	2011 - 2010	2	3	1.0	0.7	0.8	Low	Lewisham council
	Highclere street	I, V, H	T, O, I, N	1	No	2011	1	2	1.0	0.5	0.8	Low	Lewisham council
	Elm Lane	I, B	T, L, I	1	No	2010	1	3	1.0	0.3	0.7	Low	Lewisham council
	Mantle road	P, B	L	1	No	2010	1	3	1.0	0.3	0.7	Low	Lewisham council
	Ventnor road	P, H, R	L, T, B, N	2	Yes	2010 - 2009	2	4	1.0	0.5	0.8	Low	Lewisham council
	Thornsbeach road	P, B, I	B, T, O, L	1	No	2010	1	3	1.0	0.3	0.7	Low	Lewisham council
	Southend lane	H, B, R	N, B, T, L	1	No	2010	1	3	1.0	0.3	0.7	Low	Lewisham council
	Malpas road	B, R	B, D	1	No	2010	1	3	1.0	0.3	0.7	Low	Lewisham council
	Perry hill	H, P, B, I, V	L, T, G, N, B	2	Yes	2010 , 2008	3	5	0.7	0.4	0.5	Low	Lewisham council
	Davenport road	G, H, B	N, I, T, L	1	No	2010	1	3	1.0	0.3	0.7	Low	Lewisham council
	Waldram park	P, H, B	T, L, G, N	1	No	2010	1	3	1.0	0.3	0.7	Low	Red route network - TFL
	Kangley bridge road	P, B	B	1	No	2010	1	3	1.0	0.3	0.7	Low	Lewisham council
	Sanford street	B, P, I	O, T, D, N	2	Yes	2013, 2010	4	3	0.5	0.7	0.6	Low	Lewisham council
	Longton avenue	H, R, G. B	G, L, T, B	2	Yes	2013, 2009	5	4	0.4	0.5	0.5	Low	Lewisham homes / Lewisham council
	Reigate road	G, C, L	T, B, W	2	Yes	2010, 2008	3	5	0.7	0.4	0.5	Low	Lewisham council
	Brockley road	P, H, B, D	B, T, I, N	1	No	2009	1	4	1.0	0.3	0.6	Low	Lewisham council
	Wickham Gardens	H, B, R, C	T, O	1	No	2009	1	4	1.0	0.3	0.6	Low	Lewisham council
	Honor Oak Park	H, B, V	T, B, O	1	No	2009	1	4	1.0	0.3	0.6	Low	Lewisham council
	Deptford Wharf	B, G	B, O	1	No	2009	1	4	1.0	0.3	0.6	Low	Lewisham homes
	Marsala road	P, H, R	B, T	1	No	2009	1	4	1.0	0.3	0.6	Low	Lewisham council
	Jutland road	P, R	O	1	No	2009	1	4	1.0	0.3	0.6	Low	Lewisham council
	Venner road	G	L, O	1	No	2009	1	4	1.0	0.3	0.6	Low	Lewisham council
	Dartmouth road	G, P, H, B(+)	T, B, I	2	Yes	2013, 2009	5	4	0.4	0.5	0.5	Low	Lewisham council / Environmental Health

Pool court	G, C	T, L, O	2	Yes	2009, 2007	3	6	0.7	0.3	0.5	Low	Lewisham council
Ivy road	P, I	T, L	2	Yes	2009	1	4	2.0	0.5	1.3	Moderate	Lewisham council
Boveney road	C	B	1	No	2008	1	5	1.0	0.2	0.6	Low	Lewisham council
Gellatly road	G, I	T, L	1	No	2008	1	5	1.0	0.2	0.6	Low	Lewisham council
Kemsley house - (Lewisham park)	L, C	O, T, L	1	No	2008	1	5	1.0	0.2	0.6	Low	Housing
Catford Island (J/w Plassy road)	G, I, P	D, L, T	1	No	2008	1	5	1.0	0.2	0.6	Low	Private ownership
Sandhurst road	H, B, R	L, R, I, W	1	Yes	2008	1	5	1.0	0.2	0.6	Low	Private housing
Fernbrook road	P, H, B, I	T, L, I	1	No	2008	1	5	1.0	0.2	0.6	Low	Lewisham council
Jerningham road	G, C	D, L, T	1	No	2008	1	5	1.0	0.2	0.6	Low	Thames Water
Hatcham park road	P, H	B, W, L	1	No	2008	1	5	1.0	0.2	0.6	Low	Private Land owner
Clyde Terrace	H, P	T, B, N, D, O	2	Yes	2008, 2006	3	7	0.7	0.3	0.5	Low	Lewisham council
Crantock road	P, H, B, R	L, T, D, I	1	No	2008	1	5	1.0	0.2	0.6	Low	Lewisham council
Levendale road	G, V	W, I, L, T	1	No	2008	1	5	1.0	0.2	0.6	Low	Lewisham council
Southbrook road	P, B, I	B, T, O	1	No	2008	1	5	1.0	0.2	0.6	Low	Lewisham council
Loampit vale	P, H, B, I, D	T, B, D	1	No	2007	1	6	1.0	0.2	0.6	Low	Red route network - TFL
Oakridge road	G, H	T, D	1	No	2007	1	6	1.0	0.2	0.6	Low	Lewisham council
Shroffold road	G, B	T, O, B	1	No	2007	1	6	1.0	0.2	0.6	Low	Lewisham council
Sunderland road	H, B, R	T, B, N	1	No	2007	1	6	1.0	0.2	0.6	Low	Red route network - TFL
Dermody road	B, R, F	O, T, L	1	No	2007	1	6	1.0	0.2	0.6	Low	Environment agency
St Donatts Estate	B, R, C	B, T, D	1	No	2007	1	6	1.0	0.2	0.6	Low	Private housing
Kirkdale road	P, H	B, T, I, L, D	2	Yes	2007, 2005	3	8	0.7	0.3	0.5	Low	Lewisham council
Lawrie Park road	P, H, B, V	N, B, T	1	No	2007	1	6	1.0	0.2	0.6	Low	Lewisham council
Trewsbury road	H, B, V, C	T, B, N	1	No	2007	1	6	1.0	0.2	0.6	Low	Lewisham council
Molesworth Street	P, I, R	L, T, N	2	Yes	2007	1	6	2.0	0.3	1.2	Moderate	Lewisham council
Spring Hill (Sydenham)	H, P, R	B, T, N, I	1	No	2007	1	6	1.0	0.2	0.6	Low	Lewisham council
Catford road	P, H, I	B, N, I	1	No	2007	1	6	1.0	0.2	0.6	Low	Red route network - TFL
Downham way	G, C, P	T, O, G	1	No	2007	1	6	1.0	0.2	0.6	Low	Lewisham council
Calmont road	G, B	D, O	1	No	2007	1	6	1.0	0.2	0.6	Low	Lewisham council
Hassocks close	V, C, B	T, O, D, N	1	Yes	2006	1	7	1.0	0.1	0.6	Low	Lewisham council
Farley Road	P, H, B	B, D, N, L	1	No	2006	1	7	1.0	0.1	0.6	Low	Thames Water
Vineyard Close	U, V, E	T, B, L	1	No	2006	1	7	1.0	0.1	0.6	Low	Private Land owner
Duncombe Hill	B, H	B, T, N	1	No	2006	1	7	1.0	0.1	0.6	Low	Lewisham council
Chudleigh road	P, H	N, G, T, L	1	No	2005	1	8	1.0	0.1	0.6	Low	Lewisham council
South road / Westbourne drive	P, H, I, V	L, T, B, N	1	No	2004	1	9	1.0	0.1	0.6	Low	Lewisham council
Canadian Avenue	P, H, B, R	T, B, I	1	No	2012	1	1	1.0	1.0	1.0	Low	Lewisham council
Endwell Road	P, H	W, N	1	No	2013	1	0	1.0	n/a	n/a	n/a	Thames Water
Church rise (j/w south road)	H, D, E	W, I, N	1	No	2013	1	0	1.0	n/a	n/a	n/a	Thames Water
Houston Road	P, H, I, A	T, I	1	No	2013	1	0	1.0	n/a	n/a	n/a	Lewisham Council
Lucorn close	V, P	W, N	1	No	2013	1	0	1.0	n/a	n/a	n/a	Thames Water
Rockbourne Road	P	D, U*	1	No	2013	1	0	1.0	n/a	n/a	n/a	Thames Water / Lewisham council
Alpha road	B, R, P	B	1	Yes	2012	1	1	1.0	1.0	1.0	Low	Red route network - TFL
St James	G, H	B, T	1	No	2012	1	1	1.0	1.0	1.0	Low	Lewisham council
Holly Hedge Terrace	G	B, T	1	No	2012	1	1	1.0	1.0	1.0	Low	Lewisham council
Ashgrove road	G, B	T, B, I	2	Yes	2012, 2006	7	7	0.3	0.3	0.3	Low	Lewisham council
Camplin Street	H, B	T, B	1	No	2012	1	1	1.0	1.0	1.0	Low	Lewisham council
Kirkdale	G, H, I	L, W, T, B	2	Yes	2012, 2011	2	2	1.0	1.0	1.0	Low	Lewisham council
Glenville Grove	G, P	T, B	1	No	2012	1	1	1.0	1.0	1.0	Low	Private housing
Garlies road	I, H	O, T, B	1	No	2011	1	2	1.0	0.5	0.8	Low	Lewisham council
Boone street	G, H	B, T, O	1	No	2011	1	2	1.0	0.5	0.8	Low	Lewisham council
Lee Road	P, I, H	T, I, N, O	2	Yes	2011, 2002	10	11	0.2	0.2	0.2	Low	Lewisham council
Gosterwood street	G, B	T, O	1	No	2011	1	2	1.0	0.5	0.8	Low	Lewisham council
Brandram road	G, H	B, T	1	No	2011	1	2	1.0	0.5	0.8	Low	Lewisham council
The Glebe / Drewery court	G	B	1	No	2011	1	2	1.0	0.5	0.8	Low	Lewisham council
Woolstone road	I, G	O, L, T	2	Yes	2011, 2007	5	6	0.4	0.3	0.4	Low	Lewisham council
Engleheart road	I, G	T, B	1	No	2011	1	2	1.0	0.5	0.8	Low	Lewisham council
Clipper way	P, B	B, O	1	No	2011	1	2	1.0	0.5	0.8	Low	Lewisham council
Leathwell road	P, B	T, B	1	No	2011	1	2	1.0	0.5	0.8	Low	Lewisham council
Devonshire road	R	B	1	No	2010	1	3	1.0	0.3	0.7	Low	Lewisham council
Wellmeadow road	G, R	O	1	No	2010	1	3	1.0	0.3	0.7	Low	Lewisham council
Manor lane	P, I	B	1	No	2010	1	3	1.0	0.3	0.7	Low	Lewisham council
Dressington avenue	G, R	B, T, N	1	No	2010	1	3	1.0	0.3	0.7	Low	Lewisham homes
Springbank road	G, V	B, T	1	No	2010	1	3	1.0	0.3	0.7	Low	Lewisham council
Mount gardens	P, H, B, D	T, B	1	No	2010	1	3	1.0	0.3	0.7	Low	Lewisham council
London road	G, E	L, T, B, N	1	No	2009	1	4	1.0	0.3	0.6	Low	Red route network - TFL
Myron place	G, B	L, O	1	No	2009	1	4	1.0	0.3	0.6	Low	Lewisham council
Buckthorne lane	G	T, B	1	No	2009	1	4	1.0	0.3	0.6	Low	Lewisham council
Effingham road	H	W	1	No	2009	1	4	1.0	0.3	0.6	Low	Lewisham council
Ommaney road	G	B	1	No	2009	1	4	1.0	0.3	0.6	Low	Lewisham council
Edward street	P, H, I	T, B, O	1	No	2009	1	4	1.0	0.3	0.6	Low	Lewisham council
Brockley rise	G, H, B	T, O	1	No	2009	1	4	1.0	0.3	0.6	Low	Lewisham council
Ormanton road	H, G	L, T, B	1	No	2009	1	4	1.0	0.3	0.6	Low	Lewisham council
Sydenham park road	P	B	1	No	2009	1	4	1.0	0.3	0.6	Low	Lewisham council
Datchet road	G, I	L	1	No	2008	1	5	1.0	0.2	0.6	Low	Lewisham council
Lewisham high street	G, H	B	1	No	2008	1	5	1.0	0.2	0.6	Low	Lewisham council
Amberely Grove	G	B	1	No	2008	1	5	1.0	0.2	0.6	Low	Lewisham council
Vancouver road	G, H	T, B, N	1	No	2008	1	5	1.0	0.2	0.6	Low	Lewisham council
Bradford close	G, B	B, T, N	1	No	2008	1	5	1.0	0.2	0.6	Low	Private housing
Kellerton road	G, B	B, T, L	1	No	2008	1	5	1.0	0.2	0.6	Low	Lewisham council
Peak hill	H, B, V	T, B	1	No	2008	1	5	1.0	0.2	0.6	Low	Lewisham council
Penberth road	G, P, H	T, L, I	1	No	2008	1	5	1.0	0.2	0.6	Low	Lewisham council
Lee High road	P, H	T, B, I	1	No	2007	1	6	1.0	0.2	0.6	Low	Red route network - TFL
Codrington Hill	G, B	T, B	1	No	2007	1	6	1.0	0.2	0.6	Low	Lewisham council

Bellingham road	G	T, O	1	No		2007	1	6	1.0	0.2	0.6	Low	Lewisham council
Perry Vale	H	W, B	1	No		2013	1	0	1.0	n/a	n/a	n/a	Thames Water
Myers lane	B, G	B, D	1	No		2007	1	6	1.0	0.2	0.6	Low	Private housing
Bradgate road	G, H	B, T, O, L	2	Yes	2007, 2005		3	8	0.7	0.3	0.5	Low	Lewisham council
Lampmead road	G, H	T, B, L	1	No		2007	1	6	1.0	0.2	0.6	Low	Lewisham council
Monson Road	H, V	B, T, N	1	No		2006	1	7	1.0	0.1	0.6	Low	Lewisham council
Havelock walk	B, H	L, D, G	1	No		2006	1	7	1.0	0.1	0.6	Low	Lewisham council
Ennersdale road	B, H	B, T, N	1	No		2006	1	7	1.0	0.1	0.6	Low	Lewisham council
Branscombe street	H, P	B, T	1	No		2006	1	7	1.0	0.1	0.6	Low	Lewisham council
Knoyle street	H, P	T, B, I	1	No		2006	1	7	1.0	0.1	0.6	Low	Lewisham Council
Medusa road	G, B	B, O	1	No		2006	1	7	1.0	0.1	0.6	Low	Lewisham council
Embleton road	R, H, D	T, W, N	2	Yes	2013, 2006		8	7	0.3	0.3	0.3	Low	Lewisham council / Thames water
Oakridge close	G	T, O, D, N	1	No		2006	1	7	1.0	0.1	0.6	Low	Lewisham council / Thames water
Ivorydown road	G	T, O	1	No		2006	1	7	1.0	0.1	0.6	Low	Lewisham council
Chinbrook road	H, I	T, I	1	No		2005	1	8	1.0	0.1	0.6	Low	Lewisham council

Key Problem

G	General flooding
P	Water starting to pond / pool
H	Highways [Roads / pavements or tunnels] flooded
B	Buildup of surface water / foul water health hazard(+)
R	Severe or recurrent flooding
I	Impassable footpath / unusable premises
V	Travelling water / moving at velocity
C	Flooded cellar / indoor flooding or emanation of sewer water and/or smell into (or around) home (#)
D	Damage to road / hazard / accelerated degradation or freeze-thaw
A	Accumulation of sediment and/or debris (on highway)
X	External runoff (e.g. from adjacent land)
E	Erosion
F	Fluvial Flooding (I.e. Overflowing river banks)
U	Pluvial Flooding (I.e. Flooded land)
L	Localised flooding (including those in close proximity to residential areas)
Q	Compromise to quality of watercourse or river / Water pollution

Cause

L	Lack of / limited drainage
T	Torrential rain / melting precipitation / severe weather
B	Blocked gullies or local outlet / "slow runner"
O	Overflowing / insufficient capacity of sewers / local outlet / back surging during inundation^
W	Leaking or burst water main / pipe
U	Unlawful* or undesirable disposal of grey / foul water onto highway and / or into gullies / or river
R	Rising groundwater levels
D	Damaged drainage facilities or wrongly placed
I	Defective, impervious or damaged surface/road (e.g. potholes or rutting)
M	Diversion or disruption of natural flow of water caused by traffic calming measures
G	Low-lying ground
N	Nature of road surface / topography of paving

Severity		**Corresponding colour scheme**
N/A	**None**	
!	**Low**	
!!	**Mild**	
!!!	**Medium**	
!!!!	**Extreme**	

Statistical significance	
Low	≤ 1.0%
Moderate	1.1 - 1.3%
High	≥ 1.4%

Entry status:	**NEW**	Both status' expire upon reaching 1 month since initial recording is made.

Definition of Key terms

Gully - A method of draining excess surface water [see below] away from roads, public highways and areas of residence in order to prevent flooding. Gullies are often connected to public sewers where this water may join with the waste water sewers and then transported to a water-treatment plant to undergo purification and subsequent recyclying.

Surface water - The buildup of storm-water [see below] over the surface of the highway and/or pavement due to a blocked gully or insufficient Thames Water sewer.

Storm-Water - Any form of precipitation [e.g. rain, melted snow, sleet etc] that collects on the surface of the ground that may play a part in excessive surface water levels.

Groundwater - A naturally occuring water source that lies underneath the earth's surface; groundwater can be extracted for many uses but may also cause flooding in severe cases relating to the heightening of the underground water table (/level).

Erosion - The removal of both natural and man-made materials from the earth's surface by means of water-flow (possibly even heavy wind, glacial drift or gravity); in less severe cases, the top layer of a material such as ashfelt used for roads may be carried off by a strong and fast flow of water if the road surface has already suffered some form of surface damage.

Fluvial flooding - Flooding resulting from the water levels in a particular area exceeding the bank level of a main river or watercourse.

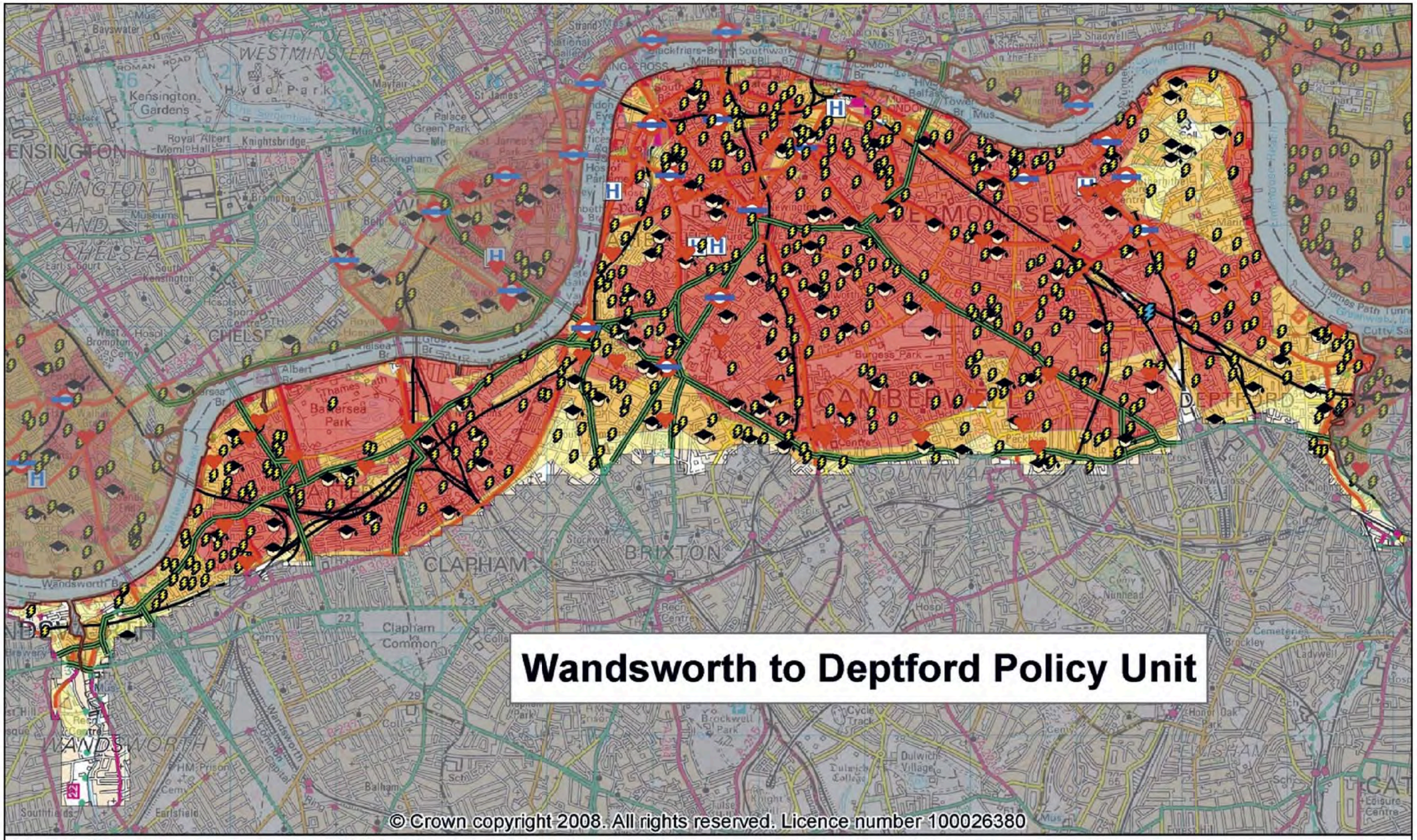
Pluvial flooding - Flooding resulting from excess surface water flowing over the surface of the ground during the over saturation of soil where the natural drainage channels have insufficient capacity to cope with additional flows in water / sheer volume of storm-water arriving on the surface.

Saturation - When the Earths natural materials, namely rocks, soils and sand have the perfect balance between both air and water molecules inbetween their pores therefore providing an optimum level of hydration or saturation. Under saturation occurs when there is an imbalance between the air and water molecules in between the pores as found in soil/rock, air is predominant if not the totally dominant form of molecule within these pores [aside from organic matter such as plants or bugs etc]. This generally dries out the material therefore making it susceptible to the propagation of cracks when impacted by a particularly potent force. Over saturation occurs when the aforementioned pores are predominantly filled with water molecules if not totally so . This is also an undesired physical property as this can lead to 'Pluvial flooding' as mentioned above.

Summary

The data displayed within this spreadsheet has been gathered from various residential complaints, as sourced from Lewisham council's archive system. The data is to be read for each individual road from left to right; where in terms of flooding, the problem/s suffered by that particular road is listed in the problem column as a key which holds a meaning as seen in the key table above.
The same can be said for the proceeding columns [cause and severity]. In relation to the severity key, each road name was assigned a key in terms of its severity according to what the actual problem was [e.g. general flooding, buildup of surface water etc] where for the higher magnitudes of severity, emphasis was placed on both severe/recurrent flooding as well as cellar/indoor flooding.
There are many reasons for this which include the general health and wellbeing of the public, severe flooding could hold many consequences for them and the same can be said for the more serious cases of flooding which directly affect areas of residential prominence.
In contrast to the actual flooding problem, the tally or number of occurrences per road had little influence on the severity key assigned to each road. Only in cases where there were many instances of fl 4 years] did the tally have any effect on the aforementioned severity key.
I felt that it was best to include four different keys for severity as it was a happy medium, it wasn't too general nor was it too broad. This way, someone who was trying to extract key information from this spreadsheet would be able to do so with a high sense of conviction.
What is meant by this is that the data as a whole is broad enough for a lead local flood authority [i.e. London borough of Lewisham] to use as a definitive source of identifying "flooding hot spots", where it is still
It is to be noted that the wording used for the severity keys was selectively chosen to place emphasis on the actual problem; as an example, the word "Extreme" was used to describe the effect that flooding had on the area/location at hand, which most of the time was just urban areas and the like.
By no means does this wording relate to large-scale flooding occurrences such as tsunami's or as when a river dam is breached by a large build-up of hydraulic pressure. In lehmans terms, they are used to provide a brief understanding of how an instance of flooding [severe or not] has impacted an area of public residence or suburban environment.
There is a link between "R" [severe or recurrent flooding] and the recurrency column situated within the spreadsheet. If a particular road has "R" in the problem column but has "No" in the recurrency column, then this means that it was a one time instance of severe or even flash flooding.
When a road has both "R" in the problem column and "Yes", then this may either mean that the problem is both particularly severe and recurrent or that the problem has insignificant severity but is still a recurrent issue; the latter is the more probable out of the two.
In regards to the "Over how many years" column, the majority of roads listed in the spreadsheet had a tally of two or less occurrences, as well as having occurred in a one year period [e.g. 1 Occurrence in 2009].
This backs-up my previous statement claiming that the majority of roads within the spreadsheet had a tally of two or less occurrences; however the actual average tally was 1.46 occurrences, so this data itself immeditately suggests that there were a number of outstanding
As a whole, the data collection proved to be quite a prolonged and repetitive process, however that was necessary for such a serious matter which may have the potential to deal great damage to all: people, infrastructure and the natural environment. Three of the most crucial features of modern society, essential for modern living and to the healthy operation of the public community.
The data was recorded with care and checked over at each stage in order to spot any errors or anomalies within the data itself. This ensures accuracy and the overall quality of the finished piece. These checks included referring back to the source of the data to ensure it was recorded correctly as well as checking the entire collection itself for repetitions and inadequate / innacurate data on top of making sure it was layed out correctly with both an easy to read and easy to understand layout/format.

Appendix E Tidal Flood Risk Data reproduced from the Thames Tidal Estuary Study 2100



At risk in Wandsworth to Deptford policy unit

Appendix F River Ravensbourne Policy Unit

Ravensbourne Policy Unit

A large part of the Ravensbourne policy unit is characterised by **highly developed floodplains with little open space and modified river channels**. The risk of flooding in these areas is relatively high and it is likely that this will increase in the future. Flooding caused by overflowing drainage systems – and the systems themselves – are the responsibility of several organisations. This makes the understanding and management of flooding even more complex.

Our flood risk management approach for this type of catchment is outlined below.

- We need long-term adaptation of the urban environment. There are massive opportunities to reduce flood risk through redevelopment. In most areas we need to change the character of the urban area in the floodplain through re-development. It must be resilient and resistant to flooding and result in a layout that re-creates river corridors
- We are seeking to re-create river corridors through redevelopment so that there is space for the river to flow more naturally and space in the floodplain where water can be attenuated
- We will be seeking to build flood defences as redevelopment occurs and as part of an overall catchment plan. This is because more attenuation and more space in the river corridors are needed for defences to be sustainable. This is more complex but represents better value for society in the long-run even if it is more costly for the Environment Agency today
- These areas are very susceptible to rapid flooding from thunderstorms. Emergency response and flood awareness are particularly important

This approach will deliver our policy for the Ravensbourne; ***Take further action to sustain the current level of flood risk into the future (responding to the potential increases in risk from urban development, land use change and climate change).***

Policy Unit Commentary

In this section we consider;

- The character of the rivers (pathways)
- The character of the catchment and of what is in the floodplain at risk from flooding (receptors)
- The character of the sources of flooding (sources)

The middle and lower parts of the Ravensbourne flow through the urban areas of South London.

Typically, through these areas we currently manage the risk of fluvial flooding by conveying water through concrete channels and draining the catchment into the Thames. The majority of the river channels have been modified. They are typically concrete-lined channels with many culverts and structures. This provides a moderate degree of conveyance, which if maintained, reduces the likelihood of properties flooding. Not all of the rivers are straightened and concrete lined and there are areas of open space; either parks, recreation areas or buffers along railway lines, rivers and other infrastructure. However, over 50% of the rivers in the Ravensbourne are artificial and there are over 70 culverts. Our current estimate is that these assets have a residual life of between 15 and 30 years with regular maintenance.

In some places maintaining and replacing the channel will be the only feasible option, but in general there will always be options to maintain the conveyance by setting back development from the river. A system based solely on conveyance using modified channels gives the impression that flooding will never occur. In fact it only reduces the likelihood of flooding. The capacity might be exceeded, or the system may fail. It is also susceptible to blockages. It requires ongoing maintenance to ensure it functions effectively, and eventually will need to be replaced. It is designed to meet only one objective.

However, there are significant constraints to maintaining and ultimately replacing this system of channels to manage flood risk. Adopting other flood risk management approaches across the catchment reduces our reliance upon this unsustainable system. The channels are at increasing risk of failure and blockage and will be increasingly ineffective against more intense rainfall events. Our aim is to reduce the reliance solely on conveyance, by re-establishing a river corridor.

Within the Ravensbourne are approximately 9,000 properties at risk from a 1% AEP fluvial flood. Along some of the river, established residential properties border the watercourse. More generally there is a mixture of land uses within the floodplain and adjacent to the river; typically made of industrial and commercial land use, recreation and general open space. The urban footprint in the floodplain is over 50%.

Fluvial flooding from the Ravensbourne and its tributaries results from the overtopping of riverbanks and the channel; either the capacity is exceeded during high flows, or blockages reduce the channel capacity. Particularly through Lewisham, several relic Thames Water footbridges reduce conveyance causing overtopping of river bank. Blockages and constrictions in and around the channel influence the scale and location of flooding. Other sources of flooding exist throughout the catchment; the overflow of surface drains; the inundation of sewers, and rapid runoff arising from urban expansion. Often these types of flooding happen together, which can make it difficult to determine the cause. The density of urban development exacerbates these problems and the encroachment of development right

up to the edge of watercourses means that structural solutions to the problems are limited.

At the bottom of the Ravensbourne catchment at the confluence with the Thames there is also a risk from tidal flooding or a combination of tidal and fluvial flooding. The lower part of the catchment is defended generally up to a 0.1% AEP Standard of Protection in combination with the Thames Barrier. However although the likelihood of flooding has been reduced there is still a risk of breaches or overtopping. As sea levels rise due to climate change, the risk of tide-locking will increase. Together with TE2100 we need to investigate what to do when the current assets come to the end of their residual life or when the tide-locking situation leads to unacceptable levels of protection.

Our message that flood defences cannot protect everything applies here, mainly because flood risk is likely to increase and the potential solutions are limited. Within the Middle and Lower parts of the catchment, particularly through Lewisham, there are locations where defences could be raised, but before these could be progressed the potential downstream impacts will need to be understood and funding levels increased.

As far as maintenance is concerned, reducing the occurrence of fly-tipping would reduce the likelihood of blockages and our reliance on emergency operational responses. Over the next 20 years we need to plan what to do when our assets reach the end of their residual life. The limitations of the existing assets, together with the high level of development and environmental concerns mean that like-for-like replacement will be difficult, expensive and unsustainable. We need to create more space for the river to flow and flood naturally, to improve access for maintenance and to provide more opportunities for flood risk management in the future.

The characteristics of the catchment mean that runoff rates are high and flooding can happen very quickly after a rainfall event, giving very little time to warn people of flooding. The Ravensbourne catchment is particularly susceptible to flooding during intense summer thunderstorms. The frequency and intensity of these storms is likely to increase with climate change. The effectiveness of the flood warning system in reducing the consequence of a flood is reliant on the amount of time available to take effective action. The short flood warning lead time means that there is often little time to take action. Further development of in flood warning technology may increase the time available to act. This can include improved rainfall detection techniques and localised direct alarm systems. In addition, improving community resilience to flooding and developing emergency response plans will have an increasingly important role.

In the longer term we need to ensure that where flooding is likely to occur rapidly, and involve fast flowing or deep water we are not reliant solely on warnings to manage peoples vulnerability. It is for

this reason that holding the line on conveyance whilst adapting the built environment to increase both resilience and space for water will be critical in these urbanised catchments.

Future Approaches

We have established that the Ravensbourne is predominantly concrete lined channel, with a range of structures – mainly culverts and trash screens – common through the part of the river flowing through the urban area of London.

One of our key messages is that redevelopment and regeneration offer a crucial opportunity to reduce flood risk. For example, many of the industrial and commercial areas and some residential areas are being regenerated and setting back the new development from the river will contribute to reducing risk. Our focus in the future will be to bring about a change in the characteristic of the river and what is in the floodplain, particularly where this redevelopment and regeneration is occurring. This will require discussions between the Environment Agency and Local Planning Authorities at a very early stage of planning. We will establish the most effective means of bringing about this change (for example Spatial Delivery Plan, through Local Development Documents or Strategic Flood Risk Assessments) in the Ravensbourne catchment so that we are clear on what can be achieved. This will need to define some of the options, but in general terms, it could comprise and develop the following principles;

- Where there are established residential areas that will remain for the foreseeable future, the likelihood is that we will need to maintain conveyance in those areas. In general this will not improve the existing standard of protection therefore, policies need to be in place within Local Plans which mean that conversion and redevelopment of individual dwellings build in flood resilience as required under PPS25.
- Redevelopment and regeneration along watercourses will need to focus on site layout to recreate a river corridor and if this takes place near to any open space, then opportunities for attenuation should be explored if there is a demonstrable hydraulic benefit in doing so.
- Policies need to be in place in Local Plans to ensure that all opportunities to set back development from watercourses are taken where they are practical to do so. A river corridor improvement plan for both flood risk and river restoration should be developed in conjunction with the London Borough of Lewisham. This would ensure that future regeneration dovetails into a coherent plan thus safeguarding the river corridor for future river restoration and flood risk reduction projects.
- There are areas in the Ravensbourne catchment where redevelopment is planned within the floodplain adjacent to open space, which is outside the floodplain. The sequential test will need to be applied in these situations to consider the possibility for land swapping

- More generally all redevelopment in the floodplain has to be flood resilient.
- There may be opportunities to develop flood storage in some of the existing open space and parkland within the catchment (for example as seen in the Quaggy Flood Alleviation scheme. Broad scale modelling has shown that flood storage could reduce flood risk to some locations. For the foreseeable future funding levels do mean that capital schemes will not be developed, but this situation may change in the future. Providing the existing open space continues with flood compatible uses such as recreation, then this opportunity will remain.

To take these approaches forward very close attention should be paid to Chapter Five (Risk Management by Design) of the PPS25 Development and Flood Risk Practice Guide in setting policy, carrying out SFRA's and planning developments. There are many ways to manage flood risk through layout and design and which are most appropriate will depend on local circumstances; the practice guide provides advice on the most appropriate mitigation. Irrespective of local circumstances, all redevelopment should be resilient to flooding.

Through regeneration we want to achieve resilient buildings, more open watercourses, more flood compatible site layout's following redevelopment and continued flood compatible uses of existing open space. Master planning, PPS25, Strategic Flood Risk Assessments and the right policies in Local Plans provide the tools to achieve this. The Spatial Delivery Plan will define how we bring these tools together to achieve our objectives.

We will also define, through an Asset Management Delivery plan, how we will link our future maintenance and replacement of assets to regeneration. This is an area that does need more consideration, but the principles will be;

- To naturalise the river where practical by removing culverts, trash screens, artificial channel and bank lining where possible.
- To align this objective to regeneration and redevelopment plans
- Accept that replacement of assets in areas where little regeneration is going to occur will have to happen. Under current funding rules, there are potential difficulties in achieving this, but planned replacement is preferable.
- To reduce the legacy costs from the replacement of assets

A large part of the **Ravensbourne** policy unit is characterised by a developed floodplain with typically concrete river channels. The risk of flooding in these areas is relatively high and it is likely that this will increase in the future. Flooding caused by overflowing drainage systems – and the systems themselves – are the responsibility of several organisations. This makes the understanding and management of flooding even more complex. Our flood risk management approach for this type of catchment is outlined below.

Highly developed floodplains with little open space and modified river channels

- We need long-term adaptation of the urban environment. There are massive opportunities to reduce flood risk through redevelopment. In most areas we need to change the character of the urban area in the floodplain through re-development. It must be resilient and resistant to flooding and result in a layout that re-creates river corridors.
- We are seeking to re-create river corridors through redevelopment so that there is space for the river to flow more naturally and space in the floodplain where water can be attenuated.
- We will be seeking to build flood defences as redevelopment occurs and as part of an overall catchment plan. This is because more attenuation and more space in the river corridors are needed for defences to be sustainable. This is more complex but represents better value for society in the long-run even if it is more costly for the EA today.
- These areas are very susceptible to rapid flooding from thunderstorms. Emergency response and flood awareness are particularly important.

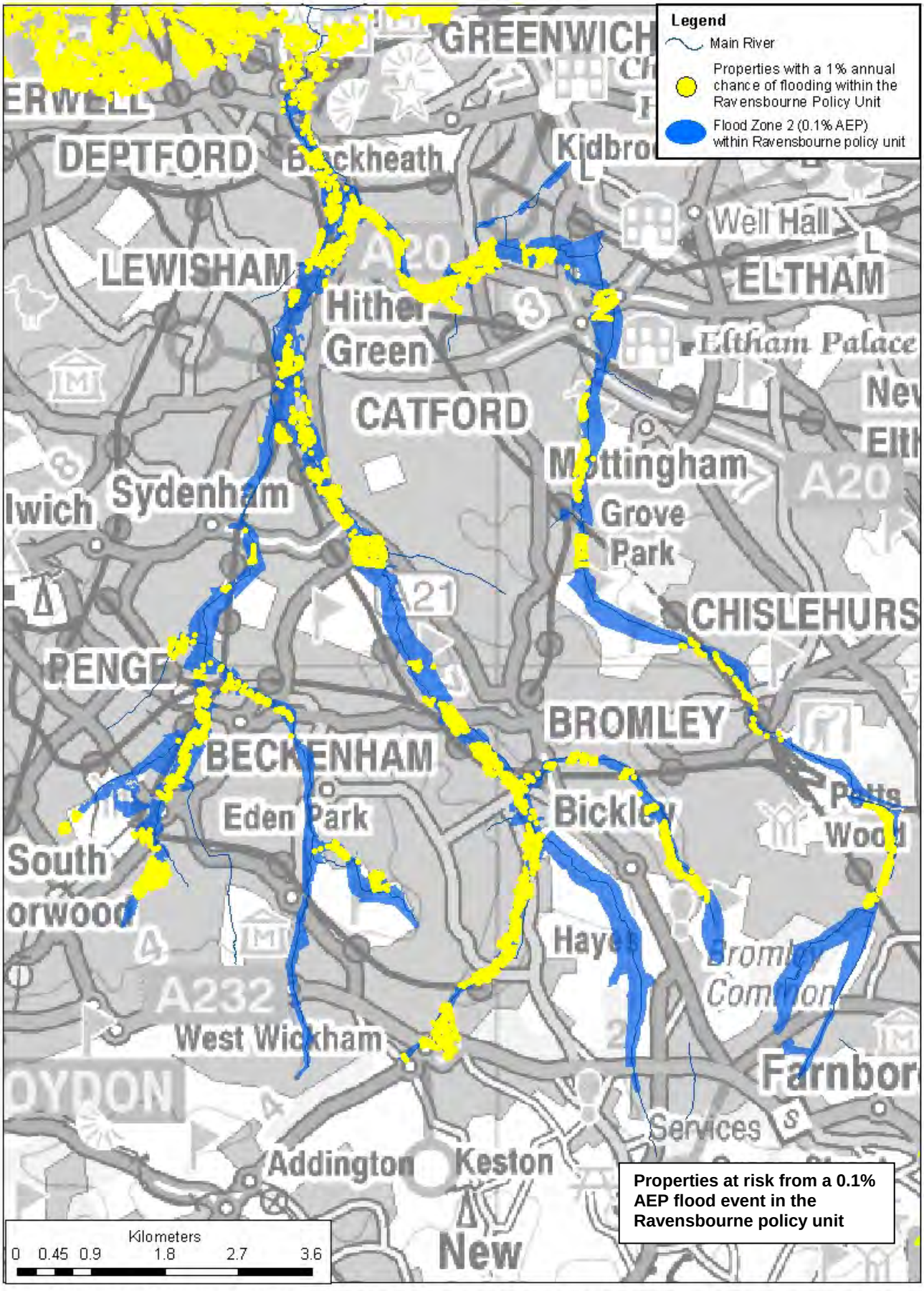
This approach will deliver our policy for the Ravensbourne: ***P4*** *– accept the risk – but in the long term take action to ensure that risk does not increase from current level*

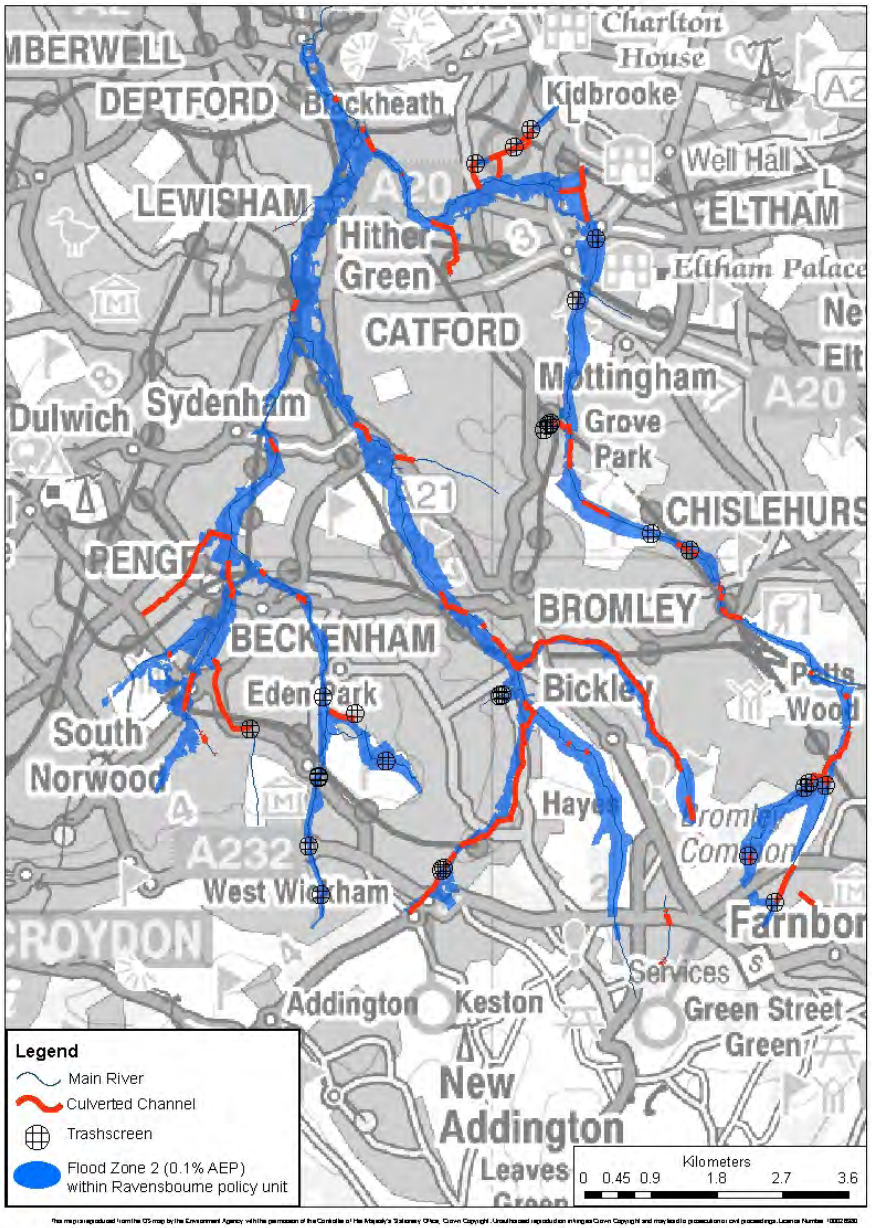
Action	Proposed Initial Action	Mechanism	Indicator	Partners	Timescale
Ra1	**Short-term planning actions** The short to medium-term priority actions in line with Planning Policy Statement 25 (PPS25) to create safe and sustainable development that positively reduces flood risk in the Ravensbourne floodplain are: • Agree the Strategic Flood Risk Assessment (SFRA) (including subsequent revisions) with the Local Authority and use the information to reduce flood risk, influence Local Development Framework (LDF) documents, Regional Spatial Strategies (RSS), planning applications and emergency and evacuation plans. • Seek commitments in land use planning documents to retain the remaining floodplain for flood risk management compatible uses. • Encourage partners to develop policies, strategies and initiatives that seek to increase the resistance and resilience of existing development at risk of flooding. • Encourage the Local Authority to adopt and apply policies that ensure that all new properties built in the floodplain are resistant and resilient to flooding. • Seek greenfield runoff discharge rates, and a reduction in runoff volumes, in new greenfield and brownfield development, and encourage initiatives to reduce run-off rates and volumes for existing development as the catchment reacts quickly to rainfall events due to its 'flashy' nature	PPS25 SFRA LDF RSS Planning applications Developer contributions Local Area Agreement River Corridor Improvement Plan Joint initiatives with partners	CFMP informs SFRA SFRA informs LDF LDF policies in place Percentage of agreed actions undertaken as part of Local Area Agreements Planning decisions	London Boroughs of Greenwich, Lewisham, Croydon, Bromley, GLA, Regional Planning Body, Developers	Short to medium
Ra2	**Long-term adaptation of the urban environment to be more flood resilient** The priority actions to achieve long-term adaptation of urban floodplain river corridors along the Ravensbourne, linked to the redevelopment of urban areas are: • Encourage refurbishment of existing buildings that increases resilience and resistance to flooding. • Identify opportunities to recreate river corridors and wetland habitats in urban areas. Encourage new development and any redevelopment of these areas to acknowledge these opportunities in their site layouts and set development back, allowing space for water, habitat, wildlife and recreation. • Removing obstructions to flow and naturalising watercourses so there is a reduced risk of blockages. • Increasing the available storage within the river corridor. • Encourage partners to assess the viability of future land swapping opportunities in those areas where there is a risk of flooding. The action recognises that there is not a single flood defence solution along most of the Ravensbourne and that there is a need to adapt. This will need to recognise both flood risk management objectives and the wider objectives of the Planning Authority and seek a net reduction in flood risk. Some areas will be redeveloped in the current LDF plan period (e.g. large parts of Lewisham). In other areas, redevelopment will be further into the future but it is important that the tools are in place (whether it is policy or otherwise) to achieve a net reduction in flood risk from future redevelopment.	SFRA LDF RSS Planning applications Developer contributions River Corridor Improvement Plan	CFMP informs SFRA SFRA informs LDF LDF policies in place Planning decisions BAP Habitat	London Boroughs of Greenwich, Lewisham, Croydon, Bromley, GLA, Regional Planning Body, Developers, Housing Associations, Business Associations	Medium to long
Ra3	**Surface water drainage** Consider the impact of other sources of flooding by assisting in the development of a Surface Water Management Plan for those areas of the Ravensbourne that are most vulnerable to this source of flooding. This plan should investigate risk from surface water and sewer flooding. This plan should consider increased risk to the drainage system from future development and climate change (see example below).	SWMP Drain London SFRA	SWMP progress	Local Authorities, Thames Water	Medium

Ra4	**Optimising attenuation and conveyance within the catchment in the long-term** It is a priority to set out a clear vision for the future management of the flow of water in the catchment. This is necessary because: • Our current management relies heavily on conveyance and this is not sustainable. • We need to link the management of current assets to a more sustainable vision (action Ra5) The outcomes that we are seeking through this action are: • Conveyance maintained where we have to, but in a more natural state. • Greater attenuation in the catchment. • A re-established and enhanced river corridor. • Reduce future legacy costs by identification of redundant asset structures. The example below indicates how this action could be taken forward.	The short-term investigations can be carried out through a Delivery Plan. Implementation in the longer-term is more likely to require a more detailed appraisal and may need a Strategy SAMPs and Performance Specs for the management of the watercourse in the intervening period.	Performance specifications reviewed and appropriate action taken	Landowners	Short to Medium
Ra5	**Short-term management of assets** Linked to Ra4 above, the approach for the short-term management of assets is: • Maintain the existing level of conveyance by keeping the existing channels clear and free from obstruction. • Where regeneration is likely in the foreseeable future (including beyond the current Plan period), manage those assets so that we avoid the need to replace the assets until the regeneration occurs and we have a better opportunity to replace them with something which supports our overall vision for the catchment (set out in Ra2 and Ra4). There are also significant number/value of Third Party Owned assets in this policy unit. Attention should be given to the Environment Agency policy guidance on dealing with third party flood defence assets (Policy Number 185_07) which describes actions of notification followed by enforcement for assets not being maintained to their target condition.	Performance specifications SAMP	Conveyance maintained. Review of performance specifications. Opportunities for solutions through the planning process are recognised	Local Authorities, Landowners, Asset owners	Short to medium
Ra6	**Flood Alleviation Schemes** Progress the Deptford Flood Alleviation Scheme (FAS). The scheme will reduce flood risk and achieve set back from the watercourse.	ASM day job	Deptford FAS completed	Local Authorities, Landowners	Medium to long
Ra7	**Flood warning, flood awareness and emergency planning** An important element of flood risk management is to prepare for and to address the consequences of flooding. The priority actions are: • Work with partners to identify critical infrastructure at risk of flooding and encourage appropriate action. • Work with partners, including the media, to ensure that effective communication plans are in place before, during and in the recovery phase of a flooding incident. • Increase public awareness. This is particularly important as we are going to be changing areas of flood warnings that are issued here.	Multi-Agency Emergency Response Plans Community Flood Plans Communications plan Evolution of the FIM day job	Community Flood Plans	Local Authorities Emergency Planners, Parish Councils, Category 1 responders, Media, Community Groups	Short to medium

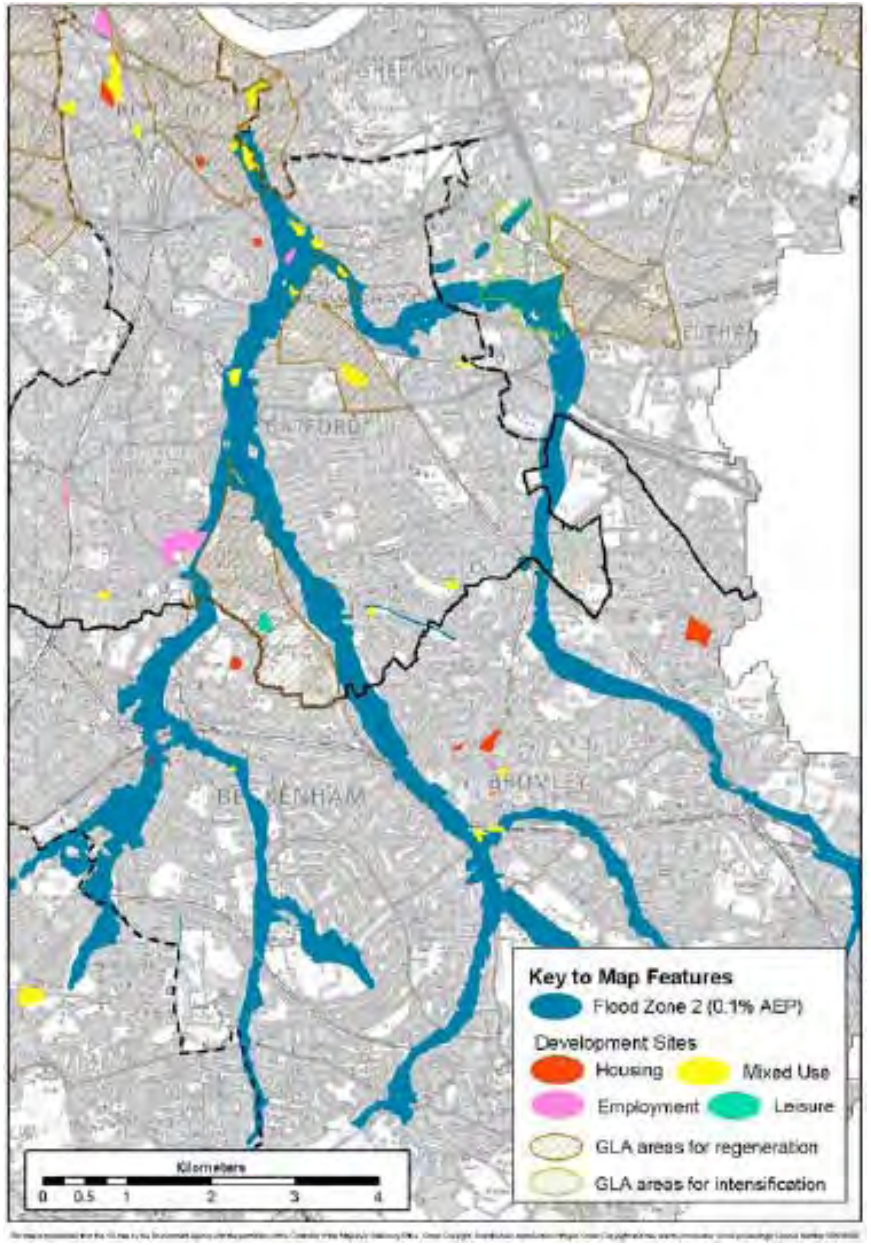
Examples		
Ra4 and Ra2	**Optimising attenuation and conveyance within the catchment in the long-term** In the longer-term, we are seeking to achieve the right balance between conveyance and attenuation within the Ravensbourne. There are areas of open space in the catchment (which we are seeking to safeguard); at some time in the future these areas may have a role in managing flood risk (for example, for water storage). Our assessment is that interventions to engineer large storage areas in the open space available in the catchment can not be justified at present. However our judgement is also that this option is likely to be much more favourable when the choice is either to do this or replace all of the existing structures and channel lining. We need to carry out some work to test this judgement. We have carried out some broad scale modelling and from this we have determined that the opportunities to store water are real (there is a significant impact on flow). What we have not done is establish which areas of open space would have the most beneficial impact on social, economic and environmental indicators. This analysis is needed to confirm that this is our long-term strategy for managing the risk. The outcomes from these investigations could comprise: <u>In the short-term</u> • Map areas where we will seek to maintain (or even improve) conveyance. Typically these will be areas where little land use change is anticipated. • Manage these assets. SAMPs and Performance Specs need to reflect this aim (see Ra5). • Determine (at a broad scale) which areas of open space offer the most potential for <u>future</u> flood storage. For example through simple high-level appraisal. • Try and get some sense of when we may be looking to do this. Is it, for example, when many of the existing assets reach the end of their life in 20 to 30 years time. Would it all be at the same time, or phased? • Safeguard these areas. • Understand how much could potentially be achieved in partnership through redevelopment and how much will require direct intervention from the Environment Agency. <u>In the longer-term</u> At the optimum time, carry out a more detailed appraisal so that the approaches described can be implemented. The implications are; • Conveyance maintained where we have to, but in a more natural state • Greater attenuation in the catchment • A re-established and enhanced river corridor • Reduced future legacy costs by identification of redundant asset structures. In the first photograph the river can be seen in the top right, flowing in a concrete lined channel between residential and semi-industrial areas and then to the right of a park towards the bottom left. It is likely that some redevelopment of the industrial areas will take place – this should impact on our decisions on the maintenance of the channel. There may also be an opportunity to attenuate water in the park towards the bottom of the picture (and other similar areas in the catchment). In the second photograph the river flows in a concrete lined channel from the bottom of the picture in an arc to the top left. Here, redevelopment may be less likely and we may need to adopt a different approach to the management of the assets. In the Ravensbourne, anywhere where redevelopment occurs along the river we would like to have LDF policies in place to ensure that there is set back from the river and opening up of culverts. At a CFMP level we do not know which culverts to remove - but the presumption is they will be unless there is a good reason not to. This is why we have an action that will lead to adaptation of the urban environment. We would like to achieve a more effective balance of conveyance and storage; we can set out how we could do it in broad terms and safeguard the land through SFRA recommendations and LDF policy.   © 2008 Google-Map data © 2008 Tele Atlas So there may be two possible routes to achieving a more sustainable management of the risk: Option (a): long-term through redevelopment results in greater resilience and a river corridor that can accommodate water and convey with a reduced dependency on asset maintenance. Option (b): A quicker way which includes option (a) but can be speeded up through the use of open space for attenuation.

	Clearly (b) is quicker, but we know we can do (a) because it is not dependent upon funding. So we follow option (a) and understand what option (b) could look like and keep the opportunity to do (b) open, without depending upon it.
Ra3	**Surface water drainage** Our understanding of the flood risk shows that a significant proportion is attributed to urban drainage problems. Ideas within 'Making Space for Water' could be applied in parts of the policy unit. At present, the delivery of many of these responses is outside of the Environment Agency remit, but this is an area where we will be looking for opportunities and partnerships to understand the problem more clearly. Priorities should include: • Investigation of those areas most prone to surface water flooding. • Assessment of the impact of allowable discharge rates from new development in the Ravensbourne. This could mean zoning catchments so that the control of surface water is targeted to best reduce flood risk considering the sites position and the response of that section of river to rainfall. This could lead to much better surface water control justifying stronger SUDS policies and the targeted use of attenuation and long term storage to both improve the current river regime and minimise flood risk. • Identification of those parts of the catchment where it would be most effective to reduce runoff from brownfield sites to better represent the conditions For the most part there is no quick fix for these existing problems. This is because drainage systems and their discharge into modified fluvial systems have tended to evolve in a piecemeal way. These problems are now recognised and in the longer-term the situation can be improved. A Surface Water Management Plan (SWMP) could identify the main problems and locations associated with surface water flooding and consider whether there is any potential and realistic short-term or long-term alleviation measures.





Location of culverted channel and trash screens within the Ravensbourne policy unit



Proposed development sites in the Ravensbourne catchment

Appendix G Figures

- Figure 1 - Borough Location Plan
- Figure 2 - Flood Risk Overview
- Figure 3 - Areas Benefitting from Defences
- Figure 4 - Historical Flooding
- Figure 5 - Vulnerable Receptors
- Figure A –Topography
- Figure B1 - Solid Geology
- Figure B2 - Drift Geology
- Figure C - Breach Outlines
- Figure D - Flood Warning Areas
- Figure E - Reservoir Flooding