SURFACE WATER MANAGEMENT PLAN





DRAIN LONDON

LONDON BOROUGH OF LAMBETH

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Executive Summary

This document forms the Surface Water Management Plan (SWMP) for the London Borough of Lambeth which has been delivered as part of the Tier 2 package of works of the Drain London Project. This document is a plan which outlines the preferred surface water management strategy for London Borough of Lambeth and includes consideration of flooding from sewers, drains, groundwater and runoff from land, small watercourses and ditches that occurs as a result of heavy rainfall.

The SWMP builds upon previous work undertaken at part of the Drain London Tier 1 package of works and has been undertaken following a four phase approach; Phase 1 – Preparation; Phase 2 – Risk Assessment; Phase 3 – Options; and Phase 4 – Implementation and Review.

Phase 1 Preparation

Phase 1 builds upon work formerly undertaken during Tier 1 of the Drain London Project to collect and review surface water data from key stakeholders and build partnerships between stakeholders responsible for local flood risk management. As part of the Drain London project, the London Borough of Lambeth has been grouped with the London Boroughs of Merton, Southwark and Wandsworth to undertake Tier 2 of the project and work together to understand local flood risk.

The London Borough of Lambeth has begun to establish a broader partnership with the neighbouring London Borough of Southwark, through the establishment of the South Central London Strategic Flood Group, in order for these local authorities to pool best practice and resources to enable each authority to discharge their responsibilities as Lead Local Flood Authority (LLFA) under the Flood and Water Management Act (FWMA) 2010.

Phase 2 Risk Assessment

As part of Phase 2 Risk Assessment, direct rainfall modelling has been undertaken across the entire Borough for five specified return periods. The results of this modelling have been used to identify Local Flood Risk Zones (LFRZs) where flooding affects houses, businesses and/or infrastructure. Those areas identified to be at more significant risk have been delineated into Critical Drainage Areas (CDAs) representing one or several LFRZs as well as the contributing catchment area and features that influence the predicted flood extent.

Fourteen (14) CDAs have been identified within or crossing the administrative boundary of the London Borough of Lambeth; these are shown in Figure 1.





The chief mechanisms for flooding in the London Borough of Lambeth can be broadly divided into the following categories:

- *River Valleys* Across the study area, the areas particularly susceptible to overland flow are formed by narrow corridors associated with topographical valleys which represent the routes of the 'lost' rivers of London including the River Effra, Falcon Brook and Clapham River. This results in large areas of deep surface water ponding in the Norwood, West Dulwich, Herne Hill, Brixton and Kennington areas;
- Low Lying Areas areas such as underpasses, subways and lowered roads beneath railway lines are more susceptible to surface water flooding;
- *Railway Embankments* discrete surface water flooding locations along the up-stream side of the raised network rail embankment (running roughly west to east through the South of the Borough);
- *Topographical Low Points* areas which are at topographical low points throughout the Borough which result in small, discrete areas of deep surface water ponding; and,
- Sewer Flood Risk areas where extensive and deep surface water flooding is likely to be the influence of sewer flooding mechanisms alongside pluvial and groundwater sources including the areas of Herne Hill, Clapham and Streatham.

Analysis of the number of properties at risk of flooding has been undertaken for the rainfall event with a 1 in 100 probability of occurrence in any given year (1% Annual Exceedance Probability, AEP). A review of the results demonstrate that 43,740 residential properties and 2,715 non-residential properties in the London Borough of Lambeth could be at risk of surface water flooding of greater than 0.03m depth during a 1% AEP rainfall event with. Of those, 1,295 residential properties and 50 non-residential properties could be at risk of flooding to a depth of greater than 0.5m during the same modelled rainfall event.

A review of these statistics coupled with local knowledge of the study area identifies that the following CDAs are at greatest risk of significant flooding (greater than 0.5m deep) from the 1% AEP rainfall event:

CDA	Flooded Receptors (>0.03m)			Flooded Receptors (>0.5m)		
ODA	Residential	Non- Residential	Total	Residential	Non- Residential	Total
Group7_033 (Brixton)	7,043	398	7,441	651	5	656
Group7_032 (Herne Hill)	6,201	339	6,540	158	33	191
Group7_028 (Nine Elms)	3,939	337	4,276	82	0	82
Group7_026 (Streatham)	1,741	112	1,853	42	8	50
Group7_027 (Clapham South)	3,176	154	3,330	40	5	45
Group7_031 (East Norwood)	1,560	49	1,609	43	0	43

Table 1 - CDAs at Greatest Risk of Surface Water Flooding in (or interacting with) the London Borough of Lambeth

Within the London Borough of Lambeth, the greatest number of receptors are at risk from significant surface water flooding (>).5m) along the route of the 'hidden' River Effra, which runs south to north through the Borough (Group7_032 (Herne Hill) and Group7_033 (Brixton) CDAs). Historic surface water flooding records (supplied by Lambeth Borough Council) support the pluvial modelling flooding in the West Dulwich and Herne Hill areas. Significant ponding of surface water (>0.5m) is modelled to impact the Nine Elms (Group7_028), Streatham (Group7_026), Clapham South (Group7_027) and East Norwood (Group7_31) CDAs. The Herne Hill, Brixton and Norwood areas are impacted from



upstream surface water flows from the London Boroughs of Southwark and Croydon, and it will therefore be important that the flood risk is managed at a catchment scale by all Councils.

A number of CDAs within the London Borough of Lambeth are cross boundary, and as such will need to be jointly managed to implement the potential flood mitigation measures and manage surface water flood risk in these areas. These include:

CDA	Lead Borough	Supporting Borough
Group7_006 (East Mitcham)	Merton	Croydon / Lambeth
Group 7_022 (Clapham Junction)	Wandsworth	Lambeth
Group 7_024 (Tooting Bec)	Wandsworth	Lambeth
Group7_025 (Streatham Common)	Lambeth	Wandsworth
Group7_028 (Nine Elms)	Lambeth	Wandsworth
Group8_030 (Norwood)	Lambeth	Croydon
Group 7_032 (Herne Hill)	Lambeth & Southwark	N/A
Group 7_036 (Camberwell)	Southwark	Lambeth
Group8_049 (Norbury)	Croydon	Lambeth

Table 2 – Cross Boundary CDAs in London Borough of Lambeth

Phase 3 Options Assessment

There are a number of opportunities for measures to be implemented across the Borough to tackle surface water flood risk. Ongoing maintenance of the drainage network and small scale improvements are already undertaken as part of the operations of the Borough. In addition, opportunities to raise community awareness of the risks and responsibilities for residents should be sought, and London Borough of Lambeth may wish to consider the implementation of a Communication Plan to assist with this.

It is important to recognise that flooding within the Borough is not confined to just the CDAs, and therefore, throughout the Borough there are opportunities for generic measures to be implemented through the establishment of a policy position on issues including the widespread use of water conservation measures such as water butts and rainwater harvesting technology and use of SuDS. In addition, there are Borough-wide opportunities to raise community awareness, look at opportunities to increase resilience to flooding and improve / target drainage network maintenance.

For each of the CDAs identified within the Borough, site-specific measures have been identified that could be considered to help alleviate surface water flooding. These measures were subsequently short listed to identify a potential preferred option for each CDA alongside recommendations for further investigation where appropriate.

Pluvial modelling undertaken as part of the SWMP has identified that flooding within Lambeth is heavily influenced by the river valley of the 'hidden' River Effra, with several areas of deeper flooding dispersed across the Borough. Historical records indicate that flooding is largely a result of the local drainage network and Thames Water sewer capacity; the majority of the Borough is served by combined sewers which, in many cases, were designed and built in the late 1800s, and subsequent urbanisation and cross-connection means that it is likely that the sewers across the Borough will have varying standards of capacities, particularly in the north of the Borough. As such, in the short to medium-term, it is recommended that the London Borough of Lambeth:

• Undertake a catchment-wide Drainage Capacity Study for the Herne Hill (Group7_032) and Brixton (Group7_033) CDAs in conjunction with the London Borough of Southwark, Thames Water and TfL to determine local drainage capacity and identify flood mitigation options through detailed modelling.

There are several other investigations that have been identified that could be progressed in the short to medium-term to improve the understanding of flood risk to those areas predicted to be most significantly impacted by surface water flooding within the Borough and identify the feasibility for flood mitigation measures including:

- Undertake a feasibility study for implementation of localised SuDS measures in North Clapham Park LFRZ (Group7_027) through provision of source control, flood storage and permeability measures (where appropriate) in existing green spaces and hardstanding areas interspersed in council estates;
- Undertake further investigations of the flooding mechanisms in the Stanthorpe Road (Group7_026) and Eardley Road (Group7_025) areas to aid in identifying cost:beneficial surface water measures to be taken forward for these areas;
- Engage with Network Rail regarding the surface water flood risk along major railway lines and to railway stations identified to flood throughout the Borough, and confirm the drainage assumptions used within the SWMP pluvial modelling. In particular this should focus on infrastructure in proximity to Streatham Common Railway Station (Group7_025), Streatham Railway Station (Group7_026) and Waterloo Railway Station (Group7_034); and
- In conjunction with the London Borough of Wandsworth and Thames Water, identify the scope for undertaking drainage investigations in the Nine Elms area, along the Lambeth / Wandsworth Boundary (Group7_028), and agree a timetable and funding sources for undertaking these.

There are a number of locations in Lambeth where pluvial modelling identifies localised areas of deep surface water flooding and where opportunities for utilisation of existing green spaces to provide 'Quick Win' schemes. It is therefore recommended that Lambeth consider the following:

- Undertake a feasibility study for, and implementation of, source control and flow path management measures in Brockwell Park (Group7_033) to mitigate surface water flooding downstream in the Dulwich Road area;
- Undertake a feasibility study for, and implementation of, flood storage measures in the Berridge Road area (Group7_031) where localised, deep areas of surface water ponding are predicted and existing green space is available for utilisation.
- Investigate and implement measures to improve resilience at King's College Hospital (Group7_036).

Other potential 'Quick Wins' for the Borough include:

- Improve maintenance regimes, and target those areas identified to regular flood or known to have blocked gullies
- Production of Community Flood Plans for the Dulwich Road area (Group7_033) and North Clapham Park LFRZ (Group7_027) to assist communities in preparing and dealing with surface water flooding;
- Ensure surface water management planning policies are included within emerging SPDS or DPDs within the Waterloo Opportunity Area (Group7_034); and,
- Improve community awareness through incorporating surface water flooding issues in River Graveney Community Awareness event (Group7_025).



Borough wide, it is recommended that Lambeth:

- Engage with residents regarding the flood risk in Lambeth, to make them aware of their responsibilities for property drainage (especially in the CDAs) and steps that can be taken to improve flood resilience;
- Provide an 'Information Portal' via the London Borough of Lambeth website, for local flood risk information and measures that can be taken by residents to mitigate surface water flooding to / around their property;
- Prepare a Communication Plan to effectively communicate and raise awareness of surface water flood risk to different audiences using a clearly defined process for internal and external communication with stakeholders and the public; and,
- Identify opportunities for introducing, encouraging and implementing 'Complimentary Measures' across the Borough to provide multifunctional and multi-beneficial approaches to surface water management.

Phase 4 Implementation & Review

Phase 4 establishes a long-term Action Plan for Lambeth to assist in their role under the FWMA 2010 to lead in the management of surface water flood risk across the Borough. The purpose of the Action Plan is to:

- Outline the actions required to implement the preferred options identified in Phase 3;
- Identify the partners or stakeholders responsible for implementing the action;
- Provide an indication of the priority of the actions and a timescale for delivery; and,
- Outline actions required to meet the requirements for Lambeth Borough Council as LLFA under the FWMA 2010.

The SWMP Action Plan is a 'living' document, and as such, should be reviewed and updated regularly, particularly following the occurrence of a surface water flood event, when additional data or modelling becomes available, following the outcome of investment decisions by partners and following any additional major development or changes in the catchment which may affect the surface water flood risk.



Glossary

Term	Definition
AEP	Annual Exceedance Probability
Aquifer	A source of groundwater comprising water bearing rock, sand or gravel capable of yielding significant quantities of water.
AMP	Asset Management Plan
Asset Management Plan	A plan for managing water and sewerage company (WaSC) infrastructure and other assets in order to deliver an agreed standard of service.
AStSWF	Areas Susceptible to Surface Water Flooding
BREEAM	BRE Environmental Assessment Method
Catchment Flood Management Plan	A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
CDA	Critical Drainage Area
Critical Drainage Area	A discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure.
CFMP	Catchment Flood Management Plan
CIRIA	Construction Industry Research and Information Association
Civil Contingencies Act	This Act delivers a single framework for civil protection in the UK. As part of the Act, Local Resilience Forums must put into place emergency plans for a range of circumstances including flooding.
CLG	Government Department for Communities and Local Government
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions.
Culvert	A channel or pipe that carries water below the level of the ground.
Defra	Department for Environment, Food and Rural Affairs
DEM	Digital Elevation Model
DG5 Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years.
DPD	Development Plan Documents
DTM	Digital Terrain Model
EA	Environment Agency
Indicative Flood Risk Areas	Areas determined by the Environment Agency as indicatively having a significant flood risk, based on guidance published by Defra and WAG and the use of certain national datasets. These indicative areas are intended to provide a starting point for the determination of Flood Risk Areas by LLFAs.
FALP	Further Alterations to the London Plan
FCERM	Flood and Costal Erosion Risk Management
FMfSW	Flood Map for Surface Water
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG.
Flood Risk Regulations	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Floods and Water Management Act	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing surface water flood risk in England.
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a main river
FRR	Flood Risk Regulations
IDB	Internal Drainage Board
iPEG	(Area of) Increased Potential for Elevated Groundwater
IUD	Integrated Urban Drainage



Term	Definition
LB	London Borough
LDF	Local Development Framework
LFRZ	Local Flood Risk Zone
Local Flood Risk Zone	Local Flood Risk Zones are defined as discrete areas of flooding that do not exceed the national criteria for a 'Flood Risk Area' but still affect houses, businesses or infrastructure. A LFRZ is defined as the actual spatial extent of predicted flooding in a single location
Lead Local Flood Authority	Local Authority responsible for taking the lead on local flood risk management
Lidar	Light Detection and Ranging
LLFA	Lead Local Flood Authority
Local Resilience Forum	A multi-agency forum, bringing together all the organisations that have a duty to cooperate under the Civil Contingencies Act, and those involved in responding to emergencies. They prepare emergency plans in a co-ordinated manner.
LPA	Local Planning Authority
LRF	Local Resilience Forum
MAFP	Multi-Agency Flood Plan
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers
MDO	Major Development Opportunity
MoU	Memorandum of Understanding
NRD	National Receptor Dataset – a collection of risk receptors produced by the Environment Agency
Ordinary	All watercourses that are not designated Main River, and which are the responsibility of Local
Vvatercourse	Authorities or, where they exist, IDBs
	Proliminary Eload Pick Assassment
	Comprehensive independent review of the 2007 summer floods by Sir Michael Pitt, which
Pitt Review	provided recommendations to improve flood risk management in England.
Pluvial Flooding	Flooding from water flowing over the surface of the ground; often occurs when the soil is saturated and natural drainage channels or artificial drainage systems have insufficient capacity to cope with additional flow.
PPS25	Planning and Policy Statement 25: Development and Flood Risk
PA	Policy Area
Policy Area	One or more Critical Drainage Areas linked together to provide a planning policy tool for the end users. Primarily defined on a hydrological basis, but can also accommodate geological concerns where these significantly influence the implementation of SuDS
Resilience	Measures designed to reduce the impact of water that enters property and businesses; could
Measures Resistance	Include measures such as raising electrical appliances.
Measures	quards for example.
RFCC	Regional Flood and Coastal Committee
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
Risk Management Authority	As defined by the Floods and Water Management Act
RMA	Risk Management Authority
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
SFRA	Strategic Flood Risk Assessment
SLA	Service Level Agreement
SMP	Shoreline Management Plan
SPD	Supplementary Planning Documents
Stakeholder	A person or organisation affected by the problem or solution, or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.
SuDS	Sustainable Drainage Systems
Sustainable	Methods of management practices and control structures that are designed to drain surface
Drainage Systems	water in a more sustainable manner than some conventional techniques.



Term	Definition
Surface water	Rainwater (including snow and other precipitation) which is on the surface of the ground (whether or not it is moving), and has not entered a watercourse, drainage system or public sewer.
SWMP	Surface Water Management Plan
TfL	Transport for London
TWUL	Thames Water Utilities Ltd
WaSC	Water and Sewerage Company



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1. Introduction

- 1.1 WHAT IS A SURFACE WATER MANAGEMENT PLAN?
- 1.1.1 A Surface Water Management Plan (SWMP) outlines the preferred surface water management strategy in a given location. In this context surface water flooding describes flooding from sewers, drains, groundwater, and runoff from land, ordinary watercourses and ditches that occurs as a result of heavy rainfall.
- 1.1.2 This SWMP study has been undertaken as part of the Drain London Project¹ in consultation with key local partners who are responsible for surface water management and drainage in the London area. These include the Greater London Authority, Thames Water, the Environment Agency and Transport for London. The Partners have worked together to understand the causes and effects of surface water flooding so that they can agree the most cost effective way of managing surface water flood risk for the long term.
- 1.1.3 This document also establishes a starting point for a long-term action plan to manage surface water and will influence future capital investment, maintenance, public engagement and understanding, land-use planning, emergency planning and future developments.

1.2 BACKGROUND

- 1.2.1 In May 2007 the Mayor of London consulted on a draft Regional Flood Risk Appraisal (RFRA). One of the key conclusions was that the threat of surface water flooding in London was poorly understood. This was primarily because there were relatively few records of surface water flooding and those that did exist were neither comprehensive nor consistent. Furthermore the responsibility for managing flood risk is split between Boroughs and other organisations such as Transport for London, London Underground, Network Rail, the Environment Agency and Thames Water. Relationships between surface water flooding and other sources of flood risk were also found to be unclear. To give the issue even greater urgency it is widely expected that heavy storms will increase in frequency with climate change.
- 1.2.2 The Greater London Authority, London Councils, Environment Agency and Thames Water commissioned a scoping study to test these findings and found that this was an accurate reflection of the situation. The conclusions were brought into sharp focus later in the summer of 2007 when heavy rainfall resulted in extensive surface water flooding in parts of the UK such as Gloucestershire, Sheffield and Hull causing considerable damage and disruption. Whilst not as severe as the flooding within Hull, Sheffield and Gloucestershire, significant disruption was caused within a number of areas of London. The Pitt Review examined the flooding of 2007 and made a range of recommendations for future flood management, most of these have been enacted through the Flood and Water Management Act (FWMA) 2010.
- 1.2.3 The Department for Environment, Food and Rural Affairs (Defra) recognised the importance of addressing surface water flooding in London and fully funded the Drain London project.
- 1.2.4 The Drain London project is being delivered using a 'tier' based approach as shown in Figure 1.2.1.

¹ Further information on the Drain London Project can be found here: <u>http://www.london.gov.uk/drain-london</u>





Figure 1.2.1 - Drain London Project 'Tier' Structure

1.2.5 Table 1.2.1 further describes the activities undertaken in each of the Tiers. The management groups for Tier 2 of the Drain London project are shown in Figure 1.2.2; the London Borough of Lambeth is within Group 7 of the Drain London management group, and is grouped with the London Boroughs of Merton, Southwark and Wandsworth. This SWMP is a direct output from Tier 2.

Tier	Summary		
Tier 1	 a) A high level strategic investigation to group the 33 separate boroughs into a smaller number of more manageable units for further study under Tiers 2 and 3. b) Collection and collation of relevant information across all London Boroughs and strategic stakeholders including the Environment Agency, Thames Water and Transport for London. c) Development of a web based 'Portal' to provide data management, data storage and access to the various data sets and information across the 'Drain London Forum' (DLF) participants and to consultants engaged to deliver Tiers 2 and 3. d) Develop technical framework documents and prioritisation tools to guide delivery of Tiers 2 and 3. 		
Tier 2	 a) Delivery of 33 Borough-level intermediate Surface Water Management Plans (SWMPs) within the management groups to define and map Local Flood Risk Zones, Critical Drainage Areas and flood policy areas and produce an Action Plan for each borough. b) Delivery of 33 Borough-level Preliminary Flood Risk Assessments to comply with the Flood Risk Regulations 2009 requirements for Lead Local Flood Authorities (LLFAs). c) Define a list of prioritised Critical Drainage Areas for potential further study or capital works in Tier 3, using the prioritisation tool developed in Tier 1. 		
Tier 3	 a) Further investigations into high priority Local Flood Risk Zones/Critical Drainage Areas to further develop and prioritise mitigation options. b) Delivery of demonstration projects of surface water flood mitigation solutions identified in Tier 2 SWMPs. c) Funding or co-funding within the London area for green roofs and other types of sustainable urban drainage (SUDS). d) Set up of at least 2 community flood plans in local communities at risk from flooding 		

Table 1.2.1 - Summary of Drain London 'Tier' Activities





Figure 1.2.2 - Drain London Management Groups

1.3 OBJECTIVES

- 1.3.1 The objectives of the SWMP are to:
 - Develop a robust understanding of surface water flood risk in and around the study area, taking into account the challenges of climate change, population and demographic change and increasing urbanisation in London;
 - Identify, define and prioritise Critical Drainage Areas (CDAs), including further definition of existing Local Flood Risk Zones and mapping new areas of potential flood risk;
 - Make sensible and varied recommendations for surface water management which improve emergency and land use planning, and enable better flood risk and drainage infrastructure investments;
 - Establish and consolidate partnerships between key drainage stakeholders to facilitate collaborative working practices and identification of cross boundary working opportunities;
 - Undertake engagement with stakeholders to raise awareness of surface water flooding, identify flood risks and assets, and agree mitigation measures and actions;
 - Deliver outputs to enable a real change on the ground rather than just reports and models, whereby partners and stakeholders take ownership of their flood risk and commit to delivery and maintenance of the recommended mitigation measures and actions; and
 - Facilitate discussions and report implications relating to wider issues falling outside the remit of this study to actively encourage and challenge the SWMP every time it is reviewed, for example, providing guidance on London Borough of Lambeth's responsibilities as Lead Local Flood Authority (LLFA) under the FWMA 2010.



1.4 STUDY AREA

TOPOGRAPHY AND LAND USE

- 1.4.1 The study area is defined by the administrative boundary of the London Borough of Lambeth, which is an inner London Borough and covers an area of approximately 27km². The River Thames forms the northern boundary of the London Borough of Lambeth, with the London Borough of Southwark bordering to the east, the London Borough of Croydon to the south and the London Boroughs of Merton and Wandsworth to the west.
- 1.4.2 The study area is characterised by a basin of low lying, relatively flat land to the north (north of the A2217), and undulating land, rising away in the south of the Borough (Figure 1.4.1). The underlying bedrock geology is London Clay, which is overlaid by superficial deposits across much of the study area, with River Terrace Deposits present in the north of the Borough.
- 1.4.3 The London Borough of Lambeth is heavily urbanised, with the northern districts having a mix of residential and non-residential areas and a strong tourism economy, whilst towards the south of the Borough, the land use is predominantly sub-urban in character. The Borough includes the districts of Waterloo and South Bank, Vauxhall, the Oval, Kennington, Stockwell, Clapham, Brixton, Seven Bridges, Herne Hill, Streatham, Tulse Hill, West Norwood and Gypsy Hill and includes several large areas of open space, namely Kennington Park, the boundary of Clapham Common and Brockwell Park (Figure 1.4.2). A 1km stretch of the River Graveney (main watercourse), a tributary to the River Wandle, runs through the Streatham Vale / Norbury area to the southern extent of the Borough, joining the Wandle at Colliers Wood. The watercourse is canalised throughout the study area having artificial banks and bed. St. Thomas' Hospital, King's College Hospital and Lambeth Hospital are also located in the Borough.
- 1.4.4 Lambeth is strategically linked on a local, regional and national scale through Road, Rail and Underground. Waterloo Station is the UK's busiest mainline terminus with 88 million passengers a year, which links Lambeth to the south and south west of England. Adjacent to Waterloo is Waterloo East with direct links to both Charing Cross and London Bridge with links to Kent, Bedfordshire and Hertfordshire. There are also links to London Overground. Lambeth has 5 underground lines serving the borough making central London 10 minutes away from Brixton with direct links to Victoria, St Pancras International, Kings Cross and Euston.
- 1.4.5 Lambeth has over 308km of road network alongside the Transport for London Road Network (TLRN) otherwise referred to as "red route". The TLRN includes roads such as the A3, 'Stane Street', A23, A24, A205 (South Circular) among other roads with the remaining public roads managed by Lambeth.
- 1.4.6 The study area falls into the Thames River Basin District (RBD) (as defined by the Environment Agency) and is located in the Environment Agency Thames Region. The water utility provider is Thames Water Utilities Ltd.

Figure 1.4.1 - LiDAR Topographic Survey Figure 1.4.2 - Land Use Areas







FLOOD RISK OVERVIEW

- 1.4.7 According to the Environment Agency's property count for their national Flood Map for Surface Water (FMfSW) dataset, approximately 46,300 residential properties and 4,200 non-residential properties in the London Borough of Lambeth could be at risk of surface water flooding of greater than 0.1m depth during a rainfall event with a 1 in 200 probability of occurrence in any given year (0.5% Annual Exceedance Probability, AEP)). Of those, 13,500 residential properties and 1,200 non-residential properties are estimated to be at risk of flooding to a depth of greater than 0.3m during the same modelled rainfall event. Figure D-1 in Appendix D shows the FMfSW dataset for the London Borough of Lambeth.
- 1.4.8 The most recent, significant surface water flooding event in the London Borough of Lambeth occurred in April 2004 affecting Herne Hill and the Dulwich Road area. Flooding was attributed to the intensity of the rainstorm (with a reported probability of less than a 1 in 300 probability of occurring in any given year (0.3% AEP)) and the topography of the area, causing runoff to accumulate in a natural valley with the Thames Water sewer system surcharging.
- 1.4.9 Under United Kingdom Climate Projections 2009 (UKCP09), predictions for future rainfall in the UK up to 2080 are that there could be around three times as many days in winter with heavy rainfall (defined as more than 25mm in a day). It is plausible that the amount of rain in extreme storms (with a 1 in 5 probability of occurrence in any given year (20% AEP) or rarer) could increase locally by 40%.
- 1.4.10 Within the Thames River Basin District, if emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past are:
 - Winter precipitation increases of approximately 15% (very likely to be between 2 and 32%);
 - Precipitation on the wettest day in winter up by approximately 15% (very unlikely to be more than 31%);
 - Relative sea level at Sheerness very likely to increase between 10 and 40cm from 1990 levels (not including extra potential rises from polar ice sheet loss);
 - Peak river flows in a typical catchment likely to increase between 8 and 18%.
- 1.4.11 The risk of exceedance of the urban drainage system and surface water flooding in the Borough is therefore likely to increase into the future unless steps are taken to manage and mitigate this form of flooding.

FUTURE DEVELOPMENT

- 1.4.12 The London Borough of Lambeth Core Strategy was adopted in January 2011 and outlines the Councils broad vision for future development within the Borough.
- 1.4.13 The Core Strategy provides an indication of the level of housing capacity required across the Borough to 2025. The Council will meet the housing needs through the provision of at least 7,700 dwellings between 2010/2011 and 2016/2017 in line with London Plan targets, and a further 8,800 dwellings by 2024/2025 subject to London Plan targets for this period.

- 1.4.14 Growth is concentrated in the following areas:
 - Brixton
 Oval
 - Clapham

Herne Hill

- •
- Stockwell Streatham
- West Norwood / Tulse Hill

Vauxhall

Waterloo

•

- 1.4.15 The London Plan designated two areas (Vauxhall/Nine Elms/Battersea and Waterloo) within the London Borough of Lambeth as Opportunity Areas, promoted to accommodate both new jobs and new homes with a mixed and intensive use of land.
- 1.4.16 Plans for urbanisation and redevelopment within the London Borough of Lambeth may present a challenge to the existing drainage systems. However, it also affords a crucial opportunity to address long-standing issues and problems relating to surface water flooding and pressure points on the drainage system through strategic improvements and upgrades to the drainage system.
- 1.4.17 The SWMP for the London Borough of Lambeth should have a particular focus on areas allocated for further development and urbanisation and identify any potential locations for strategic improvements and upgrades to the existing drainage systems.
- 1.5 FLOODING INTERACTIONS
- 1.5.1 In the context of SWMPs, surface water flooding incorporates flooding from sewers, drains, groundwater, and runoff from land, small watercourses (often referred to as ordinary watercourses) and ditches occurring as a result of heavy rainfall. These sources may operate independently or through a more complex interaction of several sources.
- 1.5.2 An initial overview of the flooding issues in the London Borough of Lambeth, based on the Environment Agency's FMfSW and historic flooding records in the Borough, indicate that several areas, including Norwood, West Dulwich and Herne Hill (in particular Dulwich Road and Railton Road) are affected by multiple sources of flood risk. These include complex interactions between urban watercourse routes, direct surface water ponding, overland flow paths, groundwater springs and the combined sewer system. There are also several cross-boundary surface water flooding issues, with surface water flows from Lambeth crossing into the London Boroughs of Southwark (West Dulwich and Camberwell) and Wandsworth (Nine Elms, Streatham, Tooting Bec and Clapham), whilst flows from the London Boroughs of Southwark (Herne Hill) and Croydon (Norwood area) flow into Lambeth.
- 1.5.3 In order for these flooding mechanisms to be adequately assessed, a holistic approach to surface water management is required. The SWMP approach will seek to ensure that all sources and mechanisms of surface water flood risk are assessed and that solutions are considered in a holistic manner so that measures are not adopted that reduce the risk of flooding from one source to the detriment of another.

1.6 LINKAGES WITH OTHER PLANS

1.6.1 The increased focus on flood risk over recent years is an important element of adaptation to climate change. It is important that the SWMP is not viewed as an isolated document, but one that connects with other strategic and local plans. Drain London links into a number of regional and local plans which are discussed in more detail below.



REGIONAL FLOOD RISK ASSESSMENT (RFRA)

- 1.6.2 The GLA as the regional planning body have produced a RFRA to accompany the London Plan. The purpose of the RFRA is to provide a broad regional understanding of the flood risks across Greater London from all sources. The RFRA is a descriptive document, intended to feed into the Strategic Sustainability Assessment (SSA) in order to help determine broad regionally significant locations for development. The regional appraisal of flood risk concludes that there are five major flood sources tidal, fluvial, groundwater, surface water and sewers that influence the Greater London area.
- 1.6.3 The RFRA will be updated in 2012 to reflect the additional information on local sources of flood risk (surface water, groundwater and ordinary watercourses) from Drain London. This may also generate new policies that would be incorporated into the London Plan when it is reviewed.

THAMES CATCHMENT FLOOD MANAGEMENT PLAN

- 1.6.4 The Thames Catchment Flood Management Plan was published in 2008 and sets out policies for the sustainable management of flood risk across the whole catchment over the long-term (50 to 100 years) taking climate change into account.
- 1.6.5 The Plan emphasises the role of the floodplain as an important asset for the management of flood risk, the crucial opportunities provided by new development and regeneration to manage risk, and the need to re-create river corridors so that rivers can flow and flood more naturally. More detailed flood risk management strategies for individual rivers or sections of river may sit under these.
- 1.6.6 This Plan will be periodically reviewed, approximately five years from when it was published, to ensure that it continues to reflect any changes in the catchment. There are links to Drain London where there are known interactions between surface water and fluvial flooding.
- 1.6.7 The CFMP highlights that urban areas, such as those present in the London Borough of Lambeth, are very susceptible to rapid flooding from thunderstorms. Emergency response and flood awareness are particularly important. Furthermore, urban flooding is likely to increase in the future as a result of:
 - 1. Ageing drainage infrastructure;
 - 2. More development covering previously permeable ground;
 - 3. Increase in paving in existing developments e.g. patios and driveways; and
 - 4. Climate change i.e. wetter winters and heavier summer rainfall.
- 1.6.8 Specific CFMP actions that relate to the London Borough of Lambeth are outlined below:
 - Long-term adaptation of the urban environment is required;
 - There are opportunities to reduce flood risk through redevelopment. In most areas there is a need to change the character of the urban area in the floodplain through the location, layout and design of re-development. It must be resilient and resistant to flooding and result in a layout that recreates river corridors, therefore reducing the consequence of flooding; and
 - Identify and seek out opportunities to open up culverts and 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.

PRELIMINARY FLOOD RISK ASSESSMENT (PFRAS)

- 1.6.9 PFRAs are required as part of the Flood Risk Regulations which implement the requirements of the European Floods Directive. The PFRA is a high level assessment of flood risk, based on existing information on both historical floods and future flood risk from the sources of flooding other than main rivers, the sea and reservoirs, and their potential consequences on human health, economic activity, cultural heritage and the environment.
- 1.6.10 As part of the Drain London project, a PFRA has been produced for each London Borough (LLFA), to give an overview of all local sources of flood risk. In London PFRAs will benefit from an increased level of information relating to surface water from the Drain London SWMPs. Boroughs will need to review these PFRAs every 6 years.
- 1.6.11 The PFRA for the London Borough of Lambeth was completed and submitted to the Environment Agency in June 2011.

SURFACE WATER MANAGEMENT PLANS (SWMPS)

- 1.6.12 Drain London is producing an SWMP for each London Borough. They provide much improved probabilistic 2-dimensional modelling and data on what has been made available at a national scale by the Environment Agency. In addition they contain an Action Plan that has been developed in conjunction with both the Borough and relevant other Risk Management Authorities. This data, actions and associated policy interventions will need to feed directly into the operational level of the Borough across many departments, in particular into spatial and emergency planning policies and designations and into the management of local authority controlled land.
- 1.6.13 This document forms the SWMP for the London Borough of Lambeth. This should be read in conjunction with the SWMPs for the London Boroughs of Southwark, Wandsworth, Merton and Croydon, due to the cross-boundary nature of the surface water flood risk across the adjoining Boroughs.

STRATEGIC FLOOD RISK ASSESSMENTS (SFRAS)

- 1.6.14 Each local planning authority is required to produce a SFRA under Planning Policy Statement 25 (PPS25). This provides an important tool to guide planning policies and land use decisions. Current SFRAs have a strong emphasis on flooding from main rivers and the sea and are relatively weak in evaluating flooding from other local sources including surface water, groundwater and ordinary watercourses. The information from Drain London will improve this understanding.
- 1.6.15 A Level 1 (June 2008) and Level 2 (August 2008) SFRA has been completed for the London Borough of Lambeth.

LOCAL FLOOD RISK MANAGEMENT STRATEGIES

- 1.6.16 The FWMA 2010 requires each LLFA to produce a Local Flood Risk Management (LFRM) Strategy. Whilst Drain London will not actually produce these strategies, the SWMPs, PFRAs and their associated risk maps will provide the necessary evidence base to support the development of LFRM Strategies. No new modelling is anticipated to produce these strategies.
- 1.6.17 Figure 1.6.1 illustrates how the CFMP, PFRA, SWMP and SFRA link to and underpin the development of a LFRM Strategy.





Figure 1.6.1 - Schematic Diagram of Development of LFRM Strategies

RIVER BASIN MANAGEMENT PLAN (RBMPs)

1.6.18 The River Basin Management Plan for the Thames River Basin District addresses the pressures facing the water environment in the district and the actions required to protect and improve the water environment. This plan has been developed in consultation with a wide range of organisations and individuals and is the first of a series of six-year planning cycles. The first cycle will end in 2015 when, following further planning and consultation, this SWMP will be updated and reissued.

LOCAL DEVELOPMENT DOCUMENTS (LDDs)

- 1.6.19 LDDs including the Core Strategy and relevant Area Action Plans (AAPs) will need to reflect the results from Drain London. This may include policies for the whole Borough, specific parts of Boroughs, for example CDAs, or cross Borough issues. There may also be a need to review AAPs where surface water flood risk is a particular issue. The SFRA and SWMP will assist with this as will the reviewed RFRA and any updated London Plan policies. In producing Opportunity Area Planning Frameworks, the GLA and Boroughs will also examine surface water flood risk more closely.
- 1.6.20 The London Borough of Lambeth's Core Strategy has been through public consultation and examination and was adopted in January 2011.

1.7 EXISTING LEGISLATION

- 1.7.1 The FWMA 2010 presents a number of challenges for policy makers and the flood and coastal risk management authorities identified to co-ordinate and deliver local flood risk management (surface water, groundwater and flooding from ordinary watercourses). 'Upper Tier' local authorities have been empowered to manage local flood risk through new responsibilities for flooding from surface and groundwater.
- 1.7.2 The FWMA 2010 reinforces the need to manage flooding holistically and in a sustainable manner. This has grown from the key principles within Defra's 'Making Space for Water' and was further reinforced by the summer 2007 floods and the Pitt Review. It implements several key recommendations of Sir Michael Pitt's Review of the Summer 2007 floods, whilst also protecting water supplies to consumers and protecting community groups from excessive charges for surface water drainage.



- 1.7.3 The FWMA 2010 must also be considered in the context of the EU Floods Directive, which was transposed into law by the Flood Risk Regulations 2009 (FRR) on 10 December 2009. The FRR 2009 requires three main types of assessment / plan:
 - PFRAs (maps and reports for surface water, ordinary watercourses and groundwater (LLFA) and Main Rivers, Sea and Reservoirs (Environment Agency) flooding- to be completed by the 22 December 2011. Flood Risk Areas, at potentially significant risk of flooding, will also be identified. Maps and management plans will be developed on the basis of these flood risk areas.
 - Flood Hazard Maps and Flood Risk Maps the Environment Agency and LLFAs are required to produce Hazard and Risk maps for surface water, ordinary watercourses and groundwater (LLFAs) and Sea, Main River and Reservoir (Environment Agency) flooding as well as 'other' relevant sources by 22 December 2013.
 - Flood Risk Management Plans the Environment Agency and LLFAs are required to produce Flood Risk Management Plans for surface water, ordinary watercourses and groundwater (LLFAs) and Sea, Main River and Reservoir (Environment Agency) flooding as well as 'other' relevant sources by 22 December 2015.
- 1.7.4 Figure 1.7.1 illustrates how this SWMP fits into the delivery of local flood and coastal risk management, and where the responsibilities for this lie.





Figure 1.7.1 - Delivery of Local Flood and Coastal Risk Management

1.7.5 Aside from forging partnerships and coordinating and leading on local flood management, there are a number of other key responsibilities that have arisen for LLFAs from the FWMA 2010, and the Flood Risk Regulations 2009. These responsibilities include those listed in Table 1.7.1.

Table 1.7.1 - LLFA Responsibilities	under FWMA 201	D
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Responsibility	Description
Forge Partnerships & Coordinate and Lead on Local Flood Management	LLFAs have a duty to lead on local flood risk management, including establishing effective partnerships within their local authority as well as with external stakeholders such as the Environment Agency, Thames Water Utilities Ltd, Transport for London, Network Rail and London Underground as well as others.
Investigate Flood Incidents	LLFAs have a duty to investigate and record details of significant flood events within their area. This duty includes identifying which



Responsibility	Description
	authorities have flood risk management functions and what they have done or intend to do with respect to the incident, notifying risk management authorities where necessary and publishing the results of any investigations carried out.
Maintain Asset Register	LLFAs also have a duty to maintain a register of structures or features which are considered to have an effect on flood risk, including details on ownership and condition as a minimum. The register must be available for inspection and the Secretary of State will be able to make regulations about the content of the register and records.
SuDS Approving Body	LLFAs are designated the Sustainable Drainage Systems (SuDS) Approving Body (SAB) for any new drainage system, and therefore must approve, adopt and maintain any new SuDS within their area. This responsibility is anticipated to commence from April 2012.
Local Flood Risk Management (LFRM) strategies	LLFAs are required to develop, maintain, apply and monitor a strategy for local flood risk management in its area. The LFRM strategy will build upon information such as national risk assessments and will use consistent risk based approaches across different local authority areas and catchments.
Works Powers	LLFAs have powers to undertake works to manage flood risk from surface runoff and groundwater, consistent with the LFRM strategy for the area.
Designation powers	LLFAs, as well as district councils and the Environment Agency have powers to designate structures and features that affect flooding in order to safeguard assets that are relied upon for flood risk management. Once a feature is designated, the owner must seek consent from the authority to alter, remove or replace it.

1.7.6 The partnerships forged and outcomes of the SWMP will assist Lambeth, as an LLFA, in starting to deliver their requirements under the FWMA 2010 and Flood Risk Regulations 2009. In particular, through the SWMP production and Drain London project, Lambeth will have established both internal and external partnerships in managing local flood risk, put in place the structures for recording flooding incidents and producing an asset register, and, through the delivery of an SWMP and PFRA (and associated flood risk depth and hazard maps), provided the necessary evidence base to support the development of LFRM Strategies.

Recommendation 1: Continue to work towards fulfilling the requirements under the Flood and Water Management Act 2010 and Flood Risk Regulation 2009



1.8 PEER REVIEW

- 1.8.1 It is essential for the Drain London Project that SWMPs are consistent and comparable across Greater London. This is to facilitate;
 - Fair, transparent and rapid allocation of funds to identified high priority flood risk areas within London;
 - Collaborative working practices between stakeholders; and
 - Building of local capability (Council officers and consultants doing work in the future will be able to make use of outputs regardless of who produced them for each Borough).
- 1.8.2 To ensure consistency and comparability between London Borough SWMPs produced, a Peer Review process has been used. The process involved the four consultant teams working on the Drain London SWMPs independently reviewing each others work. This has ensured that all outputs result from a consistent technical approach, are of a high technical quality and are communicated in the specified formats. The peer review report for this SWMP is included in Appendix F.



2. Phase 1: Preparation

2.1 PARTNERSHIP

- 2.1.1 In order for the SWMP and more general future flood risk management within Lambeth to be successful, it is essential that relevant partners and stakeholders, who share the responsibility for necessary decisions and actions, work collaboratively to understand existing and future surface water flood risk in the Borough.
- 2.1.2 The FWMA 2010 defines the unitary authority, in this instance the London Borough of Lambeth, as the LLFA. As such, the London Borough of Lambeth is responsible for leading local flood risk management, including establishing effective partnerships within their local authority as well as with external stakeholders such as the Environment Agency, Thames Water Utilities Ltd, Transport for London, Network Rail and London Underground as well as others. Ideally these working arrangements should be formalised to ensure clear lines of communication, mutual co-operation and management through the provision of Service Level Agreements (SLA) or Memorandums of Understanding (MoU).

EXISTING FLOOD RISK MANAGEMENT WITHIN THE LONDON BOROUGH OF LAMBETH

- 2.1.3 At present the responsibility for flood risk management within Lambeth Borough Council is within the departments of Environmental Services and Highways in Public Realm. Other departments are actively involved, including:
 - **Planning** responsible for the Strategic Flood Risk Assessment and Local Development Framework;
 - **Emergency Planning** responsible for the Multi-Agency Flood Plan;
 - **Environment** responsible for ensuring BREEAM (BRE Environmental Assessment Method) standards are used;
 - Cultural Services responsible for Parks within Lambeth; and,
 - Sustainability Responsible for the Sustainability Action Plan.

Recommendation 2: Establish a Flood Risk Management Group for the London Borough of Lambeth (as LLFA) to take forward FWMA and SWMP actions and Local Flood Risk Management

Recommendation 3: Ensure required skills and capacity is in place within (or between) LLFA(s) to deliver FWMA and Local Flood Risk Management requirements

SOUTH CENTRAL LONDON STRATEGIC FLOOD GROUP

2.1.4 As part of the Drain London Project, the London Borough of Lambeth is working closely with neighbouring Boroughs to forge partnerships with respect to local flood risk management. The London Borough of Lambeth's SWMP study will establish a number of essential partners, and will seek to incorporate additional partners and stakeholders as they are identified throughout the SWMP study.



2.1.5 A review of surface water flood risk in Lambeth indicates that it is potentially a wide spread problem, shared along much of its eastern border with the London Borough of Southwark. Discussions between the Boroughs of Lambeth and Southwark are currently ongoing with regards to forming a joint-working partnership approach to manage local flood risk. As part of these discussions, it has been suggested that a South Central London Flood Partnership be formed (comprising of the London Boroughs of Lambeth and Southwark and strategic partners) that would report to the Regional Flood and Costal Committee through the boroughs councillor representative on the Thames RFCC. A potential structure may look something like that shown in Figure 2.1.1.

 Councillor
 Environment Agency

South Central London Strategic Flood GroupDirectors for Southwark and LambethEnvironment AgencyThames WaterGreater London Authority

Technical Working Groups

Representatives from Southwark, Lambeth and Greater London Authority (where appropriate)HighwaysStrategic PlanningDrainageEmergency PlanningParks & Open SpacesAsset ManagementSustainabilityEnvironmentCapital ProjectsLegalCommunication

Figure 2.1.1 - Potential South Central London Strategic Flood Group Membership

BENEFITS OF COLLABORATIVE WORKING

- 2.1.6 A number of benefits will arise from the collaborative working between members of the South Central London Strategic Flood Group, including:
 - Greater understanding of urban drainage by a range of organisations;
 - A shared understanding of flood risk across the Council, Thames Water and the Environment Agency;
 - Efficiency savings for 'essential partners' though achieving outcomes;
 - Appraisal of surface water drainage options;
 - Greater certainty for developers concerning appropriate drainage;
 - Quicker, more certain decisions on development and infrastructure provision; and
 - Overall reduction in flood risk to the London Borough of Lambeth (primarily driven through Phases 3 and 4 of the SWMP and dependent upon available funding).

PROJECT GOVERNANCE FRAMEWORK

- 2.1.7 It is suggested that in the future, the South Central Strategic Flood Group (through the Technical Working Groups) addresses four main functions within each council:
 - A strategic function to contribute to the delivery of the SWMP by establishing a shared understanding of flood risk and agreeing a coordinated approach to reduce the risk;
 - An operational function to improve the co-ordination of flood incident management and emergency response and post event data collection;



- An operational function to improve the management of surface water assets, including identifying where they are located, their condition, and implementing maintenance regimes; and,
- Assigns clear roles and responsibilities within the partnership.

Recommendation 4: Formalise Governance Structure and Terms of Reference for Central London Strategic Flood Management Group

STAKEHOLDER ENGAGEMENT

- 2.1.8 As part of the preparation of PFRAs and SWMPs across London, stakeholders have been engaged representing the following organisations and authorities:
 - Environment Agency
 - Thames Water Utilities Ltd
 - Neighbouring London Boroughs
 - British Waterways
 - London Fire Brigade
 - British Geological Society

- Network Rail
- London Underground
- Transport for London
- Highways Agency
- Natural England
- British Airports Authority

PUBLIC ENGAGEMENT

- 2.1.9 Members of the public may also have valuable information to contribute to the SWMP and to an improved understanding and management of local flood risk within the study area. Public engagement can afford significant benefits to local flood risk management including building trust, gaining access to additional local knowledge and increasing the probability of stakeholder acceptance of options and decisions proposed in future flood risk management plans.
- 2.1.10 However, it is also recognised that it is crucial to plan the level and timing of engagement with communities predicted to be at risk of flooding from surface water, groundwater and ordinary watercourses. This is to ensure that the potential for future management options and actions is adequately understood and costed without raising expectations before solutions can reasonably be implemented.
- 2.1.11 It is important to undertake some public engagement when formulating local flood risk management plans (including LFRM Strategies) as this will help to inform future levels of public engagement. It is recommended that the London Borough of Lambeth follow the guidelines outlined in the Environment Agency's "Building Trust with Communities" which provides a useful process of how to communicate risk including the causes, probability and consequences to the general public and professional forums such as local resilience forums.

Recommendation 5: Actively engage with members of the public regarding local flood risk management and formulation of the LFRM Strategy



2.2 DATA COLLECTION

- 2.2.1 One of the key components of a shared understanding of flood risk is the sharing of flood risk data and knowledge between and across organisations. The collection and collation of strategic level data was undertaken as part of the Tier 1 work and disseminated to Tier 2 consultants by the GLA. Data was collected from each of the following organisations:
 - Lambeth Borough Council
 - Southwark Borough Council
 - British Airports Authority
 - British Geological Survey
 - British Waterways
 - Environment Agency

- Greater London Authority
- Highways Agency
- London Underground
- Network Rail
- Thames Water
- Transport for London
- 2.2.2 A comprehensive data set was passed onto Tier 2 consultants and in some cases additional supplemental data was provided by individual organisations.
- 2.3 DATA REVIEW
- 2.3.1 Table 2.3.1 provides a summary of the main data sources held by partner organisations used in the preparation of the SWMP. Further information regarding the datasets used as part of this SWMP are provided in Appendix A.



Table 2.3.1 - Data Sources

Data Supplier	Dataset	Description
Lambeth Borough Council	Strategic Flood Risk Assessment (SFRA)	The London Borough of Lambeth's Level 1 SFRA (June 2008) contains useful information on historic flooding, including local sources of flooding from surface water and groundwater.
	Historical flooding records	Historical records of flooding from surface water, groundwater and ordinary watercourses.
	Anecdotal information relating to local flood history and flood risk areas	Anecdotal information from authority members regarding areas known to be susceptible to flooding from excessive surface water, groundwater or flooding from ordinary watercourses.
	Local Climate Impacts Profiles (LCLIP) Report for London Local Authorities	The All-London LCLIP spreadsheet (Greater London Authority, March 2010) identifies weather-related impacts and their associated consequences on infrastructure and services across the London Borough of Lambeth.
	'Lost' Rivers of London	Information on the location of the 'lost' rivers of London, taken from the Stanford's Maps 1862, and digitised. The locations provided are approximate.
	New Development Sites	GIS dataset of location of new major development sites and Opportunity Areas.
	Maintenance Regime	Details of the maintenance regimes undertaken by Lambeth Borough Council.
Environment Agency	Environment Agency Flood Map (Fluvial)	Shows the extent of flooding from rivers with a catchment of more than 3km ² and from the sea.
	Areas Susceptible to Surface Water Flooding	A national outline of surface water flooding held by the EA and developed in response to Pitt recommendations.
	Flood Map for Surface Water	A second generation of surface water flood mapping which was released at the end of 2010.
	National Receptors Dataset (v1.0)	A nationally consistent dataset of social, economic, environmental and cultural receptors including residential properties, schools, hospitals, transport infrastructure and electricity substations.
	Indicative Flood Risk Areas	National mapping highlighting key flood risk areas, based on the definition of 'significant' flood risk agreed with the Defra.
	Historic Flood Map	Attributed spatial flood extent data for flooding from all sources.
	Groundwater Flooding Database	Database of groundwater flooding incidents recorded in the last 10 years.





Data Supplier	Dataset	Description
	Thames Estuary 2100 (TE2100) Groundwater Hazard Maps	Environment Agency / Jacobs dataset of the Thames Estuary 2100 (TE2100) Groundwater Hazard Maps
Thames Water Utilities Limited	DG5 Register for Thames Water Utilities areas	DG5 Register logs and records of properties at risk of flooding from sewers. The dataset supplied provides those properties at risk at end of June 2010.
	Thames Water Sewer Network and Asset Location	The Thames Water Sewer network shows the location and size of the foul, combined, surface water and storm relief sewers across the Greater London area along with the locations for Sewage Treatment Works, Pumping Stations and Combined Sewer Overflows.
Greater London Authority	Ordnance Survey Mapping (1:10k, 1:50k, Mastermap)	Ordnance Survey Mapping for the Greater London Area for the 1:10k and 1:50k scale and Mastermap dataset.
London Fire Brigade	Historical flooding call-out records	Records of all London Fire Brigade callouts for 'flooding' events since 2000. However, no flooding source is provided, so could be a result of water mains bursting as well as heavy rainfall / surface water flooding.
Network Rail	Areas Prone To Flooding	A list of areas prone to flooding across their South East Territory.
Transport for London	TfL Red Routes	Pdf of the TfL Red Routes for the Greater London area
	TfL Gullies	GIS dataset of the TfL owned / managed gullies along the Red Routes for the Greater London area
	TfL Pumps	Location and pump regimes for TfL owned / managed gullies in the Greater London area
London Underground	Flooding records – July 2007	Records relating to station closures (location and duration) on 20 th July 2007 due to heavy rainfall.
British Geological Survey	Groundwater Flooding Susceptibility Map	GIS dataset of areas susceptible to groundwater flooding
Jacobs / JBA	Groundwater Emergence Maps (GEMs)	GIS dataset of areas of groundwater emergence (GEMs)
	Groundwater Flood Map	GIS dataset of groundwater flood map
	Increased Potential for Elevated Groundwater (iPEG)	GIS dataset of areas of increased potential for elevated groundwater (iPEG), produced using existing Environment Agency, BGS and Jacobs / JBA datasets, produced for the Greater London area for the purpose of assessing groundwater flood risk as part of the Drain London project.


SECURITY, LICENSING AND USE RESTRICTIONS

- 2.3.2 A number of datasets used in the preparation of this SWMP are subject to licensing agreements and use restrictions.
- 2.3.3 The following national datasets provided by the Environment Agency are available to local authorities and their consultants for emergency planning and strategic planning purposes:
 - Flood Map for Rivers and the Sea
 - Areas Susceptible to Surface Water Flooding
 - Flood Map for Surface Water
 - National Receptor Database
- 2.3.4 A number of the data sources used are publicly available documents, such as:
 - Strategic Flood Risk Assessment
 - Catchment Flood Management Plan
- 2.3.5 The use of some of the datasets made available for this SWMP has been restricted and is time limited, licensed to Lambeth Borough Council via the Greater London Authority for use under the Drain London project, which includes the production of an SWMP for the London Borough of Lambeth. The restricted datasets include records of property flooding held by the Council and by Thames Water Utilities Ltd, and data licensed by the Environment Agency. Necessary precautions must be taken to ensure that all information given to third parties is treated as confidential. The information must not be used for anything other than the purpose stated in the agreement. No information may be copied, reproduced or reduced to writing, other than what is necessary for the purpose stated in the agreement.

2.4 ASSET REGISTER

2.4.1 Section 21 of the FWMA 2010 sets a duty on LLFAs to maintain a register of structures or features, and a record of information about each of those structures or features, which, in the opinion of the authority, are likely to have a significant effect on flood risk in its area. From the 6th April 2011 all LLFAs have a duty to maintain a register. The legal characteristics of the register and record are in Table 2.4.1.

	Register	Record
a.	Must be made available for inspection at all reasonable times.	Up to the LLFA to decide if they wish to make it available for inspection
b.	Must contain a list of structures or features which in the opinion of the authority, are likely to have a significant effect on a local flood risk.	For each structure or feature listed on the register, the record must contain information about its ownership and state of repair.
C.	s.21 (2) of the Act allows for further regulations to be made about the content of the register and record. There is currently no plan to provide such regulations therefore their content should be decided on by the LLFA depending on what information will be useful to them.	
d.	There is no legal requirement to have a separate register and record although as indicated above, only the register needs to be made available for public inspection.	



- 2.4.2 Defra have provided each LLFA with templates to demonstrate what information should be contained in the asset register. Although these templates are not intended as a working tool, they provide a good example of how an asset register might be structured.
- 2.4.3 Populating the asset register is outside the scope of the Drain London project and is the responsibility of each London Borough. The expectation from Defra is that LLFAs will utilise a risk-based approach to populate the register and record with those structures or features considered the most significant first, for example, those within identified Local Flood Risk Zones and / or Critical Drainage Areas. It is also important to note that the register will be a 'living' asset register and grow over time, as more structures and features are identified and added, and asset information is updated through further information, for example through surveys of the structures, being made available.
- 2.4.4 Appendix B contains further information on the Asset Register recommendations for the London Borough of Lambeth.

Recommendation 6: Implement and populate a standardised Asset Register structure for London Borough of Lambeth

- 2.5 PHASE 1 SUMMARY
- 2.5.1 Phase 1 of the SWMP has:
 - Engaged key stakeholders including the Environment Agency and Thames Water, and the London Boroughs of Merton, Wandsworth and Southwark, to discuss and agree on local flood risk management within the London Borough of Lambeth in the future;
 - Established a local flood risk partnership working approach within the London Borough of Lambeth for managing local flood risk in the future;
 - Established a sub-regional flood risk partnership structure for the London Boroughs of Lambeth and Southwark (along with other key stakeholders) to take forward and manage flood risk in the future;
 - Collected and reviewed flood risk data and knowledge from key stakeholders and partner organisations;
 - Set out recommendations for the London Borough of Lambeth's Asset Register, as required under the FWMA 2010; and
 - Set out the objectives and governance for the Phase 2 Risk Assessment, Phase 3 Options Assessment, and Phase 4- Action Plan phases of the Lambeth SWMP.



3. Phase 2: Risk Assessment

3.1 INTERMEDIATE ASSESSMENT

- 3.1.1 The aim of the Phase 2 Intermediate Risk Assessment is to identify the sources and mechanisms of surface water flooding across the study area which will be achieved through an intermediate assessment of pluvial flooding, sewer flooding, groundwater flooding and flooding from ordinary watercourses along with the interactions with main rivers and the sea. The modelling outputs will then be mapped using GIS software.
- 3.1.2 Table 3.1.1 defines the potential levels of assessment within an SWMP. This SWMP has been prepared at the 'Borough' scale and fulfils the objectives of a second level 'Intermediate Assessment'.

Level of Assessment	Appropriate Scale	Outputs
1. Strategic Assessment	Greater London	Broad understanding of locations that are more vulnerable to surface water flooding. Prioritised list for further assessment. Outline maps to inform spatial and emergency planning.
2. Intermediate Assessment	Borough wide	Identify flood hotspots which might require further analysis through detailed assessment. Identify immediate mitigation measures which can be implemented. Inform spatial and emergency planning.
3. Detailed Assessment	Known flooding hotspots	Detailed assessment of cause and consequences of flooding. Use to understand the mechanisms and test mitigation measures, through modelling of surface and sub-surface drainage systems.

Table 3.1.1 - SWMP Study Levels of Assessment [Defra 2010]

- 3.1.3 As shown in Table 3.1.1, the intermediate assessment is applicable across a large town, city or Borough. In the light of extensive and severe historical flooding and the results from the over-arching national pluvial modelling² suggesting that there are 50,500 properties at risk across the Borough for a rainfall event with a 1 in 200 probability of occurrence in any given year, it is appropriate to adopt this level of assessment to further quantify the risks.
- 3.1.4 The purpose of this intermediate assessment will be to further identify those parts of the Borough that are likely to be at greater risk of surface water flooding and require more detailed assessment. The methodology used for this SWMP is summarised below and further detail of the methodology is provided in Appendix C1.
 - 2-Dimensional Pluvial modelling (using TuFLOW software) has been undertaken following a Direct Rainfall approach. Rainfall events of known probability are applied directly to the ground surface and water is routed overland to provide an indication of potential flow path directions, velocities and depths and areas where surface water will pond;

² Source: Environment Agency National Property Count for the Flood map for Surface Water (FMfSW) dataset.



- The 2-Dimensional pluvial modelling has been supported by field visits and visual surveys have been undertaken in conjunction with Lambeth Borough Council staff and/or Environment Agency staff; and
- The outputs from the pluvial modelling are verified (where possible) against historic surface water flood records and local knowledge.

3.2 RISK OVERVIEW

MAPPING OF SURFACE WATER FLOOD RISK

- 3.2.1 The mapping shown within this report is intended to identify broad areas which are more likely to be vulnerable to surface water flooding. This allows Lambeth Borough Council and its partners to undertake more detailed analysis in areas which are most vulnerable to surface water flooding.
- 3.2.2 In addition, the mapping can also be used as an evidence base to support spatial planning to ensure that surface water flooding is appropriately considered when allocating land for development. Furthermore, the map can be used to assist emergency planners in preparing their Multi-Agency response plans.
- 3.2.3 It should be noted that the mapping only shows the predicted likelihood of surface water flooding (this includes flooding from drains, small watercourses and ditches that occurs in heavy rainfall in urban areas) for defined areas. Due to the coarse nature of the source data used, the maps are not detailed enough to define risk for individual addresses. Individual properties therefore may not always face the same probability of flooding as the areas that surround them.
- 3.2.4 There may also be particular occasions when flooding occurs and the observed pattern of flooding does not in reality match the predicted patterns shown on these maps. The maps reflect all the suitable and relevant data provided and have been produced using expert knowledge to create conclusions that are as reliable as possible. However, it is essential that users of these maps understand the complexity of the data and modelling utilised in their production and are also aware of the associated limitations and uncertainties in the mapping. The maps are not intended to be used in isolation.
- 3.2.5 The Greater London Authority, Lambeth Borough Council and Tier 1 and Tier 2 Drain London Consultants cannot be held responsible for misuse or misunderstanding of the maps provided as part of the SWMP.

FLOODING CLASSIFICATION

3.2.6 Flood risk within the London Borough of Lambeth has been classified based on the source of flooding (surface water, groundwater, fluvial / tidal and/or sewer) and scale (Local Flood Risk Zones (LFRZs), Critical Drainage Areas (CDA), Policy Areas (PA) and Indicative Flood Risk Zones). These categories are discussed in more detail below.

Source of Flood Risk

3.2.7 A range of classifications have been devised for use in the SWMP to identify the primary source(s) of flood risk to areas throughout the Borough identified through the SWMP Phase 2 Risk Assessment to be at a greater risk of surface water flooding (Table 3.2.1). These classifications have been used to inform the SWMP Action Plan (Section 5.1) as they also define probable areas of flood mitigation and management responsibility.

Flood Source Classification	Output from Pluvial Modelling	Output from Groundwater Flood Risk Assessment	EA Flood Map – Zone 3 – Areas <u>not</u> benefiting from defences	DG5 Records only
Surface Water*	~			
Groundwater		√		
Fluvial / Tidal			√	
Sewer				√
Surface Water and				
Groundwater	¥	¥		
Groundwater and Fluvial /		~	\checkmark	
Tidal**				
Surface Water and Sewer	\checkmark			✓
Surface Water	/ ***		<u>_</u>	
and Fluvial / Tidal	*		•	
Surface Water, Groundwater	/ ***			
and Fluvial / Tidal**	*	*	•	
Surface Water, Groundwater	1			
and Sewer	v	v		v
All Sources	\checkmark	\checkmark	\checkmark	\checkmark

Notes:

* Surface Water = Surface Water and / or Ordinary Watercourse

** Areas where surface water and / or groundwater flooding are fully within the EA Zone 3 (areas not benefiting from defences) are highlighted as having a primary influence from Fluvial / Tidal flooding.

*** Where pluvial modelling outputs demonstrate flooding significantly greater than Flood Zone 3, these areas should be classified as 'pluvial flooding areas'.

Scale of Flood Risk

- 3.2.8 As part of the Drain London Project, the scale of flooding has been classified as follows, from smallest to largest:
 - 1. Local Flood Risk Zone (LFRZ, managed at the local scale)
 - 2. Critical Drainage Area (CDA, containing one or more Local Flood Risk Zones managed at the local scale)
 - 3. Policy Areas (PA, containing one or more Critical Drainage Areas and covering the entire Borough)
 - 4. Indicative Flood Risk Area (as defined by the Environment Agency / Defra Indicative Flood Risk Areas an area approximately covering the entire Greater London Area and managed at a strategic scale)
- 3.2.9 The flood risk hierarchy is illustrated in Figure 3.2.1. Further information on the scale of flooding and flood risk management areas identified in the London Borough of Lambeth are provided in Table 3.2.2.





Indicative Flood Risk Area

Figure 3.2.1 - Scale of Flood Risk Hierarchy

Policy Area

Critical Drainage Area



Table 3.2.2 - SWMP Flood Risk Management Areas

Scale	Definition	Description	Lambeth-Specific Areas
Local Flood Risk Zone (LFRZ)	"A discrete areas of flooding that affect houses, businesses or infrastructure".	The LFRZ is defined as the actual spatial extent of predicted flooding in a single location. Related LFRZs can be grouped together as a CDA or left in isolation and considered within the larger Policy Areas.	 Southwest Kennington Dulwich Road Berridge Road Probyn Road Waterloo Station & St. Thomas' Hospital Eardley Road Streatham Common Station Railway Cutting Stanthorpe Road Streatham Station Railway Cutting North Clapham Park Northwest Wandsworth Road West Dulwich King's College Hospital (part of Group7_036 CDA in Southwark) West Norwood Norwood Convent
Critical Drainage Area (CDA)	"A discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more LFRZs during severe weather thereby affecting people, property or local infrastructure."	CDA units are larger than LFRZs and denote an area or catchment where mitigation measures may be implemented to reduce flooding experienced in the flood risk zone. The CDA comprises the upstream 'contributing' catchment, the influencing drainage catchments, surface water catchments and, where appropriate, a downstream area if this can have an influence on the LFRZ. CDA units should be used for site specific detailed planning and capital works schemes and may contain one or more LFRZs. Note: CDAs have been given an identification number, based on the Drain London Sub-Regional Partnership Group Number, and have been defined across the group. Therefore, CDA numbers start at 025 for the London Borough of Lambeth.	 Group7_025 (Streatham Common) Group7_026 (Streatham) Group7_027 (Clapham South) Group7_028 (Nine Elms) Group7_029 (Probyn Road) Group7_030 (Norwood) Group7_031 (East Norwood) Group7_032 (Herne Hill) Group7_033 (Brixton) Group7_034 (Waterloo Station)
Policy Area (PA)	"A discrete area within an administrative area where appropriate planning policy can be applied to manage flood risk."	Policy Areas contain one or more CDAs and cover the entire study area. Policy Areas are primarily based on hydrological catchments but may also accommodate geological concerns and other factors as appropriate. Policy areas may be used to provide guidance on general policy across the study area e.g. the use of soakaways in new development.	Given the complex and interlinked surface water flooding within the London Borough of Lambeth, it has been agreed that only one Policy Area should be defined in the London Borough of Lambeth, covering the entire administrative area.
Indicative Flood Risk Area	"Areas determined by the Environment Agency as indicatively having a significant flood risk, based on guidance published by Defra and WAG and the use of certain national datasets."	Indicative Flood Risk Areas are defined by the Environment Agency / Defra primarily for the purposes of the preparation of PFRAs.	The Greater London Area has been identified as an Indicative Flood Risk Area, with 696,805 people at risk from surface water flooding deeper than 0.3 metres during a 0.5% AEP rainfall event (based on FMfSW outputs).



3.3 SURFACE WATER FLOODING

MECHANISM OF FLOODING

- 3.3.1 Pluvial flooding occurs when high intensity rainfall generates runoff which flows over the surface of the ground and ponds in low lying areas, before the runoff enters any watercourse of sewer. It is usually associated with high intensity rainfall events and can be exacerbated when the soil is saturated and natural drainage channels or artificial drainage systems have insufficient capacity to cope with the additional flow.
- 3.3.2 No single organisation has overall responsibility for surface water flooding with different aspects of the drainage system falling to either The Highway Authority (in this case Lambeth Borough Council), Thames Water, riparian owners and Transport for London (red routes including the A3, A24, and A205).

PLUVIAL MODELLING

- 3.3.3 In order to continue developing an understanding of the causes and consequences of surface water flooding in the study area, intermediate level hydraulic modelling has been undertaken for a range of rainfall event probabilities. This hydraulic modelling has been designed to provide additional information where local knowledge is lacking and forms a basis for future detailed assessments in areas identified as high risk.
- 3.3.4 A Direct Rainfall approach using TuFLOW software has been selected whereby rainfall events of known probability are applied directly to the ground surface and is routed overland to provide an indication of potential flow path directions and velocities and areas where surface water will pond. A full methodology of the hydraulic modelling undertaken is included in Appendix C1.
- 3.3.5 Figures 3.3.1 and 3.3.2 show the modelling results for the London Borough of Lambeth for the rainfall event with a 1 in 100 chance of occurring in any given year (1% AEP) rainfall event for depth and hazard³, respectively.

Figure 3.3.1 - Surface Water Flood Depth (1% AEP) Figure 3.3.2 - Surface Water Flood Hazard (1% AEP)

³ Flood Hazard has been defined based upon the joint Environment Agency and Defra Research and Development Technical Report FD2320 (January 2006) and uses surface water flood depths and velocities to categorise the flood hazard. The degree of flood hazard can be interpreted as follows: (a) Caution: Flood zone with shallow flowing water or deep standing water; (b) Moderate: Flood zone with deep or fast flowing water. Dangerous for children, the elderly and the infirm; (c) Significant: Flood zone with deep fast flowing water. Dangerous for most people; and, (d) Extreme: Flood zone with deep fast flowing water. Dangerous for all (including emergency services)







3.3.6 Figures for the other modelled return periods are included in Appendix D (Figures D9 – D16).A summary of the suggested use for each mapped output is provided in Table 3.3.1.

Modelled Return Period	Suggested Use
1 in 30 probability of rainfall event occurring in any given year (3.3% AEP)	Since 1980, with the introduction of Sewers for Adoption, Thames Water sewers are required to be designed to accommodate 3.3% AEP rainfall event or less. However, many of the sewers in London were built pre-1980 and as such, are likely to have a lower capacity. This layer will identify areas that are prone to regular flooding and could be used by highway teams to inform maintenance regimes.
1 in 75 probability of rainfall event occurring in any given year (1.3% AEP)	In areas where the likelihood of flooding is 1 in 75 years or greater insurers will not guarantee to provide cover to property should it be affected by flooding. This GIS layer should be used to inform spatial planning as if property can not be guaranteed insurance, the development may not be viable.
1 in 100 probability of rainfall event occurring in any given year (1% AEP)	Can be overlaid with Environment Agency Flood Zone 3 GIS layer to show areas at risk under the same event from both sources. Can be used to advise planning teams.
1 in 100 probability of rainfall event occurring in any given year (1% AEP) plus 30% climate change	PPS25 requires that the impact of climate change is fully assessed. Reference should be made to this flood outline by the spatial planning teams to assess the sustainability of developments.
1 in 200 probability of rainfall event occurring in any given year (0.5% AEP)	To be used by emergency planning teams when formulating emergency evacuation plans from areas at risk of flooding.

Table 3.3.1 - Modelled Return Periods and Suggested Use

HYDROLOGICAL SITE INSPECTIONS

3.3.7 To support the pluvial modelling results and historical records, hydrological site inspections were undertaken on 20th January 2011 and then on 15th March 2011 with a member of the Public Realm team from Lambeth Borough Council to provide detailed knowledge on the sources and mechanisms of flooding at these locations as well as information regarding the improvement works that have been implemented. Site photographs were taken, and are included in this report where necessary.

HISTORICAL FLOODING

- 3.3.8 Lambeth Borough Council has provided a GIS dataset of historical surface water flood events dating back to 1911. These records are shown in Figure D-2 in Appendix D. However, it should be noted that historically, only major flooding incidents have been recorded and in many cases the historic flooding information provided is anecdotal and does not include records of antecedent conditions giving rise to the flooding (therefore typically not attributed to a flood source) or reference to a flood return period.
- 3.3.9 Table 3.3.2 provides a summary of past flood incidents in the study area, and those areas prone to surface water flooding during periods of heavy rainfall based on historical records collected as part of Drain London Tier 1, and discussions with the key stakeholders as part of the Tier 2 study.



Table 3.3.2 - Past Surfac	e Water Flood Events
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Flood Event*	Description
Regular Flooding - 1901 – 1911 (<i>Source Unknown</i>)	Based on correspondence between the Borough Engineer and the following response of Mr Fitzmaurice at the London County Council on the 29 th August 1911 that " <i>I am informed that the flooding has been the same for the past eight to ten years in times of a sudden and heavy rainfall.</i> " ⁴
11 th May 1911 (Source Unknown)	A significant number of flooding incidents throughout the Borough, in particular around Dulwich, although the exact source is unknown. ⁴
27 th July 1911 (Source Unknown)	A significant number of flooding incidents throughout the Borough, in particular around Dulwich, although the exact source is unknown. ⁴
14th June 1914 (Source Unknown)	A number of properties flooded in Wood Street Norwood (now Dunbar Street), estimated to be 6, to an approximate depth of 1.0m. Photographic evidence is available (see Figure 3.3.3)
1 st September 1926 (Source Unknown)	A significant number of flooding incidents throughout the Borough, but the exact source is not known. ⁴
4 th July 1938 31 st July 1951 7 th August 1952 18 th July 1953 19 th June 1956 <i>(Source Unknown)</i>	Single property affected in each flood event. ⁴
9 th August 2001 (Source Unknown)	A significant number of flooding incidents throughout the Borough, but the exact source is not known. ⁴
27 th April 2004	Intense periods of rainfall and thunderstorms caused extensive surface water flooding which caused damage to residential properties, public services and private businesses in the Herne Hill, Dulwich, Streatham Hill and Brixton areas. A reported 60mm of rain fell in just under one hour.
29 th June 2005	Flash flooding caused problems on three major roads in the Borough as a result of heavy rail and hailstones, particularly in the Stockwell and Oval areas.
20 th July 2007	Intense periods of rainfall caused flash floods and the capacity of the existing drainage system to be exceeded in some locations across the Borough. London Underground / TfL reported closures of up to 3 hours at Clapham Common, Kennington, Stockwell and Vauxhall railway stations as a result of surface water flooding. Lambeth Borough Council did not record any substantial flooding to residential / commercial properties as a result of this rainfall event.
Regular Flooding	Regular basement flooding reported in Dulwich Road in South Brixton (basement flooding), Dalmore Road in West Norwood (basement flooding), Coldharbour Lane and a school located on Stockport Road in Streatham Vale.

Note: * Where the source of flooding is unknown this has been indicated

 $^{^{\}rm 4}$ As reported in 'Floods Lambeth 1911 to 1956', Lambeth Borough Council





Figure 3.3.3 - Surface Water Flooding in Wood Street, Norwood (now Dunbar Street) on 14th June 1914

3.3.10 The most recent significant flood event occurred during April 2004, when intense periods of rainfall exceeded the capacity of existing drainage systems, causing significant overland flow and ponding of surface water in low lying areas. In the recent floods of 2007 which affected many neighbouring Boroughs, no significant flooding incidents were recorded in the Borough.

Recommendation 7: Implement a standardised Flood Incident Log to record and investigate future flooding incidents within the London Borough of Lambeth



3.4 ORDINARY WATERCOURSE FLOODING

- 3.4.1 Ordinary watercourse flooding includes flooding from small open channels and culverted urban watercourses⁵. These small channels often receive most of their flow from inside the urban area and perform an urban drainage function.
- 3.4.2 The Environment Agency has responsibility over flooding from designated Main Rivers, however the responsibility for maintenance of small open channels and culverted urban watercourses which are not designated as 'main river' falls to Lambeth Borough Council and riparian owners who own land on either bank i.e. Lambeth Borough Council is only responsible for ordinary watercourses where land on either bank is in council ownership, or where historical agreements have been made.
- 3.4.3 As part of this study, no information has been provided by Lambeth Borough Council regarding ordinary watercourses in the study area. The Detailed River Network (DRN) has been provided by the Environment Agency but this does not identify any non-main rivers within the London Borough of Lambeth. However, it is thought that are thought to be several hidden watercourses in the Borough, which have been culverted or routed underground, though no further information relating to these is available at the time of this study and there have been no flooding incidents reported for these.

Figure 3.4.1 – Environment Agency Flood Map and Fluvial Flood Incidents

Recommendation 8: Identify and map (in GIS) all Ordinary and Hidden Watercourses within the London Borough of Lambeth, including their condition and function where known

⁵ All watercourses that are not designated Main River, and which are the responsibility of Local Authorities





3.5 GROUNDWATER FLOODING

MECHANISM OF FLOODING

- 3.5.1 Groundwater flooding occurs as a result of water rising up from the underlying aquifer or from water flowing from abnormal springs. This tends to occur after much longer periods of sustained high rainfall, and the areas at most risk are often low-lying where the water table is likely to be at shallow depth. Groundwater flooding is known to occur in areas underlain by principal aquifers, although increasingly it is also being associated with more localised floodplain sands and gravels.
- 3.5.2 Groundwater flooding tends to occur sporadically in both location and time, and tends to last longer than fluvial, pluvial or sewer flooding. When groundwater flooding occurs, basements and tunnels can flood, buried services may be damaged, and storm sewers may become ineffective, exacerbating the risk of surface water flooding. Groundwater flooding can also lead to the inundation of farmland, roads, commercial, residential and amenity areas.
- 3.5.3 It is also important to consider the impact of groundwater level conditions on other types of flooding e.g. fluvial, pluvial and sewer. High groundwater level conditions may not lead to widespread groundwater flooding. However, they have the potential to exacerbate the risk of pluvial and fluvial flooding by reducing rainfall infiltration capacity, and to increase the risk of sewer flooding through sewer / groundwater interactions.
- 3.5.4 The need to improve the management of groundwater flood risk in the UK was identified through Defra's Making Space for Water strategy. The review of the July 2007 floods undertaken by Sir Michael Pitt highlighted that at the time no organisation had responsibility for groundwater flooding. The FWMA 2010 identified new statutory responsibilities for managing groundwater flood risk, in addition to other sources of flooding and has a significant component which addresses groundwater flooding.
- 3.5.5 Based on the hydrogeological conceptual understanding of the London Borough of Lambeth study area, the potential groundwater flooding mechanisms that may exist are provided in Table 3.5.1.

Potential Flooding Mechanism	Description
Claygate Member outcrop area in the Crystal Palace area	Water levels within the outcropping Claygate Member will be perched on top of the London Clay Formation aquiclude. This means that basements / cellars in this area may be at risk from groundwater flooding following periods of prolonged rainfall, increased utilisation of infiltration SuDs and / or artificial recharge from leaking pipes.
Superficial aquifers along the River Thames and River Graveney / Norbury Brook	Groundwater flooding may be associated with the substantial sand and gravel River Terrace Deposits, or to a lesser degree with Head and Alluvium deposits, where they are in hydraulic continuity with surface watercourses. Stream levels may rise following high rainfall events but still remain 'in-bank', and this can trigger a rise in groundwater levels in the associated superficial deposits. The properties at risk from this type of groundwater flooding are probably limited to those with basements / cellars, which have been constructed within the superficial deposits. It is noted that groundwater / surface water interactions will be limited by modifications to the surface water watercourses e.g. canalisation of River Graveney / Norbury Brook. However, without evidence in the form of groundwater levels, this groundwater flooding mechanism cannot dismissed.

Table 3.5.1 - Potential Groundwater Flooding Mechanisms in Lambeth



Potential Flooding Mechanism	Description
Superficial aquifers not in hydraulic continuity with surface watercourses (various locations)	Groundwater flooding may be associated with substantial River Terrace Deposits (gravel and sand) and Head deposits, but occurs where they are not hydraulically connected to surface watercourses. Perched groundwater tables can exist within these deposits, developed through a combination of natural rainfall recharge and artificial recharge e.g. leaking water mains. The properties at risk from this type of groundwater flooding are probably limited to those with basements / cellars. It is also worth noting that groundwater levels are likely to be closer to ground level in those areas where historic / lost rivers were located i.e. where ground elevation is lower.
Impermeable (silt and clay) areas downslope of superficial aquifers in the southern half of London Borough of Lambeth	Groundwater flooding may occur where groundwater springs / seepages form minor flows and ponding over impermeable strata where there is poor drainage. This mechanism may occur as a result of natural (e.g. rainfall) or artificial (e.g. water main leakage) recharge.
Artificial ground in various locations	Groundwater flooding may occur where the ground has been artificially modified to a significant degree. If this artificial ground is of substantial thickness and permeability, then a shallow perched water table may exist. This could potentially result in groundwater flooding at properties with basements, or may equally be considered a drainage issue. Areas mapped by the BGS as containing artificial ground are shown in Figures D-7 and D-8 in Appendix D. It is noted that the artificial ground deposits are mostly over the London Clay Formation and, depending on the composition of the artificial ground, may allow the development of a perched aquifer.

HISTORIC FLOODING

- 3.5.6 Figure 3.5.1 shows the locations of a number of groundwater flooding incidents between 2000 and 2010 within the study area that have been reported by the Environment Agency and Lambeth Borough Council. Further details are presented in Appendix C2.
- 3.5.7 It should be noted that there has not been a statutory obligation to record incidences of groundwater flooding in the past. It is therefore likely that this list of groundwater flooding incidents is not exhaustive.
- 3.5.8 The historical records show that many of the flooding incidents are referenced as flooding of cellars / basements, which is a common outcome of a rising water table following a period of heavy or persistent rainfall, particularly in shallow aquifers often associated with superficial deposits.
- 3.5.9 Instances of groundwater flooding have been reported on Ferndene Road adjacent to Ruskin Park in Central Brixton and Dulwich Road adjacent to Brockwell Park. There are also instances of groundwater flooding reported in West Norwood, Norbury New Town, Streatham, Streatham Hill, east of Clapham Common and Brixton.
- 3.5.10 Each recorded incident has been appraised based on the underlying geology and the identified potential groundwater flooding mechanisms. Further information on the appraisal of the records are provided in Appendix C2.

Figure 3.5.1 – Groundwater Flooding Records & Increased Potential for Elevated Groundwater Map







- Lambeth Borough Council
- Groundwater Flood Incident (EA Records)
- ▲ Groundwater Flood Incident (Other Records)
- Increased Potential for Elevated Groundwater in
- Permeable Superficial Deposits
- Consolidated Aquifers

<u>Notes</u>

1. The increased Potential for Elevated Groundwater map shows those areas within the London Boroughs where there is an increased potential for groundwater to rise sufficiently to interact with the ground surface or be within 2m of the groundsurface. Such groundwater rise could lead to the following:

-Flooding of basements of buildings below ground level; -Flooding of buried services or other assets below ground level; -Inundation of farmland, roads, commercial, residental and amenity areas;

-Flooding of ground floors of buildings above ground level; and Overflowing of sewers and drains

2.Incident records shown are generally unconfirmed and may include issues such as water main bursts or non-groundwater related problems.

3.Areas not shown to have increased potential for elevated groundwater should be considered to have a low potential for elevated groundwater - Lack of information does not imply 'no potential' of elevated groundwater in that area.
4.Includes groundwater flood mapping provided by JBA consulting, Copyright. Jeremy Benn Associates Limited 2008-2011, partially derived from data supplied by the Environment Agency.





INCREASED POTENTIAL FOR ELEVATED GROUNDWATER (IPEG)

- 3.5.11 Areas where there is increased potential for groundwater levels (iPEG areas) to rise within 2 m of ground surface, following periods of higher than average recharge, are shown in Figure 3.5.1. These are separated into permeable superficial deposits and bedrock (consolidated) aquifers. The data set was produced for the whole of the Drain London project area, derived from four individual data sources:
 - British Geological Survey (BGS) Groundwater Flood Susceptibility Map;
 - Environment Agency / Jacobs Thames Estuary, 2100 groundwater hazard maps;
 - Jacobs Groundwater Emergence Maps; and
 - JBA Groundwater Flood Map.
- 3.5.12 However, in the London Borough of Lambeth area, only the BGS groundwater flooding susceptibility and EA Thames Estuary 2100 data sets were available.
- 3.5.13 Figure 3.5.1 shows that within the London Borough of Lambeth area, the increased potential for elevated groundwater is associated with permeable superficial deposits, not bedrock (consolidated) aquifers. This is in broad agreement with the groundwater flooding mechanisms identified. The permeable superficial deposits that have been identified as having an increased potential for elevated groundwater are the River Terrace Deposits and Head, where they overlie the London Clay Formation aquiclude, ground elevations are low (e.g. near to lost / historic surface watercourses).

GROUNDWATER FLOODING SUSCEPTIBILITY

3.5.14 Due to the significant thickness of underlying London Clay Formation in the majority of the Borough, the susceptibility from groundwater flooding from rising groundwater levels in the Chalk and 'Basal Sands' is considered to be negligible. Where the Lambeth Group outcrops in the east of the London Borough of Lambeth (Brockwell Park area), groundwater levels are suppressed due to regional groundwater abstractions. Therefore, the key groundwater flooding mechanisms are associated with permeable superficial deposits (Table 3.5.2).

Flooding Mechanism	Description
South east where Claygate Member is underlain by London Clay Formation (Crystal Palace area)	The Claygate member is classified as a secondary aquifer and is water bearing, with potential for a perched groundwater table(s) on the London Clay Formation aquiclude. Consequently, site specific investigations will be important for any proposed development sites, particularly those considering basements / underground structures such as soakaways.
Lower elevation land where London Clay Formation is overlain by superficial deposits, including those areas where historic / lost rivers existed	Figure 3.5.1 shows that the superficial deposits in these areas have an increased potential for elevated groundwater. Whilst no groundwater level data for the superficial deposits are available, where groundwater tables exist they are expected to be close to or at ground level. Therefore basements and cellars may be at risk from groundwater flooding and use of structures such as sheet piling may exacerbate the problem if they intercept the water table. Superficial deposits are likely to be variable in composition across the London Borough of Lambeth. Site investigation will be key for any proposed development sites, to

Table 3.5.2 - Current Groundwater Susceptibility Flooding Mechanisms



Flooding Mechanism	Description
	understand the local groundwater conditions, particularly those areas located near to lost rivers (where topographic lows exist).
Land where London Clay Formation outcrops at surface	The London Clay Formation is an aquiclude and does not permit groundwater flow. Therefore in areas where there are no overlying superficial deposits and the London Clay Formation is of an appreciable thickness, the potential for elevated groundwater levels is considered to be negligible. However, where the London Clay Formation has been removed and replaced with more permeable artificial ground, there may be increased potential of elevated groundwater as groundwater becomes trapped in these deposits.
Groundwater Springs	It is possible that groundwater springs could emerge from permeable superficial deposits and flow over the London Clay Formation, resulting in groundwater flooding. Further analysis of the pluvial modelling where the spring lines are likely to exist may provide an indication of the likely flow paths.

3.5.15 Susceptibility to groundwater flooding in the Lambeth area may change as a result of climate change, or changes to water management. One of the climate change predictions includes an increase of high rainfall events. This could lead to further groundwater flooding in the London Borough of Lambeth due to increased perched groundwater levels and associated spring flows. It is also noted that a shift in drainage policy, with increased infiltration SUDS, may also lead to increased incidents of groundwater flooding. The small perched superficial deposit aquifers will be sensitive to increased recharge due to their limited storage capacity.

GROUNDWATER RISK ASSESSMENT CONCLUSIONS

- 3.5.16 Based on the Groundwater Assessment undertaken as part of this SWMP (Appendix C2), the following conclusions can be drawn:
 - The London Clay Formation hydraulically separates the underlying Chalk principal aquifer from overlying superficial deposits in the majority of the Borough. Where the London Clay Formation is absent in the Brockwell Park area, Lambeth Group groundwater levels are suppressed due to regional groundwater abstractions and are expected to be at least 30 m below ground level.
 - The superficial deposits, particularly the River Terrace Deposits, are expected to form a significant perched aquifer over the London Clay Formation aquiclude, particularly in areas of lower elevation along the historic / lost rivers. Whilst there is monitoring of Chalk groundwater levels in the area, the Environment Agency / Lambeth Borough Council do not currently monitor groundwater levels in the superficial deposits.
 - A perched water table(s) may exist within the Claygate Member in the south east (near to Crystal Palace). However, there is no monitoring of this unit by either the Environment Agency or Lambeth Borough Council.
 - A number of potential groundwater flooding mechanisms have been identified. Of significance are those flooding mechanisms associated with the superficial aquifers. Underground structures including basements and cellars are at most risk from groundwater flooding.
 - Areas with increased potential for elevated groundwater have been identified using a number of data sets, including the BGS groundwater flooding susceptibility data set.



These appear to be sensible; they are in agreement with the identified groundwater flooding mechanisms i.e. they highlight areas of low ground level with permeable superficial deposits.

- Groundwater flooding incident data provided by the Environment Agency have been assessed and a reasonable correlation exists with areas mapped as having an increased potential for elevated groundwater. However, there are a number of discrepancies between these data sets. These are potentially a result of (i) the BGS groundwater flooding susceptibility data set not taking into account groundwater springs / seepages from superficial deposits that flow onto the impermeable London Clay Formation, or (ii) the increased potential for elevated groundwater data set needing to be refined. Alternatively, those flood incidents may not be related to groundwater conditions.
- The majority of the groundwater flooding incidents are thought to be related to perched water tables within superficial deposits, particularly the River Terrace Deposits. Many of the groundwater flooding incidents are located near to / along lost rivers such as the River Effra. These will be topographic lows and perched groundwater tables are likely to be close to ground surface in these areas, so that there is an increased susceptibility to groundwater flooding.
- The assessment of increased potential for elevated groundwater and suitability for infiltration SUDS could be improved by additional groundwater level / river stage monitoring and the development / use of a numerical groundwater model.

Recommendation 9: Work with the Environment Agency to record and investigate groundwater flooding incidents and mechanisms



3.6 SEWER FLOODING

FLOODING MECHANISM

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

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

Since the late 1970s, and with the publication of Sewers for Adoption⁶ in 1980, sewer systems have typically been designed and constructed to accommodate a rainfall event with a 1 in 30 probability of occurrence in any given year (3.3%) or less. Therefore, rainfall events with a rainfall probability of greater than 3.3% AEP would be expected to result in surcharging of some of the sewer system. While Thames Water is concerned about the frequency of extreme events, it is not economically viable to build sewers that could cope with every extreme. It is important to note that most of the sewer system in London was built prior to the 1970s, and in many cases has a capacity of far less than 3.3% AEP. The London Borough of Lambeth is served by a combined sewer system and it is thought that many parts of the system are only designed to accommodate a rainfall event with a 1 in 15 probability of occurrence in any given year (6.6% AEP).

2. The system becomes blocked by debris or sediment

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

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

Within the Borough, and adjacent London Borough of Wandsworth, there is potential for sewer outfalls to rivers to become submerged during high water levels (either fluvial or tidal). When this happens, water is unable to escape into the river and flows back along the sewer. Once storage capacity within the sewer itself is exceeded, the water will overflow into streets and houses.

RESPONSIBLE ORGANISATIONS

- 3.6.2 The Highway Authority (Lambeth Borough Council and TfL in the case of red routes including the A3, A24 and A205) are responsible for the effectual drainage of roads insofar as ensuring that drains, including kerbs, road gullies and the pipe network which connects to the trunk sewers are maintained (Figure 3.6.1).
- 3.6.3 Thames Water are responsible for surface water drainage from development via adopted sewers and are responsible for maintaining trunk sewers into which much of Lambeth's highway drainage connects.
- 3.6.4 Riparian owners are responsible for private drainage networks and receiving watercourses where they are small open channels and culverted urban watercourses.

⁶ The Sewers for Adoption guide was first issued in 1980 by WRc. Since then the document has become the standard for the design and construction of sewers to adoptable standards in England and Wales. It acts as a guide to assist developers in preparing their submission to a sewerage undertaker before they enter into an Adoption Agreement under Section 104 of the Water Industry Act 1991







- 3.6.5 In addition to the Thames Water network, there are also some sewers and drains which are in private ownership. Most of these private systems connect to the Thames Water public sewerage system for treatment; however private owners can also connect foul water to septic tanks and storm water to soakaways.
- 3.6.6 The River Effra is one of London's Lost Rivers and is incorporated as a combined Storm Relief Sewer in the Thames Water network along its entire course through the London Borough of Lambeth, approximately 12 metres below ground. It runs south to north through the Borough and crosses through Herne Hill, Brockwell Park, Brixton and onto Kennington before flowing out into the River Thames by Vauxhall Bridge.

THAMES WATER DATA

DG5 Register

- 3.6.7 Thames Water has provided their DG5 database which details the total number of properties at risk of sewer flooding (both externally and internally) at the end of June 2010. The DG5 dataset is provided on a four-digit postcode area, which makes it difficult to determine more precisely where sewer flooding risk is greatest. The number of records for each postcode district have been summed to provide area-based sewer flooding risk dataset (Figure D-5 Appendix D). In addition, Thames Water focus their efforts on removing properties from the DG5 register, and therefore this dataset may no longer accurately represent those properties which are currently at risk.
- 3.6.8 The DG5 Register highlights the following areas as being at a higher risk of sewer flooding (*numbers in brackets indicate number of records of sewer flooding incidents*):
 - Herne Hill (including Dulwich Road, Railton Road and the area to the west of Brockwell Park) – Postcode Districts SW2 2 (64), SE24 9 (53) and SE24 0 (58);
 - Streatham Postcode Districts SW16 6 (32) and SW16 2 (48); and;
 - West Brixton Postcode Districts SW4 7 (20), SW9 8 (18), SW9 9 (17) and SW2 5 (17).



Sewer Network Location

- 3.6.9 Thames Water has also provided details of their utility infrastructure including sewers, pumping stations and outfalls. This information has been overlaid onto CDAs to inform potential mitigation options for each location. Thames Water is keen to work with Councils in order to mitigate flood risk issues. Where required to inform detailed design of mitigation options, Thames Water have agreed to make network models available. Figure D-4 shows the Thames Water sewer network serving the London Borough of Lambeth.
- 3.6.10 The majority of Lambeth is served by combined sewers which, in many cases which were designed and built to accommodate an approximate rainfall event with a 1 in 15 probability of occurrence in any given year (6.6% AEP) in the late 1800s. In many locations, this has decreased due to urbanisation and cross-connection and, as such, it is likely that the sewers across the London Borough of Lambeth will have varying standards of capacities, particularly in the north of the Borough.
- 3.6.11 There are also Storm Relief Sewers some of the Borough, which incorporate the 'lost' River Effra⁷, which is now contained within a Storm Relief sewer 12 metres underground. The sewer flows entirely underground, discharging to the south of the Borough of Lambeth, near Crystal Palace, and flowing in a northerly direction through Norwood Cemetery, Dulwich, Herne Hill, Brockwell Park, Brixton, Kennington to flow out into the Thames by Vauxhall Bridge. The interactions between these and surface water flows are unknown and may require further modelling to better represent the drainage capacity in the central and northern parts of the Borough.
- 3.6.12 In 1965, to overcome problems of damp and occasional flooding in the basements of Dulwich Road in South Brixton, a storm relief sewer was built, running from Burbage Road to Clapham. During heavy rain events, surplus water is now allowed to overflow into this sewer which runs 12 metres below Brixton Water Lane and later, when the tide is low enough, it can be released into the River Thames⁸. Historical anecdotal evidence suggests that the watercourse flooded during heavy rain approximately every decade, with records of flooding in June 1914, July 1980 and again in June 2007. Flooding was recorded along its path in the Elder Road/Chestnut Road area of West Norwood.
- 3.6.13 Several sewer upgrades have taken place in the Borough over the past 10 years, including a scheme to increase the sewer capacity along Coldharbour Lane in 2007.

Planned Sewer Upgrades

- 3.6.14 As part of their AMP5 Business Plan (2010 2015), Thames Water are planning to develop catchment solutions within the London Borough of Lambeth (extending to areas on the London Boroughs of Southwark and Wandsworth) to address sewer flooding.
- 3.6.15 Thames Water report in their Business Plan⁹ that there are currently 323 properties recorded in 56 separate clusters on the Sewer Flooding History Database that have experienced sewer flooding in the Lambeth catchment. The sizeable area stretches from Clapham Common in the west to Streatham Common in the south across to Peckham Rye Park in the east. Preliminary modelling results indicate that in addition to the 323 properties already

⁷ Underground rivers of London are the tributaries of the River Thames and River Lea that were built over during the growth of the metropolis of London. Since it is difficult to stop water from flowing downhill, the rivers now flow through underground culverts.

⁸ Vauxhall Society Newsletter January 1987, <u>http://www.vauxhallcivicsociety.org.uk/home/history/effra-river</u>

⁹ Thames Water AMP5 Business Plan, <u>http://www.thameswater.co.uk/cps/rde/xbcr/corp/archived-business-plan-b6-3.1.pdf</u>



recorded on the Sewer Flooding History Database, a further 4,139 properties are potentially at risk of flooding. As such, Thames Water have included planning and investment expenditure to develop their preferred option throughout AMP5, which comprises a new storm relief tunnel to Greenwich sewage pumping station, where storm flow can discharge to the River Thames when there is spare capacity to do so¹⁰.

Recommendation 10: Work with Thames Water Utilities to identify areas where sewer flooding impacts surface water flooding

¹⁰ See here for information relating to sewer flooding alleviation: <u>http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/7637.htm</u>



3.7 OTHER INFLUENCES

- 3.7.1 The Environment Agency has responsibility over flooding from designated Main Rivers and flooding from this source has been further assessed as part of the previously completed Level 1 and 2 Strategic Flood Risk Assessments for the London Borough of Lambeth.
- 3.7.2 The River Thames runs along the northern boundary of the London Borough of Lambeth, and a 1km stretch of the River Graveney, a tributary of the River Wandle, flows through the south western part of Lambeth. The River Graveney is canalised throughout the study area, having artificial banks and beds (Figure 3.7.1).



Figure 3.7.1 - River Graveney looking North from Acacia Road

- 3.7.3 The River Thames and River Graveney are the only sources of fluvial / tidal flooding in the London Borough of Lambeth. The northern area of Lambeth lies within Flood Zone 3 of the River Thames, but is defended to the 0.1% AEP (1 in 1000 probability of occurring in any given year) design standard in 2030. There are no defences along the River Graveney, though as mentioned above, the river is canalised through the section within Lambeth. Considerable flooding was experienced throughout the study area during 1928, 1937 and 1968 as a result of combined fluvial / tidal flooding. On 6th August 1981, Flooding from the River Graveney reported along Abercain Road in Streatham. Several garages and gardens were flooded, with the water level reported as 0.5 inches below residential properties front doors.
- 3.7.4 Figure D-3 in Appendix D shows the main rivers and Flood Zones covering the London Borough of Lambeth, using the Environment Agency Flood Map.
- 3.7.5 The effects of Main River flooding have not been assessed as part of this study.

Recommendation 11: Work with the Environment Agency to incorporate any findings from the SWMP into SFRA and other fluvial / pluvial modelling projects

3.8 CRITICAL DRAINAGE AREAS (CDAS)

- 3.8.1 As shown in Figure 3.3.1, fourteen CDAs have been identified within or crossing the administrative boundary of the London Borough of Lambeth. For cross-boundary CDAs, a 'lead' Borough has been identified to define which Borough should be leading on managing surface water flood risk, with support from the other Borough. The only exception to this, is for the CDA covering the Herne Hill area (Group7_032) which has been identified as a joint management due to its large spatial extent in both Southwark and Lambeth.
- 3.8.2 The London Borough of Lambeth has been identified as the 'lead' Borough in terms of managing flood risk within ten of these CDAs, and within the remaining four as the 'supporting' Borough. It will be necessary to work in partnership with other Boroughs to manage flood risk within several of the CDAs.
- 3.8.3 Table 3.8.1 identifies the cross boundary CDAs in the London Borough of Lambeth and the 'lead' and 'supporting' Boroughs.

CDA	Lead Borough	Supporting Borough
Group7_006 (East Mitcham)	Merton	Croydon / Lambeth
Group 7_022 (Clapham Junction)	Wandsworth	Lambeth
Group 7_024 (Tooting Bec)	Wandsworth	Lambeth
Group7_025 (Streatham Common)	Lambeth	Wandsworth
Group7_028 (Nine Elms)	Lambeth	Wandsworth
Group8_030 (Norwood)	Lambeth	Croydon
Group 7_032 (Herne Hill)	Lambeth & Southwark	N/A
Group 7_036 (Camberwell)	Southwark	Lambeth
Group8_049 (Norbury)	Croydon	Lambeth

Table 3.8.1 - Cross Boundary CDAs in the London Borough of Lambeth

3.8.4 The remainder of this Section provides a description of each CDA including details of the flooding mechanisms and interaction between flooding locations within the CDA, the level of validation, any specific assumptions made, and the number and types of receptors identified to be at risk.

PROPERTY COUNT

- 3.8.5 Surface water modelling completed as part of Phase 2 of the Drain London Project affords an improved understanding of the level of flood risk facing the London Borough of Lambeth. In order to provide a quantitative indication of potential risks, a property count has been undertaken for the 1% AEP rainfall event for the London Borough of Lambeth. This has been undertaken using the Environment Agency's National Receptors Dataset (NRD) and follows the methodology defined in the Drain London Data and Modelling Framework. The property counts have been undertaken for two scenarios:
 - Those buildings where the average depth of flooding across the building footprint is greater than 0.03m (30mm), reflecting that the building stubs have been modelled as 100mm above the recorded ground level to represent building thresholds; and
 - Those buildings where the average depth of flooding across the building footprint is greater than 0.5m.

- 3.8.6 To provide an indication of the spatial flood risk across the Borough, a property count has been undertaken for each of the CDAs in the London Borough of Lambeth for 1% AEP rainfall event. These values are included in the following tables for each CDA and a full summary provided in Section 3.9.
- 3.8.7 It is important to note that the counts have been undertaken on a CDA basis, and therefore, for those cross boundary CDAs, not all flooded properties will lie within the London Borough of Lambeth administrative area.

MAPPING OUTPUTS

3.8.8 Figures 3.8.1a – 3.8.10b show the modelling results for each CDA where the London Borough of Lambeth has been identified as the 'lead' Borough; two maps for each CDA have been included which show the surface water depth and surface water flood hazard rating (and general flow direction) during the rainfall 1% AEP rainfall event.



CDA: Group7_025 (Streatham Common)		
London Borough:	London Borough of Lambeth (Lead)	
	London Borough of Wandsworth (Supporting)	
Flood Risk Categorisation:	Surface Water, Groundwater and Sewer	
Description:	• Surface water generally flows from east to west across the CDA, and	
	accumulates on the railway line to the south of Streatham Common station.	
	There is also a ponding of surface water along Eardley Road to the east of	
	the railway underpass. Water flows from the east and ponds behind and to	
	the west of the underpass which is at a topographical low point, and is	
	affected by runoff from the railway embankments.	
	• The western and central area of the CDA falls an area of iPEG in	
	permeable superficial deposits.	
Critical Infrastructure:	Railway line east and west of Streatham Common Station	
Property Count:	• 1,538 residential and 43 non-residential properties flood to a depth >0.03m	
	 39 residential properties flood to a depth >0.5m 	
Validation:	• There are some incidents of sewer flooding, and there are two incidents of	
	Groundwater flooding within the CDA.	
Local Flood Risk Zones:	• Streatham Common Station Railway Cutting - pluvial modelling shows	
	flooding along the railway cutting east and west of Streatham Common	
	Railway Station.	
	• Eardley Road – pluvial modelling identifies ponding along Eardley Road to	
	the east of the railway underpass.	
and the second second second		



Eardley Road (looking northwest) and Edgington Road (looking north)

Figure 3.8.1a - Group7_025 (Streatham Common) - Surface Water Flood Depth (1% AEP) Figure 3.8.1b - Group7_025 (Streatham Common) - Surface Water Flood Hazard (1% AEP)







CDA: Group7_026 (Streatham)		
London Borough:	London Borough of Lambeth (Lead)	
Flood Risk Categorisation:	Surface Water, Groundwater and Sewer	
Description:	 Surface water generally flows from east to west across the CDA, and ponds to the north of Streatham Station along Stanthorpe Road, with depths up to 1.5m predicted for the 1% AEP rainfall event. The station itself is on a hill so does not flood but the railway track to the east of the station (and south of Stanthorpe Road) is predicted to flood during the 1% AEP rainfall event. The surface water originates from three distinct directions; one from the east that flows down Hill House Road; one from the northeast and one from the north across urban areas. The A23 is embanked and restricts the movement of surface water. A small area close to the railway line in the west of the CDA lies within an area of iPEC in permeable superficial deposite. 	
Critical Infrastructure:	Railway line to east of Streatham Station	
Property Count:	 1,741 residential and 112 non-residential properties flood to a depth >0.03m 42 residential and 8 non-residential properties flood to a depth >0.5m 	
Validation:	• There are four records of groundwater flooding for this area. There are approximately 50 records of sewer flooding within the postcode areas that fall within the CDA.	
Local Flood Risk Zones:	 Stanthorpe Road – pluvial modelling indicates ponding of surface water to the north of Streatham Station along Stanthorpe Road up to depths of 1.5m during 1% AEP rainfall event. Streatham Station Railway Cutting – pluvial modelling shows flooding along the railway cutting east of Streatham Railway Station. 	



Stanthorpe Road (looking east) and Streatham Road (looking north)

Figure 3.8.2a - Group7_026 (Streatham) - Surface Water Flood Depth (1% AEP) Figure 3.8.2b - Group7_026 (Streatham) - Surface Water Flood Hazard (1% AEP)







CDA: Group7_027 (Clapham South)		
London Borough:	London Borough of Lambeth (Lead)	
Flood Risk Categorisation:	Surface Water, Groundwater and Sewer	
Description:	• This CDA is located in the west of the Borough and includes Clapham	
	Park. There are two main flow directions; one from the southwest which is	
	joined by a flow path from Clapham Park. They merge and flow through	
	the railway underpass into Stockwell (into Group7_028 (Nine Elms)) CDA.	
	There are two areas of ponding in this CDA one near Tableer Avenue and	
	one around Cato Road where depths up to 1m are predicted for the 1 in	
	The ODA area is divided from north to pout how on area of iDEO in	
	Ine CDA area is divided from north to south by an area of IPEG in	
Critical Infrastructure:	Iriangle Nursery School	
	King's Avenue School	
Property Count:	• 3,176 residential and 154 non-residential properties flood to a depth	
	>0.03m	
	 40 residential and 5 non-residential properties flood to a depth >0.5m 	
Validation:	• There are some recorded surface water flood events along Sandmere,	
	Bedford and Ferndale Road in 1911.	
	 There are six records of groundwater flooding in the CDA. 	
	• There are 30 sewer flooding incidents recorded in the north and south of	
	the CDA.	
Local Flood Risk Zones:	• North Clapham Park – pluvial modelling indicates surface water flooding	
	along the course of the hidden 'Clapham River', with deeper flooding (up to	
	1m during the 1% AEP rainfall event along Clapham Park Road, St	
	Alphonsus Road and Crescent Lane, to the northwest of Abbeville Road.	



Crescent Lane (looking north) and Allnutt Way (looking south)

Figure 3.8.3a - Group7_027 (Clapham South) - Surface Water Flood Depth (1% AEP) Figure 3.8.3b - Group7_027 (Clapham South) - Surface Water Flood Hazard (1% AEP)






CDA: Group7_028 (Nine B	Elms)						
London Borough:	London Borough of Lambeth (Lead)						
	London Borough of Wandsworth (Supporting)						
Flood Risk Categorisation:	Surface Water and Groundwater						
Description:	• This CDA is located on the 7 boundary of Lambeth and Wandsworth. It is linked to the Group7_027 (Clapham South) CDA via a flow path through the railway underpass which is directed northwest to Carey Gardens (Wandsworth). A significant amount of surface water ponding occurs along the Borough boundaries as a result of local topography.						
	The CDA falls within an area of iPEG in permeable superficial deposits.						
Critical Infrastructure:	Heathbrook School						
Property Count:	 3,939 residential and 337 non-residential properties flood to a depth >0.03m 82 residential properties flood to a depth >0.5m 						
Validation:	 There are some records of surface water flooding in the CDA from 1911. There are two records of groundwater flooding in the CDA. There are a number of sewer flooding records along the northern boundary of the CDA. 						
Local Flood Risk Zones:	 Northwest Wandsworth Road – pluvial modelling identifies surface water ponding along the Lambeth / Wandsworth administrative boundary north east of Wandsworth Road. This is largely a result of local topography. 						
Figure 3.8.4a - Group7_028 (Figure 3.8.4b - Group7_028 ((Nine Elms) - Surface Water Flood Depth (1% AEP) (Nine Elms) - Surface Water Flood Hazard (1% AEP)						







CDA: Group7_029 (Proby	n Road)
London Borough:	London Borough of Lambeth (Lead)
Flood Risk Categorisation:	Surface Water and Groundwater
Description:	 This CDA is located to the east of Streatham Hill. Ponding occurs on the east side of Probyn Road that has flowed overland from the west and as well as surface water that has been funnelled to the area along Leigham Vale. The water on Leigham Vale originated from the south of the railway line where there is a steep slope from the Royal Circus.
	 There are areas of IPEG in permeable superficial deposits in the north and centre of the CDA.
Critical Infrastructure:	Kingsdale Nursing Home
Property Count:	 967 residential and 9 non-residential properties flood to a depth >0.03m
	 31 residential and 1 non-residential properties flood to a depth >0.5m
Validation:	There are some sewer flooding incidents recorded in the CDA.
	• There are five records of Groundwater flooding recorded in the CDA, but
	these are not within an iPEG area.
	There are no historical records of surface water flooding.
Local Flood Risk Zones:	• Probyn Road - pluvial modelling identifies ponding of surface water along
	Probyn Road up to depths of 1.5m during the 1% AEP rainfall event.
Figure 3.8.5a - Group7_029 (Probyn Road) - Surface Water Flood Depth (1% AEP)
Figure 3.8.5b - Group7_029	Probyn Road) - Surface Water Flood Hazard (1% AEP)







CDA: Group7_030 (Norwood)						
London Borough:	London Borough of Lambeth (Lead)					
	London Borough of Croydon (Supporting)					
Flood Risk Categorisation:	Surface Water					
Description:	 This CDA is located in the south of Lambeth but a large part of the catchment (source) lies within Croydon. A significant flow path originates on Norwood Heights which is directed west and is joined by some flow from the south. Ponding occurs in two places near a convent before surface water flows over Crown Dales into the Borough of Lambeth. In Lambeth flow is directed across the western edge of Norwood Park to the railway underpass where it flows into Group7_032 (Herne Hill) CDA. Some lateral flow along Norwood Park Road and Eylewood Road contribute to the surface water prior to it flowing through the underpass. 					
Critical Infrastructure:	Norwood School					
	St Joseph's RC Junior School					
	Virgo Fidelis Convent Senior School					
Property Count:	• 1,928 residential and 183 non-residential properties flood to a depth					
	>0.03m					
	 20 residential and 3 non-residential properties flood to a depth >0.5m 					
Validation:	• There are records of Groundwater flooding along the south boundary of					
	Norwood Park, along the groundwater/springline contour.					
	There are a number of sewer flooding records within the CDA.					
Local Flood Risk Zones:	• West Norwood (Lambeth) - pluvial modelling shows flooding up to 1m deep (during the 1% AEP rainfall event) along the route of the 'lost' River Effra					
	 Norwood Convent (Croydon) - pluvial modelling indicates that the Convent and an area south of Hermitage Road could flood to depths of up to 1.5m for the 1% AEP rainfall event. 					
Figure 3.8.6a - Group7_030	Norwood) - Surface Water Flood Depth (1% AEP)					
Figure 3.8.6b - Group7_030	(Norwood) - Surface Water Flood Hazard (1% AEP)					







CDA: Group7_031 (East N	lorwood)
London Borough:	London Borough of Lambeth (Lead)
	London Borough of Southwark (Supporting)
Flood Risk Categorisation:	Surface Water and Groundwater
Description:	 The majority of predicted flooding to the south of the CDA is a result of ponding of water. There is a general flow of water from southwest to north east across the CDA, with more substantial flow along Berridge Road, where water ponds (greater than 1.5m) due to the area being a topographical low point. Surface water then flows from Berridge Road northeast to the railway underpass and into Group7_032 (Herne Hill) CDA. There are small localised areas of iPEG in permeable superficial deposits, but these are not considered to be significant.
Critical Infrastructure:	Gipsy Hill Police Station
	Paxton Primary School
Property Count:	 1,560 residential and 49 non-residential properties flood to a depth >0.03m
	 43 residential properties flood to a depth >0.5m
Validation:	• There are two records of Groundwater flooding recorded in the centre of
	the CDA, but these are not within an iPEG area.
Local Flood Risk Zones:	• Berridge Road - pluvial modelling indicates ponding of surface water to
	depths greater than 1.5m during the 1% AEP rainfall event.
Figure 3.8.7a - Group7_031 ((East Norwood) - Surface Water Flood Depth (1% AEP)
Figure 3.8.7b - Group7_031	(East Norwood) - Surface Water Flood Hazard (1% AEP)







CDA: Group7_032 (Herne	Hill)							
London Borough:	London Borough of Southwark (Joint Lead)							
	London Borough of Lambeth (Joint Lead)							
Flood Risk Categorisation:	Surface Water, Groundwater and Sewer							
Description:	 A large amount of surface water from Dulwich Village (Southwark) is directed towards Herne Hill at which point it backs up as it is constricted through the railway underpass. The modelled flood depths here are greater than 1.5m during the 1% AEP rainfall event and this area is known to have experienced flooding. There is also a flow path from West Dulwich (Lambeth) north along the route of the hidden 'River Effra' watercourse which flows to Herne Hill. 							
	 There are a significant number of sewer flooding incidents within the CDA. An area of iPEG in permeable superficial deposits. is located in the centre of the CDA, as well as in the north. 							
Critical Infrastructure ¹¹ :	Elm Wood School							
	Oakfield Preparatory School							
Property Count ¹² :	 6,201 residential and 339 non-residential properties flood to a depth >0.03m 158 residential and 33 non-residential properties flood to a depth >0.5m 							
Validation:	There are historical records of surface water flooding in West Dulwich and							
	Herne Hill areas.							
	• There are over 100 records of sewer flooding within the CDA.							
Local Flood Risk Zones ¹³ :	• West Dulwich - historical flooding records and pluvial modelling results							
	show deep ponding of water along the course of the hidden 'River Effra'							
	where local topography dictates surface water flows.							

Chestnut Road, West Dulwich (looking north) and Half Moon Lane (looking west towards Brockwell Park)

Figure 3.8.8a - Group7_032 (Herne Hill) - Surface Water Flood Depth (1% AEP) Figure 3.8.8b - Group7_032 (Herne Hill) - Surface Water Flood Hazard (1% AEP)

¹¹ Critical infrastructure that is predicted to flood during the 1% AEP rainfall event within the London Borough of Lambeth.

¹² Property count for the entire CDA – including properties within both the London Borough of Lambeth and London Borough of Southwark.

¹³ Local Flood Risk Zones within the London Borough of Lambeth.







CDA: Group7_033 (Brixto	n)						
London Borough:	London Borough of Lambeth (Lead)						
Flood Risk Categorisation:	Surface Water, Groundwater and Sewer						
Description:	 This CDA has two LFRZs in the south (Dulwich Road) and north (Southwest Kennington). The general flow direction within the CDA is south to north along Brixton Road which acts as a conduit of surface water away from Brixton centre towards The Oval and the residential area to the south The CDA broadly follows the course of the 'lost' River Effra. One of the main sources of flooding in this CDA is from the Group7_032 (Herne Hill) CDA; the flow from which enters this CDA from Norwood Road and Half Moon Lane (via the railway underpass at Herne Hill). Herne Hi (Southwark) has been known to flood in the past. From here surface water is directed along Dulwich Road and in a westerly direction towards Brixton centre. Further surface water joins this flow path from the urban areas surrounding Brockwell Park and the park itself, and from Brixton Hill which originates in Streatham Hill. The north of the CDA falls within an area of iPEG in permeable superficia deposits. 						
Critical Infrastructure:	Ashmole Primary School St Mark's C.E. School						
	Archbishop Tenison's C.E. School Effra Nursery School						
	Reay Primary School St Jude's C.E. Primary School						
Property Count:	 7,043 residential and 398 non-residential properties flood to a depth >0.03m 651 residential and 5 non-residential properties flood to a depth >0.5m 						
Validation:	• There are numerous flooding records (including basement flooding) for						
	Dulwich Road, Railton Road and the minor roads located between these to the north of Brockwell Park.						
	There are over 50 sewer flooding incidents recorded in the south of the CDA.						
Local Flood Risk Zones:	 Dulwich Road - pluvial modelling and historical flood records highlight flooding along the main road, adjacent roads and residential properties from Herne Hill and Brockwell Park. Southwest Kennington - pluvial modelling indicates surface water from 						
	Herne Hill and Dulwich Road area flows north along Brixton High Street and ponds in the residential area to the south of the Oval.						



Dulwich Road (looking west), Brixton Road (looking south), Fentiman Road (looking west) Figure 3.8.9a - Group7_033 (Brixton) - Surface Water Flood Depth (1% AEP) Figure 3.8.9b - Group7_033 (Brixton) - Surface Water Flood Hazard (1% AEP)







CDA: Group7_034 (Water	loo Station)						
London Borough:	London Borough of Lambeth (Lead)						
Flood Risk Categorisation:	Surface Water						
Description:	 Surface water ponds around the periphery of Waterloo Station with depths over 1m, potentially causing issues accessing and exiting the station during heavy rainfall. Surface water flows off the roof and tracks of the station and flows to the east along Cornwall Road and Wootton Street. Surface water also ponds to the entrance and exit of St Thomas' Hospital. The south-east of the CDA falls within an area of iPEG in permeable superficial deposits. There are a limited number of sewer flooding incidents within the postcode areas that fall within the CDA 						
Critical Infrastructure:	Waterloo Station						
	St Thomas' Hospital						
Property Count:	90 residential and 209 non-residential properties flood to a depth >0.03m						
	 4 non-residential properties flood to a depth >0.5m 						
Validation:	There are no historical records of groundwater or surface water flooding for						
	this area.						
Local Flood Risk Zones:	• Waterloo Station & St. Thomas' Hospital – surface water is predicted to						
	pond around the station and entrances/exits to/from St Thomas' Hospital.						



Mepham Street, Waterloo Station (looking east) and York Road (looking east) Figure 3.8.10a - Group7_034 (Waterloo) - Surface Water Flood Depth (1% AEP) Figure 3.8.10b - Group7_034 (Waterloo) - Surface Water Flood Hazard (1% AEP)







3.9 SUMMARY OF RISK

OVERVIEW OF SURFACE WATER FLOODING IN LAMBETH

- 3.9.1 The following conclusions can be drawn from the Phase 2 Risk Assessment, which has involved pluvial modelling combined with site visits and review of historical flood records provided by the Council, Thames Water and the Environment Agency:
 - The outputs from the intermediate level 2D pluvial modelling revealed that the most significant surface water flooding and higher risk areas are along narrow corridors associated with topographical valleys which represent the routes of the 'lost' rivers of London including the River Effra, Falcon Brook, Clapham River and Falls Brook (Figure 3.9.1). The majority of these flow south to north through the Borough;
 - The outputs from the intermediate level 2D pluvial modelling revealed discrete surface water flooding locations along the up-stream side of the raised network rail embankment (running roughly west to east through the south of the Borough); and
- 3.9.2 There are three areas where surface water flooding is likely to be the influence of pluvial, groundwater and sewer flooding including:
 - Dulwich Road / Railton Road / Herne Hill the pluvial modelling shows this area to experience significant flooding during the 1% AEP rainfall event along the route of the 'lost' River Effra. Additionally, the DG5 sewer flooding database records over 150 sewer flooding incidents in this vicinity, whilst the area is identified as having an increased potential for elevated groundwater, supported by records of groundwater flooding;
 - Clapham the pluvial modelling shows this area to experience during the 1% AEP rainfall event. Additionally, the DG5 sewer flooding database records over 50 sewer flooding incidents in this vicinity, whilst the eastern area is identified as having an increased potential for elevated groundwater, supported by records of groundwater flooding; and
 - Streatham the pluvial modelling shows this area to experience during the 1% AEP rainfall event. Additionally, the DG5 sewer flooding database records over 100 sewer flooding incidents in this vicinity, whilst the western area is identified as having an increased potential for elevated groundwater, supported by records of groundwater flooding.
- 3.9.3 Within the London Borough of Lambeth, the main surface water flooding occurs along the route of the 'lost' River Effra, which runs north to south through the length of the Borough (including the CDAs of Group7_030, Group7_032 and Group7_033). Significant ponding of surface water is modelled to impact Norwood, West Dulwich, Herne Hill, Brixton and Kennington, with the Herne Hill and Dulwich Road areas, historically flooded during heavier rainfall events. The area of Herne Hill and downstream Dulwich Road area are impacted from upstream surface water flows from Dulwich in the London Borough of Southwark, and it will therefore be important that the flood risk is managed at a catchment scale by both Boroughs.

Figure 3.9.1 – Lambeth Hidden Watercourses Rivers and Surface Water Flood Depth (1% AEP)





RISK TO EXISTING PROPERTIES & INFRASTRUCTURE

- 3.9.4 As part of the Phase 2 assessment, a quantitative assessment of the number of properties at risk of flooding has been undertaken for each CDA. The 1% AEP rainfall event has been used to inform this assessment, as specified in the Drain London Data and Modelling Framework.
- 3.9.5 The Borough-wide quantitative assessment is provided in Table 3.9.1. Table 3.9.2 provides a summary of the flooded properties for each identified CDA within the London Borough of Lambeth alongside information on the various property categories used, and methodology for defining these. The property count has been calculated for infrastructure, households and commercial/industrial properties for the 1% AEP rainfall event.

Property Type	Sub Category	No. of properties flooded >0.03m	No. of properties flooded >0.5m	
	Essential Infrastructure	46	0	
Infractructura	Highly Vulnerable	7	0	
Initiastructure	More Vulnerable	151	0	
	Other Infrastructure	90	4	
	Deprived (All)	19,401	632	
Households	Deprived (Basements)	3,710	209	
	Non-Deprived (All)	24,340	661	
	Non-Deprived (Basements)	5,570	270	
Commercial /	Commercial/Industrial (All)	2,404	42	
Industrial	Commercial/Industrial Basements	1,058	14	
Other		17	1	
	TOTAL	46,456	1,340	

Table 3.9.1 - Borough-Wide Summary of Flood Risk for 1% AEP Rainfall Event¹⁴

3.9.6 The figures in Table 3.9.2 identify that a 1% AEP rainfall event is likely to have the greatest impact, in terms of number of properties affected, in the Herne Hill and Brixton area (Group7_032 and Group7_033 CDAs). Approximately 880 properties are predicted to flood to depths greater than 0.5m in these areas (including those areas within the London Borough of Southwark).

Recommendation 12: Validate SWMP Model Outputs through engagement with the public and confirming outputs and drainage capacity assumptions with key stakeholders including Thames Water, Network Rail, Transport for London and London Underground

¹⁴ The Basement Counts are subsets of the previous dataset (e.g. Deprived, Non Deprived or Commercial / Industrial), and are therefore not included in total Borough count



	Infrastructure					Households								Commercial / Industrial							
CDA ID	CDA Name	Esse	ential	Hig Vulne	jhly erable	More Vu	Inerable	Non-Do (A	eprived All)	Non-De (Baser	eprived nents)	Depriv	ed (All)	Dep (Base	rived ments)	A	AII	Baseme	nts Only	То	tal
		>0.03m	> 0.5m	>0.03m	> 0.5m	>0.03m	> 0.5m	>0.03m	> 0.5m	>0.03m	> 0.5m	>0.03m	> 0.5m	>0.03m	> 0.5m	>0.03m	> 0.5m	>0.03m	> 0.5m	>0.03m	>0.05m
Group7_025	Streatham Common	0	0	0	0	3	0	937	39	167	6	601	0	115	0	40	0	12	0	1,581	39
Group7_026	Streatham	1	0	1	0	7	0	825	0	85	0	916	42	219	7	103	8	57	1	1,853	50
Group7_027	Clapham South	6	0	0	0	9	0	2,396	36	795	10	780	4	118	0	139	5	74	4	3,330	45
Group7_028	Nine Elms	6	0	0	0	12	0	2,748	70	745	19	1,191	12	218	11	319	0	156	0	4,276	82
Group7_029	Probyn Road	0	0	0	0	1	0	742	31	83	14	225	0	41	0	8	1	0	0	976	32
Group7_030	Norwood	1	0	0	0	13	1	1,282	18	127	0	646	2	39	0	169	2	35	0	2,111	23
Group7_031	East Norwood	0	0	1	0	3	0	533	24	154	16	1,027	19	62	0	45	0	24	0	1,609	43
Group7_032	Herne Hill	5	0	1	0	21	1	4,964	117	611	31	1,237	41	158	7	312	32	140	27	6,540	191
Group7_033	Brixton	7	0	2	0	29	0	1,974	201	821	115	5,069	450	1,595	176	360	5	185	4	7,441	656
Group7_034	Waterloo Station	0	0	1	0	6	0	21	0	20	0	69	0	19	0	202	4	125	4	299	4

Table 3.9.2 - Summary of Surface Water Flood Risk (based on pluvial modelling results for the 1% AEP rainfall event)

Notes: The summary of risk table is populated by calculating the total number of units from each sub-category that are affected by surface water flooding from the 1% AEP rainfall event. The Infrastructure and Household Sub-Categories are described Table 3.9.3 and Table 3.9.4; further information on these categories and their use is available in the Drain London Data and Modelling Framework and Prioritisation Matrix Guidance.

Table 3.9.3 - Infrastructure Sub-Categories

Category	Description
Essential	Essential transport infrastructure which has to cross the area at
Infrastructure	risk
	Mass evacuation routes
	Tube stations and entrances
	 Essential utility infrastructure which has to be located in a flood risk area for operation reasons
	 Electricity generating power stations and grid and primary substations
	Water treatment works
Highly	Police stations, Ambulance stations, Fire stations, Command
Vulnerable	Centres and telecommunications installations
	Emergency disposal points
	 Installations requiring hazardous substances consent
More	Hospitals
Vulnerable	Health Services
	Education establishments, nurseries
	 Landfill, waste treatment and waste management facilities for hazardous waste
	Sewage treatment works
	Prisons

Table 3.9.4 - Household and Basement Sub-Categories

Category	Description
Households	All residential dwellings
	Caravans, mobile homes and park homes
	intended for permanent residential use
	Student halls of residence, residential care
	homes, children's homes, social services homes and hostels
Deprived Households	 Those households falling into the lowest 20% of ranks by the Office of National Statistics' Indices of Multiple Deprivation.
Non-Deprived Households	Those households not falling into the lowest 20%
	of ranks by the Office of National Statistics'
	Indices of Multiple Deprivation
Basements	All basement properties, dwellings and vulnerable balance and standard standards (where identified in
	below ground structures (where identified in
	Thames Water and Environment Agency's
	National Receptor Database).
Non-Deprived Households Basements	 ranks by the Office of National Statistics' Indices of Multiple Deprivation. Those households not falling into the lowest 20% of ranks by the Office of National Statistics' Indices of Multiple Deprivation All basement properties, dwellings and vulnerable below ground structures (where identified in existing dataset including those provided by Thames Water and Environment Agency's National Receptor Database).



RISK TO FUTURE DEVELOPMENT

- 3.9.7 The Core Strategy identifies that the Council will make provision for the Borough's share of London's housing needs and for local needs of at least 7,700 net additional dwellings by 2016/2017, and a further 8,800 by 2024/2025. The London Plan designated two areas (Vauxhall/Nine Elms/Battersea and Waterloo) within the London Borough of Lambeth as Opportunity Areas, promoted to accommodate both new jobs and new homes with a mixed and intensive use of land. Figure 3.9.2 shows the identified Opportunity Areas within the London Borough of Lambeth along with Major Development Opportunity (MDO) sites identified through the Core Strategy (2011) and Unitary Development Plan (UDP, 2007). The MDO sites are due to be updated and consulted on in late 2011 as part of the Site Allocations Development Plan Document (DPD). At the same time, the Development Management DPD will be consulted on; the evidence gathered as part of this SWMP may provide the opportunity to influence policies in the Development Management DPD and expand on the existing policies in the Core Strategy.
- 3.9.8 Any future development within Lambeth should be in accordance with Policy S6 of the Lambeth Core Strategy (Box 3.9.1), and adaptations to this, relating specifically to surface water flooding and the findings of this SWMP, should be considered by Lambeth Borough Council.

Box 3.9.1 – Policy S6 – Flood Risk (Lambeth Core Strategy, adopted January 2011)

Policy S6 – Flood Risk

The Council will work in partnership with the Environment Agency in order to manage and mitigate flood risk.

- (a) Development will be steered towards areas of lowest flood risk through the application of the sequential test in PPS25, taking the vulnerability of the proposed uses into account.
- (b) Development will only be considered in the areas of higher flood risk where it can be demonstrated that there are no reasonably available sites within Flood Zone 1 (low risk) appropriate to the type of use proposed
- (c) All new development in Flood Zones 2, 3a and 3b defined in the Strategic Flood Risk Assessment should contribute positively to actively reducing flood risk in line with PPS25, through avoidance, reduction, management and mitigation.
- (d) Flood Risk Assessment (FRA) will be required for major development proposals within Flood Zone 1 and all new development within Flood Zones 2, 3a and 3b. The FRA should be proportionate with the degree of flood risk posed to and by the proposed development and take account of the advice and recommendations set out in the Strategic Flood Risk Assessment (SFRA).
- (e) Where development is permitted within flood risk areas it must demonstrate that, where required, it will reduce fluvial, tidal and surface water flood risk and manage residual risks through appropriate flood risk measures.
- (f) On sites adjacent to the River Thames and River Graveney, maintenance, remediation and improvements to the flood defence walls will be required where these are in poor condition.
- (g) Measures to mitigate flooding from groundwater and sewers should be included in development proposals for which this is a risk.
- 3.9.9 Land available for development is scarce within the Borough and is being put under increasing pressure due to the demand for new housing. It is essential that decisions are made through the spatial planning process which guarantees that land is used efficiently. However, it is also essential that the impact of future development on existing infrastructure, including the drainage systems, is assessed and adequately managed.



3.9.10 Findings from the Risk Assessment (Phase 2) of the SWMP identify that parts of Lambeth, namely Herne Hill, Brixton and Streatham are at significant risk of flooding from pluvial and groundwater sources. Given the residential and non-residential growth proposed for these areas, it is important that the risk of surface water flooding is clearly understood in order that measures to mitigate this risk can be adopted.

Figure 3.9.2 – Lambeth Major Development Areas and Surface Water Flood Depth (1% AEP)





COMMUNICATE RISK

Professional Stakeholders

- 3.9.11 There are various professional stakeholders which are interested in increasing their knowledge of risks from surface water flooding. It is essential that the SWMP partnership actively engages with these groups, where appropriate, to share the findings of this report. This will ensure that emerging plans and policies are informed by the latest evidence contributing to an improved understanding of surface water flood risk issues.
- 3.9.12 Appendix G Spatial Planning Information Pack and Appendix H Resilience Forum and Emergency Planner Information Pack provide guidance on how the SWMP outputs should be used in updating existing planning documents, such as Strategic Flood Risk Assessments (SFRAs) and Multi-Agency Flood Plans (MAFPs), and informing emerging planning policy and spatial planning decisions.

Recommendation 13: Actively engage with professional stakeholders to communicate findings of SWMP and local flood risk management

Local Resilience Forums

3.9.13 In line with the SWMP Technical Guidance it is strongly recommended that the information provided in the Phase 2 SWMP is issued to the Local Resilience Forum. Surface water flood maps and knowledge of historic flood events should be used to update Incident Management Plans, Community Risk Registers and Multi-Agency Flood Plans for the area. It is recommended that the results of the intermediate pluvial modelling are used to identify likely flow-paths and locations of ponding of surface water. This information can be used in parallel with Extreme Rainfall Alert (ERA) service provided by the Flood Forecasting Centre¹⁵. In addition, maps showing the depth of pluvial flooding during a range of return period rainfall events can be used to inform operations undertaken by emergency response teams especially near public buildings and major routes through the Borough.

Communication and Engagement Plan

- 3.9.14 It is recommended that a Communication and Engagement Plan should be produced for the London Borough of Lambeth to effectively communicate and raise awareness of surface water flood risk to different audiences using a clearly defined process for internal and external communication with stakeholders and the public.
- 3.9.15 The Plan should:
 - Develop clear key messages from the SWMP (and PFRA) relating to local surface water flood risk and management;
 - Create simplified maps and meaningful data for communications materials;
 - Clearly define a structure for internal and external (multi-agency) partnership working (based on the partnership structure identified in Phase 1 of the SWMP); and
 - Provide a strategy for communicating the SWMP findings to political stakeholders, local resilience forum members, RFCC members and the general public and engaging these parties in future local flood risk management actions.

Recommendation 14: Design and gain buy-in to a Communication and Engagement Plan to identify how to effectively communicate and raise awareness of local flood risk to different audiences

¹⁵ The Flood Forecasting Centre was set up in 2008 by the Met Office and the Environment Agency to provide services to emergency and professional partners.



4. Phase 3: Options

4.1 OBJECTIVES

- 4.1.1 The purpose of Phase 3 is to identify a range of structural and non-structural measures for alleviating flood risk in the London Borough of Lambeth and assess them to eliminate those that are not feasible or cost beneficial. The remaining options are then developed and tested against their relative effectiveness, benefits and costs.
- 4.1.2 To maintain continuity within the report and to reflect the flooding mechanisms within the Borough the option identification has taken place on an area-by-area (site-by-site) basis following the process established in Phase 2. Therefore, the options assessment undertaken as part of the SWMP assesses and short lists the measures for each CDA and identifies any non-standard measures available.
- 4.1.3 Phase 3 delivers a high level option assessment for each of the CDAs identified in Phase 2. No monetised damages have been calculated and flood mitigation costs have been determined using engineering judgement, but have not undergone detailed analysis. As such, the costs provided as part of this study have been assigned to cost bands¹⁶ to reflect that the costs presented are estimates and not based upon detailed analysis; this will be undertaken as part of feasibility studies and/or through Tier 3 of the Drain London project. The options assessment presented here follows that described in the Defra SWMP Guidance but is focussed on highlighting areas for further detailed analysis and immediate 'quick win' actions. Further detailed analysis may occur for high priority CDAs as defined by the London-wide Prioritisation Matrix in the next Tier (Tier 3) of the Drain London project (see Section 4.5).

4.2 METHODOLOGY

- 4.2.1 Phase 3 has been undertaken in four stages as summarised below and discussed in more detail in proceeding Sections:
 - Stage 1 Identify Potential Measures (structural and non-structural) based on the standard measures identified by Tier 1 of the Drain London project for all CDAs irrespective of the costs or benefits associated with these;
 - Stage 2 Identify Potential Options based on those measures identified in Stage 1

 these may be a single measure or a combination of measures. This stage may also identify that further investigation or confirmation of existing drainage infrastructure is required prior to taking forward options;
 - Stage 3 Short List Potential Options based on a range of social, environmental technical and economic criteria to determine the preferred schemes for consideration in Stage 4; and,
 - Stage 4 Determine High-level Costs & Benefits for short listed potential options using unit costs provided by Tier 1 of the Drain London project and estimating potential benefits to LFRZs.

¹⁶ As defined by Drain London Prioritisation Matrix Guidance, the cost bands to be used are: <£25k, £26k - £50k, £51k - £100k, £101k - £250k, £251k - £500k, £501k - £1m, £1m - £10m and >£10m.



STAGE 1 - IDENTIFY POTENTIAL MEASURES

- 4.2.2 This stage aims to identify a number of measures that have the potential to alleviate surface water flooding in all CDAs identified through Phase 2 of the SWMP within the London Borough of Lambeth. It has been informed by the knowledge gained as part of the Phase 1 and Phase 2 assessment. At this stage the option identification pays no attention to constraints, such as funding or delivery mechanisms, to enable a robust assessment.
- 4.2.3 A standard set of structural¹⁷ and non-structural¹⁸ measures have been specified by the Drain London Board for consideration within each CDA (Table 4.2.1) and follow the source-pathway-receptor model (Figure 4.2.1).

Source	Pathway	Receptor
 Green roof Soakaways Swales Permeable Paving Rainwater Harvesting Detention Basins 	 Increasing capacity in drainage systems Separation of foul and surface water sewers Improved maintenance regimes Managing overland flows Land management practices 	 Improved weather warning Planning policies to influence development Temporary or demountable flood defences Social change, education and awareness Improved resilience and resistance measures

Table 4.2.1 - Drain London Structural and Non-Structural Measures for Consideration



Figure 4.2.1 - Source-Pathway-Receptor Model ('adapted from SWMP Technical Guidance, 2010)

4.2.4 An opportunity assessment was undertaken for each CDA to evaluate where there were opportunities for the implementation of structural and non-structural measures identified by the Drain London Board and through consultation with relevant stakeholders. The results from the Opportunity Assessment are summarised for each CDA in Table 4.2.2; further details from the full assessment are included in Appendix E.

¹⁷ Structural measures are considered to be those which require fixed or permanent assets to mitigate flood risks.

¹⁸ Non-structural measures are those which are responses to urban flood risk that may not involve fixed or permanent facilities, and whose positive contribution to the reduction of flood risk is most likely through a process of influencing behaviour.



Table 4.2.2 - Measures Opportunity Assessment

CDA ID	CDA Name				Sou	irce							Path	way						Rece	ptor		
		Green Roof	Soakaways	Swales	Permeable Paving	Rainwater Harvesting	Detention Basins	Ponds and Wetlands	Other 'Source' Measures	Increasing Capacity in Drainage Systems	Separation of Foul and Surface Water Sewers	Improved Maintenance Regimes	Managing Overland Flows (Online Storage)	Managing Overland Flows (Preferential Flow paths)	Land Management Practices	Deculverting Watercourse(s)	Other 'Pathway' Measures	Improved Weather Warning	Planning Policies to Influence Development	Temporary or Demountable Flood Defences	Social Change, Education and Awareness	Improved Resilience and Resistance Measures	Other 'Receptor' Measures
Group7_025	Streatham Common	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	x		\checkmark	\checkmark	\checkmark			x	х		\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark
Group7_026	Streatham	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	×		\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	X			\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	
Group7_027	Clapham South	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	×			\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	×			\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	
Group7_028	Nine Elms	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	×		\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	×			\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	
Group7_029	Probyn Road	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	×		\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	×			\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	
Group7_030	Norwood	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark		\checkmark	\checkmark	\checkmark	\checkmark	\sim	×	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark
Group7_031	East Norwood	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	×		\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	×			\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	
Group7_032	Herne Hill	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark		\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	_×			\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	
Group7_033	Brixton	\checkmark	\checkmark	\sim	\checkmark	\sim	\checkmark	×		\sim	\checkmark	\sim	\checkmark	\sim	×				\sim	\sim	\checkmark	\sim	
Group7_034	Waterloo Station	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	×	х		\checkmark	\checkmark	\checkmark	x	\checkmark	x	х		\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark

Meas	ures Opportunity Assessment Criteria
\checkmark	There are opportunities for implementation of this mitigation measure within the CDA. Measure should be considered in the Options Assessment.
\checkmark	There may be some, but limited opportunities for implementation of this mitigation measure within the CDA. Measures should be considered in the Options Assessment but would likely be limited in effectiveness or be subject to site-specific investigations prior to consideration.
×	There are no opportunities for implementation of measure within CDA. The measure it not suitable or required to address the surface water flood risk within the CDA.
N/A	Not applicable - to be used where not other measures are identified.



STAGE 2 - IDENTIFY POTENTIAL OPTIONS

- 4.2.5 Following Stage 1 a series of options have been identified based on a standard list of potential options defined by the Drain London Board (Table 4.2.3), which include¹⁹:
 - Options that change the source of risk;
 - Options that modify the pathway or change the probability of flooding;
 - Options that manage or modify receptors to reduce the consequences;
 - Temporary as well as permanent options;
 - Options that work with the natural processes wherever possible;
 - Options that are adaptable to future changes in flood risk;
 - Options that require actions to be taken to deliver the predicted benefits (for example, closing a barrier, erecting a temporary defence or moving contents on receiving a flood warning);
 - Innovative options tailored to the specific needs of the project; and,
 - Options that can deliver opportunities and wider benefits, through partnership working where possible.
- 4.2.6 Each of the Standard Measures identified in Stage 1 have been categorised within an option.
- 4.2.7 Where possible options have been identified that have multiple benefits, for example to alleviate flooding from other sources, or provide environmental benefits such as water quality, biodiversity and amenity benefits.

¹⁹ Environment Agency (March 2010) 'Flood and Coastal Flood Risk Management Appraisal Guidance', Environment Agency: Bristol.



Table 4.2.3 - Potential Options

Description		Standard Measures Considered
Do Nothing	Make no intervention / maintenance	None
Do Minimum	Continue existing maintenance regime	None
Improved Maintenance	Improve existing maintenance regimes e.g. target improved maintenance to critical points in the system.	Improved Maintenance Regimes
Planning Policy	Use forthcoming development control policies to direct development away from areas of surface water flood risk or implement flood risk reduction measures. Planning policy could also be used for requiring new development to comply with BREEAM and Code for Sustainable Homes standards.	Planning Policies to Influence Development
Source Control, Attenuation and SuDS	Source control methods aimed to reduce the rate and volume of surface water runoff through infiltration or storage, and therefore reduce the impact on receiving drainage systems.	 Green Roof Soakaways Swales Permeable paving Rainwater harvesting Detention Basins Ponds and Wetlands Land Management Practices
Flood Storage / Permeability	Large-scale SUDS that have the potential to control the volume of surface water runoff entering the urban area, typically making use of large areas of green space. Upstream flood storage areas can reduce flows along major overland flow paths by attenuating excess water upstream.	 Detention Basins Ponds and Wetlands Managing Overland Flows (Online Storage) Land Management Practices
Separate Surface Water and Foul Water Sewer Systems	Where the CDA is served by a combined drainage network separation of the surface water from the combined system should be considered. In growth areas separation creates capacity for new connections.	Separation of Foul and Surface Water Sewers
De-culvert / Increase Conveyance	Deculverting of watercourses and improving in-stream conveyance of water.	Deculverting Watercourse(s)
Preferential / Designated Overland Flow Routes	Managing overland flow routes through the urban environment to improve conveyance and routing water to watercourses or storage locations.	 Managing Overland Flows (Preferential Flow paths) Temporary or Demountable Flood Defences
Community Resilience	Improve community resilience and resistance of existing and new buildings to reduce damages from flooding, through, predominantly, non- structural measures.	 Improved Weather Warning Temporary or Demountable Flood Defences Social Change, Education and Awareness Improved Resilience and Resistance Measures
Infrastructure Resilience	Improve resilience of critical infrastructure in the CDA that is likely to be impacted by surface water flooding e.g. electricity substations, pump houses.	Improved Resilience and Resistance Measures
Other - Improvement to Drainage Infrastructure	Add storage to, or increase the capacity of, underground sewers and drains and improving the efficiency or number of road gullies.	 Increasing Capacity in Drainage Systems
Other or Combination of Above	Any alternative options that do not fit into above categories and any combination of the above options where it is considered that multiple options would be required to address the surface water flooding issues.	



STAGE 3 - SHORT LIST POTENTIAL OPTIONS

4.2.8 This stage takes the options identified through Stage 2 and short lists them based on a range of technical, economic, social, environmental and flood mitigation success criteria. A high-level scoring system has been developed based on the guidance in the Environment Agency's Flood and Coastal Flood Risk Management Appraisal Guidance and Defra's SWMP Technical Guidance. The scoring criteria are provided in Table 4.2.4.

Criteria	Description	Score
Technical	 Is it technically possible and buildable? Will it be robust and reliable? Would it require the development of a new technique for its implementation? 	
Economic	 Will benefits exceed costs? Is the measure within the available budget? Estimate the whole life costs of the option including asset replacement, operation and maintenance. The scoring of this measure will depend on the budget available from the local authority although it should be remembered that alternative routes of funding could be available such as Thames Region Flood Defence Committee. 	U: Unacceptable (measure eliminated from further consideration) -2: Severe negative outcome -1: Moderate negative outcome
Social	 Will the community benefit or suffer from implementation of the measure? Does the option promote social cohesion or provide an improved access to recreation/open space? Does the option result in opposition from local communities for example if an option involves the displacement of houses? 	0: Neutral +1: Moderate positive outcome +2: High positive outcome
Environmental	 Will the environment benefit or suffer from implementation of the measure? Would the option have a positive or negative effect on the environment for example, water quality and biodiversity? 	
Objectives	 Will it help to achieve the objectives of the SWMP partnership? Does the option meet the overall objective of alleviating flood risk? 	

Table 4.2.4 - Oblivits Assessifient Shutt Listing Chief

4.2.9 An Options Workshop was held with Lambeth Borough Council on 15th March 2011 to discuss and agree the short listed options identified for each CDA through the options assessment. The process aimed to ensure that inappropriate measures were eliminated early in the process to avoid investigation of options that are not acceptable to stakeholders. The agreed short listed options have been progressed to the Preferred Options stage where they have been further developed.

Appendix E provides the short listed options that have been identified for each CDA and the associated scoring criteria.

STAGE 4 – DETERMINE HIGH-LEVEL COSTS AND BENEFITS

- 4.2.10 Following the Options Workshop and consultation with relevant stakeholders, the preferred options have been identified for each CDA and further assessed to:
 - Estimate benefits; and
 - Estimate the approximate implementation costs.


4.2.11 A detailed appraisal of cost and benefits of each of the options is not deemed to be practical for the strategic level of this study and should be carried out as part of a more detailed cost:benefit appraisal for individual CDAs and/or options, potentially as part of a feasibility study.

Benefits

- 4.2.12 For the purpose of the Drain London Prioritisation Matrix, it is necessary to determine the benefits of each preferred option:
 - The potential benefits of the scheme are measured using an estimated percentage of units removed from the predicted floodplain (eliminated) or where flood frequency is reduced (mitigated).
 - The percentage has been determined by calculating the number of flooded units within the LFRZ that the particular scheme has been designed to mitigate, as a percentage of the number of flooded units within the CDA as a whole.
 - The input is restricted to multiples of five percent.
 - The information has been calculated purely for input into the Drain London Prioritisation Matrix and should be treated as such. Further modelling would be required to determine more accurately the potential benefits of the suggested schemes.

Costs

- 4.2.13 An estimated cost for the preferred flood mitigation option for each identified CDA has been calculated based on standard unit costs provided as part of Tier 1 of the Drain London Project (as provided in Appendix E). No monetised damages have been calculated, and flood mitigation costs have been determined using engineering judgement, but have not undergone detailed analysis. The following standard assumptions have been applied, as determined in the Drain London Prioritisation Matrix Guidance:
 - The costs are the capital costs for implementation of the scheme only;
 - Costs do not include provisions for consultancy, design, supervision, planning process, permits, environmental assessment or optimum bias;
 - No provision is made for weather (e.g. winter working);
 - No provision is made for access constraints;
 - Where required, it will be stated if costs include approximate land acquisition components;
 - No operational or maintenance costs are included; and,
 - No provision is made for disposal of materials (e.g. for flood storage or soakaway clearance).
- 4.2.14 As a result, costs have been provided as cost bands²⁰, reflecting the strategic nature of the SWMP study and options identification.

²⁰ As defined by Drain London Prioritisation Matrix Guidance, the cost bands to be used are: <£25k, £26k - £50k, £51k - £100k, £101k - £250k, £251k - £500k, £501k - £1m, £1m - £10m and >£10m.



4.3 PREFERRED OPTIONS

4.3.1 The preferred options have been identified through Stages 1 - 4 of the Options Assessment and are discussed in further detail within this Section.

LAMBETH WIDE PREFERRED OPTIONS

- 4.3.2 The Options Assessment identified a number of measures that were common to all CDAs, and should be considered across the London Borough of Lambeth Policy Area (Group7PA_003²¹) which covers the Borough administrative area. The Council and relevant stakeholders may consider adopting these as part of their responsibility as LLFA for local flood risk management.
- 4.3.3 The preferred Borough-wide options include:
 - Raising Community Awareness;
 - Ongoing Improvements to Maintenance of Drainage Network;
 - Planning and Development Policies;
 - Water Conservation;
 - Improving Resilience to Flooding; and
 - Complimentary Measures to deliver wider benefits to the community as a whole.

CDA SPECIFIC PREFERRED OPTIONS

- 4.3.4 For most CDAs, a range of options / measures have been identified to help alleviate flooding alongside further studies for Lambeth Borough Council to take forward. Details of these are presented within this Section and included within the London Borough of Lambeth's draft Action Plan (see Section 5.1 and Appendix I).
- 4.3.5 Where it is considered that further investigation / collaboration with third parties such as Thames Water or Network Rail is required before determining the preferred capital option for a CDA this has been highlighted, with the potential options for consideration and 'Quick Wins' highlighted where appropriate, based on those short-listed through the Options Assessment.
- 4.3.6 Where the preferred option and/or a 'Quick Win' capital scheme has been identified for a CDA, these have been included within the London-wide Prioritisation Matrix (Section 4.5).
- 4.3.7 It is expected that the preferred options presented within this Section will be developed and/or altered as further information, potentially through on-site investigation and /or third party collaborations, becomes available.

Cross Boundary Working

4.3.8 A significant amount of surface water flood risk in the London Borough of Lambeth is shared along the majority of its eastern boundary with the London Borough of Southwark and along its western border (to a lesser extent) with the London Borough of Wandsworth. As such, several of the CDAs identified for the London Borough of Lambeth are cross boundary and will require close working between the adjacent Boroughs to implement flood mitigation measures. The reader should refer to the London Boroughs of Southwark and Wandsworth's SWMPs for further information relating to cross boundary CDAs and proposed flood mitigation measures.

²¹ As part of Phase 2 of the SWMP Policy Areas have been defined across the Borough within which appropriate planning policies should be applied to manage flood risk. These Policy Areas cover the entire Borough and are not limited to CDA extents. The reason for the inclusion of these areas is to highlight the fact that even if an area does not fall within a CDA it does not mean that surface water discharge from these areas can be uncontrolled, merely that the need for considering direct options for the area are not so critical.

Lambeth-Wide Options: Raising Community Awareness

A 'quick win' action that should be implemented in the short-term is to increase awareness of flooding within communities at risk, and across the Borough as a whole. This could be achieved through a number of measures including:

- Newsletters (Figure 4.3.1);
- Drop-in surgeries;
- Promotion on Lambeth Council's website; and/or
- Community Flood Plan.

The aim of this action is to raise the risks and consequences of surface water flooding amongst local communities and, through this, encourage residents to take up measures to combat flooding, such as installation of water butts to capture roof runoff and consideration to the extent and materials used when replacing permeable areas with hard standing areas within their property e.g. through the installation of driveways and patios.

<image/> <complex-block><complex-block><complex-block></complex-block></complex-block></complex-block>					
Option A	Undertake a letter drop to highlight the improvement works that have been implemented as well as works that are planned for the future.				
Option B	 Hold a public meeting following the letter drop where residents can highlight any issues. This could include a talk from the key partner organisations – Environment Agency, Thames Water and Lambeth Borough Council – on the work that is being undertaken and who is responsible. Such a meeting should also outline how residents can help themselves and highlight their responsibility for maintaining private drainage, soakaways, driveway drainage etc. 				
Option C	Consider preparing a Community Flood Plan for those communities identified to be at high risk.				



Lambeth-Wide Option: Ongoing Improvements to Maintenance of Drainage Network

The management and maintenance of urban drainage network in the London Borough of Lambeth is the responsibility of a number of organisations:

- Lambeth Borough Council highway drainage including gully pots, non-main river channel maintenance and surface water;
- Thames Water main sewers and lateral sewers;
- Environment Agency flood risk management assets including culverts, raised defences, trash screens, Main River channel;
- TfL highway drainage along the 'Red Routes'; and
- Network Rail railway drainage.

Effective cleansing of gully pots is fundamental to the drainage across the Borough and Lambeth Borough Council operates a regular maintenance regime for gully cleansing. Based upon our consultation with Lambeth Council Highways Department, we understand that there are approximately 15,500 road drainage gully pots on Public Highways within the Council boundaries. Gully pots are fundamental to integrated urban drainage in that during intense precipitation events, surface water runoff is routed off roadways and other hard-standing and into gully pots and then into the public sewer system. In essence, gully pots are a critical link in the performance of the overall drainage network

A summary of the identified drainage maintenance issues in the London Borough of Lambeth are:

- Level of Service The current Lambeth Borough Council Highways Department maintenance cycle is on a 1-year maintenance regime for cleaning gully pots.
- **Development Pressures and Urban Creep** During site visits, the conversion of front gardens to paved areas for car parking was observed. This gradual increase in hard-standing (impervious area) results in cumulative impacts and additional pressure on the drainage system to cope with increased runoff.
- Blocked Gullies Lambeth Borough Council recorded 304 blocked gullies in 2008/2009 and 267 in 2009/2010.
- Weaknesses in Data Systems Improvement in the management of the Council's Highway Department drainage system is needed. While it appears that Lambeth Borough Council's Highways Department has made some improvements to the management of its drainage assets, further improvement is recommended.

drainage network		
Option A	Gullies that are known to flood could be painted yellow to encourage residents to check if they are blocked and to avoid parking directly over them thereby preventing access for gully clearing team.	
Option B	Encourage gully cleansing contractors to use powers to enforce movement of parked cars to ensure all gullies are regularly cleared.	
Option C	Coordinate timing of gully cleansing rounds to ensure that they do not coincide with school opening and closing times and other peak times that would prevent gaining access to gullies.	
Option D	Focus attention on the maintenance of gully pots in the identified CDAs which are considered to be high risk and on those areas identified as being at risk from blocked gullies	
Option E	Build on existing gulley database to develop a GIS database of all Council-owned flood / drainage assets (in line with FWMA 2010 requirements).	
Option F	As LLFA, the Council must record and investigate incidents of flooding. It is recommended that the source of flooding be recorded, e.g. gully surcharging, to inform maintenance priorities.	
Option G	Aerating sports grounds and football pitches to reduce compaction of ground and improve infiltration potential.	



A number of options and policies have been identified for the study area that Lambeth Borough Council and relevant stakeholders may consider adopting as part of their responsibility as LLFA for local flood risk management. The majority of the following options are common across the Borough; however the way in which they are implemented may vary.

Paved Gardens

Impermeable paving in gardens can significantly increase surface water runoff entering the local drainage network. From the 1st October 2008 the permitted development rights that allow householders to pave their front garden with hard standing without planning permission was removed. Residents should be encouraged to design their gardens in a way that optimises drainage and reduces runoff. The Council should publicise this issue and refer to standard guidance on the surfacing of front gardens provided by the CLG and Environment Agency in September 2008.



Figure 4.3.2 - Examples of Permeable Front Gardens Allowing for Parking (Source: CLG/EA Guidance on the permeable surfacing of front gardens 2008; Richmond Scrutiny Report 2008) Recommendation 17: Ensure appropriate Development Control Policy for repaving of gardens or driveways and explore education / awareness opportunities for general public regarding SuDS guidance and 'best practice'

Option A	Council could encourage residents to ensure that paved areas in front gardens drain onto flower beds rather than running onto the highway.		
Option B	The council could aim to raise awareness of the options for installation and maintenance of permeable surfaces within property grounds.		
Option C	The council could aim to provide an information portal that residents can consult for further information on permeable paving and other SuDS measures, including links to other organisations (e.g. Environment Agency) who can provide 'best practice' guidance and examples		
	The Council could aim to educate/train their staff to ensure that planning officers:		
	 are aware of the existing planning permissions, guidance and best practice; 		
Option D	 are in a position to educate the public if enquiries are made regarding planning permission to change their drive/garden; and 		
	 can identify/enforce for non-compliance or non permitted conversion (in particular in CDAs where it exacerbates the problem). 		
Sustainabl	e Drainage Systems (SuDS)		

A number of policies have already been implemented within the London Borough of Lambeth to ensure that new development incorporates Sustainable Drainage Systems (SuDS) wherever possible. It is recommended that these are reviewed and updated where necessary in the light of the Groundwater Assessment (Appendix C2) and the SuDS Suitability Map shown in Figure D-6. For example, planning policy could be included in the forthcoming Development Management DPD regarding SuDS. A summary of the type of SuDS that could be utilised is provided below.



SuDS techniques can be used to reduce the rate and volume and improve the water quality of surface water discharges from sites to the receiving environment (i.e. natural watercourse or public sewer etc). Various SuDS techniques are available and operate on two main principles; attenuation and infiltration. All systems generally fall into one of these two categories, or a combination of the two.

Infiltration SuDS

This type of SuDS relies on discharges to ground, where suitable ground conditions exist or are appropriate. Therefore, infiltration SuDS are reliant on the local ground conditions (i.e. permeability of soils and geology, the groundwater table depth and the importance of underlying aquifers as a potable resource) for their successful operation.

Development pressures and maximisation of the developable area may reduce the area available for infiltration systems. This can be overcome through the use of a combined approach with both attenuation and infiltration techniques e.g. attenuation storage may be provided in the sub-base of a permeable surface, within the chamber of a soakaway or as a pond/water feature.

Permeable surfaces are designed to intercept rainfall and allow water to drain through to a sub-base. The use of a permeable sub-base can be used to temporarily store infiltrated run-off underneath the surface and allows the water to percolate into the underlying soils. Alternatively, stored water within the sub-base may be collected at a low point and discharged from the site at an agreed rate.

Permeable paving prevents runoff during low intensity rainfall, however, during intense rainfall events some runoff may occur from these surfaces.

Programmes should be implemented to ensure that permeable surfaces are kept well maintained to ensure the performance of these systems is not reduced. The use of grit and salt during winter months may adversely affect the drainage potential of certain permeable surfaces.

Types of permeable surfaces include:

- Grass/landscaped areas
- Gravel
- Solid Paving with Void Spaces
- Permeable Pavements

Where permeable surfaces are not a practical option more defined infiltration systems are available. In order to infiltrate the generated run-off to ground, a storage system is provided that allows the infiltration of the stored water into the surrounding ground through both the sides and base of the storage. These systems are constructed below ground and therefore may be advantageous with regards to the developable area of the site. Consideration needs to be given to construction methods, maintenance access and depth to the water table. The provision of large volumes of infiltration/sub-surface storage has potential cost implications. In addition, these systems should not be built within 5m of buildings, beneath roads or in soil that may dissolve or erode.

Various methods for providing infiltration below the ground include:

- Geocellular Systems
- Filter Drain
- Soakaway (Chamber)
- Soakaway (Trench)
- Soakaway (Granular Soakaway)

The infiltration SuDS suitability assessment shown in Figure D-6 is based on minimum permeability data obtained from the BGS. There also exist maximum permeability data, however, only the minimum permeability is used, as this is understood to be more representative of the bulk permeability.



Three permeability zones have been identified:

- Infiltration SuDS potentially suitable: Minimum permeability is high or very high for bedrock (and superficial deposits if they exist).
- Infiltration SuDS potentially unsuitable: Minimum permeability is low or very low for bedrock (and superficial deposits if they exist).
- Infiltration SuDS suitability uncertain: Minimum permeability is low or very low for bedrock and high or very high for superficial deposits OR minimum permeability is low or very low for superficial deposits and high or very high for bedrock.

Figure D-6 shows that much of the London Borough of Lambeth is potentially unsuitable for infiltration SUDS; this is where the impermeable London Clay Formation is at surface. The suitability of infiltration SUDS in those areas with River Terrace Deposits in uncertain i.e. the ability of the River Terrace Deposits to store and transmit groundwater without causing flooding / drainage issues is uncertain and requires further investigation.

It is noted that this is a high level assessment and only forms an approximate guide to infiltration SUDS suitability; a site investigation is required in all cases to confirm local conditions.

Attenuation SuDS

If ground conditions are not suitable for infiltration techniques then management of surface water runoff prior to discharge should be undertaken using attenuation techniques. This technique attenuates discharge from a site to reduce flood risk both within and to the surrounding area. It is important to assess the volume of water required to be stored prior to discharge to ensure adequate provision is made for storage. The amount of storage required should be calculated prior to detailed design of the development to ensure that surface water flooding issues are not created within the site.

The rate of discharge from the site should be agreed with the Local Planning Authority and the Environment Agency. If surface water cannot be discharged to a local watercourse then liaison with the Sewer Undertaker should be undertaken to agree rates of discharge and the adoption of the SuDS system.

Large volumes of water may be required to be stored on site. Storage areas may be constructed above or below ground. Depending on the attenuation/storage systems implemented, appropriate maintenance procedures should be implemented to ensure continued performance of the system. On-site storage measures include basins, ponds, and other engineered forms consisting of underground storage.

Basins are areas that have been contoured (or alternatively embanked) to allow for the temporary storage of runoff from a developed site. Basins are designed to drain free of water and remain waterless in dry weather. These may form areas of public open space or recreational areas. Basins also provide areas for treatment of water by settlement of solids in ponded water and the absorption of pollutants by aquatic vegetation or biological activity. The construction of basins uses relatively simple techniques. Local varieties of vegetation should be used wherever possible and should be fully established before the basins are used. Access to the basin should be provided so that inspection and maintenance is not restricted. This may include inspections, regular cutting of grass, annual clearance of aquatic vegetation and silt removal as required.

Ponds are designed to hold the additional surface water run-off generated by the site during rainfall events. The ponds are designed to control discharge rates by storing the collected run-off and releasing it slowly once the risk of flooding has passed. Ponds can provide wildlife habitats, water features to enhance the urban landscape and, where water quality and flooding risks are acceptable, they can be used for recreation. It may be possible to integrate ponds and wetlands into public areas to create new community ponds. Ponds and wetlands trap silt that may need to be removed periodically. Ideally, the contaminants should be removed at source to prevent silt from reaching the pond or wetland in the first place. In situations where this is not possible, consideration should be given to a small detention basin placed at the inlet to the pond in order to trap and subsequently remove the silt. Depending on the setting of a pond, health and safety issues may be important issues that need to be taken into consideration. The design of the pond can help to minimise any health and safety issues (i.e. shallower margins to the pond reduce the danger of falling in, fenced margins).



Various types of ponds are available for utilising as SuDS measures. These include:

- Balancing/Attenuating Ponds
- Flood Storage Reservoirs
- Lagoons
- Retention Ponds
- Wetlands

Site constraints and limitations such as developable area, economic viability and contamination may require engineered solutions to be implemented. These methods predominantly require the provision of storage beneath the ground surface, which may be advantageous with regards to the developable area of the site but should be used only if methods previously described cannot be used. When implementing such approaches, consideration needs to be given to construction methods, maintenance access and to any development that takes place over the storage facility. The provision of large volumes of storage underground also has potential cost implications.

Methods for providing alternative attenuation include:

- Deep Shafts
- Geocellular Systems
- Oversized Pipes
- Rainwater Harvesting
- Tanks
- Green and Brown Biodiverse Roofs

In some situations it may be preferable to combine infiltration and attenuation systems to maximise the management of surface water runoff, developable area and green open space.

Recommendation 18: Ensure Development Control Policy incorporates surface water flood risk conditions and the latest available surface water flooding information including runoff rates, SuDS, driveway repaving etc.



Lambeth-Wide Options: Water Conservation

Water conservation is a key option for reducing peak discharges and in turn downstream flood risk. This can be applied using a number of options including planning led encouragement of the use of rainfall in rainwater harvesting systems and property level use of water butts. Both are described in more detail below.

Rainwater Harvesting

The potential for the use of rainwater should be jointly led by Thames Water and the council. Promotion of the benefits of such schemes could be rolled out across multiple Boroughs to reduce costs. The principle of rainwater harvesting in both domestic and commercial property is the same. Rainwater from roof areas is passed through a filter and stored within large underground tanks. When water is required, it is delivered from the storage tank to toilets, washing machines and garden taps for use. If the tank becomes low on stored water, demand is topped up from the mains supply. Any excess water can be discharged via an overflow to a soakaway or local drainage network.

Rainwater harvesting systems could be retrofitted to local schools within the Borough. A case study for Southampton University Student Services Building is described below, with an example layout of a system illustrated in Figure $4.3.3^{22}$:

- Roof Area: 1000m²
- Underground storage tank: 15,000 litres
- Building occupancy: 150 people
- Planned usage: 21 WCs and 3 urinals
- Expected annual rainwater collection: 410,000 litres
- Capital cost: £4,325
- Expected pay back time 5.3 years (based on Southern Water 2006 tariff)



²² Source: Rainwaterharvesting systems UK

Lambeth-Wide Options: Water Conservation

Recommendation 19: Consider opportunities to promote rainwater harvesting in both new and existing development throughout the London Borough of Lambeth

Option A	systems across the Borough. This may be linked to the Council's sustainability checklist.
Option B	The Council could consider retrofitting rainwater harvesting systems on Council owned properties, such as schools, for example, which offer educational opportunities as well as local surface water flood mitigation.
Option C	The Council could explore potential opportunities for the installation of rainwater harvesting systems on new or regenerated development areas (in particular where there is high footfall / potential for use)

Water Butts

One of the preferred measures to reduce peak discharges and downstream flood risk, is the robust implementation of water butts on all new development within Lambeth, and where possible and higher surface water flooding risk has been identified, retrofitting these to existing properties. Given the constraints associated with infiltration in much of the Borough, the wholesale implementation of water butts can significantly reduce peak discharges.

Water butts often have limited storage capacity given that when a catchment is in flood, water butts are often full, however it is still considered that they have a role to play in the sustainable use of water and there is potential to provide overflow devices to soakaways (where geology permits) or landscaped areas to ensure that there is always a volume of storage available.

Whether to construct formal spill pipes to soakaways, or to allow simple overspill to the adjacent ground are detailed decisions that will need to be based on a site-by-site basis; this will have only minor significance on the proposals with respect to the surface water drainage.



Figure 4.3.4 - Example of a 100L Water Butt Retrofitted to Existing Development

Recommendation 20: Consider opportunities to promote use of water butts in both new and existing development throughout the London Borough of Lambeth

Option D	Consider installation of water butts for all new development. This ties in with the SuDS hierarchy and reduces peak discharges to surface water and is likely to have positive impacts to sustainability and water re-use
Option E	Consider retrofitting water butts on all existing development (as shown on Figure 4.3.4). This provides supplementary benefits beyond regeneration and redevelopment sites (volumetric reduction with opportunity for complimentary water quality improvements). However there are Currently no available incentives to encourage homeowners to install water butts.
Option F	It is recommended that the Council promote the use of water butts across the Borough and provide information (either directly or through links to external websites) on potential costs, installation and benefits.



Lambeth-Wide Options: Improving Resilience to Flooding

Property Resilient Measures (Increasing Property or Gate Thresholds)

One method to reduce the risk of surface water flooding to properties is raising property thresholds. Raising the threshold of entrances to property land, i.e. where there are currently gates adjacent to paved walls (Figure 4.3.5 may offer flood resilience benefits, especially where the property contains a basement. Property level thresholds could also be increased where possible to improve resilience to surface water flooding, and especially where roads are predicted to flood and the properties contain no front gardens (Figure 4.3.5).

Thresholds as shown in Figure 4.3.5 are a useful and an accepted method of defending property against flooding, although this can conflict with possible accessibility issues within Part M, Section 6 of the Building Regulations 2004 and the requirements of the Disability Discrimination Act 1996 (DDA). Until such time as national guidance or best practice is available Lambeth will, when required, work with residents to realise suitable, sensible and cost effective solutions which allow access and deliver mitigation against possible flooding.



Figure 4.3.5 - Example of Raised Property Thresholds

(Gate Threshold on Dulwich Road and Property Threshold on Robson Road, London Borough of Lambeth) Recommendation 21: Consider opportunities to promote awareness of property level thresholds throughout the London Borough of Lambeth, particularly in area of higher flood risk

Option A	It is recommended that the Council aim to raise the awareness of the options for increasing property thresholds
Option B	It is recommended that the Council work with residents to realise suitable, sensible and cost effective property level resilience to potential flooding (through, for example raising property thresholds to 100mm), particularly in areas where roads / properties are known / identified to be susceptible to surface water flooding.

Community Flood Plans

Completing a Community Flood Plan will help communities decide what practical actions to take before and during a flood, which may help reduce the damage flooding could cause. The flood planning process makes use of local knowledge and experience to produce a plan that caters for (a) preparing for a flood, (b) during a flood, and (c) after a flood, and should aim to complement the authorities' emergency plans and to provide essential information to help manage a flood event.

Working together as a community or group has multiple benefits, including:

- Sharing information on what to expect and what to do before, during and after a flood incident;
- Identify and clarify the responsibilities of all those involved (this avoids duplication, saving time and money);
- Clarifying the responsibilities of all those involved;
- Improving communication throughout the community and with the organisations involved before, during and after a flood;



Lambeth-Wide Options: Improving Resilience to Flooding

Property Resilient Measures (Increasing Property or Gate Thresholds)

- Help share local knowledge and that of people who have been flooded with professional organisations and ensure people's concerns are heard;
- Increasing preparedness to reduce the damage and distress of a flood;
- Being involved in flood planning will enable a community or group to take control and help during a flood, when other organisations could be overstretched or unable to reach them; and,
- Increasing community resilience.

Further information regarding Community Flood Plans (including a Community Flood Plan Pack) is available on the Environment Agency's website: <u>http://www.environment-agency.gov.uk/homeandleisure/floods/38329.aspx</u>.

Recommendation 22: Identify areas where Community Flood Plans my be effective and consider opportunities to develop these, in conjunction with the local community



Lambeth-Wide Options: Complimentary Measures

Alongside more '*traditional*' and accepted methods and measures to alleviate and mitigate flood risk, softer measures and relevant levels of enforcement, including realising the positive effects a scheme can have positive effects above and beyond the primary function of flood mitigation and alleviation.

Lambeth have identified a number of 'complimentary measures' and actions which they could endeavour to introduce, encourage and implement across Lambeth as a whole, and where practical and feasible across borough boundaries. The approach will include design guidance for residents, advice on water use, amenity, inclusive public realm design alongside this there will be practical guidance and advice to assist residents and businesses in being more resilient and prepared in the future should there be an extreme rainfall event.

This approach has the potential to deliver positive benefits not only for surface water management but also provide greater and wider benefits to the community as a whole, such as empowering communities in taking greater interest in how their environment is shaped and moulded, and encouraging greater resilience to communities as well as individuals in the event of a flooding incident.

Design Guidance

A series of Design Guidance documents could be produced to provide simple, clear advice with cost effective measures which can be undertaken by to make greater use of rain water, such as water butts, green roofs, changing gradients of patios etc. The documents could be aimed at a range of audiences including Residents, Engineers and Developers and guide the design and implementation of surface water measures within the Borough.

Amenity

Lambeth could consider opportunities to allow and encourage amenity alongside surface water mitigation by instilling amenity into the designs at the outset to deliver high quality designed schemes that are multifunctional, in that they provide flood mitigation and alleviation alongside an amenity which can be used and enjoyed all year round. Examples include:

- Creating a "Swale Maze"²³ which is primarily designed to attenuate water in extreme events however during any other time it is a fun informal play space for children;
- Constructing a rain garden which incorporates a sensory garden or an accessible garden, but whose
 primary purpose is flood mitigation or alleviation to attenuate storm water during a 1 or 0.5% chance of
 flooding event in any given year. This means that there will be long periods of time and years where
 these schemes may not be used for their intended purpose this does not mean they should be fenced off
 and restricted they should where it is feasible and practical to do so made to be enjoyed and incorporated
 into the urban environment for all to enjoy.

Best Practice

Lambeth could explore Best Practice approaches from around the world and endeavour to implement similar schemes which multifunctional, and, alongside other benefits achieve both the primary role of flood mitigation and alleviation but also amenity.

One example is North America which has had vast experience in dealing with and designing surface water run off in urban environments where amenity, as standard, is included in the final designs, such as Seattle and the 'Green Streets' project complimented with other high profile elements such as 'Adopt-a-drain' where residents are encouraged to look after the drains in their street. This approach to drainage is repeated across many cities, such as Washington, New York, Chicago, Detroit and towns where there is a collective responsibility for drainage. It is accepted that although these approaches to surface water run off in North America are well thought out and work well, it does not mean they will translate immediately to Lambeth.

²³ Further information is available here: <u>http://www.sustainabledrainage.co.uk/</u>



Lambeth-Wide Options: Complimentary Measures

Therapeutic Landscapes

Although in its infancy in inclusive design Therapeutic Landscapes have long been associated with healing and well-being. For example, places such as Lourdes and Epidaurus, have long been known to have positive effects on people, their health, well-being and recovery from illness. This has been supported in the fact that many hospitals now include these designed areas to create an escape from the hospital milieu, such as Great Ormond Street Hospital and the proposed designs for Moorfields Eye Hospital, again these areas also include amenity and other aspects such as sensory gardens.

The benefits of such landscapes have been recently recognised through the Urban River Corridors and Sustainable Living Agendas (URSULA) project where the well being and health of people is a part of the research²⁴ and was realised through 'day-lighting' work undertaken in Sheffield. It is clear that well designed amenity and the inclusion of water has positive benefits on the well being of people, and Lambeth could consider opportunities for implementing Therapeutic Landscapes within the Borough.

Social Inclusion and Health Agenda

Flooding does not understand or discriminate against social mobility or standing, however it can be demonstrated that in certain instances the more vulnerable in society may well be at more risk from the effects of flooding. It can also be demonstrated that those in society who have greater mobility needs are generally housed in ground floor properties which places a greater risk and need for greater resilience although, paradoxically, wheelchair users in specifically designed dwellings will probably be more resilient to flooding due to design requirements.

Voluntary organisations can play an important, and have an extremely positive, role within the community. Lambeth could work with organisations such as SusTrans through their liveable neighbourhoods initiatives including DIY Streets and 'Free Range Kids' through to Living Streets, GrassRoutes, Groundwork and many similar organisations who all bring a different valuable aspects to discussions and designs. These organisations engage with communities on different levels which can be essential in obtaining general consensus and understanding in what Lambeth will be aiming to achieve, in terms of flood mitigation and alleviation alongside amenity and well-being.

Aside from voluntary organisations, other authorities from the GLA, London Councils through to the Environment Agency bring expertise and different perspectives to what is being proposed. Authorities such as the GLA have a larger and wider understanding of concerns affecting London as a whole and oversee projects such as the Green Grid and 'Sowing the Seeds' where their primary role is to deliver real measurable benefits which will compliment and contribute flood mitigation and alleviation through wider community engagement and understanding.

Enforcement

Enforcement is not necessarily associated with flooding and being a part of mitigation or alleviation, however the enforcement of clearly communicated actions could lead to benefits across Lambeth and beyond. It is well documented that placing fat, oils and Greases (FOG) down a drain can lead to blockages in the sewer network; this is more so in a central London authority with the extent and limitations of the combined sewer network.

Lambeth could encourage all food outlets which use FOG for cooking to actively re-cycle their used FOG for biofuels; there are companies who will collect used oil in exchange for new oil free of charge. Although this is a small step it can assist in keeping the sewers free of oil. Alongside this approach Lambeth could support Thames Water in any publicity undertaken surrounding the disposal of FOG down drowns.

It is also essential that there is greater awareness by developers, builders and residents who are undertaking renovations of properties that it is not acceptable to mix concrete on the street and wash the residue into the street drains or dispose of other materials into the street drains as this will block the drains which in turn will

²⁴ Further information is available here: <u>http://www.ursula.ac.uk/research/river</u>



Lambeth-Wide Options: Complimentary Measures

render them useless when they are needed. This also applies to utility companies and Lambeth's own works and to ensure materials are not stored on top of or adjacent to any street gullies and that the any drainage channels are not blocked. Lambeth could ensure that appropriate guidance and penalties (if appropriate) are in place to ensure that no damage or adverse impact to Lambeth's drainage network or assets are incurred from third parties.

Water Use

Lambeth could consider opportunities to encourage water use reduction across the Borough to reduce water entering the sewer system and thereby provide an increased level of capacity within the sewer system for surface water.

Although water use and the reduction is as important as implementing schemes to alleviate and mitigate against flood risk, current levels of water use are likely to increase across the Borough in future years as a result of new development and changing customer behaviour. This increased water demand is likely to lead to an increase use in the sewer system which is likely to be close to its design limits at present across some parts of the network. By managing water use through, for example, metering and using water butts (to water gardens rather than using the potable drinking water), a reduction in the wastewater entering the sewer system could be achieved and provide an increased level of capacity in the sewer system.

Water Quality

The Water Framework Directive 2000 clearly sets out relevant standards on water quality and how it should be treated and disposed off. Water runoff should not knowingly carry any pollution and should protect from diffuse pollution in urban environments.

Water quality can be affected by many different aspects, there are however a multitude of other causes and risks which need to be mitigated and will have to be undertaken on individual basis, such as motor mechanics repair garages having appropriate spill kits and interceptors in place through to general detritus being swept into street drains.

Lambeth could consider providing appropriate guidance in relation to reducing water quality impacts and explore opportunities for providing water quality benefits through any future flood mitigation schemes or measures implemented within the Borough.

Recommendation 23: Identify opportunities for introducing, encouraging and implementing '*Complimentary Measures'* across the London Borough of Lambeth



CDA: Group7_025 (Streatham Common)

Preferred Option: Further Investigation of Flooding Mechanisms

Pluvial modelling for this area indicates that during heavy rainfall events, surface water will pond in the Eardley Road railway underpass and along the adjacent Edgington Road, and to the railway cutting to the east and west of Streatham Common Railway Station. Discussions with Lambeth Borough Council and cross referencing against historical flooding records indicate that there have been some groundwater and sewer flooding incidents in this area but no significant surface water flooding recorded. The pluvial modelling outputs indicate that 40 residential properties (in the Edgington Road area) are at risk of flooding to a depth of greater than 0.5m during the 1% AEP rainfall event. It is therefore recommended that Lambeth Borough Council could consider further investigating the flooding mechanisms in this area, through undertaking a topographical survey of the Eardley Road LFRZ and the Streatham Common Station Railway Cutting LFRZ, and identifying the local and railway drainage capacity, to improve the understanding of surface water flooding risk to surrounding properties and infrastructure during extreme rainfall events. The results of the investigations could be fed into the Drain London surface water models, to update the flood depth and hazard outputs from this study.

Approximate Costs <£25		
Potential Benefits		ved understanding of surface water flooding mechanisms and flood risk ved evidence to justify flood mitigation options in the CDA ved understanding of risk to critical infrastructure ved evidence for prioritising third-party localised drainage improvements
Potential C	Options for Considera	tion Following Further Investigation
Option A	Increase the number or size of gullies to collect runoff and discharge to sewer	The number and size of gullies along Eardley Road and Edgington Road could be increased to collect surface water and discharge to sewer. This would require agreement with Thames Water, following further investigation of the existing local drainage arrangements and capacity.
Option B	Attenuate flows under or adjacent to railway underpass (Eardley Road)	Attenuation of flood water alongside the railway embankment or underneath the railway underpass. The area alongside the railway track (adjacent to Edgington Road) is currently used for storage / industrial purposes so land ownership will need to be determined and the feasibility of using this area for storage assessed (Figure 4.3.6). The road under the railway underpass is at a topographical low point and there is potential here to attenuate water during flooding as surface water is predicted to pond in and behind the underpass.
Option C	Improve Community Resilience through installation of Demountable Flood Barriers	Property level demountable flood barriers could be installed to those properties in the Edgington Road / Eardley Road area that are predicted to flood to depths of greater than 0.5m during the 1% AEP rainfall event. This measure should be combined with ensuring that gate and property thresholds are at least 100mm.



CDA: Group7_025 (Streatham Common)

Potential 'Quick Win' - Improve Community Awareness - River Graveney Community Awareness Event

Investigate opportunities to improve community awareness of the surface water flood risk through the proposed 'river party' for residents in the River Graveney area, with support from the Environment Agency. The aim is to get people signed up to the flood-line and raise awareness of the flooding risk in the area. Lambeth would like to include extend this work to include the Eardley Road area, as a sub stream of work concentrating on the issues of surface water.

Existing Schemes

Some measures are already underway in the wider CDA to address localised surface water flood risk. An attenuation scheme has recently been implemented on Streatham Common, to the east of the CDA, where the land drainage has been renewed, and rather than allowing the surface water to discharge directly to the sewers, a 'barrier' has been implemented to slow the water runoff. The scheme includes 3m lengths of polystyrene packaging in nets (laid 3-wide and 2-high in the bottom of the trench) laid across the width of the common and then connected directly into the nearest drain (see Figure 4.3.7). The scheme runs north to south across the common as the fall is east to west. At present the benefits of the scheme are unknown, but are likely to be localised and therefore additional schemes may be required to address predicted surface water flooding in the downstream Eardley Road area.



Figure 4.3.7 - Streatham Common SuDS Scheme (Source: Lambeth Borough Council)



CDA: Group7_026 (Streatham)

Preferred Option: Further Investigation of Flooding Mechanisms

Pluvial modelling for this area indicates that during heavy rainfall events, surface water will pond in the Stanthorpe Road area and along the railway line to the east of Streatham Common Station. Discussions with Lambeth Borough Council and cross referencing against historical flooding records, indicate that there have been some groundwater and sewer flooding incidents in this area but no significant surface water flooding recorded. The pluvial modelling outputs indicate that approximately 40 residential properties and 10 non-residential properties (the majority in the Stanthorpe Road area) are at risk of flooding to a depth of greater than 0.5m during the 1% AEP rainfall event. Further discussions with the Council regarding potential options for this CDA indicated that given the currently level of information available in this area there are currently considered to be limited options, beyond increasing the capacity of the sewer network and/or separating the network (which is a costly solution given that, historically, there are no recorded surface water flooding incidents). Without further investigation and understanding of topography it is not possible to determine the best mitigation options for flooding in this area.

It is therefore recommended that Lambeth Borough Council consider further investigating the flooding mechanisms in the Stanthorpe Road LFRZ and Streatham Station Railway Cutting LFRZ, through undertaking a detailed topographical survey of the LFRZs, and identifying the local and railway drainage capacity, to improve the understanding of surface water flooding risk to surrounding properties and infrastructure during extreme rainfall events. The results of the investigations could be fed into the Drain London surface water models, to update the flood depth and hazard outputs from this study.

Approximate Costs		<£25k		
Potential Benefits		Improv	ed understanding of surface water flooding mechanisms and flood risk	
		Improved evidence to justify flood mitigation options in the CDA		
		 Improv 	ed understanding of risk to critical infrastructure	
		 Improv 	ed evidence for prioritising third-party localised drainage improvements	
Potential C	Options for	Considerat	ion Following Further Investigation	
Option A	Flood Storage in Playing Fields (South of Curtis Field Road)		One option for consideration is the construction of a flood storage pond in the playing field south of Curtis Field Road. The playing field offers some opportunity for flood storage but the benefits are likely to be localised and may help alleviate some surface water flows in the upstream part of the CDA. The playing field could offer up to 7,000m ³ of potential storage volume, assuming a depth of 1m. It is recommended that the playing fields are lowered by 1m to provide the flood storage area. The cost to implement this scheme is likely to range from £101k - £250k and offer benefits to the immediate area downstream, but is unlikely to significantly alleviate flooding in the Stanthorpe Road area.	
Option B	Formalise Sunnyhill School Field as Flood Storage Area		Sunnyhill School Field is modelled to accumulate 3,500m ³ of surface water during the 1% AEP rainfall event, with the existing topography acting as a flood storage bowl and containing flood water falling on the area, and flowing to the area from the northeast. It is recommended that Sunnyhill School field is formalised as a Flood Storage Area and appropriate measures are put in place for times of flooding. It is recommended that this is confirmed through on-site investigations and that safe access and egress arrangements from the school are in place.	
Option C	Railway D Improvem (Network	Drainage nent Rail)	Investigate opportunities to improve the Network Rail drainage system along railway track. Opportunities could include installation of swales along the railway track (space allowing). This will require confirmation by Network Rail in relation to their current drainage capacity along the stretch of railway between Streatham Railway Station and tunnel entrance south of Leigham Court Road. It is estimated that swales, space permitting, could be installed at three stretches along the railway line either side of the	



CDA: Group7_026 (Streatham)			
		railway (and along adjacent paths – in combination with attenuation option discussed below); whilst no properties would be mitigated against flooding, the railway tracks would not flood during the 1% AEP rainfall event, allowing a main train route into central London to remain open and operating.	
Option D	Attenuation and Drainage (footpath adjacent to railway track)	In combination with Improvement to the Drainage Infrastructure along the railway line, it is recommended that further investigation is undertaken to assess the opportunities for attenuation of surface water along the footpath adjacent to the railway line (east of Streatham Railway station) as attenuation and the mechanisms for the drainage of this water to the existing sewer system.	



CDA: Group7_027 (Clapham South)

Preferred Option: Source Control, Attenuation and SUDS in North Clapham Park LFRZ

There are limited opportunities for implementing flood mitigation measures in this CDA, given the urbanised nature of the CDA and type of housing. Therefore, the preferred capital option for the CDA is to use the open space in council housing estates in the North Clapham Park LFRZ as temporary flood storage (by installing swales) and provide permeable paved surfaces where feasible. This may require some re-landscaping of areas but there are several locations where this could be successfully applied and help alleviate flooding to properties (Figure 4.3.8 and Figure 4.3.9).

Approximately 5,100m³ of storage could be offered (assuming a depth of 500mm) by implementing swales throughout the area to the northwest of Abbeville Road. This would cost £101k - £250k to implement.

The council could also consider the use of permeable surfaces where there are large areas of hardstanding (Figure 4.3.8) to provide some local flood risk attenuation. The cost of implementing permeable surfaces has not been undertaken at this time as it would require on-site investigation to determine feasibility. Figure 4.3.9 provides an indication of where permeable surfaces could be considered.

It is recommended that a feasibility study is undertaken to determine the viability of the potential flood storage and permeable surface sites, and identify the site-specific storage volumes, surface water flow paths and runoff from surrounding areas and to determine local topography.



Figure 4.3.8 - Clapham Crescent (Opportunities for Flood Storage) and Worsopp Drive (Opportunities for Permeable Surfaces)





CDA: Group7_027 (Clapham South)		
Approximate Costs	£101k - £250k	
Potential Benefits	 Potential to provide flood mitigation to 10% of the infrastructure, 20% of the households and 30% of the commercial properties predicted to flood during the 1% AEP rainfall event. Improved amenity / social benefits in the council estates in the Abbeville Road area 	
Potential 'Quick Win' - Community Flood Plan (North Clapham Park LFRZ)		
The majority of the flooded area in this CDA is social housing. Therefore improving the resilience of the local community will be of high priority and need to be Council-led. Lambeth Borough Council could consider undertaking a Community Flood Plan for the North Clapham Park LFRZ as a 'Quick Win' option. Producing a Community Flood plan for this area could improve preparedness for future flood events and ensure that measures are in place to deal with any future flooding events.		



CDA: Group7_028 (Nine Elms)

Preferred Option: Surface Water Drainage Catchment Study

Flooding within this CDA is widespread with deep areas of surface water flooding (greater than 0.5m for the 1% AEP rainfall event extending along the northwest Lambeth / Wandsworth boundary (Northwest Wandsworth Road LFRZ). There are some, but limited records of surface water, groundwater and sewer flooding in this area, and 82 residential properties are predicted to flood to a depth greater than 0.5m during the 1% AEP rainfall event. Through the pluvial modelling undertaken for this study, it is considered that local topography is the main contributing factor to predicted flooding in this area. It is therefore recognised that further assessment will be required, in conjunction with the London Borough of Wandsworth and Thames Water, to identify the best location based on benefits, costs and social / environmental impacts, and assess the technical feasibility of providing flood storage areas throughout the CDA.

It is therefore recommended that flooding within this CDA is further assessed, potentially through detailed modelling, to identify opportunities for those options provided below.

Approximate Costs		<£25k	
Potential Benefits •		 Improv decisic Potent econor part of Provisi identify 	ed understanding of flood risk and flooding mechanisms to inform in making. al for identifying those schemes that provide environmental and socio- nic benefits such as water quality and amenity within the catchment as a range of measures to be taken forward. on of sufficient information to undertake a cost / benefit analysis to y those measures to be taken forward.
Potential C	Options for Co	onsideration	1
Option A	Utilising open spaces in housing, industrial estates and schools as temporary flood storage		This may require some re-landscaping of areas but there are several locations where this could be successfully applied and help alleviate local surface water flooding to properties (Figure 4.3.10), particularly in the north of the CDA (along the Lambeth / Wandsworth border). Based on areas identified through preliminary assessment, up to 3,000m ³ of flood storage (assuming an area of 3,000m ² and depth of 1m) could be available throughout the CDA (excluding the lager parks of Larkhall, Heathbrook and Clapham Common / Clapham Gateway).
Option B	Separating s water and fo systems alor / Wandswort Boundary	urface ul water ng Lambeth h	The sewer system throughout the CDA is combined. There are some trunk sewers (1000mm to 1600mm) running north-south and west-east through the north of the CDA, where the greatest flooding is predicted. In terms of capacity within the combined system there are limited benefits in upgrading this further. The best option may be to consider separating sewers in this area and/or combining with pumping surface



CDA: Gro	oup7_028 (Nine Elms)		
		water out of the area into the River Thames (perhaps from Brockheath Park). In the short to medium term it is recommended that all new development in this area should be built with a separate surface and foul sewer system to avoid additional overloading of the combined sewer.	
Option C	Utilising parks for large scale flood storage	Larkhall Park (London Borough of Lambeth) and/or Heathbrook Park (London Borough of Wandsworth), for example, could be used as temporary flood storage areas for surface water flooding in the north of the CDA. Flows could be diverted from Corland Grove, and potentially mitigate flooding to 135 buildings downstream to the north of Corland Grove and Larkhall Park. In Heathbrook Park, flood storage of up to 4,050m ² could be available for flood storage and mitigate flooding to the LFRZ.	
Existing S	Existing Schemes		

A SuDS scheme is currently being implemented at Clapham Gateway (north Clapham Common), to create a swale in the Old Town. Other opportunities are also being considered as the design is being further developed. The SuDS scheme is part funded by TfL. When completed, this should help alleviate some of the downstream surface water flooding, holding back flows from Clapham Common area. This will have some, but limited, impact on surface water flooding in the north of the CDA.



CDA: Group7_029 (Probyn Road)

Preferred Option: Further Investigation of Flooding Mechanisms

Pluvial modelling for this area indicates that during heavy rainfall events, surface water will pond in and to the east of Probyn Road. Discussions with Lambeth Borough Council and cross referencing against historical flooding records indicate that there have been some groundwater and sewer flooding incidents in this area but no significant surface water flooding recorded. The pluvial modelling outputs indicate that 30 residential properties (predominating to the east of Probyn Road) are at risk of flooding to a depth of greater than 0.5m during the 1% AEP rainfall event. It is therefore recommended that Lambeth Borough Council could consider further investigating the flooding mechanisms in this area, through undertaking a topographical survey of the Probyn Road area, and identifying the local drainage capacity, to improve the understanding of surface water flooding risk to surrounding properties during extreme rainfall events. The results of the investigations could be fed into the Drain London surface water models, to update the flood depth and hazard outputs from this study.

Approximate Costs		<£25k		
Potential Benefits		Improved understanding of surface water flooding mechanisms and flood risk		
		 Improved evidence to justify flood mitigation options in the CDA 		
Potential C	Options for	Considerat	ion Following Further Investigation	
Option A	Increase Drainage Capacity in Probyn Road		The existing drainage system capacity serving the Probyn Road area could be increased and connections to drainage system upgraded. It is recommended that this is undertaken along Probyn Road. This option will require further assessment of the mechanics of the problem prior to installation / upgrade. On-site investigations should be undertaken to get a full understanding of the existing drainage capacity in the Probyn Road area.	
Option B	Improve Community Resilience in Probyn Road		It is recommended that residents be encouraged to install / implement property level resilience measures and ensuring 100mm household and gate thresholds (due to some properties along Probyn Road having basements) to reduce the likelihood and consequences of surface water flooding in the area and to individual properties. Implementation of property level demountable flood barriers could also be considered for those properties predicted to flood to depths greater than 0.5m.	
Option C	Swales Adjacent to Railway Line / Leigham Vale		Attenuation in swales adjacent to Leigham Vale and railway line could help alleviate some flooding along Leigham Vale and reduce surface water flowing to Probyn Road. It is estimated that swales, space permitting, could be installed at two stretches along Leigham Vale at the base of the railway embankment; these are illustrated in Figure 4.3.11.	



CDA: Group7_030 (Norwood)

Preferred Option: Combined Measures:

- Flood Storage / Permeability Norwood Park
- Flood Storage / Permeability Convent & St. Joseph's Primary School Grounds

This CDA covers the upper catchment of the 'lost' River Effra. Therefore by attenuating surface water in this part of the catchment, downstream flood alleviation benefits can be realised, both within the CDA and the downstream (Group7_032 (Herne Hill)) CDA. The CDA has a number of recorded groundwater and sewer flooding records, and some areas (including Norwood Convent and West Norwood) are predicted to flood to up to depths of 1.5m during the 1% AEP rainfall event. The preferred option in this CDA is to provide flood storage in Norwood Park alongside providing storage in the Covent and St. Joseph's Primary School Grounds. The schemes in combination offer the opportunity to provide greater benefits (in terms of surface water flooding alleviation, education, amenity and the environment) than in isolation. It could also lessen the flood storage area size, as it could be split between two sites.

- Flood Storage in Norwood Park Norwood Park could be used as a flood storage area to alleviate downstream surface water flooding, which follows the course of the 'lost' River Effra and effects areas to the east of Norwood High Street and west of the railway embankment. Surface water flows would need to be diverted to the park from Elder Road, and any actions will need to be agreed with the London Borough of Croydon, as the park sits just to the north of the Lambeth / Croydon administrative boundary.
- Flood Storage in the Convent and St. Joseph's Primary School The Convent and St. Joseph's Primary School land could be used as a flood storage area and consider implementation of other, smaller, flood alleviation measures, such as swales and rainwater harvesting. The location of this scheme offers educational opportunities for the school. As the Convent and school are in the London Borough of Croydon, these will need agreement with Croydon Council regarding proposed mitigation measures.

There is a large area of space available to provide flood storage requirements within both the convent site and Norwood Park, and it is estimated that a maximum of $13,500m^3$ of storage could be required in this vicinity (Figure 4.3.12). The schemes, in combination, are likely to cost £251k - £500k and it is estimated the up to 210 residential and 50 non-residential properties in the area and downstream could benefit from the schemes.

Prior to the implementation of this scheme, a feasibility study will be required to determine the on-site suitability for the potential scheme, storage volumes, and opportunities for environmental enhancement. It is recommended that flood storage options in Norwood Park be further investigated in partnership with the London Borough of Croydon and in consultation with the Environment Agency.



© Crown Copyright. All rights reserved. GLA (LA100032379) 2011. **Figure 4.3.12 - Example of Potential Space for Flood Storage areas in Norwood Park, Convent and St. Joseph's Primary School Grounds**



CDA: Group7_030 (Norwood)		
Approximate Costs	£251k - £500k	
Potential Benefits	 Potential to provide flood mitigation to 25% of the infrastructure, 15% of the households and 30% of the commercial properties predicted to flood during the 1% AEP rainfall event 	
	Improved amenity / social benefits within the parks	
	Provision of educational opportunities for the primary school	
Alternative Option for Further Investigation - 'Day-lighting' the River Effra		

In discussions with Lambeth Borough Council, it was agreed that opportunities to consider deculverting ('daylighting') the 'lost' River Effra through the Norwood Park area should be investigated. This will be dependent on the depth of the River Effra below current ground levels (currently unknown) and this will require confirmation prior to any proposed study. It is therefore recommended that Lambeth Borough Council consider commissioning a drainage study to investigate the drainage and location of 'lost' River Effra through the Norwood Park area of the CDA. The study will need to confirm the existing drainage arrangements in this area, the location of the River Effra and depth from the surface, and the feasibility of deculverting this watercourse. In particular, discussions will be required with the Environment Agency, Thames Water and the London Borough of Croydon to agree the feasibility of the proposals and, if considered suitable, roles for each stakeholder in taking the scheme forward.



CDA: Group7_031 (East Norwood)

Preferred Option: Combined Measures:

- Source Control / Attenuation and SuDS Berridge Road) Potential 'Quick Win'
- Preferential / Designated Overland Flow Routes Berridge Road

The pluvial modelling identified an area of significant ponding of surface water in the Berridge Road area during the 1% AEP rainfall event. Whilst there are some groundwater flooding records in this area, there are no records surface water flooding records or properties at risk of sewer flooding. Lambeth Borough Council have confirmed that this area is prone to some shallow localised flooding, largely as a result of local topography. There are limited opportunities in this CDA for addressing the predicted surface water flooding and it is considered that temporary flood storage in the green space to the west of Berridge Road, alongside managing overland flow paths along Berridge Road (through increasing / ensuring appropriate kerb heights are in place) to provide a 'flow route' to this space provide the best mitigation option for the area (Figure 4.3.13). Whilst further investigation would provide further clarification on the flooding, and therefore a feasibility study on the preferred option discussed below would provide the same benefits in terms of improved understanding and at the same time determine the feasibility of the proposed scheme.

Temporary Flood Storage Area - Berridge Road

It is estimated that the open space to the east of Berridge Road could be utilised to provide surface water storage through implementing a detention basin to attenuate surface water flows during peak storm flows and discharge this water to the local sewer system once the storm has receded. On-site suitability and storage requirements will need to be determined prior to any proposed scheme being implemented. It is estimated that up to 1,500m³ (assuming a depth of 1m) surface water could be stored in the green space.



© Crown Copyright. All rights reserved. GLA (LA100032379) 2011. Figure 4.3.13 - Example of Potential Flood Storage Area in Berridge Road

Increase Kerb Heights / Lower Road Level - Berridge Road

In combination with temporary storage of flood water adjacent to Berridge Road, options could be considered to define the flow path along the road to the green space to ensure surface water is directed to the temporary flood storage area. This can be achieved through either raising kerbs or lowering the road level.

Approximate Costs	£51k - £100k	
Potential Benefits	 Potential to provide flood mitigation to 5% of the residential properties predicted to flood within the CDA during the 1% AEP rainfall event, including the 43 residential properties predicted to flood to a depth >0.5m along Berridge Road. 	



CDA: Group7_032 (Herne Hill)

Preferred Option: Surface Water Drainage Catchment Study

It is recommended that a catchment-wide study of the Herne Hill (Group7_032) and Brixton (Group7_033) CDAs should be undertaken as a high priority 'Quick Win' action for the London Boroughs of Lambeth and Southwark. This study should be undertaken in conjunction with the London Borough of Southwark, Thames Water and TfL. Across the London Boroughs of Lambeth and Southwark, the Herne Hill and Brixton CDAs have the greatest significant flood risk identified through the 2D pluvial modelling work undertaken as part of the Drain London project. These CDAs have both the deepest and largest areas of surface water ponding, as well as identified flow paths to these areas. It is recommended that further investigation into the potential flooding mechanisms and drainage capacity throughout these two CDAs is undertaken, particularly with regard to the capacity and function of the Storm Relief sewers that convey the 'hidden' River Effra. Detailed surface water modelling (and interactions with the sewer system) should be undertaken to gain a better understanding of risk and viability/effectiveness of potential options within the CDAs.

It is recommended that the study should build on the work undertaken as part of this SWMP and consider the following:

- Determining the capacity in the existing sewer network, and likely spill volumes during different rainfall event;
- Undertaking detailed pluvial modelling of the area, incorporating updated drainage capacity assumptions including sewer capacity information from Thames Water, where available;
- Identifying and recording surface water assets including their asset type, location and condition (required as part of the Asset Register);
- Determining the current condition of gullies and carrier pipes;
- Determining the capacity of gullies and carrier pipes;
- Determining the connections to Thames Water surface water sewers and assets;
- Undertaking CCTV surveys for those areas where there are known blockages in the local pipes and/or surface water sewers;
- Clearing those gullies or pipes identified as blocked during investigations (as part of annual maintenance routine);
- Determining upgrade requirements and costs for the local drainage infrastructure and seek funding opportunities to implement these; and
- Providing updates to the Drain London pluvial models, to update the Flood Depth and Hazard maps for these areas with local drainage capacity information;
- Following the updated modelling, assess the options for flood alleviation in the catchment including consideration of upgrades to the local and/or sewer drainage network, flood storage and/or source control SuDS, and model and cost these options to identify the most cost / beneficial option(s) for mitigating surface water flood risk in the catchment.

Any identified options should be agreed by all stakeholders. Potential Options are discussed below.

Approximate Costs	£26k - £50k	
Potential Benefits	 Improved understanding of flood risk and flooding mechanisms to inform decision making. 	
	 Potential for identifying those schemes that provide environmental and socio- economic benefits such as water quality and amenity within the catchment as part of a range of measures to be taken forward. 	
	 Provision of sufficient information to undertake a cost / benefit analysis to identify those measures to be taken forward. 	



CDA: Group7_032 (Herne Hill)				
Potential Options for Consideration As Part of Drainage Catchment Study – Group7_032 (Herne Hill)				
Option A (Lambeth)	Source Control, Attenuation and SuDS (Brockwell Park)	Brockwell Park is the best opportunity for providing flood alleviation to Herne Hill. Historically ponds used to be located along the eastern edge of the park (adjacent to Norwood Road) and these areas still pond when it rains (Figure 4.3.14). Although the ponds are no longer there, it is recommended that the eastern edge of the park is considered as a flood storage area to restrict surface water flows from Brockwell Park flowing to Norwood Road and thereby alleviating flooding in the Herne Hill area (Figure 4.3.20). A potential 5,565m ³ of storage volume could be provided, at a cost of £101k - £250k. Figure 4.3.14 - Ponding of Water along Eastern Edge of Brockwell Park (adjacent to Norwood Road)		
Option B (Lambeth)	Define Flow Paths (Norwood Road)	The flow paths to/from Brockwell Park could be reconfigured to ensure that surface water flows from the park reaching Norwood Road / Herne Hill Underpass are minimised. By reconfiguring the flow paths into and out of Brockwell Park, for example at the entrance to/from Brockwell Park (to restrict flow entering Herne Hill - Figure 4.3.15 and Figure 4.3.16) surface water flood risk downstream could be mitigated. It is recommended that this is undertaken in conjunction with adding Flood Storage in Brockwell Park.		



CDA: Group7_032 (Herne Hill)			
Option C (Lambeth)	Improve Community Resilience in West Dulwich Area	A number of measures should be considered to improve community resilience in the West Dulwich area where deep ponding is predicted to occur, due to the topographical river valley characteristics of the roads in this area (Figure 4.3.17). Measures include installation of receptors (such as sub-surface storage with permeable pavement, which could incorporate a cellular storage system such as 'Rainstore') under roads in West Dulwich to attenuate flows and grass crete/roadside verges/roadside gardens to alleviate flooding. It is recommended that further onsite investigations are undertaken to assess the feasibility of the different measures before a preferred option is agreed for this area.	
Option D (Lambeth)	Investigate Drainage Capacity in West Dulwich Investigate Drainage Capacity in West Dulwich Invest Dulwich Inve		
Option E (Lambeth)	Topographical Survey (Auckland Hill)	A long-term action for the CDA, is to undertake a detailed topographical survey in the Auckland Hill area to determine local topography and flooding mechanisms. There is some known history of surface water flooding in this area but without further investigation and understanding of topography it is not possible to determine the best mitigation options for flooding in this area.	
Option F (Southwark)	Source Control (Dulwich Park)	A boating lake is located at the western (downstream) end of Dulwich Park. By increasing the area of the pond and/or increasing the depth by 100mm, surface water in the upper part of the CDA can be attenuated. The pond is currently approximately 9,500m ² in area, and there is the potential to increase this up to 15,300m ² by increasing the area of the pond (Figure 4.3.18). This could offer a potential 1,530m ³ of flood storage. Alternatively, increasing the existing depth by 100mm could provide 950m ³ . The approximate cost for this scheme is £26k - £50k.	



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CDA: Group7_032 (Herne Hill)			
Option G (Southwark)	Online Flood Storage (Sports Field South of Turney Road)	Online storage could be provided through using the Sports Field south of Turney Road to provide online storage and mitigate flood risk in the local area. The area identified in Figure 4.3.19 covers an area of 50,000m ² , and is already lowered by approximately 0.25m. It is recommended that this is lowered a further 0.75m to offer 50,000m ³ of storage. The cost of this would be approximately £501k - £1m and provide up to 10% flood risk mitigation in the CDA. The entrance to park would also need to be reconfigured to allow flows from Turney Road to be diverted to the sports field, and ensure that flows are contained within the field.	
Option H (Southwark)	Online Flood Storage (Railway Land Adjacent to Giant Arches Road)	Investigate opportunities to utilise areas adjacent to the railway along Burbage Road / Giant Arches Road. Land in this location could be utilised to store flood water from railway tracks and diverted from Burbage Road. This option would need to be discussed within Network Rail and agreement made regarding use of their land. As part of this option, there is also the opportunity to address maintenance of drainage from railway infrastructure (which in some locations was observed as damaged during the site visit).	
Option I (Southwark)	Flood Storage (Belair Park)	Investigate opportunities to utilise Belair Park for flood storage. A potential flood storage area of 23,000m ³ could be utilised through relandscaping of the park (to a depth of 1m) and/or installing swales.	
Option J (Southwark)	Community Resilience Measures (Herne Hill)	Southwark Borough Council could encourage residents in the Herne Hill area to implement community-level and property-level flood resilience measures, e.g. raising property entry thresholds and property-level source control measures, e.g. installing water butts. Particular focus should be given to basement properties in the area. The majority of the area predicted to be at greatest risk of surface water flooding is comprised of commercial development and therefore demountable flood barriers may be appropriate in these areas.	
Option K (Southwark)	Flood Storage (Velodrome Redevelopment)	Opportunities for flood storage as part of the Velodrome redevelopment could be investigated by the council. Where feasible, flood storage within the development should be encouraged, and may offer some mitigation to flooding in the area.	



CDA: Group7_033 (Brixton)

Preferred Option: Surface Water Drainage Catchment Study

It is recommended that a catchment-wide study of the Herne Hill (Group7_032) and Brixton (Group7_033) CDAs should be undertaken as a high priority, short-term action for the London Borough of Lambeth. Further information on this option is provided within the Group7_032 (Herne Hill) preferred option.

Potential Options within this CDA are discussed below and should be included within the Catchment study, including the identified potential 'quick win' scheme within Brockwell Park.

Approximate Costs		£26k - £50k		
Potential Benefits		 Improved understanding of flood risk and flooding mechanisms to inform decision making. Potential for identifying those schemes that provide environmental and socio-economic benefits such as water quality and amenity within the catchment as part of a range of measures to be taken forward. Provision of sufficient information to undertake a cost / benefit analysis to identify those measures to be taken forward. 		
Potential C	Options for	Considerat	ion As Part of Drainage Catchment Study – Group7_033 (Brixton)	
Option A	Increase Drainage Capacity (Dulwich Road		Dulwich Road frequently floods during heavy rainfall events, and has been identified by Lambeth Borough Council as one of the main focus areas for surface water flood mitigation in the short-term. The local drainage capacity along Dulwich Road could be increased through adding more carrier drains and/or pipe storage between buildings. This would need further assessment through on-site investigations, but is likely to help mitigate flood risk to 1,100 residential and 50 non-residential properties in the Dulwich Road area.	
Option B	'Urban Greening' in Stockwell / Oval Area		Soft landscaping and 'greening' of areas in the Stockwell / Oval area (near Fentiman Road) could be considered to address the surface water flood risk in this area However, opportunities for implementation may be limited.	
Option E	on E Fon E Topographical Survey & Investigation (Fentiman Road)		A long-term action for the CDA to gain a better understanding of flood risk in the Fentiman Road area is to commission a topographical survey to determine local topography and flood mitigation options. The modelling undertaken to date has indicated that deep ponding is likely to occur along Fentiman Road (as a result of local topography and flows from Brixton High Street), but as there are few historical flooding incidents in this area, further investigation of the local topography and on-site investigations of potential options should be undertaken.	

Potential 'Quick Win' - Community Flood Plan (Dulwich Road)

Lambeth Borough Council (in conjunction with Southwark Borough Council) could consider undertaking a Community Flood Plan for the Dulwich Road area as a 'Quick Win' option. Residential properties to the west of the Southwark / Lambeth administrative boundary (along Dulwich Road) are predicted to flood to depths of greater than 0.5m during a 1% AEP rainfall event and have previously experience flooding (in April 2004). Producing a Community Flood plan for this area could improve preparedness for future flood events and ensure that measures are in place to deal with any future flooding events. This could be undertaken in conjunction with a Community Flood Plan for the Herne Hill area (within Group7_032 (Herne Hill) CDA) led by the London Borough of Southwark.

CDA: Group7_033 (Brixton)

Potential 'Quick Win' - Source Control and Flow Path Management (Brockwell Park)

A Quick Win Scheme in this CDA is to provide flood storage in Brockwell Park alongside reconfiguring the entrance to/from the park east of the Lido to restrict flows entering Dulwich Road:

Source Control (Brockwell Park)

Brockwell Park offers the most advantageous opportunity for providing flood alleviation to Dulwich Road. Historically ponds used to be located along the northern edge of the park (adjacent to Dulwich Road). The ponds are no longer there but it is recommended that the northern edge of the park is considered as a flood storage area to restrict surface water flows from Brockwell Park flowing to Dulwich Road and thereby alleviating flooding in the Dulwich Road Area (Figure 4.3.20). 2,500m³ of storage could be provided through implementation of swales across the northern boundary of the park, at a cost of £51k - £100k.



© Crown Copyright. All rights reserved. GLA (LA100032379) 2011. Figure 4.3.20 - Example Flood Storage Area and Park Entrance Reconfigurement

Flow Path Management (Dulwich Road)

The flow paths to/from Brockwell Park could be reconfigured to ensure that surface water flows from the park reaching Dulwich Road are minimised. By reconfiguring the flow paths into and out of Brockwell Park, for example at the entrance to the Lido (to restrict flow entering Dulwich Road - Figure 4.3.20 and Figure 4.3.21) surface water flood risk downstream could be mitigated. It is recommended that this is undertaken in conjunction with adding Flood Storage in Brockwell Park.



Figure 4.3.21 - Entrance to/from Lido (looking towards Dulwich Road)

Existing Schemes

The following schemes are already being planned or implemented within the Brixton CDA:

- Improved Maintenance Regimes (Dulwich Road) Lambeth Council is currently revising its annual maintenance regime to ensure that those areas at greater risk are targeted for maintenance when required. One of the priority areas for this is Dulwich Road which is historically known to flood, partly due to drainage incapacity, in the April to September period. The council are proposing to change the timing of their annual cleaning regime to ensure that this area is cleaned in February or March each year prior to the known flooding period. It is recommended that this regime is reviewed following implementation, and if required, a further cleaning round is undertaken in the April to September period.
- **Brockwell Park Redevelopment** Consultants are currently producing designs for the improvement and redevelopment of areas of Brockwell Park. Part of these plans include drainage alterations to the ponds located to the southwest of the Park.

CDA: Group7_034 (Waterloo Station)

Preferred Option: Confirm Flood Risk Following Drainage Improvement Works

As drainage improvement works are already underway at Waterloo Station, and St. Thomas's Hospital has already taken flood resilience measures, it is not considered that there are any cost beneficial capital schemes that would alleviate flooding in this area in the short-medium term.

It is recommended that following the ongoing drainage improvements in the Waterloo Station vicinity, the findings and modelling results of this SWMP are reviewed and risk assessments updated to ensure that the capacity of the upgraded and existing drainage systems (local and sewers) serving this area are sufficient to accommodate surface water flows, and the residual surface water flooding risk is understood and mitigated where possible. It is recommended that drainage modelling/assessment work undertaken as part of the upgrades is incorporated into the SWMP where possible.

Approximate Costs	<£25k	
Potential Benefits	 Improved understanding of risk to critical infrastructure 	
	 Improved evidence for prioritising third-party localised drainage improvements 	
	Provision of further information to inform decision making	
Potential 'Quick Win' - Waterloo Opportunity Area		

Surface water flooding planning policies (including those in PPS25 or the replacement National Planning Policy Framework) should be included within any Supplementary Planning Documents (SPDs) / Development Plan Documents (DPDs) within the Waterloo Opportunity Area to ensure that due consideration is given to surface water flooding to or from any development site, and opportunities are identified for any additional surface water mitigation measures at the earliest opportunity.



OPTIONS FOR CDAS WHERE LAMBETH IS THE 'SUPPORTING BOROUGH'

4.3.9 Table 4.3.1 identifies the cross boundary CDAs in the London Borough of Lambeth where the Borough is identified as the 'supporting' Borough. The reader is referred to the 'lead' Borough's SWMPs for further information on the preferred option(s) for these CDAs, but Table 4.3.1 identifies the preferred option for each of the CDAs. These actions are recorded in the London Borough of Lambeth Action Plan (Section 5.1 and Appendix I).

CDA	Preferred Option	Stakeholders (Lead Borough in bold)
Group 7_022	Drainage Capacity Study covering	London Borough of Wandsworth
(Clapham Junction)	entire CDA, but focussing on Falcon	London Borough of Lambeth
	Road area.	Thames Water
		TfL
Group 7_024	Confirm drainage capacity along	London Borough of Wandsworth
(Tooting Bec)	Railway line between Streatham	London Borough of Lambeth
	Common Railway Station and Balham	Network Rail
	Railway Station and consider options	
	for Flood Storage on Tooting Bec	
	Common.	
Group 7_036	Soft Landscaping in Comber Grove	London Borough of Southwark
(Camberwell)	Area, Flow Diversion and Flood	London Borough of Lambeth
	Storage in Ruskin Park and Improved	Network Rail
	Resilience at King's College Hospital.	
Group8_049	Do Nothing – flooding primarily fluvial	Environment Agency
(Norbury)	so responsibility of Environment	
	Agency.	

Table 4.3.1 - Cross Boundary CDA Preferred Options

4.3.10 In relation to the preferred options for Group7_036 (Camberwell), Lambeth have been identified as leading on the proposed flood storage scheme for Ruskin Park and the potential 'Quick Win' measure for improving resilience at King's College Hospital, as both these areas fall within the London Borough of Lambeth administrative boundary. The reader is referred to the London Borough of Southwark SWMP for full details regarding the preferred options for this CDA, but, for reference, the information relating to the schemes identified for Lambeth to lead are reproduced below and included within the London Borough of Lambeth Action Plan (Section 5.1 and Appendix I).

CDA: Group7_036 (Camberwell)

Preferred Option: Combined Measures:

- Urban Greening (Comber Grove)
- Flow Diversion and Flood Storage (Ruskin Park)

The preferred option in this CDA is to provide 'Urban Greening' / soft landscaping in the Comber Grove area (London Borough of Southwark) alongside providing flood storage and flow diversion in Ruskin Park (London Borough of Lambeth).

Flow Diversion, Flood Storage (Ruskin Park) and Confirmation of Railway Infrastructure Drainage Capacity (London Borough of Lambeth, Network Rail)

Pluvial modelling shows that both King's College Hospital and the railway line to the west of Denmark Hill Station (to the south of the Hospital) are at risk of deep surface water flooding during the 1% AEP rainfall event. Local topography (the railway line is below ground level) dictates surface water flows in this area, and Ruskin Park has been identified as a possible contributor to the flooding with surface water flows modelled to flow from here onto the railway line and also potentially impact King's College Hospital.



CDA: Group7_036 (Camberwell)

It is therefore recommended that opportunities are investigated to, where possible, change the existing surface water flow paths to ensure that surface water stays within Ruskin Park rather than flow overland onto the railway track and subsequently King's College Hospital grounds. Flood Storage measures in Ruskin Park could be implemented to attenuate flows and restrict them flowing across the railway line and to the hospital site. It is recommended that the flood storage area covers the area illustrated in Figure 4.3.22, which could offer approximately $4,250m^3$ of storage. The indicative cost of this scheme is estimated to be £51k - £100k. A feasibility study should be undertaken prior to taking this option forward and use evidence gathered from consultations with Network Rail regarding the current drainage infrastructure and capacity along the railway line running to the north of the Park.



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Figure 4.3.22 - Example of Potential Location for Flood Storage Area (blue hatching) to Mitigate Surface Water Flooding to Kings College Hospital

Approximate Costs	£101k - £250k (for combined scheme)	
Potential Benefits	 Potential to provide flood mitigation to 20% of the infrastructure, 20% of the households and 15% of the commercial properties predicted to flood during the 1% AEP rainfall event. Improved amenity / social benefits in Comber Grove area Improved resilience of critical infrastructure to surface water flooding Improved evidence for prioritising third-party localised drainage improvements 	
Potential 'Quick Win' - I Lambeth)	mprove Resilience at King's College Hospital (London Borough of	
Lambeth Borough Council should ensure that King's College Hospital have an Emergency Plan in place for surface water flooding, and that resilience measures are taken, such as ensuring there are		

place for surface water flooding, and that resilience measures are taken, such as ensuring there are no key assets, services or power generators on the basement or ground level. It is also recommended that the hospital undergo a 'flooding exercise' to ensure they are prepared and have emergency plans in place to deal with flood events.

4.4 PREFERRED OPTIONS SUMMARY

4.4.1 Table 4.4.1 summarises the preferred options identified through the Phase 3 - Options Assessment for addressing surface water flood risk in CDAs.


Table 4.4.1 - Preferred Options Summary

			Combination Scheme?	Potential	Costing & Storage Volumes								
CDA_ID	Option Category	Option Description		'Quick Win'?	Measures	Cost (£)	Unit Description	Unit	Area	Depth	Volume	Drain London Cost Band	Cost Band for Combination Scheme
Group7_025	Further Investigate Flooding Mechanisms	Further investigate flooding mechanisms in Eardley Road LFRZ and Streatham Common Station Railway Cutting LFRZ.	×		Investigation	-	-	-	-	-	-	<£25k	-
(Streatham Common)	Community Resilience	Improve community awareness through incorporating surface water flooding issues in River Graveney Community Awareness event.	×	\checkmark	Social Change, Education and Awareness	-	-	-	-	-	-	<£25k	-
Group7_026 (Streatham)	Further Investigate Flooding Mechanisms	Further investigate flooding mechanisms in Stanthorpe Road LFRZ and Streatham Station Railway Cutting LFRZ.	×		Investigation	-	-	-	-	-	-	<£25k	-
		Implementation of swales in available green space in North Clapham Park LFRZ (council estates to the northwest of Abbeville Road).	\checkmark		Swales	16	m ² of swale area	m²	10,200	0.5	5,100	£101k - £250k	£101k - £250k
Group7_027 (Clapham South)	Source Control, Attenuation and SUDS	Installation of permeable surfaces where there are large areas of hardstanding within North Clapham Park LFRZ (council estates to the northwest of Abbeville Road).	\checkmark		Permeable Paving	44	m ² of surface	m²	Unknown at present - requires feasibility study	-	-	Unknown at present - requires feasibility study	
	Community Resilience	Production of a Community Flood Plan for the council estates located in the North Clapham Park LFRZ to assist communities in preparing and dealing with surface water flooding.	x	V	Social Change, Education and Awareness	-	-	-	-	-	-	<£25k	-
Group7_028 (Nine Elms)	Drainage Capacity Study	Undertake drainage capacity study for entire CDA, but focussing on area around Lambeth / Wandsworth administrative boundary (Northwest Wandsworth Road LFRZ).	×		Investigation	-	-	-	-	-	-	<£25k	-
Group7_029 (Probyn Road)	Further Investigate Flooding Mechanisms	Further investigate flooding mechanisms in Probyn Road LFRZ.	×		Investigation	-	-	-	-	-	-	<£25k	-
	Flood Storage / Permeability	Installation of flood storage measures in Norwood Park (detention basin).	\checkmark		Detention Basins	22	m ³ of detention volume	m ³	10,000	1	10,000	£101k - £250k	£251k - £500k
Group7_030 (Norwood)	Flood Storage / Permeability	Installation of flood storage measures in the Covent and St. Joseph's Primary School Grounds (smaller detention basin, swales and/or rainwater harvesting for the school).	\checkmark		Detention Basins	22	m ³ of detention volume	m³	3,500	1	3,500	£51k - £100k	
Group7_031	Flood Storage / Permeability	Installation of an online, temporary flood storage area adjacent to Berridge Road.	\checkmark	\checkmark	Detention Basins	22	m ³ of detention volume	m ³	1500	1	1500	£26k - £50k	
(East Norwood)	Preferential / Designated Overland Flow Routes	Defining an overland flow paths (through, for example, raising kerbs) in Berridge Road area to direct flows to the temporary flood storage area.	\checkmark	\checkmark	Managing Overland Flows (Preferential Flow Paths)	-	-	-	-	-		<£25k	£51k - £100k
Group7_032 (Herne Hill)	Drainage Capacity Study	Undertake Surface Water Drainage Catchment Study and incorporate CDA Group7_033 Brixton). Undertake study in conjunction with London Borough of Southwark and Thames Water.	×		Investigation	-	-	-	-	-	-	£26k - £50k	-
Group7_033 (Brixton)	Drainage Capacity Study	Undertake Surface Water Drainage Catchment Study and incorporate CDA Group7_032 (Herne Hill). Undertake study in conjunction with London Borough of Southwark and Thames Water.	×		Investigation	-	-	-	-	-	-	-	-

4 Phase 3: Options



		Option Description		Potential 'Quick Win'?				Costing	& Storage Volum	ies			
CDA_ID	Option Category		Combination Scheme?		Measures	Cost (£)	Unit Description	Unit	Area	Depth	Volume	Drain London Cost Band	Cost Band for Combination Scheme
Group7_033 (Brixton)	Community Resilience	Production of a Community Flood Plan for the Dulwich Road area to assist communities in preparing and dealing with surface water flooding.	x	\checkmark	Social Change, Education and Awareness	-	-	-	-	-	-	<£25k	-
	Source Control, Attenuation and SUDS	Provide flood storage (swales) in Brockwell Park, adjacent to northern edge of park and south of Dulwich Road, and reconfigure the entrance to/from the park east of the Lido to restrict flows entering Dulwich Road.	x	~	Swales	16	m ² of swale area	m²	5000	0.5	2500	£51k - £100k	-
Group7_034 (Waterloo Station)	Confirm Drainage Capacity	Confirm drainage capacity of schemes already being implemented in the vicinity of Waterloo Station.	×		Investigation	-	-	-	-	-	-	<£25k	-
	Planning Policy	Ensure surface water policies included in any emerging policy, SPDs or DPDs within the Waterloo Opportunity Area.	×	\checkmark	Planning Policies to Influence Development	-	-	-	-	-	-	<£25k	-

Note: This table has been produced to assist with the preliminary cost estimates as part of the SWMP for London Borough of Lambeth dimensions and costs are indicative and should only be used for preliminary estimates due to the generalised nature of the information used to compile it. An estimated cost for the preferred flood mitigation option for each identified CDA has been calculated based on standard unit costs provided as part of Tier 1 of the Drain London Project. No monetised damages have been calculated, and flood mitigation costs have been determined using engineering judgement, but have not undergone detailed analysis. The following standard assumptions have been applied, as determined in the Drain London Prioritisation Matrix Guidance:

- The costs are the capital costs for implementation of the scheme only.
- Costs do not include provisions for consultancy, design, supervision, planning process, permits, environmental assessment or optimum bias.
- No provision is made for weather (e.g. winter working).
- No provision is made for access constraints
- Where required, it will be stated if costs include approximate land acquisition components.
- No operational or maintenance costs are included.

• No provision is made for disposal of materials (e.g. for flood storage or soakaway clearance).

As a result, costs have been provided as cost bands, reflecting the strategic nature of the SWMP study and options identification.

4 Phase 3: Options



4.5 OPTIONS PRIORITISATION PRIORITISATION SUMMARY

- 4.5.1 It is recognised that a number of CDAs have been identified throughout the Borough, and it will not be possible, with available resources and funds, to address identified surface water flood risk within all of these in the short to medium term. It is therefore important to prioritise those schemes that are deemed to be most beneficial and address those areas known to experience surface water flooding within the London Borough of Lambeth. Discussions with the London Borough of Lambeth through the Options Workshop and throughout the study have confirmed that priority should be assigned to addressing surface water flooding risk in those areas that:
 - Experience regular or significant surface water / groundwater / sewer flooding;
 - Contain basement properties;
 - Contain critical infrastructure; and / or
 - Through the pluvial modelling undertaken, are predicted to face significant surface water flooding depths (>0.5m) and hazard (high flow velocities and depth) for the 1% AEP rainfall event.
- 4.5.2 Table 4.5.1 uses the above criteria to identify the CDAs that could be prioritised in terms of taking forward the preferred options. However, it is important to note that the number of flooded properties is dependent on the CDA size, is based on predicted flood risk and contains no historical flooding information; therefore the information presented in Table 4.5.1 is provided as an indication only of where the Council may wish to focus their efforts and is subject to change following further investigations.

CDA Rank	CDA Name	Flooded Buildings (>0.5m)		Flooded Basements (>0.5m)		Floo Depr Propo (>0.	oded rived erties 5m)	Critical Infra-	Average CDA
		Total	CDA Rank	Total	CDA Rank	Total	CDA Rank	Structure	Rank
1	Group7_033 (Brixton)	656	1	295	1	450	1		1.00
2	Group7_032 (Herne Hill)	191	2	65	2	41	3		2.33
3	Group7_028 (Nine Elms)	82	3	30	3	12	5		3.67
4	Group7_026 (Streatham)	50	4	8	7	42	2	\checkmark	4.33
5	Group7_031 (East Norwood)	43	6	16	4	19	4		4.67
6	Group7_027 (Clapham South)	45	5	14	5	4	6		5.33
7	Group7_029 (Probyn Road)	32	8	14	5	0	8		7.00
8	Group7_025 (Streatham Common)	39	7	6	8	0	8	\checkmark	7.67
9	Group7_030 (Norwood)	23	9	0	10	2	7		8.67
10	Group7_034 (Waterloo Station)	4	10	4	9	0	8	\checkmark	9.00

Table 4.5.1 - CDA & Option Prioritisation



DRAIN LONDON PRIORITISATION MATRIX

4.5.3 The Prioritisation Matrix was developed out of the need for a robust, simple and transparent methodology to prioritise the allocation of funding for surface water management schemes across the 33 London Boroughs by the Drain London Programme Board. As such, the prioritisation should be understood in the high-level decision-making context it was designed for. It is not intended to constitute a detailed cost-benefit analysis of individual surface water flood alleviation schemes. A summary of the preferred capital options discussed in Section 4.3 are presented in Table 4.5.2. The information within this table will be input into the Prioritisation Matrix by the Drain London Programme Board. It is important to note that the table includes the preferred 'Capital' scheme, and in many cases within the London Borough of Lambeth the preferred option is not a capital scheme.



		Scheme Category			Infrasti	ucture				House	eholds		Commercia		
	Scheme Location		Essential		Highly Vu	ulnerable	More Vulnerable		Non-Deprived (All)		Deprived (All)		All		Capital Cost
OBAID			Eliminated	Mitigated	Eliminated	Mitigated	Eliminated	Mitigated	Eliminated	Mitigated	Eliminated	Mitigated	Eliminated	Mitigated	Band
			(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	
Group7_027	North Clapham Park	Source Control, Attenuation and SuDS	0	0	0	0	0	10%	0	15%	0	25%	0	30%	£101k - £250k
Group7_030	Norwood Park, Convent and St. Joseph's Primary School	Flood Storage / Permeability	0	0	0	0	0	25%	0	10%	0	15%	0	30%	£251k - £500k
Group7_031	Berridge Road, Norwood	Flood Storage / Permeability	0	0	0	0	0	0	0	0	0	5%	0	0	£51k - £100k
Group7_033	Brockwell Park, Dulwich Road	Source Control, Attenuation and SuDS	0	0	0	0	0	5%	0	10%	0	20%	0	15%	£51k - £100k
Note: The Dra scheme has b	Note: The Drain London Prioritisation Matrix requires an estimation of the percentage of total number of units that have the potential to benefit from the proposed scheme. This has been determined by calculating the number of units within the LFRZ that the scheme has been designed to mitigate, as a percentage of the number of units within the CDA as a whole. The input is restricted to multiples of five percent. It should be noted that the information within this table is purely for input into the Drain London														

Table 4.5.2 - Phase 3 Summary of Preferred Options (for input to the Drain London Prioritisation Matrix)

Prioritisation Matrix and should be treated as such.

4 Phase 3: Options



4.6 RECOMMENDATIONS FOR NEXT STEPS AND QUICK WINS

4.6.1 Taking into account the nature of the surface water flooding in the London Borough of Lambeth, the options identified through the Phase 3 – Options Assessment it is considered that the following options should be prioritised in the short to medium-term:

Table 4.6.1 -	· Recommendations	for Next	Steps and	Quick Wins

	Recommendation 15:	Consider and implement options for raising community awareness including letter drop, information portal and/or preparation of a Community Flood Plan.					
	Recommendation 16:	Consider opportunities for ongoing improvements to the maintenance of the drainage network.					
	Recommendation 17:	Ensure appropriate Development Control Policy for repaving of gardens or driveways and explore education / awareness opportunities for general public regarding SuDS guidance and 'best practice'.					
Vide	Recommendation 18:	Ensure Development Control Policy incorporates surface water flood risk conditions and the latest available surface water flooding information including runoff rates, SuDS, driveway repaving etc.					
orough-\	Recommendation 19:	Consider opportunities to promote rainwater harvesting in both new and existing development throughout the London Borough of Lambeth.					
Ξ	Recommendation 20:	Consider opportunities to promote use of water butts in both new and existing development throughout the London Borough of Lambeth.					
	Recommendation 21:	Consider opportunities to promote awareness of property level thresholds throughout the London Borough of Lambeth, particularly in areas of higher flood risk.					
	Recommendation 22:	Identify areas where Community Flood Plans my be effective and consider opportunities to develop these, in conjunction with the local community.					
	Recommendation 23:	Identify opportunities for introducing, encouraging and implementing 'Complimentary Measures' across the London Borough of Lambeth.					
: Investigations	Recommendation 24:	Undertake a Drainage Capacity Study (in conjunction with the London Borough of Southwark and Thames Water) for the Herne Hill (Group7_032) and Brixton (Group7_033) CDAs, to determine local drainage capacity and future management options. This should include an assessment of the options for flood alleviation in the catchment including consideration of upgrades to the local and/or sewer drainage network, flood storage and/or source control SuDS, and model and cost these options to identify the most cost:beneficial option(s) for mitigating surface water flood risk in the catchment.					
CDA Specific	Recommendation 25:	Undertake a feasibility study for implementation of localised SuDS measures in North Clapham Park LFRZ (Group7_027) through provision of source control, flood storage and permeability measures (where appropriate) in existing green spaces and hardstanding areas interspersed in council estates.					
	Recommendation 26:	Undertake further investigations of the flooding mechanisms in the Stanthorpe Road (Group7_026) and Eardley Road (Group7_025) areas to aid in identifying cost:beneficial surface water measures to be taken forward for these areas.					





	Recommendation 27:	Undertake a feasibility study for providing source control measures in Ruskin Park to mitigate surface water flooding to the railway line to the west of Denmark Hill Station and King's College Hospital (Group7_036). To be undertaken in conjunction with Network Rail and in consultation with the London Borough of Southwark.
arty Collaboration/ vestigations	Recommendation 28:	Engage with Network Rail regarding the surface water flood risk along major railway lines and to railway stations identified to flood throughout the Borough, and confirm the drainage assumptions used within the SWMP pluvial modelling. In particular this should focus on infrastructure: - To the east and west of Streatham Common Railway Station (Group7_025) - To the east of Streatham Railway Station (Group7_026) - Waterloo Railway Station (Group7_034).
Third-Pa Inv	Recommendation 29:	In conjunction with the London Borough of Wandsworth and Thames Water, identify the scope for undertaking drainage investigations in the Nine Elms area, along the Lambeth / Wandsworth Boundary (Group7_028), and agree a timetable and funding sources for undertaking these.
	Recommendation 30:	Improve community awareness through incorporating surface water flooding issues in River Graveney Community Awareness event (Group7_025).
	Recommendation 31:	Production of Community Flood Plans for the Dulwich Road area (Group7_033) and North Clapham Park LFRZ (Group7_027) to assist communities in preparing and dealing with surface water flooding.
ick Wins'	Recommendation 32:	Undertake a feasibility study for, and implementation of, source control and flow path management measures in Brockwell Park (Group7_033) to mitigate surface water flooding downstream in the Dulwich Road area.
nØ,	Recommendation 33:	Undertake a feasibility study for, and implementation of, flood storage measures in the Berridge Road area (Group7_031) where localised, deep areas of surface water ponding are predicted and existing green space is available for utilisation.
	Recommendation 34:	Ensure surface water management planning policies are included within emerging SPDS or DPDs within the Waterloo Opportunity Area (Group7_034).
	Recommendation 35:	Investigate and implement measures to improve resilience at King's College Hospital (Group7_036).



5. Phase 4: Implementation and Review

5.1 ACTION PLAN

- 5.1.1 The purpose of Phase 4 of the SWMP is to clearly identify actions and responsibilities for the ongoing management of surface water flood risk within the London Borough of Lambeth that have been identified throughout the work undertaken in Phases 1 to 3. These build on the recommendations identified throughout the SWMP and options developed through Phase 3.
- 5.1.2 A draft Action Plan has been created for the London Borough of Lambeth and is located within Appendix I. The draft Action Plan, is a simple summary spreadsheet that has been formulated by reviewing the previous phases of the SWMP in order to create a useful set of actions relating to the management and investigation of surface water flooding going forward. It is the intention that the Action Plan is a live document, maintained and regularly updated by the Borough, as actions are progressed and investigated, and as such has been issued as a draft Action Plan. It should be understood that following further detailed investigation the preferred option in each CDA, and even in some cases the need for any action other than basic investigation in a particular CDA may be discounted. Likewise new actions may be identified by the Borough, or may be required by changing legislation and guidance over time.

5.1.3 The Action Plan identifies:

- Actions required to meet the requirements for Lambeth Borough Council as LLFA under the FWMA 2010 and Flood Risk Regulations 2009;
- Future studies and consultations for investigation and confirming the level of flood risk within the Borough;
- An estimation of costs for investigations and optioneering works including possible sources of funding – for the CDAs within the Borough, as identified in Phase 3 of the SWMP;
- The partners or stakeholders responsible for implementing and supporting the actions;
- An indication of when the actions should be undertaken, reviewed and updated (these should be confirmed by the London Borough of Lambeth upon adoption of the draft Action Plan);
- An indication of the priority of the actions high, medium or low to aid the London Borough of Lambeth in prioritising the actions; and
- Linkage between actions.
- 5.1.4 Actions within the Action Plan have been categorised as summarised in Table 5.1.1.



Definition	Description
FWMA 2010 / Flood Risk Regulations 2009	Duties and actions as required under the Flood Risk Regulations and FWMA - Refer to Appendix A of the LGG 'Preliminary Framework to assist the development of the Local Strategy for Flood Risk Management' (February 2011) for minimum requirements.
Policy Action	Spatial planning or development control actions.
Communication / Partnerships	Actions to communicate risk internally or externally to LLFA or create / improve flood risk related partnerships.
Financial / Resourcing	Actions to secure funding internally / externally to support works or additional resources to deliver actions.
Investigation / Feasibility / Design	Further investigation / feasibility study / Design of mitigation.
Flooding Mitigation Action	Maintenance or capital works undertaken to mitigate flood risk.

Table 5.1.1 - Types of Action within the London Borough of Lambeth Action Plan

5.1.5 As part of the preparation of the draft Action Plan and the SWMP, the requirement for a Strategic Environmental Assessment (SEA), an Appropriate Assessment (required by the Habitats Directive) or an Article 4.7 assessment (under the Water Framework Directive) was considered. A 'screening decision' was made which suggested that the SWMP alone does not require any of the environmental assessments described above. However, it is possible that any actions which are taken forward will require such assessments and it is envisaged that the requirement for this will form part of feasibility studies for individual schemes.

Recommendation 36: Develop, update and maintain the draft Action Plan to meet London Borough of Lambeth's local flood risk management priorities

5.2 SUMMARY OF KEY ACTIONS

- 5.2.1 The key (high priority) actions for the London Borough of Lambeth over the short- to medium-term, on the whole, relate to requirements under the FWMA 2010 and Flood Risk Regulations 2009, and general actions and investigations that apply to the wider Borough and include the identified CDAs and consultation with professional and political stakeholders and the public.
- 5.2.2 Proposed actions have been classified into the following timeframes:
 - Short term Actions to be undertaken within the next year;
 - Medium term Actions to be undertaken within the next year to five years; and
 - Long term Actions to be undertaken beyond the next five years.
- 5.2.3 A number of recommendations have been identified throughout the report and have been incorporated within the draft Action Plan Table 5.2.1. Alongside these, the preferred options and 'quick wins' identified for each CDA have been included in the draft Action Plan. All actions included within Table 5.2.1 have been identified as 'High Priority' actions. The reader is referred to the draft Action Plan in Appendix I for all actions identified for the London Borough of Lambeth.



5.2.4 It should be noted that the London Borough of Lambeth is identified as the 'lead organisation' for the majority of the actions identified within the draft Action Plan. It is envisaged that though many of the actions should be taken forward in collaboration with third-parties such as Thames Water, the Environment Agency or Network Rail, for example, and could be partly or fully funded by these parties, the initial emphasis is likely to come from the Borough as the 'lead' organisation for local flood risk management. It will therefore be essential that responsibility and funding opportunities for any potential actions are identified at the earliest opportunity.

Recommendation 37: Identify local flood risk management funding opportunities through internal, external, existing and future funding initiatives and mechanisms

- 5.2.5 A summary of the key actions are:
 - FWMA 2010 / Flood Risk Regulations 2009 Actions A number of the key actions for Lambeth Borough Council relate to duties and responsibilities under the FWMA 2010 and the Flood Risk Regulations 2009 outlined in Section 1.7. It is likely that these actions may require consideration of internal Borough functions, roles of specific personnel, and adopting new systems of data collection and asset management. For clarity it is noted that the FWMA places immediate or in some cases imminent new responsibilities on LLFAs.
 - Financial / Resourcing Actions To deliver the requirements of the FWMA 2010 and, to a lesser extent, the Flood Risk Regulations 2009, alongside local flood risk management actions as identified in this SWMP, the London Borough of Lambeth is likely to require additional resources and funding over the long-term.
 - Communication / Partnerships Actions As our understanding about surface water flood risk improves and more information is made available, it becomes increasingly important to be able to communicate the risk effectively both within Lambeth Borough Council and to other stakeholders and members of the public. To this end a number of actions relate to the future communication of flood risk and Lambeth Borough Council may wish to consider the implementation of a Communication Plan to deliver this action. Building on the relationships developed through the Drain London Project and continuing to forge partnerships with neighbouring London Boroughs through the establishment of the South Central London Strategic Flood Group will be essential to the continued management of surface water across this area in a joined-up manner. Collaboration with neighbouring London Boroughs is also likely to aid each local authority in meeting the requirements of the Flood Risk Regulations 2009 and taking on new roles and responsibilities under the FWMA 2010.
 - **Policy Actions** Actions that will need to be delivered through policy include policies or strategies for influencing the use of rainwater harvesting techniques, managing driveway resurfacing and associated drainage, and the use of SuDS. These may be delivered across the Borough or for specific CDAs within the Borough.
 - Investigation / Feasibility / Design Actions As well as these Borough-wide actions, a number of actions have been identified for specific CDAs based upon the preferred options identified for each CDA. Within the London Borough of Lambeth, these are predominantly either capital works in the form of SuDS and creation of flood storage areas, or further investigation through more detailed modelling and initial surveys or, where appropriate, feasibility studies.



 Flooding Mitigation Actions - There are some flooding mitigation actions which can be can be progressed immediately without any further investigation to assist in the delivery of flood risk management and mitigation across the Borough, or within specified CDAs or LFRZs. It is recommended that improved and targeted maintenance of the drainage network is one of the key actions over the next 1-2 years, whilst longer-term flood mitigation options and schemes are investigated and designed.



D	Recommendation	Action Type	Timofromo	Respor	Action	
ĸ	ecommendation	Action Type	Timeiraine	Lead	Other	Plan IDs
1	Continue to work towards fulfilling the requirements under the Flood and Water Management Act 2010 and Flood Risk Regulation 2009	FWMA 2010 / FRR 2009	Short	LBL	All	LAM1 – LAM14
2	Establish a Flood Risk Management Group for the London Borough of Lambeth (as LLFA) to take forward FWMA and SWMP actions and Local Flood Risk Management	FWMA 2010 / FRR 2009	Short	LBL	-	LAM5
3	Ensure required skills and capacity are in place within (or between) LLFA(s) to deliver FWMA and Local Flood Risk Management requirements	Financial / Resourcing	Medium	LBL	-	LAM16
4	Formalise Governance Structure and Terms of Reference for South Central London Strategic Flood Management Group	FWMA 2010 / FRR 2009	Short	LBL, LBS	-	LAM6
5	Actively engage with members of the public regarding local flood risk management and formulation of the LFRM Strategy	Communication / Partnerships	Short	LBL	LC, GLA, EA, Com	LAM7, LAM18
6	Implement and populate a standardised Asset Register for the London Borough of Lambeth, prioritising surface water assets in those areas that are known to regularly flood	FWMA 2010 / FRR 2009	Short	LBL	-	LAM1
7	Implement a standardised Flood Incident Log to record and investigate future flooding incidents within the London Borough of Lambeth	FWMA 2010 / FRR 2009	Short	LBL	-	LAM3
8	Identify and map (in GIS) all Ordinary Watercourses within the London Borough of Lambeth, including their condition and function	FWMA 2010 / FRR 2009	Short	LBL	EA	LAM11
9	Work with the Environment Agency to record and investigate groundwater flooding incidents and mechanisms	FWMA 2010 / FRR 2009	Medium	LBL	EA	LAM12
10	Work with Thames Water Utilities to identify areas where sewer flooding impacts surface water flooding	FWMA 2010 / FRR 2009	Medium	LBL	TWUL	LAM13
 11	Work with the Environment Agency to incorporate any findings from the SWMP into SFRA and other fluvial / pluvial modelling projects	Communication / Partnerships	Medium	LBL	EA	LAM14
12	Validate SWMP model outputs through engagement with the public and confirming outputs and drainage capacity assumptions with key stakeholders including Thames Water, Network Rail, Transport for London and London Underground	Investigation / Feasibility / Design	Medium	LBL	EA, TWUL, NR, TfL, LU	LAM26 – LAM32

²⁵ Abbreviations for Organisations: LBL = London Borough of Lambeth; LBS = London Borough of Southwark; LBW = London Borough of Wandsworth; EA = Environment Agency; TWUL = Thames Water Utilities Limited; GLA = Greater London Authority; NR = Network Rail; TfL = Transport for London; LU = London Underground; LC = London Councils; Com = Communities / General Public; All = All third parties involved in local flood risk management





De	ecommendation	Action Type	Timofromo	Respor	Action	
Re	commendation	Action Type	Timetrame	Lead	Other	Plan IDs
13	Actively engage with professional stakeholders to communicate findings of SWMP and local flood risk management	Communication / Partnerships	Short	LBL	LC, GLA	LAM19, LAM20
 14	Design and gain buy-in to a Communication and Engagement Plan to identify how to effectively communicate and raise awareness of local flood risk to different audiences	Communication / Partnerships	Short	LBL	LC, EA	LAM18
15	Consider and implement options for raising community awareness including letter drop, information portal and/or preparation of a Community Flood Plan	Communication / Partnerships	Medium	LBL	EA, Com	LAM34
16	Consider opportunities for ongoing improvements to the maintenance of the drainage network	Flooding Mitigation Action	Medium	LBL	-	LAM39
17	Ensure appropriate Development Control Policy for repaving of gardens or driveways and explore education / awareness opportunities for general public regarding SuDS guidance and 'best practice'	Policy Action	Medium	LBL	EA	LAM45
18	Ensure Development Control Policy incorporates surface water flood risk conditions and the latest available surface water flooding information including runoff rates, SuDS, driveway repaying etc.	Policy Action	Medium	LBL	EA	LAM50
19	Consider opportunities to promote rainwater harvesting in both new and existing development throughout the London Borough of Lambeth	Flooding Mitigation Action	Medium	LBL	-	LAM51
20	Consider opportunities to promote use of water butts in both new and existing development throughout the London Borough of Lambeth	Flooding Mitigation Action	Medium	LBL	-	LAM55
21	Consider opportunities to promote awareness of property level thresholds throughout the London Borough of Lambeth, particularly in areas of higher flood risk	Flooding Mitigation Action	Medium	LBL	-	LAM59
22	Identify areas where Community Flood Plans my be effective and consider opportunities to develop these, in conjunction with the local community	Flooding Mitigation Action	Medium	LBL	EA, Com	LAM34
23	Identify opportunities for introducing, encouraging and implementing 'Complimentary Measures' across the London Borough of Lambeth.	Flooding Mitigation Action	Short	LBL	-	LAM110





D	ecommendation	Action Turne	Timofromo	Respor	Action	
Re	ecommendation	Action Type	Timetrame	Lead	Other	Plan IDs
24	Undertake a Drainage Capacity Study (in conjunction with the London Borough of Southwark and Thames Water) for the Herne Hill (Group7_032) and Brixton (Group7_033) CDAs, to determine local drainage capacity and future management options. This should include an assessment of the options for flood alleviation in the catchment including consideration of upgrades to the local and/or sewer drainage network, flood storage and/or source control SuDS, and model and cost these options to identify the most cost:beneficial option(s) for mitigating surface water flood risk in the catchment.	Investigation / Feasibility / Design	Short	LBL / LBS	TWUL	LAM63 / SOU61
25	Undertake a feasibility study for implementation of localised SuDS measures in North Clapham Park LFRZ (Group7_027) through provision of source control, flood storage and permeability measures (where appropriate) in existing green spaces and hardstanding areas interspersed in council estates.	Investigation / Feasibility / Design	Medium	LBL	-	LAM88
26	Undertake further investigations of the flooding mechanisms in the Stanthorpe Road (Group7_026) and Eardley Road (Group7_025) areas to aid in identifying cost:beneficial surface water measures to be taken forward for these areas.	Investigation / Feasibility / Design	Medium	LBL	LBW	LAM78, LAM83
27	Undertake a feasibility study for providing source control measures in Ruskin Park to mitigate surface water flooding to the railway line to the west of Denmark Hill Station and King's College Hospital (Group7_036). To be undertaken in conjunction with Network Rail and in consultation with the London Borough of Southwark.	Investigation / Feasibility / Design	Medium	LBL	LBS, NR	LAM76 / SOU77
28	Engage with Network Rail regarding the surface water flood risk along major railway lines and to railway stations identified to flood throughout the Borough, and confirm the drainage assumptions used within the SWMP pluvial modelling. In particular this should focus on infrastructure: - To the east and west of Streatham Common Railway Station (Group7_025) - To the east of Streatham Railway Station (Group7_026) - Waterloo Railway Station (Group7_034).	Investigation / Feasibility / Design	Medium	LBL	NR	LAM28, LAM78, LAM83
29	In conjunction with the London Borough of Wandsworth and Thames Water, identify the scope for undertaking drainage investigations in the Nine Elms area, along the Lambeth / Wandsworth Boundary (Group7_028), and agree a timetable and funding sources for undertaking these.	Investigation / Feasibility / Design	Medium	LBL	LBW, TWUL	LAM91



Recommendation		Action Type	Timeframe	Responsibility ²⁵		Action
				Lead	Other	Plan IDs
30	Improve community awareness through incorporating surface water flooding issues in River Graveney Community Awareness event (Group7_025).	Communication / Partnerships	Short	LBL	EA	LAM82
31	Production of Community Flood Plans for the Dulwich Road area (Group7_033) and North Clapham Park LFRZ (Group7_027) to assist communities in preparing and dealing with surface water flooding.	Communication / Partnerships	Short	LBL	LBS, Com, LC, EA	LAM89, LAM102
32	Undertake a feasibility study for, and implementation of, source control and flow path management measures in Brockwell Park (Group7_033) to mitigate surface water flooding downstream in the Dulwich Road area.	Investigation / Feasibility / Design	Medium	LBL	-	LAM103, LAM104
33	Undertake a feasibility study for, and implementation of, flood storage measures in the Berridge Road area (Group7_031) where localised, deep areas of surface water ponding are predicted and existing green space is available for utilisation.	Investigation / Feasibility / Design	Medium	LBL	-	LAM100, LAM101
34	Ensure surface water management planning policies are included within emerging SPDS or DPDs within the Waterloo Opportunity Area (Group7_034).	Policy Action	Short	LBL	-	LAM109
35	Investigate and implement measures to improve resilience at King's College Hospital (Group7_036).	Flooding Mitigation Action	Medium	LBL	LBS	LAM77 / SOU78
36	Develop, update and maintain the draft Action Plan to meet the London Borough of Lambeth's local flood risk management priorities	FWMA 2010 / FRR 2009	Short	LBL	-	LAM15
37	Identify local flood risk management funding opportunities through internal, external, existing and future funding initiatives and mechanisms	Financial / Resourcing	Short	LBL	-	LAM17



5.3 REVIEW TIMEFRAME AND RESPONSIBILITIES

- 5.3.1 The draft Action Plan identifies the relevant internal departments and external partnerships that should be consulted and asked to participate when addressing an action, though these should be checked and confirmed by the London Borough of Lambeth as the first stage in taking forward their Action Plan recommendations. After an action has been addressed, it is recommended that the responsible department (responsible for completing the action) review the Action Plan and update it to reflect any issues (communication or stakeholder participation) which arose during the completion of an action and whether or not additional actions are required.
- 5.3.2 It is recommended that the Action Plan is reviewed and updated on a quarterly basis to reflect any necessary amendments. In order to capture the works undertaken by the Council and other stakeholders, it is recommended that the Action Plan review should not be greater than an annual basis.

5.4 ONGOING MONITORING

- 5.4.1 The partnership arrangements established as part of the SWMP process (e.g., proposed South Central London Strategic Flood Group, Drain London Group 7 Working Group, Environment Agency, and Thames Water working in collaboration) should continue beyond the completion of the SWMP in order to discuss the implementation of the proposed actions, review opportunities for operational efficiency and to review any legislative changes.
- 5.4.2 The draft SWMP Action Plan should be reviewed and updated annually as a minimum, but there may be circumstances which might trigger a review and/or an update of the Action Plan in the interim, for example:
 - Occurrence of a surface water flood event;
 - Additional data or modelling becoming available, which may alter the understanding of risk within the study area;
 - If the outcome of an investment decision by partners is different to the preferred option, which may require a revision to the action plan, and;
 - Additional (major) development or other changes in the catchment which may affect the surface water flood risk.
- 5.5 UPDATING SWMP REPORTS AND FIGURES
- 5.5.1 In recognition that the SWMP will be updated in the future, the report has been structured in chapters according to the SWMP guidance provided by Defra. By structuring the report in this way, it is possible to undertake further analyses on a particular source of flooding and only have to supersede the relevant chapter, whilst keeping the remaining chapters unaffected.
- 5.5.2 In keeping with this principle, the following tasks should be undertaken when updating SWMP reports and figures:
 - Undertake further analyses as required after SWMP review
 - Document all new technical analyses by rewriting and replacing relevant chapter(s) and appendices.
 - Amend and replace relevant SWMP Maps.
 - Reissue to departments within the London Borough of Lambeth and other stakeholders.



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No allowance has been made for changes in prices or exchange rates or changes in any other conditions which may result in price fluctuations in the future. Where assessments of works or costs necessary to achieve compliance have been made, these are based upon measures which, in URS Scott Wilson's experience, could normally be negotiated with the relevant authorities under present legislation and enforcement practice, assuming a pro-active and reasonable approach by site management.

Forecast cost estimates do not include such costs associated with any negotiations, appeals or other nontechnical actions associated with the agreement on measures to meet the requirements of the authorities, nor are potential business loss and interruption costs considered that may be incurred as part of any technical measures.

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Appendix A - Data Review

A review of the data provided as part of Drain London Tier 1 package of works and that used within this SWMP has been undertaken and is provided electronically alongside this report.

Appendix A: DLT2-GP7-LAMBETH-AppendixA-DataReview_v1pt0.pdf



Appendix B - Asset Register Recommendation

A review of the existing Council-held asset information and systems and recommendations for compliance with the Flood and Water Management Act 2010 Asset Register requirements has been undertaken for the London Borough of Lambeth and is provided electronically alongside this report.

Appendix B: DLT2-GP7-LAMBETH-AppendixB-AssetRegister_v1pt0.pdf



Appendix C - Risk Assessment: Technical Details

Appendix C1 – Pluvial Modelling Methodology

Appendix C1: DLT2-GP7-LAMBETH-AppendixC1-ModellingMethod_v1pt0.pdf

Appendix C2 – Intermediate Assessment of Groundwater Flooding Susceptibility

Appendix C2: DLT2-GP7-SWMP-LAMBETH-AppendixC2-GWAssessment_v1pt0.pdf



Appendix D - Maps

D-1	Environment Agency Flood Map for Surface Water
D-2	Maximum Flood Depth (1 in 100 year Rainfall Event) & Recorded Surface Water
	Flooding Incidents
D-3	Environment Agency Flood Map and Fluvial Flooding Incidents
D-4	Thames Water Sewer Network
D-5	Recorded Incidents of Sewer Flooding
D-6	Infiltration SuDS Suitability Map
D-7	Geological Map - Bedrock
D-8	Geological Map - Bedrock and Superficial
D-9	1 in 30 year Rainfall Event: Maximum Flood Depth
D-10	1 in 30 year Rainfall Event: Hazard Rating
D-11	1 in 75 year Rainfall Event: Maximum Flood Depth
D-12	1 in 75 year Rainfall Event: Hazard Rating
D-13	1 in 100 year Rainfall Event plus Climate Change: Maximum Flood Depth
D-14	1 in 100 year Rainfall Event plus Climate Change: Hazard Rating
D-15	1 in 200 year Rainfall Event: Maximum Flood Depth
D-16	1 in 200 year Rainfall Event: Hazard Rating



Appendix E - Options Assessment Details

The Options Assessments for each CDA have been provided electronically as part of this report.

Appendix E: *DLT2-GP7-SWMP-LAMBETH-AppendixE-Options_v1pt0.pdf*



Appendix F - Peer Review

The Peer Review undertaken as part of this SWMP is provided electronically alongside this report.

Appendix F: DLT2-GP7-LAMBETH-AppendixF-PeerReview_v1pt0.pdf



Appendix G - Spatial Planning Information Pack

A Spatial Planning Information Pack has been produced as part of the SWMP and is provided electronically alongside this report.

Appendix G: DLT2-GP7-LAMBETH-AppendixG-SpatialPlanning_v1pt0.pdf

Appendix H - Resilience Forum and Emergency Planner Information Pack

A Resilience Forum and Emergency Planner Information Pack has been produced as part of the SWMP and is provided electronically alongside this report.

Appendix H: DLT2-GP7-LAMBETH-AppendixH-EmergencyPlanning_v1pt0.pdf



Appendix I - Action Plan

The **draft** Action Plan for the London Borough of Lambeth has been provided as an Excel Worksheet alongside this report.

Appendix I: DLT2-GP7-SWMP-LAMBETH-AppendixI-ActionPlan-v1pt0-DRAFT.xls