PRELIMINARY FLOOD RISK ASSESSMENT

DRAIN LONDON

LONDON BOROUGH OF Ealing

GREATER LONDON AUTHORITY

www.ealing.gov.uk
Revision Schedule

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Cover: River Brent, Hanwell, W7
Photograph Phillip Perry Source: [http://www.geograph.org.uk/photo/678302](http://www.geograph.org.uk/photo/678302)
Acknowledgements

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- The British Geological Survey;
- British Waterways;
- Drain London Group 1 Boroughs:
  - London Borough of Hounslow;
  - London Borough of Ealing; and
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- The Environment Agency;
- The Greater London Authority;
- London Councils;
- The London Fire Brigade;
- Network Rail;
- The Highways Agency;
- Thames Water;
- Transport for London; and
- London Underground
Executive Summary

Background

This report has been prepared for the London Borough of Ealing primarily to deliver the first step of the Flood Risk Regulations (2009). The London Borough of Ealing is defined as a Lead Local Flood Authority (LLFA) under the Floods and Water Management Act (the Act). The first step of the Flood Risk Regulations is for LLFAs to produce a Preliminary Flood Risk Assessment (PFRA), comprising this document, the supporting spreadsheet and GIS layer. PFRAs were already required prior to the implementation of the Act by the EU Flood Risk Management Regulations (‘Floods Directive’) and are therefore not a new requirement. The timetable for production of PFRAs and subsequent documents and strategies is defined by the Floods Directive. Some of the information within this report will also assist the London Borough of Ealing to manage local flood risk, in accordance with their duties under the Flood and Water Management Act 2010 (the Act).

The PFRA process is aimed at providing a high level overview of flood risk from all sources within a local area, including consideration of surface water, groundwater, ordinary watercourses and canals. As a LLFA, the London Borough of Ealing is required to submit their PFRA to the Environment Agency for review by 22nd June 2011. This PFRA has been produced as part of a coordinated programme of work across greater London facilitated by the Drain London Forum and the GLA. The methodology for producing this PFRA is consistent with other London Boroughs and has been based on the Environment Agency’s Final PFRA Guidance and Defra’s Guidance on selecting Flood Risk Areas, both published in December 2010.

Indicative Flood Risk Areas

Prior to the development of PFRAs the Environment Agency has used a national methodology, which has been set out by Defra, to identify broad indicative Flood Risk Areas across England where flooding could result in ‘significant harmful consequences’. Of the ten indicative Flood Risk Areas that have been identified nationally, one is the Greater London administrative area. The majority of the London Borough of Ealing is within this Flood Risk Area, with the main exception being the area of relatively rural land in the north east of the borough.

To date significant harmful consequences have been assessed at a national scale based on a set of National Indicators developed by Defra:

- Human health – 30,000 people or 150 critical services (e.g. schools, hospitals, etc);
- Economic activity – 3,000 non-residential businesses; and
- Impact on environmental designations, heritage and pollution.

Ealing is only one part of the Greater London Indicative Flood Risk Area that met this threshold. Currently there is little guidance available on how national indicators should be applied at the local level and it is expected LLFAs develop their own relevant thresholds based on these indicators.

Review of Indicative Flood Risk Areas

Information relating to past flood events, caused by flooding from local sources, was collected and analysed. However, comprehensive details on flood extents and consequences of these events were largely unavailable. Based on the evidence that was collected, no past flood events could be determined with any certainty to have had ‘significant harmful consequences’. Therefore, the decision was made to not include any records of past flooding in Annex 1 of the Preliminary Assessment Spreadsheet.

Following consultation with the Environment Agency, it is recommended that the Flood Risk Area boundary originally identified by the EA in this area is amended slightly to reflect the relevant administrative boundaries and communities in Norwood Green.
In order to develop a clear overall understanding of the flood risk across the London Borough of Ealing, flood risk data and records of historic flooding were collected from local and national sources including within the Borough, the Environment Agency, Thames Water, emergency services and other risk management authorities such as TfL.

However, there is a high future risk of flooding from local sources in parts of Ealing, particularly from surface water. The Drain London project is delivering surface water management plans for each London borough, including hydraulic modelling of surface water runoff. Based on Drain London outputs it is estimated that approximately 67,900 properties are potentially at risk from flooding during a rainfall event with a 1 in 200 annual chance of occurring. The number of properties and businesses at risk for a future flood event is estimated to have ‘significant harmful consequences’ at a local scale as has been included in Annex 2 of the Preliminary Assessment Spreadsheet for collation and review by the Greater London Authority and Environment Agency for the Greater London Flood Risk Area.

Following on from approval of this PFRA, the Flood Risk Regulations require the borough to carry out two subsequent key stages:

- Flood hazard maps and flood risk maps (by June 2013); and
- Flood risk management plans (by June 2015).

The next cycle of the Flood Risk Regulations will begin in 2017 with review and update of this PFRA.
## Glossary

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<tr>
<td>Aquifer</td>
<td>A water bearing rock, sand or gravel capable of yielding significant quantities of water.</td>
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<td>Asset Management Plan (AMP)</td>
<td>In the context of water services, a plan for managing water and sewerage company (WaSC) infrastructure and other assets in order to deliver an agreed standard of service.</td>
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<tr>
<td>ASiSWF</td>
<td>Areas Susceptible to Surface Water Flooding – The first generation broadscale national mapping of surface water flooding prepared for the Environment Agency.</td>
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<td>Catchment Flood Management Plan (CFMP)</td>
<td>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.</td>
</tr>
<tr>
<td>CiRIIA</td>
<td>Construction Industry Research and Information Association</td>
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<td>Civil Contingencies Act 2004</td>
<td>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.</td>
</tr>
<tr>
<td>CLG</td>
<td>Government Department for Communities and Local Government</td>
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<tr>
<td>Climate Change</td>
<td>Long term variations in global temperature and weather patterns caused by natural and human actions.</td>
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<td>Critical Drainage Area (CDA)</td>
<td>Areas of significant flood risk, characterised by the amount of surface runoff that drains into the area, the topography and hydraulic conditions of the pathway (e.g. sewer, river system), and the receptors (people, properties and infrastructure) that may be affected.</td>
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<tr>
<td>Culvert</td>
<td>A buried or underground channel or pipe that carries a watercourse below the level of the ground.</td>
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<tr>
<td>Defra</td>
<td>Department for Environment, Food and Rural Affairs</td>
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<td>DEM</td>
<td>Digital Elevation Model – three dimensional digital representation of unfiltered topography surface of an area.</td>
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<tr>
<td>DG5 Register</td>
<td>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 10 years.</td>
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<tr>
<td>DTM</td>
<td>Digital Terrain Model – three-dimensional digital representation of a bare earth surface (i.e. with buildings, trees removed)</td>
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<tr>
<td>EA</td>
<td>Environment Agency – Who’s play a central role in delivering the environmental priorities of central government and the Welsh Assembly Government through functions and roles</td>
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<tr>
<td>Indicative Flood Risk Areas</td>
<td>Areas determined by the Environment Agency as potentially having a significant level of 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.</td>
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<tr>
<td>FMfSW</td>
<td>Flood Map for Surface Water – second generation mapping prepared for the Environment Agency on the risk of surface water flooding</td>
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<tr>
<td>Flood defence</td>
<td>Infrastructure used to protect an area against floods. For example, floodwalls and embankments; they are designed to a specific standard of protection (design standard).</td>
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<td>Flood Risk Area</td>
<td>An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG.</td>
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<td>Flood Risk Regulations (FRR)</td>
<td>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.</td>
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<td>Flood and Water Management Act</td>
<td>An Act of Parliament passed into law in 2010 which forms part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, a major recommendation of which is to clarify the legislative framework for managing surface water flood risk in England.</td>
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<tr>
<td>Fluvial Flooding</td>
<td>Flooding resulting from water levels exceeding the bank level of a river or stream.</td>
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<td>IDB</td>
<td>Internal Drainage Board - Internal Drainage Boards (IDBs) are independent bodies responsible for land drainage in areas of special drainage.</td>
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<td>IUD</td>
<td>Integrated Urban Drainage</td>
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<td>LB</td>
<td>London Borough</td>
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<td>LDF</td>
<td>Local Development Framework</td>
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<td>Lead Local Flood Authority</td>
<td>Local Authority responsible for taking the lead on local flood risk management</td>
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<td>LiDAR</td>
<td>Light Detection and Ranging</td>
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<td>LLFA</td>
<td>Lead Local Flood Authority</td>
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<td>Local Resilience Forum</td>
<td>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.</td>
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<td>LPA</td>
<td>Local Planning Authority</td>
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<td>LRF</td>
<td>Local Resilience Forum</td>
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<td>Main River</td>
<td>A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers</td>
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<td>NGR</td>
<td>National Grid Reference - a system of geographic grid references used in Great Britain</td>
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<td>NRD</td>
<td>National Receptor Dataset – a collection of risk receptors produced by the Environment Agency</td>
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<td>Ordinary Watercourse</td>
<td>All watercourses that are not designated Main River, and which are the responsibility of Local Authorities or, where they exist, IDBs</td>
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<tr>
<td>Partner</td>
<td>A person or organisation with responsibility for the decision or actions that need to be taken.</td>
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<td>PFRA</td>
<td>Preliminary Flood Risk Assessment</td>
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<td>Pitt Review</td>
<td>Comprehensive independent review of the 2007 summer floods by Sir Michael Pitt, which provided recommendations to improve flood risk management in England.</td>
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<tr>
<td>Pluvial Flooding</td>
<td>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.</td>
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<td>PPS25</td>
<td>Planning and Policy Statement 25: Development and Flood Risk</td>
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<tr>
<td>Resilience Measures</td>
<td>Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.</td>
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<tr>
<td>Resistance Measures</td>
<td>Measures designed to keep flood water out of properties and businesses; could include flood guards for example.</td>
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<tr>
<td>Risk</td>
<td>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.</td>
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<td>Risk Management Authority (RMA)</td>
<td>As defined by the Floods and Water Management Act</td>
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<td>River Basin District (RBD)</td>
<td>A River Basin or Basins used for both strategic planning and reporting to the European Commission for the Water Framework Directive. There are eleven RBDs in England and Wales.</td>
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<tr>
<td>Sewer Flooding</td>
<td>Flooding caused by a blockage or overflowing in a sewer or urban drainage system.</td>
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<td>SFRA</td>
<td>Strategic Flood Risk Assessment</td>
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<td>Stakeholder</td>
<td>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.</td>
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<td>SuDS</td>
<td>Sustainable Drainage Systems</td>
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<tr>
<td>Sustainable Drainage Systems</td>
<td>Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.</td>
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<tr>
<td>Surface Water</td>
<td>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.</td>
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<td>SWMP</td>
<td>Surface Water Management Plan</td>
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<td>Tfl</td>
<td>Transport for London</td>
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<td>TWUL</td>
<td>Thames Water Utilities Ltd</td>
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<td>WaSC</td>
<td>Water and Sewerage Company</td>
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Figure C-1 Revised Indicative Flood Risk Areas
1 Introduction

1.1 What is a Preliminary Flood Risk Assessment?

1.1.1 A Preliminary Flood Risk Assessment is a high level screening exercise to identify areas of significant flood risk within a given study area. The PFRA involves collecting information on past and future (potential) floods, assembling the information into a Preliminary Flood Risk Assessment report, and identifying Flood Risk Areas.

1.1.2 This Preliminary Flood Risk Assessment (PFRA) for the London Borough of Ealing provides a high level summary of significant flood risk, based on available and readily derivable information, describing both the probability and harmful consequences of past and future flooding. The development of new information is not required by the process, but new analysis of existing information may be needed.

1.1.3 The accompanying Preliminary Flood Risk Assessment Spreadsheet contains the following annexes:

- Annex 1: Records of past floods and their significant consequences;
- Annex 2: Records of future floods and their significant consequences: This includes a complete record of future flood risk within the Borough, including details of the potential consequences of flooding to key risk receptors; and
- Annex 3: Flood Risk Area: This includes the three identified Flood Risk Areas within the London Borough of Ealing and justification for proposed changes to the boundary of the Environment Agency’s Indicative Flood Risk Area.

1.1.4 This PFRA has been based on existing and readily available information and brings together information from a number of available sources such as the Environment Agency’s national information (for example Flood Map for Surface Water) and existing local products such as Strategic Flood Risk Assessments (SFRAs) and Surface Water Management Plans (SWMPs).

1.2 Background

1.2.1 The primary driver behind the Preliminary Flood Risk Assessment is the Flood Risk Regulations 2009, which came into force on the 10th December 2009 and transpose the EC Floods Directive (Directive 2007/60/EC on the assessment and management of flood risks) into domestic law in England and Wales and to implement its provisions.

1.2.2 In particular the Regulations place duties on the Environment Agency and Local Lead Flood Authorities to prepare a number of documents across an ongoing 6-year cycle. These can be located Figure 1-1 within overleaf:

1.2.3 The purpose of the Preliminary Flood Risk Assessment under the Regulations is to provide the evidence for identifying Flood Risk Areas. The report will also provide a useful reference point for all local flood risk management and inform local flood risk strategies.
1.2.4 The scope of the PFRA is to consider past flooding and potential future flooding from the sources of flooding other than main rivers, the sea and reservoirs. In particular this includes surface runoff, groundwater and ordinary watercourses and any interaction these have with drainage systems other sources.

1.3 Objectives

1.3.1 The key objectives of the PFRA are summarised as follows:

- Collect information on past (historic) and future (potential) floods within the study area and record it within the Preliminary Flood Risk Assessment spreadsheet;
- Assemble the information into a Preliminary Flood Risk Assessment report;
- Review the Indicative Flood Risk Areas delineated by the Environment Agency and where necessary provide explanation and justification for any amendments required to the Indicative Flood Risk Areas;
- Provide a summary of the systems used for data sharing and storing and the provision for quality assurance, security and data licensing arrangements;
- Describe arrangements for partnership and collaboration for ongoing collection, assessment and storage of flood risk data and information;
- Identify relevant partner organisations involved in future assessment of flood risk; and summarise means for future and ongoing stakeholder engagement;
- Provide a useful reference point for all local flood risk management and inform future local strategies.

1.4 Study Area

1.4.1 The London Borough of Ealing covers an area of approximately 55.36km² in West London and includes a combination of land uses which include:

- Urban areas of Ealing, Northolt, Greenford, Southall and Acton;
1.4.2 The River Brent, Yeading Brook, River Thames (and its tributaries) and the Grand Union Canal pass through or adjacent to the Borough. The main watercourses within the London Borough of Ealing are summarised below, refer to Figure 1 and Figure A-2 which identifies the watercourses in Ealing.

![Figure 1-2 Watercourses within the London Borough of Ealing]

1.4.3 The River Brent has an approximate catchment area of 168 km² which is a tributary of the River Thames. It runs for approximately 18 miles in a southerly direction towards its confluence with the River Thames in Brentford (NGR 518160 177370). The River is formed by the confluence of the Silk Stream, Dollis Brook, Decoy Brook and a number of unnamed streams.
1.4.4 The Coston's Brook source can be found in two places, the western branch forming beyond Belvue Park in Northolt and the eastern branch in the Ealing Northern Sports Centre, which join together near the Greenford Road roundabout under the A40. The Brook then travels south meeting the Brent just before the Brent changes course from a westerly direction to southward. The Coston's Brook is culverted along the majority of its course as a result of development in the study area over the last century.

1.4.5 The Dormer's Wells Stream is a tributary of the River Brent. Its source lies within the Dormer's Wells Golf Course where several smaller streams combine into a large pond to the west of Greenford Road. The stream then travels under Argyle Road before joining the Brent by Brent Lodge Park.

1.4.6 The Perivale Park Brook is a small tributary of the River Brent. Its source lies somewhere within the Perivale Industrial Park. It then travels south, culverted much of the way until it joins the Brent to the north of Gurnell Swimming Pool.

1.4.7 The Twyford ditch/stream forms at Twyford Abbey Farm's Pond (Mapping shows this now to be a Brewery and is a small tributary of the River Brent. The stream then flows north joining the River Brent slightly downstream of the Grand Union Canal Aqueduct. The stream is culverted for the majority of its course as it travels under a School and the North Circular (A406).

1.4.8 The Osterley Park Boundary Stream is classified as an EA main river, a tributary of the River Brent, its source is located in Norwood Green. It forms the northern boundary of Osterley Park.

1.4.9 The Yeading Brook is tributary of the Crane and is approximately 25.8km in length. The Crane classified by the EA as a main river and is located to the west of the Study Area. It runs along a short length of the Borough's western boundary.

1.4.10 The London end of the Grand Union Canal begins in Brentford, it enters the London Borough of Ealing slightly upstream of Osterley Lock in the south east of the borough. It then heads west towards Norwood Green and Southall. At Bulls Bridge the Paddington arm branches off to the north whilst the western branch continues into Hayes, leaving the London Borough of Ealing.

1.4.11 For more information relating to these watercourses it is recommended that the reader refers to the London Borough of Ealing Strategic Flood Risk Assessment, prepared by Capita Symonds, dated December 2007.
2 LLFA Responsibilities

2.1 Legislative Background

2.1.1 The key drivers behind the Preliminary Flood Risk Assessment are two pieces of new legislation, the Flood Risk Regulations 2009 which came into force on the 10th December 2009, and the Flood & Water Management Act (FWMA) which gained Royal Assent on the 8th April 2010.

2.1.2 The Flood Risk Regulations 2009 was created to transpose the EU Floods Directive (Directive 2007/60/EC) into domestic law in England and Wales. The Floods Directive provides a framework to assess and manage flood risks in order to reduce adverse consequences for human health, the environment (including cultural heritage) and economic activity.

2.1.3 The Flood and Water Management Act 2010 makes specific provision for the recommendations provided by Sir Michael Pitt in his independent review of the flooding experienced across much of England and Wales in 2007.

2.1.4 Under these pieces of legislation, all Unitary Authorities are designated ‘Local Lead Flood Authorities’ (LLFA) and have formally been allocated a number of key responsibilities with respect to local flood risk management.

2.2 Leadership & Partnership

2.2.1 The Flood and Water Management Act 2010 defines the Lead Local Flood Authority (LLFA) for an area as the unitary authority for the area, in this case London Borough of Ealing. As such, the London Borough of Ealing is responsible for leading local flood risk management including establishing effective partnerships with 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 Level of Service Agreements (LoSA) or Memorandums of Understanding (MoU).

2.2.2 The London Borough of Ealing forms part of the ‘Group 1’ group of boroughs, established as part of the Drain London programme, formed to assist delivery of Drain London, but also to establish an ongoing working partnership for managing local flood risk in the area. Drain London Group 1 includes the London boroughs of:

- Ealing
- Hounslow; and
- Hillingdon.

2.2.3 Group 1 are represented on the Thames Regional Flood Defence Committee (RFDC) by the councillor from the London Borough of Hounslow.
2.3 Stakeholder Engagement

2.3.1 As part of the PFRA and parallel preparation of the SWMP for the area, London Borough of Ealing has sought to engage stakeholders representing the following organisations and authorities.

- Environment Agency
- Thames Water Utilities Ltd
- Neighbouring London Boroughs
- British Waterways
- London Fire Brigade
- Network Rail
- London Underground
- Transport for London
- Highways Agency
- Natural England

2.3.2 Of these organisations, the Environment Agency and London Borough of Ealing representatives were actively engaged and assisted in the preparation of this document.

2.3.3 Within London Borough of Ealing, representatives from a number of departments and sectors have been engaged in the PFRA process including Emergency Planning, Strategic Planning, Parks, Highways and Drainage.

2.4 Public Engagement

2.4.1 Members of the public may also have valuable information to contribute to the PFRA 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 chances of stakeholder acceptance of options and decisions proposed in future flood risk management plans.

2.4.2 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.

2.4.3 It is important to undertake some public engagement when formulating local flood risk management plans, following the designation of Flood Risk Areas within the study area as this will help to inform future levels of public engagement. As part of the Drain London project, the Greater London Authority are reviewing how the project outputs generated could be communicated to the public and will provide advice to boroughs.

2.4.4 It is recommended that the London Borough of Ealing 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.
2.5 Other Responsibilities

2.5.1 Aside from forging partnerships and coordinating and leading on local flood management, there are a number of other key responsibilities that have arisen for Local Lead Flood Authorities from the Flood & Water Management Act 2010, and the Flood Risk Regulations 2009. These responsibilities include:

- **Investigating flood incidents** – LLFAs have a duty to investigate and record details of significant flood events within their area. This duty includes identifying which 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.

- **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 SuDS Approving Body (SAB) for any new drainage system, and therefore must approve, adopt and maintain any new sustainable drainage systems (SuDS) within their area. This responsibility is anticipated to commence from April 2012.

- **Flood risk management strategies** – LLFAs are required to develop, maintain, apply and monitor a strategy for local flood risk management in its area. The local 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 local flood risk management 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.
3 Methodology & Data Review

3.1 Data Sources & Availability

3.1.1 Table 3-1 provides a summary of the data sources held by partner organisations and provides a description of the dataset and its availability at the time the PFRA was produced. This data was collated centrally by the Greater London Authority through the Drain London project, including centralising relevant data sharing agreements and licensing. This data was then disseminated to consultants Capita Symonds with Scott Wilson for the preparation of the London Borough of Ealing PFRA.

Table 3-1 Data Sources

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment Agency Flood Map (Flood Zones)</td>
<td>Shows extent of flooding from rivers with a catchment during 1 in 100yr flood and 1 in 1000yr flood. Shows extent of flooding from the sea during 1 in 200yr and 1 in 1000yr flood events. Ignores the presence of defences.</td>
</tr>
<tr>
<td>Areas Susceptible to Surface Water Flooding</td>
<td>A national outline of surface water flooding held by the EA and developed in response to Pitt recommendations.</td>
</tr>
<tr>
<td>Flood Map for Surface Water</td>
<td>A second generation of surface water flood mapping which was released at the end of 2010.</td>
</tr>
<tr>
<td>Areas Susceptible to Groundwater Flooding</td>
<td>Mapping showing areas susceptible to groundwater flooding.</td>
</tr>
<tr>
<td>Groundwater Flooding Incidents</td>
<td>Records of historic incidents of groundwater flooding as recorded by the Environment Agency.</td>
</tr>
<tr>
<td>National Receptors Dataset</td>
<td>A nationally consistent dataset of social, economic, environmental and cultural receptors including residential properties, schools, hospitals, transport infrastructure and electricity substations.</td>
</tr>
<tr>
<td>Indicative Flood Risk Areas</td>
<td>National mapping highlighting key flood risk areas, based on the definition of significant flood risk agreed with the Defra and WAG.</td>
</tr>
<tr>
<td>Historic Flood Outline</td>
<td>Attributed spatial flood extent data for flooding from all sources.</td>
</tr>
<tr>
<td>Rainfall Data</td>
<td>15 minute and daily rainfall gauge records from approximately 1990 – 2010 for gauge sites across London.</td>
</tr>
<tr>
<td>Source protection zones</td>
<td>Show the risk of contamination that might cause pollution in the area. The maps show three main zones (inner, outer and total catchment).</td>
</tr>
<tr>
<td>Asset data</td>
<td>Details on the location and extent of flood defences across Group 1 as well as a system asset management plans.</td>
</tr>
<tr>
<td>Strategic Flood Risk Assessments (SFRA)</td>
<td>SFRAs may contain useful information on historic flooding, including local sources of flooding from surface water, groundwater and flooding from canals.</td>
</tr>
<tr>
<td>Historical flooding records</td>
<td>Historical records of flooding from surface water, groundwater and ordinary watercourses.</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Source</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anecdotal information relating to local flood history and flood risk areas</td>
<td>Anecdotal information from authority members regarding areas known to be susceptible to flooding from excessive surface water, groundwater or flooding from ordinary watercourses.</td>
</tr>
<tr>
<td>Highways Flooding Reports</td>
<td>Highways Flooding Reports, including analysis of the flood risk at each location.</td>
</tr>
<tr>
<td>DG5 Register for Thames Water Utilities areas</td>
<td>DG5 Register logs and records of sewer flooding incidents in each area.</td>
</tr>
<tr>
<td>Sewer pipe network</td>
<td>GIS dataset providing the georeferenced location of surface water, foul and combined sewers across Group 1. Includes pipe size and some information on invert levels.</td>
</tr>
<tr>
<td>British Waterway's canal network</td>
<td>Detailed GIS information on the British Waterway’s canal network, including the location of canal centrelines, sluices, locks, culverts, etc.</td>
</tr>
<tr>
<td>Records of canal breaches and overtopping events</td>
<td>Records of historical canal overtopping and drainage misconnections.</td>
</tr>
<tr>
<td>Geological datasets</td>
<td>Licenced GIS datasets including:</td>
</tr>
<tr>
<td></td>
<td>- Geological indicators of flooding;</td>
</tr>
<tr>
<td></td>
<td>- Susceptibility to groundwater flooding;</td>
</tr>
<tr>
<td></td>
<td>- Permeability;</td>
</tr>
<tr>
<td></td>
<td>- Bedrock and superficial geology.</td>
</tr>
<tr>
<td>Deprived Areas</td>
<td>Index of Multiple Deprivation, ranking all London Ward's.</td>
</tr>
<tr>
<td>Historic flooding records</td>
<td>Recorded incidents of flooding to London Underground and National Rail infrastructure</td>
</tr>
</tbody>
</table>

### 3.2 Limitations

#### 3.2.1 Records of Past Floods

The most significant data gap across the London Borough of Ealing relates to records of past ‘local’ flooding incidents. This is a common issue across the UK as record keeping of past floods has historically focussed on flooding from rivers or the sea. Records of past incidents of surface water, sewer, groundwater or ordinary watercourse flooding has been inconsistent.

#### 3.2.2 Thames Water

Thames Water have provided postcode-linked data (DG5 register) on records of sewer flooding, however more detailed data on the location and cause of sewer flooding is not currently available.
3.2.3 Some incidents have been digitised into GIS from hard copy maps by London Borough of Ealing, however there is very little information on the probability, hazard or consequence of flooding.

3.2.4 Similarly, the London Fire Brigade have recorded incidents of call outs relates to flooding, however there is no information on the source of flooding (e.g. many may be burst pipes), or probability, hazard or consequence of the flooding.

**Future Groundwater Flooding**

Groundwater flooding is dependent on local variations in topography, geology and soils. The causes of groundwater flooding are generally understood however it is difficult to predict the actual location, timing and extent of groundwater flooding without comprehensive datasets.

3.2.5 There is a lack of reliable measured datasets to undertake flood frequency analysis and even with datasets this analysis is complicated due to the non-independence of groundwater level data. Surface water flooding incidents are sometimes mistaken for groundwater flooding incidents, e.g. where runoff via infiltration seeps from an embankment, rather than locally high groundwater levels.

**Future Surface Water Flooding**

3.2.6 The Environment Agency data sets ‘Areas Susceptible to Surface Water Flooding’ and second generation ‘Flood Map for Surface Water’ are national scale assessments suitable for broadly identifying surface water flood risk. The datasets are of a resolution suitable for the PFRA, however are limited in their use in addressing the next stages of the Flood Risk Regulations (2009), e.g. Hazard Maps. The outputs from Drain London will assist in addressing this data limitation.

**Flooding Consequences**

3.2.7 The analyses to prepare the indicative Flood Risk Areas issued to accompany the final PFRA Guidance were based on the National Receptors Database (NRD) version 1.0 (for the counts of properties and other receptors). Receptor information was prepared for all London Boroughs in December 2010 in order to undertake property counts required for the SWMPs, also using NRD version 1.0. Version 1.1 of the NRD has subsequently been issued and contains modifications and corrections since version 1.0. However, in order to avoid repetition of work, and ensure consistency between the SWMP and the PFRA, it was decided to complete the PFRA using NRD version 1.0.

3.3 **Security, Licensing and Use Restrictions**

3.3.1 A number of datasets used in the preparation of this PFRA are subject to licensing agreements and use restrictions.

3.3.2 The following national datasets provided by the Environment Agency are available to lead local flood authorities for local decision making:

- EA Flood Zone Map;
- Areas Susceptible to Surface Water Flooding;
- Flood Map for Surface Water; and
- National Receptor Database.

3.3.3 A number of the data sources used are publically available documents, such as:
• Strategic Flood Risk Assessment;
• Catchment Flood Management Plan; and
• Surface Water Management Plan.

3.3.4 The use of some of the datasets made available for this PFRA has been restricted. These include:

• Records of property flooding held by Thames Water Utilities Ltd;
• British Geological Society geology datasets;
• London Fire Brigade call outs for flooding; and
• Index of Multiple Deprivation

3.3.5 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.

3.4 Quality Assurance

3.4.1 The datasets used to inform this PFRA were collected centrally for all London Boroughs as part of the Tier 1 Drain London work package. All data received was subject to quality assurance measures to monitor and record the quality and accuracy of the data and information. A data quality score was given to all the data which is a qualitative assessment based on the Data Quality System provided in the SWMP Technical Guidance (March 2010). This system is explained in Table 3-2.

Table 3-2 Data Quality System (SWMP Technical Guidance March 2010)

<table>
<thead>
<tr>
<th>Data Quality Score</th>
<th>Description</th>
<th>Explanations</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Best available</td>
<td>No better available; not possible to improve in the near future</td>
<td>2D Pluvial Modelling Outputs</td>
</tr>
<tr>
<td>2</td>
<td>Data with known deficiencies</td>
<td>Best replaced as soon as new data is available</td>
<td>Historic Flood Records</td>
</tr>
<tr>
<td>3</td>
<td>Gross assumptions</td>
<td>Not invented but based on experience and judgement</td>
<td>Location, extent and depth of surface water flooding</td>
</tr>
<tr>
<td>4</td>
<td>Heroic assumptions</td>
<td>An educated guess</td>
<td>Impact of a historic flood event</td>
</tr>
</tbody>
</table>

3.4.2 The use of this system provides a basis for analysing and monitoring the quality of data that is being collected and used in the preparation of the PFRA. As mentioned in Section 3.2, some of the datasets collected for this PFRA were of poor quality, and this has been identified and recorded using this system.
4 Past Flood Risk

4.1 Summary of Past Floods

4.1.1 Table 4-1 provides a summary of the past flooding recorded in more than one location in London Borough of Ealing, and known to be from surface water, sewer or groundwater sources. Records in Table 4.1 are based on more than one reported incidence of flooding on a particular day, however as identified in Section 3.2, it does not necessarily represent every flooding incident in the London Borough of Ealing.

4.1.2 The LB Ealing SFRA Indicates that approximately 30 properties (at the time of writing) had been flooded by surface

<table>
<thead>
<tr>
<th>Main source of flooding</th>
<th>Description/Location</th>
<th>Data Source</th>
<th>Date</th>
<th>Significant harmful consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pluvial</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface water flooding on Victoria Road, North Acton.</td>
<td>LB Ealing</td>
<td>August 2004</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Minor surface water flooding on Victoria Road, North Acton</td>
<td>Ealing SFRA</td>
<td>May 2006</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>Victoria Road, North Acton</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Church Road and Regley Close (central Acton) were flooded. There were three unconfirmed reports within June and August 2005.</td>
<td>Ealing SFRA</td>
<td>July 2007</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Flooding neat the intersection of Lower Boston Road and Uxbridge Road, Hanwell.</td>
<td>Ealing SFRA</td>
<td>July 2007</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Uxbridge Road: O/S Ealing Hospital</td>
<td>LB Ealing</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Trumpers Way: Low area by canal bridge</td>
<td>LB Ealing</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Victoria Road W3-Complete Road</td>
<td>LB Ealing</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Long Drive &amp; Olympic Way Greenford: Complete Roads.</td>
<td>LB Ealing</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Acton Lane W3: Complete Road</td>
<td>LB Ealing</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>South Parade &amp; Fishers Lane W4: Complete Roads</td>
<td>LB Ealing</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Horn Lane W3: Uxbridge Road to Noel Road</td>
<td>LB Ealing</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Boston Parade (outside shops) &amp; Boston Road (From Rosebank Road to Elthorne Park Road)</td>
<td>LB Ealing</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Ealing Road Northolt: Complete Road</td>
<td>LB Ealing</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Acton Lane O/S WM Hospital &amp; by Waxlow Road</td>
<td>LB Ealing</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Rowdell Road &amp; Kensington Road Southall Northolt</td>
<td>LB Ealing</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Old Oak Lane</td>
<td>LB Ealing</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Subways:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Within Greenford Roundabout complex: Specialist equipment required + Manual Cleansing</td>
<td>LB Ealing</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>- By Southall Station: Manual Cleansing.</td>
<td>LB Ealing</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Main source of flooding</td>
<td>Description/Location</td>
<td>Data Source</td>
<td>Date</td>
<td>Significant harmful consequences</td>
</tr>
<tr>
<td>------------------------</td>
<td>----------------------</td>
<td>-------------</td>
<td>------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Pitshanger Park, adjacent to Western Avenue—water logging in the garden for 2 months</td>
<td>EA</td>
<td>-</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Easton Rise - Damp</td>
<td>EA</td>
<td>6 November 2002</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Elers Road - Standing Water</td>
<td>EA</td>
<td>8 January 2003</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Elton Avenue Wet</td>
<td>EA</td>
<td>16 July 2003</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Shakespeare Road - Standing Water</td>
<td>EA</td>
<td>5 April 2004</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Avenue Road - Standing Water</td>
<td>EA</td>
<td>20 April 2004</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Killowen Avenue - Standing Water</td>
<td>EA</td>
<td>11 May 2004</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Ealing Road - Standing Water</td>
<td>EA</td>
<td>5 April 2005</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Twyford Abbey Road - Wet</td>
<td>EA</td>
<td>6 June 2005</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Cleveland Road - Wet</td>
<td>EA</td>
<td>7 June 2005</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Twyford Avenue - Standing Water</td>
<td>EA</td>
<td>23 June 2005</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Hadden Way - Standing Water</td>
<td>EA</td>
<td>3 October 2005</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Castlebar Park - Wet</td>
<td>EA</td>
<td>24 October 2005</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Connell Crescent - Seepage</td>
<td>EA</td>
<td>25 November 2005</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Madeley Road - Standing Water</td>
<td>EA</td>
<td>20 January 2006</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Studland Road - Standing Water</td>
<td>EA</td>
<td>13 September 2006</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Gordon Road - Seepage</td>
<td>EA</td>
<td>13 November 2006</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Upper Town Road - Standing Water</td>
<td>EA</td>
<td>11 April 2007</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Mount Park Crescent - Standing Water</td>
<td>EA</td>
<td>18 September 2007</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Birkbeck Road - Standing Water</td>
<td>EA</td>
<td>2 October 2007</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Framfled Road - Flowing Water</td>
<td>EA</td>
<td>2 October 2007</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Courtfield Gardens - Walterlogged</td>
<td>EA</td>
<td>29 February 2008</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Heath Close - Flowing Water</td>
<td>EA</td>
<td>10 March 2008</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Borders Road - Slow Flowing Water</td>
<td>EA</td>
<td>6 July 2009</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Cornwall Avenue - Damp Patch</td>
<td>EA</td>
<td>4 December 2009</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Heathfield Road - Spring</td>
<td>EA</td>
<td>20 January 2010</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Lindfield Road - Standing Water</td>
<td>EA</td>
<td>22 April 2010</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Churchfield Road - Damp Patch</td>
<td>EA</td>
<td>14 July 2010</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Briar Crescent - Standing Water</td>
<td>EA</td>
<td>26 July 2010</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Marlborough Road - Damp Patch</td>
<td>EA</td>
<td>16 September 2010</td>
<td>No</td>
</tr>
</tbody>
</table>

4.1.3 The complete record of known and recorded flooding incidents in the London Borough of Ealing are shown on the following figures in Annex A:

- A-1 Surface Water Flooding Incidents
- A-2 Main River / Fluvial / Tidal Flooding Incidents
- A-3 Groundwater Flooding Incidents
- A-4 Sewer Flooding Incidents
4.2 Significant Harmful Consequences

4.2.1 There is very little reliable information available on the consequences of each of the flood events in Table 4.1; therefore there is no certainty in being able to classify them as having "significant harmful consequences" as required by the Flood Risk Regulations. In the absence of any reliable data, the London Borough of Ealing believes none of these events meet the criteria to be included in Annex 1 of the PFRA.

4.2.2 Available data on historic flooding in the London Borough of Ealing has been assembled into a standardised GIS data record as part of the Drain London project to assist with consistent and suitably detailed recording of future flooding incidents for the next cycle of the Flood Risk Regulations.

4.3 Interactions with Other Flooding Sources

4.3.1 Flooding is often the result of water from more than one source, or water building up because another source (such as a river, or the sea) has prevented it from discharging normally. Information about past flooding can often be from an unknown source (i.e. it is not clear where the water came from), or flooding as a result of interactions between sources (in which case more than one source may be recorded).

4.3.2 An example of multiple sources contributing to flooding would be where water levels in a river (or watercourse) exacerbate surface water flooding within a catchment. This can occur when flows within a river exceed the channels capacity causing flooding of the local floodplain (i.e. fluvial flooding). As a result, these high water levels, within the river, will restrict the ability of surface water sewers to drain adequately. This can then lead to areas located outside of the floodplain to experience flooding (surface water flooding) due to the reduced capacity within the drainage network as a result of the outfall being submerged by fluvial flooding.

4.3.3 Where flood records within the study area are known to be from more than one flood source, this has been recorded in the Preliminary Flood Risk Assessment spreadsheet. Where the source of flooding is not known this has also been recorded.
5 Future Flood Risk

5.1 Summary of Future Flood Risk

5.1.1 Information about future flood risk, or potential flooding, is usually produced by computer models. The Environment Agency has several national datasets showing risk of flooding from surface water, groundwater and main rivers and ordinary watercourses that are available to LLFAs:

- Areas Susceptible to Surface Water Flooding (ASTSWF);
- EA Flood Map for Surface Water (FMfSW);
- Areas Susceptible to Groundwater Flooding; and
- EA Flood Zone Map

5.2 Locally Agreed Information on Future Flood Risk

Surface Water and Ordinary Watercourses

5.2.1 In addition to these national datasets more locally specific surface water information is available for the study area. The London Borough of Ealing is in the process of completing a Surface Water Management Plan (SWMP) as part of the Drain London project. As part of this study, direct rainfall modelling has been undertaken to simulate surface water flooding in the study area and is presented as mapping in the SWMP. In accordance with the PFRA guidance (2010), this mapping represents the locally agreed surface water information for Ealing.

5.2.2 Figures B-1 and B-2 included in Annex B show the results from this modelling for the 1 in 200 year return period rainfall event. Figure B-1 shows the Maximum Flood Depth and Figure B-2 shows the Flood Hazard Rating and general Flow Direction. Figures B-3 and B-4 show the same outputs for the 1 in 100 year return period rainfall event.

5.2.3 For a full methodology, the reader is referred to the Surface Water Management Plan for London Borough of Ealing. For details on the significant consequences of the identified flooding refer to Annex 2 of the PFRA spreadsheet.

5.2.4 The direct rainfall modelling undertaken for Drain London represents an improvement on the existing national data sets (e.g. Flood Map for Surface Water) and has therefore been used as the primary dataset to determine the significance of flooding from surface water and ordinary watercourses. Table 5.2 lists the calculated number of properties flooded for each rainfall event modelled

Groundwater - Increased Potential for Elevated Groundwater (iPEG) Mapping

Background

5.2.5 Large areas within the Drain London area are underlain by permeable substrate and thereby have the potential to store groundwater. Under some circumstances groundwater levels can rise and cause flooding problems in subsurface structures or at the ground surface. The mapping technique described below aims to identify only those areas in which there is the greatest potential for this to happen and in which there is the highest possible confidence in the assessment.
5.2.6 The following four data sources have been utilised to produce the increased Potential for Elevated Groundwater map:

- British Geological Survey (BGS) Groundwater Flood Susceptibility Map;
- Jacobs Groundwater Emergence Maps (GEMs);
- Jeremy Benn Associates (JBA) Groundwater Flood Map; and
- Environment Agency/Jacobs Thames Estuary 2100 (TE2100) groundwater hazard maps.

5.2.7 To produce the iPEG map for consolidated aquifers, an area was defined as having increased potential for elevated groundwater levels if at least two of the three mapping techniques listed above produced a corresponding area. For the permeable superficial deposits, only Band 1 Very High of the BGS and the TE2100 data were used as this was judged to best represent the hazard.

5.2.8 The techniques used to generate the iPEG map produced some small areas of increased potential and some dry islands within increased potential areas. These have not been cleaned in order to best represent the original data.

How to Use and Interpret the Map

5.2.9 The increased Potential for Elevated Groundwater map shows those areas within the Borough where there is an increased potential for groundwater to rise sufficiently to interact with the ground surface or be within 2 m of the ground surface.

5.2.10 Groundwater may become elevated by a number of means:

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

5.2.11 With the exception of groundwater rebound which is not covered, the iPEG map will identify those areas most prone to the mechanisms described above. The map shows those areas considered to have the greatest potential for elevated groundwater. Additional areas within the London Boroughs have permeable geology and therefore could also produce elevated groundwater levels. However, to produce a realistic map, only where there is the highest degree of confidence in the assessment are the areas delineated. This ensures resources are focused on the most susceptible areas. In all areas underlain by permeable substrate, groundwater should still be considered in planning developments.

5.2.12 Within the areas delineated, the local rise of groundwater will be heavily controlled by local geological features and artificial influences (e.g. structures or conduits) which cannot currently be represented. This localised nature of groundwater flooding compared with, say, fluvial flooding suggests that interpretation of the map should similarly be different. The map shows the area within which groundwater has the potential to emerge but it is unlikely to emerge uniformly or in sufficient volume to fill the topography to the implied level. Instead, groundwater emerging at the surface may simply runoff to pond in lower areas. The localised nature of groundwater flooding and the different interpretation of the maps required is illustrated in the cartoon in Figure 5-1.
5.2.13 For this reason within iPEG areas, locations shown to be at risk of surface water flooding are also likely to be most at risk of runoff/ponding caused by groundwater flooding. Therefore the iPEG map should not be used as a “flood outline” within which properties at risk can be counted. Rather it is provided, in conjunction with the surface water mapping, to identify those areas where groundwater may emerge and if so what would be the major flow pathways that water would take.

Results

5.2.14 The iPEG mapping is presented in Appendix A, Figure A-5.
### Table 5-1 Summary of Potential Future Flood Risks and Consequences from Pluvial/ordinary Watercourses

<table>
<thead>
<tr>
<th>Main source of flooding</th>
<th>Probability</th>
<th>Description</th>
<th>Data Source</th>
<th>No. Flooded Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pluvial/ordinary watercourses</td>
<td>1 in 30</td>
<td>'Intermediate Assessment' in accordance with Defra Guidance. Topography is derived from LIDAR (in larger urban areas, on 1m, 2m grids; original accuracy ± 0.15m), processed to remove buildings and vegetation, then degraded to a composite 5m DTM. Manual edits applied where flow paths clearly omitted e.g. below bridges. 100mm upstand created for all buildings (above average ground level) to represent floor levels and preferential flow around buildings.</td>
<td>Drain London direct rainfall modelling</td>
<td>61,600</td>
</tr>
<tr>
<td></td>
<td>1 in 75</td>
<td></td>
<td></td>
<td>65,000</td>
</tr>
<tr>
<td></td>
<td>1 in 100</td>
<td></td>
<td></td>
<td>65,900</td>
</tr>
<tr>
<td></td>
<td>1 in 100  (plus climate change)</td>
<td></td>
<td></td>
<td>69,500</td>
</tr>
</tbody>
</table>
|                          | 1 in 200 | • Flow routes dictated by topography; 6.5mm/hr of the rainfall applied to the model is removed to account for drainage (Thames Water guidance), however the drainage has not been explicitly modelled.  
• Areas that may flood are defined by dynamically routing a 3 hour duration storm with 1 in 30 chance of occurring in any year, over the DTM using Tuflow 2D hydrodynamic modelling software. Model run for double duration to enable assessment of runoff through catchments.  
• Varying Manning’s n applied to landuse based on OS Mastermap data to represent variable 'roughness' of different landuses. Varying runoff coefficients to represent variable runoff from different landuses (e.g. parkland vs buildings)  
• River flood defences and other key structures that will significantly affect local flood mechanisms are included (e.g. transportation tunnels).  
• Flood depth less than 100mm filtered from results so areas of most significant flooding are clear. |             | 67,800 |

5.2.15 Information on the probability and consequences of future sewer flooding, based on detailed modelling of the sewer network, is not available for this PFRA.

### 5.3 Impact of Climate Change

5.3.1 There is clear scientific evidence that global climate change is happening now. It cannot be ignored.

5.3.2 Over the past century around the UK we have seen sea level rise and more of our winter rain falling in intense wet spells. Seasonal rainfall is highly variable. It seems to have decreased in summer and increased in winter, although winter amounts changed little in the last 50 years. Some of the changes might reflect natural variation, however the broad trends are in line with projections from climate models.
5.3.3 Greenhouse gas (GHG) levels in the atmosphere are likely to cause higher winter rainfall in future. Past GHG emissions mean some climate change is inevitable in the next 20-30 years. Lower emissions could reduce the amount of climate change further into the future, but changes are still projected at least as far ahead as the 2080s.

5.3.4 We have enough confidence in large scale climate models to say that we must plan for change. There is more uncertainty at a local scale but model results can still help us plan to adapt. For example we understand rain storms may become more intense, even if we can't be sure about exactly where or when. By the 2080s, the latest UK climate projections (UKCP09) 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 annual chance, or rarer) could increase locally by 40%.

5.3.5 If emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past are

- Winter precipitation increases of around 15% (very likely to be between 2 and 32%)
- Precipitation on the wettest day in winter up by around 15% (very unlikely to be more than 31%)
- Relative sea level at Sheerness very likely to be up 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%

**Implications for Flood Risk**

5.3.6 Climate changes can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability.

5.3.7 Wetter winters and more of this rain falling in wet spells may increase river flooding in both rural and heavily urbanised catchments. More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers, so we need to be prepared for the unexpected.

5.3.8 Rising sea or river levels may increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses.

5.3.9 There is a risk of flooding from groundwater-bearing chalk and limestone aquifers across the district. Recharge may increase in wetter winters, or decrease in drier summers.

5.3.10 Where appropriate, we need local studies to understand climate impacts in detail, including effects from other factors like land use. Sustainable development and drainage will help us adapt to climate change and manage the risk of damaging floods in future.

5.3.11 The pluvial modelling completed for the Surface Water Management Plan for London Borough of Ealing included a model scenario with an allowance for climate change over the next 100 years by increasing rainfall intensity by 30%.

5.4 **Major Developments**

5.4.1 The Local Development Framework (LDF) for the London Borough of Ealing identifies two key growth corridors, where new homes and business space will be primarily concentrated as follows:
The Uxbridge Road/Crossrail corridor – particularly focused in Acton, Ealing and Southall town centres; around key stations at Acton Main Line, Ealing Broadway and Southall; and, municipal housing estates including Copley Close, Green Man Lane, Havelock and South Acton.

The A40/Park Royal corridor – particularly focused in Greenford town centre; Acton Main Line, Greenford and North Acton stations; Park Royal and, other industrial estates.

5.4.2 The Development Sites document which forms part of the portfolio of LDF documents, provides further guidance on how development should be brought forward in relation to individual development sites forming part of the growth areas identified in the Strategy. All sites forming part of the Development sites document have been the subject of a sequential test in accordance with PPS25, which seeks to direct new development to areas of least risk. The emerging Development Management document will also comprise policies for managing flood risk (for all sources) in relation to new development proposals.

5.5 Long Term Developments

Adapting to Change

5.5.1 Past emission means some climate change is inevitable. It is essential we respond by planning ahead. We can prepare by understanding our current and future vulnerability to flooding, developing plans for increased resilience and building the capacity to adapt. Regular review and adherence to these plans is key to achieving long-term, sustainable benefits.

5.5.2 Although the broad climate change picture is clear, we have to make local decisions against deeper uncertainty. We will therefore consider a range of measures and retain flexibility to adapt. This approach, embodied within flood risk appraisal guidance, will help to ensure that we do not increase our vulnerability to flooding.

Long Term Developments

5.5.3 It is possible that long term developments might affect the occurrence and significance of flooding. However current planning policy aims to prevent new development from increasing flood risk.

5.5.4 In England, Planning Policy Statement 25 (PPS25) on development and flood risk aims to "ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall."

5.5.5 In Wales, Technical Advice Note 15 (TAN15) on development and flood risk sets out a precautionary framework to guide planning decisions. The overarching aim of the precautionary framework is "to direct new development away from those areas which are at high risk of flooding."

5.5.6 Adherence to Government policy ensures that new development does not increase local flood risk. However, in exceptional circumstances the Local Planning Authority may accept that flood risk can be increased contrary to Government policy, usually because of the wider benefits of a new or proposed major development. Any exceptions would not be expected to increase risk to levels which are "significant" (in terms of the Government's criteria).
6 Review of Indicative Flood Risk Areas

6.1 Extent of Flood Risk Areas

6.1.1 Figure C-1 included in Annex C shows the Indicative Flood Risk Areas that have been identified by the Environment Agency. Greater London, and the majority of the London Borough of Ealing is shown to be included in an Indicative Flood Risk Area.

6.1.2 There are areas within the Borough that do not lie within the Indicative Flood Risk Areas defined by the Environment Agency. This is result of the assessment method which utilised a screening and clustering method based on 1km grids. The assessment thresholds utilised within the national assessment was:

- Number of people > 200; or
- Critical services > 1; or
- Number of non-residential properties > 20.

6.1.3 Where these squares are on the edge of a settlement and therefore do not contain many receptors, they did not meet the Flood Risk and were not flagged as being an Indicative Flood Risk Area. As a result, the

6.1.4 A review of the Indicative Flood Risk Areas indicates that the Norwood Green is currently excluded from the Indicative Flood Risk Area maps.

6.2 Review Comments

6.2.1 Recognising that some communities within the London Borough of Ealing are currently excluded from the Indicative Flood Risk Areas a review has been undertaken based on the guidance in Table 5 in the Preliminary Flood Risk Assessment Final Guidance (December 2010, Environment Agency).

6.2.2 The Indicative Flood Risk Areas have been reviewed in the context of the locally agreed surface water information – in this case the Drain London SWMP mapped outputs. Overall this more detailed information supports the current extent of the Indicative Flood Risk Areas in Ealing from a flood risk perspective. However, a minor amendment to the Indicative Flood Risk Area boundary is recommended for administrative purposes (refer to Section 7.1).
7 Identification of Flood Risk Areas

7.1 Amendments to Flood Risk Areas

7.1.1 Only one community was outside of the Indicative Flood Risk Areas following review to assess the suitability of changing the boundary. Only one minor change to the boundary of the Indicative Flood Risk Area are recommended to avoid partial exclusion of community.

Norwood Green

7.1.2 The existing boundary of the Indicative Flood Risk Area excludes Norwood Green. This flooding in isolation is unlikely to result in "significant harmful consequences", however it is recommended that Norwood Green are assessed with the remainder of the community.

7.2 Amended Flood Risk Area

7.2.1 Figure C in Annex C sets out the suggested minor amendments to the geographic boundary of the Indicative Flood Risk Area.

7.2.2 The local Environment Agency office have reviewed these areas and confirmed their agreement with the amendments. It is expected the Environment Agency will update the Indicative Flood Risk Area following national review.
8 Next Steps

8.1 Scrutiny & Review

8.1.1 As the Lead Local Flood Authority, London Borough of Ealing is required to review and approve this PFRA in accordance with their own internal processes, such as consideration by Cabinet, Council or an overview and scrutiny committee. Table 8.1 sets out the scrutiny process for the London Borough of Ealing.

Table 8-1 LB Ealing Approval Process

<table>
<thead>
<tr>
<th>Stage</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Preparation of the PFRA by Capita Symonds with Scott Wilson</td>
</tr>
<tr>
<td>2</td>
<td>Review by LB Ealing representative on the Drain London Forum</td>
</tr>
<tr>
<td>3</td>
<td>Preparation of Summary Cabinet Report by LB Ealing representative</td>
</tr>
<tr>
<td>4</td>
<td>Submission of Summary Cabinet Report and PFRA to Cabinet</td>
</tr>
<tr>
<td>5</td>
<td>Review by Cabinet and approval or amendments proposed</td>
</tr>
<tr>
<td>6</td>
<td>Finalise PFRA and final Cabinet Approval</td>
</tr>
<tr>
<td>7</td>
<td>Issue of PFRA to the Environment Agency for Review</td>
</tr>
</tbody>
</table>

8.2 Data Collection & Management

8.2.1 As identified in Section 3.2, a number of data gaps have been identified that limit the capacity to accurately summarise the risk of flooding in the London Borough of Ealing from 'local' sources.

8.2.2 Key activities that could assist with addressing these gaps prior to the next round of PFRAs (expected in 2016):

- Investigation and recording of significant past flooding incidents (as discussed below);
- Refining of the Drain London direct rainfall modelling in critical drainage areas to improve the understanding of flood mechanisms and flood hazard, and therefore whether the consequences of future flooding in these areas should be classified as significant;
- Work in partnership with flood risk management organisations (e.g. Thames Water and the Environment Agency) to refine and share information on groundwater flooding and sewer flooding;
8.3 Incident Recording

8.3.1 The London Borough of Ealing propose to implement a system for recording local flood incidents across the borough. Where notification is given by the public, or other body, regarding flooding these will be recorded in a database provided through the Drain London project and containing existing records of past flooding in the London Borough of Ealing.

8.4 Other FRR Requirements

8.4.1 In accordance with the Flood Risk Regulations, the London Borough of Ealing will prepare Flood Hazard and Flood Risk Maps for Flood Risk Areas, followed by a Flood Management Plan. The Surface Water Management Plan currently being prepared for the London Borough of Ealing is expected to deliver many of the other requirements in the first cycle of the Flood Risk Regulations.

8.4.2 Once guidance on Flood Hazard Mapping and Flood Risk Management Plans is issued, the London Borough of Ealing will review its Surface Water Management Plan to determine compliance and any further work required.

8.4.3 The next cycle of preparing PFRAs will begin in 2017.
9 References

Capita Symonds Ltd, 2007, London Borough of Ealing Strategic Flood Risk Assessment

Capita Symonds Ltd, 2011, Surface Water Management Plan (Draft) for the London Borough of Ealing


Appendix A  Past Floods

Figure A-1 Surface Water Flooding Incidents
Figure A-2 Main River / Fluvial / Tidal Flooding Incidents
Figure A-3 Groundwater Flooding Incidents
Figure A-4 Sewer Flooding Incidents
Figure A-5 Increased Potential for Elevated Groundwater
London Borough of Ealing

Preliminary Flood Risk Assessment

Summary Map of Past Floods - Main River / Fluvial / Tidal Incidents

Consultants
CAPITA SYMONDS
Level Seven,
52 Grosvenor Gardens,
Belgravia,
London
SW1W 0AU

Drain London Programme Board Members

Notes
1. Environment Agency Flood Zone 3: Land assessed, ignoring the presence of flood defences, as having a 1% or greater annual probability of fluvial flooding or a 0.5% or greater annual probability of tidal flooding.
2. Environment Agency Flood Zone 2: Land assessed, ignoring the presence of flood defences, as having between a 1% and 0.1% annual probability of fluvial flooding or between a 0.5% and 0.1% annual probability of tidal flooding in any year.
Summary Map of Past Floods - Ground Water Incidents

Drain London Programme Board Members

FIGURE A-3.0

Consultants

Notes

Preliminary Flood Risk Assessment

London Borough of Ealing

Groundwater Flood Incident (EA Records)

Groundwater Flood Outline

Permanent Watercourse

Culverted Watercourse (Main River)

Main River

Borough Administrative Boundary

Legend

Capita Symonds
Level Seven,
52 Grosvenor Gardens,
Belgravia,
London
SW1W 0AU
Summary Map of Past Floods - Sewer Incidents

1. Sewer flood records relate to internal and external flooding of properties
2. Data supplied by Thames Water Ltd and is correct as at June 2010

Legend
- Borough Administrative Boundary
- Sewer Flooding Incidents
- Sewer Flood Outline

No. of Sewer Flood Records
- None
- 1 - 5
- 6 - 10
- 11 - 20
- 21 - 50
- 51 - 100
- 101+

Notes
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- Digital geological data reproduced from British Geological Survey (c) NERC Licence No 2011/053A
- Scale at A3
- 1:45,000

Approved by: P. Hlinovský
Date: 06/04/2011
Drawn by: R. Moore
Notes
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 2 m of the ground surface. Such groundwater rise could lead to the following consequences:
   - flooding of basements of buildings below ground level;
   - flooding of buried services or other assets below ground level;
   - inundation of farmland, roads, commercial, residential 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.
Appendix B  Future Floods

Figure B-1 Maximum Flood Depth – 1 in 200yr Rainfall Event
Figure B-2 Flood Hazard & Flow Direction – 1 in 200yr Rainfall Event
Figure B-3 Maximum Flood Depth – 1 in 100yr Rainfall Event plus Climate Change
Figure B-4 Flood Hazard & Flow Direction – 1 in 100yr Rainfall Event plus Climate Change
FIGURE B-1.0

London Borough of Ealing

Preliminary Flood Risk Assessment

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Surface Water Depth (m)
1 in 200 Chance of rainfall event occurring in any given year (0.5% AEP)

Notes
1. This map only shows the predicted likelihood of surface water flooding (this includes flooding from sewers, drains, small watercourses and ditches that occurs in heavy rainfall) for defined areas, and due to the coarse nature of the source data used, are not detailed enough to account for precise addresses.
2. Users of this map should refer to section 3.2 of the Surface Water Management Plan for a complete description of limitations and accuracy of the flood/hazard extents shown.

Legend
- Borough Administrative Boundary
- Main River
- Ordinary Watercourse
- Culverted Watercourse (Main River)
- Permanent Water Bodies

Flood Depth
- < 0.1m
- 0.1m - 0.25m
- 0.25m - 0.5m
- 0.5m - 1.0m
- 1.0m - 1.5m
- > 1.5m

Scale at A3
1:45,000

Approved by
P. HLINOVSKY
Date
06/04/2011

Drawn by
R. MOORE

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

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Drain London Programme Board Members

Environment
London

Greater London Authority

GREATERTHAMESERVICES
London Borough of Ealing

Preliminary Flood Risk Assessment

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Surface Water Flood Hazard Rating
1 in 200 Chance of rainfall event occurring in any given year (0.5% AEP)

Consultants
CAPITA SYMONDS
Flood Risk Management

Drain London Programme Board Members

Notes
1. This map only shows the predicted likelihood of surface water flooding (this includes flooding from sewers, drains, small watercourses and ditches that occurs in heavy rainfall) for defined areas, and due to the coarse nature of the source data used, are not detailed enough to account for precise addresses.
2. Users of this map should refer to Section 3.2 of the Surface Water Management Plan for a complete description of limitations and accuracy of the flood / hazard extents shown.
3. Flood Hazard has been defined based upon the joint EA and Defra R&D Technical Report FD2320 (January 2006).
4. Degree of flood hazard can be interpreted as follows:
   - Caution: Flood zone with shallow flowing water or deep standing water
   - Moderate: Flood zone with deep or fast flowing water. Dangerous for children, the elderly and the infirm
   - Significant: Flood zone with deep fast flowing water. Dangerous for most people.
   - Extreme: Flood zone with deep fast flowing water. Dangerous for all (including emergency services)

Legend

- Borough Administrative Boundary
- Critical Flood Hazard
- Caution (very low hazard)
- Moderate (danger for some)
- Significant (danger for most)
- Extreme (danger for all)

Critical Flood Hazard

- Caution
- Moderate
- Significant
- Extreme

Flow Direction

Critical Flood Hazard

Legend

- Borough Administrative Boundary
- Culverted Watercourse (Main River)
- Ordinary Watercourse
- Permanent Water Bodies

Notes
1. This map only shows the predicted likelihood of surface water flooding (this includes flooding from sewers, drains, small watercourses and ditches that occurs in heavy rainfall) for defined areas, and due to the coarse nature of the source data used, are not detailed enough to account for precise addresses.
2. Users of this map should refer to Section 3.2 of the Surface Water Management Plan for a complete description of limitations and accuracy of the flood / hazard extents shown.
3. Flood Hazard has been defined based upon the joint EA and Defra R&D Technical Report FD2320 (January 2006).
4. Degree of flood hazard can be interpreted as follows:
   - Caution: Flood zone with shallow flowing water or deep standing water
   - Moderate: Flood zone with deep or fast flowing water. Dangerous for children, the elderly and the infirm
   - Significant: Flood zone with deep fast flowing water. Dangerous for most people.
   - Extreme: Flood zone with deep fast flowing water. Dangerous for all (including emergency services)
**Legend**
- Borough Administrative Boundary
- Main River
- Ordinary Watercourse
- Culverted Watercourse (Main River)
- Permanent Water Bodies

**Flood Depth**
- < 0.1m
- 0.1m - 0.25m
- 0.25m - 0.5m
- 0.5m - 1.0m
- 1.0m - 1.5m
- > 1.5m

**Notes**
1. This map only shows the predicted likelihood of surface water flooding (this includes flooding from sewers, drains, small watercourses and ditches that occurs in heavy rainfall) for defined areas, and due to the coarse nature of the source data used, are not detailed enough to account for precise addresses.
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**London Borough of Ealing**

**Preliminary Flood Risk Assessment**

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Scale at A3
1:45,000
Date
06/04/2011
Drawn by
R.MOORE
Approved by
P.HLINOVSKY

**Surface Water Depth (m)**
1 in 100 plus climate change Chance of rainfall event occurring in any given year (1% AEP + CC)

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Belgravia,
London
SW1W 0AU

**Drain London Programme Board Members**

**FIGURE B-3.0**
1. This map only shows the predicted likelihood of surface water flooding (this includes flooding from sewers, drains, small watercourses and ditches that occurs in heavy rainfall) for defined areas, and due to the coarse nature of the source data used, are not detailed enough to account for precise addresses.

2. Users of this map should refer to Section 3.2 of the Surface Water Management Plan for a complete description of limitations and accuracy of the flood / hazard extents shown.

3. Flood Hazard has been defined based upon the joint EA and Defra R&D Technical Report FD2320 (January 2006).

4. Degree of flood hazard can be interpreted as follows:
   - Caution: Flood zone with shallow flowing water or deep standing water
   - Moderate: Flood zone with deep or fast flowing water. Dangerous for children, the elderly and the infirm
   - Significant: Flood zone with deep fast flowing water. Dangerous for most people.
   - Extreme: Flood zone with deep fast flowing water. Dangerous for all (including emergency services).

Legend
- Borough Administrative Boundary
- Main River
- Ordinary Watercourse
- Culverted Watercourse (Main River)
- Permanent Water Bodies
- Flow Direction
- Critical Flood Hazard

Notes
- Caution (very low hazard)
- Moderate (danger for some)
- Significant (danger for most)
- Extreme (danger for all)

London Borough of Ealing

Preliminary Flood Risk Assessment

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Surface Water Flood Hazard Rating
1 in 100 plus climate change Chance of rainfall event occurring in any given year (1% AEP + CC)

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Drain London Programme Board Members

FIGURE B-4.0
Appendix C  Flood Risk Areas
1. This map only shows the predicted likelihood of surface water flooding (this includes flooding from sewers, drains, small watercourses and ditches that occurs in heavy rainfall) for defined areas, and due to the coarse nature of the source data used, are not detailed enough to account for precise addresses.

2. Users of this map should refer to section 3.2 of the Surface Water Management Plan for a complete description of limitations and accuracy of the flood/hazard extents shown.
Appendix D Review Checklist
Appendix E  GIS Layer of Flood Risk Area(s)

Provided to the Drain London board for a pan-London submission to the Environment Agency