Level 1
Strategic Flood Risk Assessment

Epping Forest District Council
Harlow Council

March 2010

Strategic Flood Risk Assessment

Final Report

Issue Date: xxx

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Version History

Version xx.xx
Revised xx.xx.xx

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1. Introduction

1.1 Overview

This is a Level 1 Strategic Flood Risk Assessment (SFRA) produced jointly by Epping Forest and Harlow District Councils in accordance with Planning Policy Statement 25 (PPS25) Development and Flood Risk (March 2010). An SFRA is the 'categorisation' of flood risk on an area-wide basis and the application of a risk-based approach to flood risk management. The preparation of a joint SFRA for the two districts will enable an assessment of flood risk based on a wider geographical area and a more strategic catchment wide assessment. The neighbouring East Hertfordshire District Council has published a Level 1 SFRA and details can be found on the Council's web site at www.eastherts.gov.uk.

The Practice Guide Companion (Dec 2009) to PPS25 indicates that a Level 1 SFRA "should be sufficiently detailed to allow application of the Sequential Test… or whether application of the Exception Test is necessary" (para 3.53). The Sequential Test (see section 1.3 below) is aimed at locating development in areas with the lowest risk of flooding. The Exception Test (see section 1.3 below) requires that, if development has to be located in an area of flood risk, (i) it must provide wider sustainability benefits that outweigh these risks, (ii) it should be on previously developed land and (iii) it must be safe.

The mapping outcomes of this study will form the basis for application of the Sequential and Exception Tests. The outcomes will also contribute to a Level 2 SFRA, which is a more targeted look at specific areas and which will be carried out if required after publication of this Level 1 SFRA.

This SFRA assumes the reader is competent in the knowledge of processes and systems contributing to flooding, the principles of flood risk management, the measures to minimise flood risk and the principles behind an informative and useful Flood Risk Assessment (FRA). Basic level information is therefore not discussed but various references for further reading are provided in the text.

1.2 Aims and objectives

Planning policy should aim "to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at the 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" (PPS25, para 5). In identifying suitable locations for development, PPS25 therefore requires local planning authorities (LPAs) to apply a precautionary approach to the issue of flooding, using a sequential approach to avoid such risk where possible and to manage it elsewhere. PPS25 also aims to reduce risk by using opportunities offered by new development to reduce the causes and impacts of flooding.

The aim of this SFRA is to identify areas within Epping Forest and Harlow Districts that may be at risk from all sources of flooding, to identify and detail factors which may influence current and future flood risk and to identify what development may be suitable for different areas of land. The key planning objective, as identified by

PPS25, is to help to deliver sustainable development by appraising, managing and reducing flood risk.

The SFRA will be used to inform the Sustainability Appraisals (incorporating the Strategic Environmental Assessment (SEA) Directive) of Local Development Documents (LDDs), and will provide the basis from which to apply the Sequential and Exception Tests in land allocations and the development control/management process. It will also be used to assist emergency planning processes.

This SFRA does not contain advice for existing occupiers who currently live in designated Flood Zones. For further information and advice on flooding and how to safeguard premises the Environment Agency can be contacted on 08708 506506 (general enquiries) or 0845 9881188 (Floodline) or via their Website at http://www.environment-agency.gov.uk/subjects/flood/.

1.3 The Sequential and Exception Tests

The aim of the Sequential Test is to steer development to areas at the lowest risk of flooding. The Sequential Test should be applied at all levels of the planning process. When allocating land for development as part of the LDD, the LPAs will apply the Sequential Test in a transparent way using the data and mapping outcomes of this SFRA. A LPA should apply the Sequential Test to demonstrate that that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed (PPS25).

For individual planning applications where a site has not been sequentially tested in the LDD, the Sequential Test will need to be applied at the individual site level. It is the responsibility of the developer to provide site specific evidence (not this SFRA) to the LPA in order for the LPA to apply the test. It is for the LPA, taking advice from the Environment Agency as appropriate, to consider the extent to which Sequential Test considerations have been satisfied, taking into account the particular site circumstances.

Preference should be given to locating new development in Flood Zone 1 (refer to section 4.4 for Flood Zone definitions). If there is no reasonably available site in Flood Zone 1, the flood vulnerability of the proposed development (see Table D.2 in PPS25) can be taken into account in locating development in Flood Zone 2 and then Flood Zone 3. Within each Flood Zone new development should be directed to sites at the lowest probability of flooding from all sources as indicated by this SFRA (PPS25).

Application of the Sequential Test should ensure that more vulnerable property types, such as residential housing, will not be allocated to areas at high risk of flooding. In exceptional circumstances, there may be valid reasons for a development type which is not compatible with the level of flood risk at a particular site to be considered. In these circumstances it must be demonstrated that the development passes all elements of the Exception Test. Refer to Table D.3 in PPS25 which describes what land uses are appropriate in each Flood Zone, which land uses are only appropriate subject to meeting the Exception Test and which land uses are always inappropriate. The Exception Test should only be applied following application of the Sequential Test (PPS25 Practice Guide).

For the Exception Test to be passed:

a) It must be demonstrated that the development provides wider sustainability benefits to the community outweigh flood risk. If the Development Plan Document has reached the 'submission' stage the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal;

b) The development should be on developable brownfield land or, if it is not on brownfield land, that there are no reasonable alternative sites on developable brownfield land; and

c) A Flood Risk Assessment (FRA) must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

The requirements necessary to meet part c) are described in section 6.1 below.

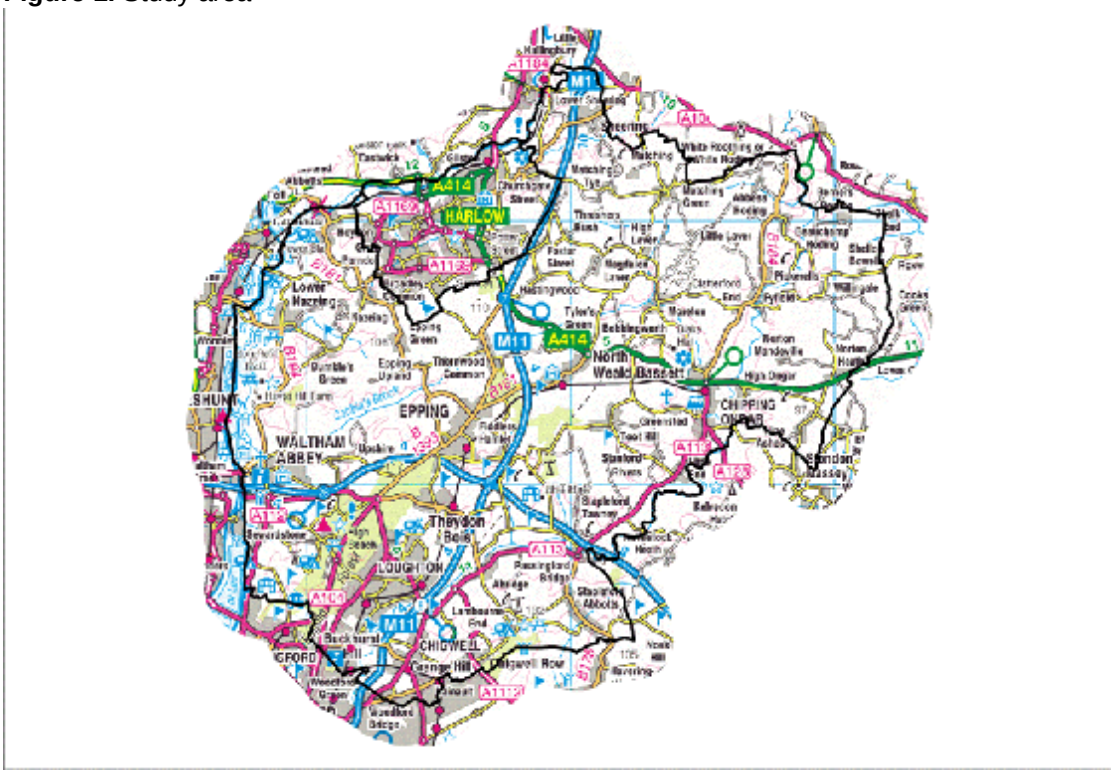
The PPS25 Practice Guide should be consulted for further guidance on applying the Sequential and Exception Tests.

2. Flood Risk in Epping Forest and Harlow Districts

2.1 Study area

The study area comprises the district council areas of Epping Forest and Harlow as shown in Figure 1.

Figure 1. Study area



2.1.1 Epping Forest

Epping Forest District is situated within the Metropolitan Green Belt, abutting the north-east edge of London, in the south west corner of Essex. It comprises the towns of Loughton/Buckhurst Hill (population 41,000), Waltham Abbey (pop. 20,400), Chigwell (pop. 12,500), Epping (pop. 11,000) and Chipping Ongar (pop. 6,000) together with villages, the largest of which are Theydon Bois, North Weald Bassett, Roydon and Nazeing. These figures were taken from the 2001 census. Many of the towns and villages are historic but those close to London grew rapidly as commuter towns. This was particularly in connection with the coming of what is now the Central Line of London Underground.

The District has an important position in the national motorway network. The M11 runs north-south almost through the centre of the District with local road connections at Hastingwood (just south of Harlow) and Loughton (exit only north-bound and entrance only south-bound). The M25 crosses the District east-west with a local road junction at Waltham Abbey and an interchange with the M11. The Central Line of the London Underground has stations at Buckhurst Hill, Loughton, Debden, Theydon Bois, Epping, Roding Valley, Chigwell and Grange Hill. Roydon is the only National Rail station in the District - on the line between Liverpool Street, Stansted and Cambridge.

With the exception of the towns and larger villages the District is entirely within the Metropolitan Green Belt. The consistent application of Green Belt policies has meant that some 90% of the District's 130 square miles is still open and undeveloped comprising generally attractive countryside. The District's population was 121,000 in 2001 Census.

2.1.2 Harlow

Harlow is located in the west of the county and on the border with Hertfordshire, on the Stort Valley. Harlow is bordered by Epping Forest District Council to the west, south and east, and East Herts District Council to the north, with the River Stort forming a natural boundary. The town is parallel to the M11 and forms part of the London commuter belt and M11 London - Cambridge growth corridor. The district has a current population of 78,768 (2005 estimate).

Harlow is a former new town, conceived in the 1940s in response to the need for housing arising from wartime destruction in London and the south east. The opportunity was taken to create a properly planned town that met housing, employment, leisure and other community needs in a co-ordinated way and which accorded with emerging good practice in town planning.

Sir Frederick Gibberd was commissioned to prepare a masterplan that would create homes and employment areas as well as places to shop and places that provided for leisure and recreation. These were provided within a comprehensively designed town centre and employment areas and in a number of neighbourhood and smaller centres (hatches) distributed across the town serving adjoining residential areas. These areas were held together through a network of green wedges that brought the countryside within easy reach of residents and which provided an accessible green framework for leisure, recreation and other community needs.

The principles on which Harlow was founded have provided a model of sustainable development that continues to have relevance in securing the sustainable communities of tomorrow. The original purpose behind the development of Harlow to house people in the south east in genuine well designed communities with access to good services and amenities while protecting and enhancing environmental quality is as relevant today as it was in 1947 when Gibberd’s Masterplan was originally unveiled. The building blocks provided by the Masterplan, have contributed positively to the creation of Harlow’s distinct character.

2.2. Geography, geology and river catchments

2.2.1 Epping Forest

The District geography is predominantly made up of gentle rolling landscapes with steeper slopes in southern areas surrounding Epping Forest. Catchments in the district are largely rural arable, horticultural or grassland with some areas of woodland. The major tributary catchments are generally considered to be relatively steep and flashy and respond quickly to rainfall. The district is well drained by established local drainage systems which in turn feed the larger watercourses.

Except for a small area west of Nazeing, the entire Epping Forest District is underlain by the London Clay Formation. The highly impermeable nature of this unit precludes the use of infiltration drainage throughout most of the district. Northeast of Epping the London Clay is overlain by variable thicknesses of Drift deposits consisting of glacial

till (boulder clay) of variable permeability. West and south of Epping (Waltham Abbey, Loughton, Buckhurst Hill) the London Clay outcrops at surface.

The Claygate Member of the Upper London Clay underlies the 'Epping Forest spine' between High Beach and North Weald and small areas around Epping Green, Abridge, and High Ongar. This unit is predominantly composed of sands and has a higher permeability than the rest of the London Clay.

In the vicinity of Lower Nazeing the London Clay Formation is missing and the underlying geology is the Lambeth Group, consisting of generally highly permeable sands.

Other Drift deposits in the Epping Forest District consist of minor extents of river terrace gravels (Kesgrave Sands and Gravels) in the vicinity of the River Lee, 'floodplain' alluvium associated with the River Lee and Roding systems, and slope movement 'Head' in the immediate vicinity of many of the major drainage channels.

The permeability and hence adequacy of infiltration systems should be tested on site where anything other than London Clay is exposed at surface, however it should be borne in mind that the surface geology may be relatively thin and the underlying geology is impermeable. Use of infiltration drainage could contribute to groundwater flooding elsewhere.

The District consists of two major river systems namely the Roding and Lee rivers. The Roding runs from north to south along parts of the eastern boundary of the District and the Lee flows along the western boundary. The major catchment system within the district is relatively simple with the Roding catchment dominating the eastern two-thirds of the district, the Lee catchment occupying the western one-third and a small section at the north of the district being home to the Stort catchment. Pincey Brook is the dominant watercourse and key feature within the Stort catchment.

The Lower Lee catchment is heavily urbanised with large parts of the floodplain developed. The combination of man-made surfaces and clayey soils means local rivers respond rapidly to rainfall and are liable to sudden flooding after storms. The Lower Lee also drains a large, mainly rural area upstream. Nazeing Brook and Cobbins Brook are the two main tributaries of the Lower Lee within the study area.

The River Roding has its source just north of Epping Forest District. The river runs south from Beauchamp Roding to the east of Fyfield and Ongar, then forms the eastern boundary of the district to Passingford Bridge, where it turns west, running north of Abridge, and then south-west between Loughton/Buckhurst Hill and Chigwell. The catchment has a rapid response to rainfall which is typical for a catchment overlying London Clay. Cripsey Brook, which is a major tributary of the Roding, has its source near Thornwood and flows in a gentle bend eastwards towards the Roding.

2.2.2 Harlow

The District has one major river running through it which forms the northern boundary of the town, namely the River Stort. Throughout its length in Harlow it is canalised and is consequently navigable. British Waterways is responsible for the navigation.

A number of springs supply other water courses in the town. These are Todd Brook and Parndon Brook which flow into Canons Brook, which feeds into the Stort Navigation. These Brooks run through some of Harlow's main Green Wedges.

Harlowbury Brook is to the east of the town. It runs partly in a culvert through Churchgate Street, and then to the east of Old Harlow, finally flowing into the navigation at Harlow Mill. Pincey Brook forms the north eastern boundary of the town and flows into the navigation.

The landscape character of Harlow has evolved as a result of a complex interaction between its physical structure, vegetation and historic land use, all of which have been strongly influenced by the underlying geology.

The oldest rocks consist of hard, slaty shales, mudstones and sandstones. Overlying this base are a number of different geological layers formed between 135 million years ago to the present, leading up to and including the Harlow area's surface geology.

The surface geology of Harlow overlies an occasionally exposed layer of London Clay interspersed with Claygate Beds. Lowestoft Till laid down during the Anglian Ice Age (472 – 428 thousand years ago) dominates the drift geology. As a consequence the majority of the surface geology is composed of clays, silts and sands with scattered boulders (erratics) known collectively as boulder clay. This originally formed a plateau that has been slowly dissected by the formation of the rivers.

The rivers and their valleys lie on alluvium composed of clay, silt, sand and gravel; products of fluvial erosion of the Kesgrave formation and Lowestoft Till deposited along the river floor and its surrounding floodplain. Sand and gravel are found adjacent to the alluvium along the outer extents of the valley floor. However the higher, smaller tributaries have exposed head and glaciolfluvial deposits. On the steeper valley sides, especially to the east of the River Lee, the drift geology has been entirely eroded away to expose London Clay and the remains of a landslide south of the River Lee and Stort confluence.

The catchment area for Harlow is the River Stort. To the south this is indicated by a strong ridge line which forms the southern boundary of the built up area. Within Harlow the brooks and other drainage features flow north through the town towards the River Stort. The watercourses run largely through open spaces and undeveloped parkland.

Map 1 shows the main watercourses within the Assessment area while Map 2 shows the major river catchments.

2.3 History of flooding

Map 3 shows historical flooding incidents within the Assessment area.

2.3.1 Epping Forest

It was as a result of the high risk of flooding in the district that a land drainage section was formed in 1978 and the Council has continued to allocate funds for a wide range of flood defence measures. Major flooding events have since occurred in 1987, 1993, 1997 and October 2000 which had varying degrees of impact.

2.3.2 Harlow

From the inception of the New Town the flood of 1947 seems to have had the most impact on the town. It covered an extensive area of the River Stort valley and covered significant areas of the town's major employment area at Templefields. In addition both Todd Brook and Parndon Brook flooded.

Since then the town's development has to a great extent ameliorated the potential flooding in the town. Floods of 1947, 1968, 1974, 1992, 1993, 2001, 2002 and 2003 have been mostly confined to the functional flood plain.

3. Policy Framework

3.1 Overview

This section covers planning policy documents related to flood risk, including national, regional and development plans at local policy level. Development plans provide clear guidance for prospective developers and are prepared following wide community consultation and stakeholder involvement.

3.2 Objective

PPS25 published by DCLG in December 2006 (and revised in March 2010), sets out the need for LPAs to assess the potential impact of flooding so that this may be fully taken into account in the preparation of local development documents.

A Level 1 SFRA is required to be sufficiently detailed to allow application of the Sequential Test, which is aimed at locating development in areas with the lowest risk of flooding. The Exception Test requires that, if development has to be located in an area of flood risk, it must provide wider sustainability benefits that outweigh the risks.

The following provides an overview of the relevant policy documents and a brief explanation of their significance for the SFRA.

3.3 The European Policy Framework

3.3.1 The Water Framework Directive 2000

This became part of UK law in December 2003. The main aim is to plan and deliver a better water environment (focusing on ecology) by protecting and enhancing surface freshwater (including lakes, rivers and streams) and groundwater. Other objectives include 'good status' for all waters by a set deadline , and water management based on river basins rather than by administrative boundaries. The Environment Agency is the lead authority.

3.3.2 The Habitats Directive 1992

The EU Habitats Directive aims to protect the wild plants, animals and habitats that make up our diverse natural environment. The directive created a network of protected areas of national and international importance. In the UK, the Habitats Directive is implemented by the Conservation (Natural Habitats) Regulations (1994), more commonly known as the Habitats Regulations.

3.4 National Policy and Legislation in England

3.4.1 The Planning and Compulsory Purchase Act 2004

This Act introduced the Local Development Framework with Regional Spatial Strategies and Development Plan Documents replacing Structure Plans and Local Plans, although RSSs have now been abolished by the Coalition Government. Wider community engagement and the inclusion of plans and programmes of other agencies (eg health, education) are key to the production of the LDF, which should be seen as the mechanism to draw together public service capital programmes.

Section 39 of the Act introduces the need to "contribute to the achievement of sustainable development" in the preparation of local development documents.

3.4.2 Future Water 2007

The Government's water strategy 'Future Water' sets out a vision for more effective management of surface water, taking into account the effects of climate change and in order to deal with pressures of future housing demand. The intention is to manage surface water more sustainably by 2030 allowing for the increased capture and reuse of water, slow absorption through the ground, and where appropriate more above-ground storage and routing of surface water separate from foul sewers. To reduce costs, water will be increasingly managed on the surface, rather than relying on wholesale upgrade of the sewer system to higher design standards. (http://www.defra.gov.uk/environment/quality/water/strategy/pdf/future-water.pdf)

3.4.3 The Town and Country Planning (Flooding) (England) Direction 2007

To safeguard against inappropriate development in flood risk areas, the Direction introduces a requirement for LPAs to notify the Secretary of State of any application for major development (e.g. 10 or more dwellings) in a flood risk area which it proposes to approve against the Environment Agency's advice.

3.4.4 The Town and Country Planning (General Permitted Development)(Amendment) (No. 2) England) Order 2008 Guidance on the Permeable Surfacing of Front Gardens – 10 September 2008

The Order changed permitted development arrangements relating to works that householders can carry out to include development within their gardens. The amendments to the General Permitted Development Order (GDPO) permit hard surfacing of more than five square metres of domestic front gardens, only where the surface in question is rendered permeable with a porous finish.

Following the changes to the GDPO, the guidance on permeable surfacing provides advice to householders of the options for achieving permeability. This document can be found at:
(http://www.communities.gov.uk/publications/planningandbuilding/pavingfrontgardens?view=Standard)

3.4.5 Surface Water Management Plan (SWMP) Technical Guidance – Living draft version 1 (February 2009)

SWMPs will have a significant role in the management of flood risk as it will look at the interaction between rivers, surface water and sewers.
(http://www.defra.gov.uk/environment/flooding/documents/manage/surfacewater/swmp-guide.pdf)

The Guidance develops some of the key policy proposals set out in "Future Water". In line with Pitt Review of the 2007 summer floods (in particular recommendation 18), the Guidance proposes local SWMPs to be co-ordinated by local authorities in partnership with stakeholders including water companies/ utilities, the Environment Agency, and Internal Drainage Boards, to provide the basis for managing all local flood risk (as set out in PPS25).
(http://www.cabinetoffice.gov.uk/thepittreview)

3.4.6 The Flood Risk Regulations 2009

Essex County Council is Lead Local Flood Authority (LLFA) as defined in the Flood Risk Regulations 2009 and is required to produce a range of plans to satisfy the requirements of the EU Floods Directive, these are:

- Preliminary Flood Risk Assessment

- Flood Risk and Flood Hazard Map

- Flood Risk Management Plan

These plans will be submitted to the Environment Agency and need to be reviewed on a six yearly cycle. The EA is currently developing guidance on producing PFRAs, which will include methods to take account of environmental impacts and will identify where there is likely to be a significant risk of flooding ("significant" remains to be defined).
(http://www.opsi.gov.uk/si/si2009/uksi_20093042_en_1)

3.4.7 The Flood and Water Management Act (2010)

The Act received Royal Assent in April 2010 and will come into force in April 2011:

- The Environment Agency (EA) will be required to develop a national strategy for the management of all sources of flood risk for England;

- The lead local flood authority for the study area, responsible for developing, maintaining and monitoring a strategy for local flood risk management, will be Essex County Council. The local strategy will not be secondary to the national strategy – rather it will have distinct objectives to manage flood risks important to local communities. Local flood risk includes surface run-off, groundwater and ordinary watercourses (including lakes and ponds);

- The Act recognises the roles of, inter alia, district councils and water companies and these are identified as risk management authorities, along with the EA and County Council. Partnership working is encouraged, and the lead local authority can delegate flood functions to another risk management authority;

- The County Council also becomes the SuDS Approving Body (SAB) for the study area, responsible for the approval of proposed drainage systems in new developments and redevelopments, subject to exemptions and thresholds. No construction can commence until such approval is given. The SAB will also be responsible for adopting and maintaining SuDS which serve more than one property, where they have been approved. The County Council, as highways authority, will also be responsible for maintaining SuDS in public roads;

- The County Council, Epping Forest and Harlow Councils and the Environment Agency can "designate" structures that affect flooding or the risk of flooding. Once a structure or feature is designated, the owner must seek consent from the designating authority to alter, remove or replace it. This new power is intended to overcome the risk of a person damaging or removing a structure or feature on private land which is relied on for flood risk management. The SAB will also be required to place all approved SuDS on

the register of structures and features. Updates of this SFRA will include a list of the designated structures.

3.4.8 Planning policy statements

National planning policy plays a key role in shaping the direction in which local planning authorities (LPAs) prepare their local development frameworks (LDFs).

Planning policy statements set out Government's policies on different aspects of land use planning in England. Whilst not all policy is directly relevant to the development of a SFRA, it is important to recognise that the exercise takes place within the context of other planning policy statements, some of which also require sequential testing of site allocations and development proposals. Key principles from these statements for the SFRA are described in the following sections.
(http://www.communities.gov.uk/planningandbuilding/planning/planningpolicyguidance/planningpolicystatements/)

3.4.9 Planning Policy Statement 1: Delivering Sustainable Development (PPS1) and PPS: Planning and Climate Change – Supplement to PPS1 (2007) and Planning Policy Statement Consultation: Planning for a Low Carbon Future in a Changing Climate (March 2010)

PPS1 sets out Government's objectives on the delivery of sustainable development through the planning system; this should take into account the impact of climate change for the lifetime of new development. PPS: Planning and Climate Change Supplement to PPS1 provides policy advice for selecting suitable development sites. LPAs should take into account known physical and environmental constraints on the development of land, flood risk and stability, and take a precautionary approach to increases in risk that could arise as a result of likely changes to the climate (Paragraph 24)

3.4.10 Planning Policy Statement 3: Housing (PPS3) (2007)

PPS3 sets out the Government's strategic housing policy objectives. LPAs and stakeholders are required to establish criteria to be used in identifying the broad locations and specific sites for housing development, to address demand for the next 15 years. This would take into account the constraints of the physical environment and natural hazards, such as flooding, when identifying broad locations for housing development.

3.4.11 Planning Policy Statement 25: Development and Flood Risk (PPS 25) (2010) Planning Policy Statement 25: Development and Flood Risk - Practice Guide – Published 7 December 2009

PPS25 requires LPAs to consider flood risk and mitigation. All forms of flooding and their impact on the natural and built environment are material planning considerations; therefore future development should be discouraged in areas of highest risk. LPAs must prepare SFRAs that will contribute to the Sustainability Appraisal of their Local Development Frameworks (LDFs) and provide background information for all Development Plan Documents (DPDs) and Supplementary Planning Documents (SPDs).
(http://www.communities.gov.uk/publications/planningandbuilding/pps25guideupdate)

3.5 Regional Planning Policy

3.5.1 Thames Catchment Flood Management Plan – Managing flood risk (2009)

The Thames Region CFMP is a strategic planning document through which the Environment Agency will work with other stakeholders to identify and agree policies for long-term flood risk management over the next 50 to 100 years.

In the Thames Region, Harlow has a low risk of flooding (100 to 250 properties). Epping Forest District Council has a significantly higher risk where 2000 to 5000 properties are at risk of flooding annually.

The four main messages from the Thames CFMP are:

- Flood defences cannot be built to protect everything;
- Climate change will be the major cause of increased flood risk in the future;
- The floodplain is our most important asset in managing flood risk; and
- Development and urban regeneration provide a crucial opportunity to manage the risk

(http://publications.environment-agency.gov.uk/pdf/GETH1209BQYL-e-e.pdf)

3.5.2 Rye Meads Water Cycle Strategy

A Water Cycle Study is a method of assessing what water resources are required and where and when they will be needed. It should address water resources and quality, potable water supply infrastructure, sewerage network capacity, wastewater treatment, flood risk and mitigation, and environmental opportunities. Relevant organisations, such as water companies and the EA, should be involved in early discussions regarding infrastructure requirements. The integrated approach should ensure that land allocations and development proposals make the best use of environmental capacity and opportunities, and adapt to environmental constraints.

The Rye Meads Strategy was prepared in response to the proposals for Harlow (and Stevenage) growth in the now revoked East of England Plan. The Rye Meads Wastewater Treatment Works will require substantial upgrades in future if the growth numbers envisaged by the EEP become a reality – this is obviously relevant for Harlow's growth, including any urban extensions into Epping Forest District. The south of Epping Forest District (where the significant majority of that population lives) is served by the Beckton Sewage Treatment Works in Barking, where it is understood that there is ample capacity for population growth.

Thames Water is responsible for potable water supply in most of the study area, and is satisfied that existing plans for asset management and development will cope with population increases until at least 2035.

3.6 Local Planning Policy

3.6.1 EFDC Local Plan (1998)

EFDC's Local Plan and Alterations adopted in 2006 will remain the statutory plan until they are replaced by the core strategy and other LDF documents. The relevant current policies are:

U2A: Development in flood risk areas

Development proposals within the Environment Agency's currently designed flood risk zones will be determined in accordance with a sequential approach as set out in PPG25. This will be, in order of priority:

(a) areas with little or no flood risk
(b) areas of low to medium risk
(c) areas of high risk
(d) areas of functional flood plain.

In accordance with this order of priority, the Council will only permit development in areas of functional flood plain if:

(i) it involves use of land only, and would not increase flood risk or danger from flood risk; or
(ii) it is proven to be essential infrastructure which cannot be located elsewhere. No such development will be allowed if it would cause any negative impacts on any part of the flood regime of the watercourse involved.

Development in high risk areas will only be allowed if:

(iii) there will be no increased risk of flooding either on site or elsewhere in the floodplain or suitable mitigation measures will be incorporated as part of the scheme; and
(iv) the development would not reduce the effectiveness of existing flood defence measures; and
(v) there is no suitable alternative site available in the locality which is at a lower risk of flooding; and
(vi) there will be no significant adverse effects upon a watercourse, navigable waterway or sewer; or
(vii) adequate and appropriate flood-prevention measures to minimise the risk of flooding are incorporated as part of the development.

Development in all other flood risk areas will be allowed under this policy, provided that suitable flood minimisation and/or mitigation measures are included as part of the development. All applications or proposals for development in flood risk areas will be required to be accompanied by a flood risk assessment covering matters (i) to (v) above, to be carried out to the satisfaction of the Council and/or the Environment Agency.

U2B – Flood risk assessment zones

Within the flood risk assessment zones as shown on the alterations proposals map, flood risk assessments will be required for any development proposals (other than house extensions) which exceed 50m^2. Outside these zones, a flood risk assessment will be required for any proposals which exceed 235m^2.

U3A – Catchment effects

The council will not permit development which would result in either:

(i) increased risk of flooding or a reduction in the effectiveness of existing flood defence measures, either on site or elsewhere within the catchment; or
(ii) significant adverse effects upon a watercourse, navigable waterway or sewerage infrastructure;

Unless it is satisfied that adequate and appropriate attenuation measures, such that there is no increase in the risk of flooding, are incorporated as part of the development.

U3B – Sustainable drainage systems

In consultation with the Environment Agency and, where appropriate, sewerage undertakers, the council may require developments to include sustainable drainage systems to control the quality or attenuate the rate of surface water run-off. Contributions in the form of commuted sums may be sought in legal agreements to ensure that the drainage systems can be adequately maintained.

3.6.2 Replacement Harlow Local Plan (2006)

This was adopted in July 2006 and ran to 2009. The majority of policies have been saved by the Secretary of State to allow the plan to remain in force until 2012. The plan provides for over 2000 new dwellings and around 15 hectares of new employment land within the plan period.

The following is an extract from the Saved Adopted Replacement Harlow Local Plan which sets out both the preamble to Policy and Policy CP12.

It is Government's policy to reduce the risks of flooding to people and the developed and natural environment. Flood risk should properly be taken into account in the planning of developments to reduce the risk of flooding and the damage that floods cause. Floodplains perform the essential function of storing water during flood events. Developments within the floodplain are not only at risk of flooding but by reducing the amount of land available for storage of floodwater, and by impeding flows, they can increase the risk of flooding off site. The Environment Agency has produced "indicative floodplain maps" that should be considered when developments are proposed in the town's river corridors.

Areas liable to flood in the Harlow area are indicated on the Proposals Map. It is not considered that any development allocations in this Local Plan fall within a high or medium/low risk zone as indicated in PPG25. However, areas of Harlow are at risk of flooding, as shown on the Environment Agency's indicative floodplain maps. Whilst these may not be defined as the areas to be developed in the Local Plan, any proposed developments in these areas shall only proceed in accordance with PPG25.

CP12	**Development that will be at risk of flooding, or will contribute to flood risk or has an adverse impact on the river corridor will be resisted.**

Development of green field sites usually results in an increase in the amount of impermeable land. Drains and sewers generally convey surface water from impermeable areas directly, or via a sewerage system, to a watercourse. This can alter the natural water cycle as rates and volumes of surface water reaching a watercourse generally increase. Surface water systems serving industrial, highway, residential or commercial schemes can result in pollution if prevention measures are not installed.

Sustainable drainage involves moving away from traditional piped drainage systems to softer engineering solutions that are closer to their natural drainage regimes. The control of surface water run-off should be as close to the origin as possible before it discharges to a watercourse or to the ground to achieve the following objectives of:

a) Reducing the flood risk from development within a river catchment;
b) Minimising diffuse pollution arising from surface water runoff;
c) Minimising environmental damage, e.g. bank erosion, and damage to habitats;
d) Maintaining or restoring the natural flow regime of the receiving watercourse;
e) Maintaining recharge to groundwater subject to minimising the risk of pollution to groundwater;
f) Achieving environmental enhancements, including improvement to wildlife habitats, amenity and landscape quality.

Where risks are identified appropriate flow attenuation facilities or mitigation measures may be a prerequisite for development. Such problems can be reduced by the use of sustainable drainage systems (SuDS) to control surface water run-off. Proposals should take account of water conservation and incorporate sustainable drainage systems within the design. This may include:

a) Minimising external hard surfaces and giving preference to permeable surfaces;
b) Attenuation of runoff to mimic natural site conditions;
c) Use of infiltration ponds, strips or swales;
d) Grey water reuse;
e) Improving the quality of run-off by means of reed beds or other methods; and
f) Designs that improve the amenity and biodiversity in urban areas.

Major allocations are under construction including The Gateway Scheme which when complete will provide around 780 dwellings. Newhall to the east of the town will produce 750 houses.

4. Strategic Flood Risk Assessment

4.1 Overview

The main objective of this Level 1 SFRA is to collate all available information on all sources of flood risk within the study area. The data are then presented in a mapping format that allows the application of the Sequential Test for site allocations and where necessary will identify sites that require the Exception Test. It is the responsibility of the LPA to carry out these tests.

Throughout the data collection process emphasis has been placed on the use of existing data and information relating to flood risk in the study area. No new studies or investigations were commissioned for the benefit of this SFRA. As some data gaps have been indentified in certain areas, these should be investigated if a Level 2 SFRA is required.

The Environment Agency has been the primary source of data to inform this SFRA. Data were also sourced from Thames Water Utilities Ltd, Epping Forest District Council and Harlow Council. The collected data were then integrated into a GIS system and reviewed to establish baseline data sets and identify if any data were missing.

As a result of the data collection process, 13 large scale maps have been produced. The methodology of how these maps were produced and further details on data sources are outlined in the following paragraphs.

4.2 List of maps

Map 1	Watercourses, ponds, lakes, Main Rivers
Map 2	Main River catchments
Map 3	Historical flooding incidents
Map 4	Flood Zones
Map 5	Climate change
Map 6	Areas susceptible to surface water flooding
Map 7	Drift geology
Map 8	Solid geology
Map 9	Flood defences/structures
Map 10	Emergency planning
Map 11	Roads at risk of becoming impassable
Map 12	EFDC Flood Risk Assessment Zones
Map 13	Soil types

4.3 List of data sources

Table 1 lists the data that have been analysed as part of this SFRA.

Table 1. SFRA data sources

Information	Source
Main River map	Environment Agency
Flood Zones map	Environment Agency
Historic flood outlines	Environment Agency
Defence details taken from the National Flood and Coastal Defence Database	Environment Agency

(NFCDD)	
Lower Stort modelled levels and outputs	Environment Agency
Middle Roding Section 105 (Jacobs Gibb, 2003)	Environment Agency
Upper Roding Section 105 (Jacobs Gibb, 2003)	Environment Agency
Lee Hydrology and Mapping Study (Halcrow, 2007)	Environment Agency
Thames CFMP	Environment Agency
Areas susceptible to surface water flooding (see section 4.5 for details)	Environment Agency
Database of recorded groundwater incidents since 2001	Environment Agency
Groundwater flooding reports	Environment Agency
Geology and soil GIS layers	Environment Agency
Flood defence details	Environment Agency
Flood Incident Databases	EFDC and Harlow
Location of flood defence assets	Epping Forest District Council
Location of ordinary watercourses	Epping Forest District Council
Location of roads at risk of becoming impassable	Epping Forest District Council
Ordnance Survey maps	Epping Forest District Council
Sewer flooding records	Thames Water

4.4 Fluvial flooding

Rivers flood when the amount of water in them exceeds the flow capacity of the river channel and floodwater spills out of the banks into a floodplain. Land use, topography and the form of local development can have a strong influence on the velocity and volume of flood water and its flow direction at particular points. Flooding can occur when culverts and bridges are blocked by debris or when the capacity of channels is reduced (PPS25). Paragraph C4 in PPS25 expands on this explanation of fluvial flooding.

By identifying areas at risk of fluvial flooding the Flood Zone maps provide the basis for application of the Sequential Test by the LPA. The definitions of the Flood Zones from PPS25 are provided in Table 2 below.

Table 2. Flood Zone definitions from PPS25

Flood Zone	Definition	Probability of Flooding
Flood Zone 1	At risk from flood event greater than the 1 in 1000 year event (greater than 0.1% annual probability)	Low Probability
Flood Zone 2	At risk from flood event between 1 in 100 and 1 in 1000 year event (between 1% and 0.1% annual probability)	Medium probability
Flood Zone 3a	At risk from a flood event less than or equal to the 1 in 100 year event (greater than 1% annual probability)	High probability
Flood Zone 3b Functional Floodplain	Land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood should provide a starting point for consideration to identify the functional floodplain.	Functional Floodplain

The Flood Zones are based on flood outlines that ignore the presence of defences, such as walls and embankments, except for the Functional Floodplain which does take into account the presence of defences. Ignoring the presence of defences allows consideration of residual risk to properties, should any of the defences fail.

Map 4 defines the geographical extents of Flood Zones 1, 2, 3a and 3b for the study region.

Flood Zone 3b – Functional Floodplain

Functional Floodplain Zone 3b is defined in PPS25 as those areas in which water has to flow or be stored in times of flood. Within this study Functional Floodplain has been defined by the following criteria:

- Land subject to flooding in the 1 in 20 year event;
- Land which provides a function of flood conveyance or flood storage, through natural processes or through design (e.g. washlands, flood storage areas);
- Areas which would naturally flood with an annual exceedence probability of 1 in 20 (5% Annual Exceedence Probability, AEP) or greater, but which are prevented from doing so by existing buildings, defences and other high flood risk management infrastructure will not normally be defined as Functional Floodplain.

The approach used to define the extent of Flood Zone 3b is summarised in Table 3 below. Note that the 'defended outline' is the extent of flooding taking into account the positive effect of flood defences, while the 'undefended outline' is the extent of flooding without taking into account flood defences.

Table 3. Flood Zone 3b data sources

Watercourse	Zone 3b Data source
Lee	1 in 20 year defended outline from the River Lee Mapping & Hydrology Study (Halcrow, 2007)
Roding	1 in 20 year defended outline from Middle/Upper Roding Section 105 (Jacobs Gibb 2003)
Stort	1 in 20 year defended outline from Stort Strategy Model (Atkins 2004) and the 1993 and 2001 historic flood events.
Other unmodelled tributaries	1993 and 2001 historic flood events (from EA) have been used for the whole study area as they are the worst two flood events in the last 20 years.

Detailed modelling is unavailable outside the Rivers Lee, Roding and Stort so the 1993 and 2001 flood extents have been used to identify the Functional Floodplain. The EA agreed that this was an acceptable approach for defining the Functional Floodplain. Whilst the EA could not provide annual probability or return periods for the historic events, the events are considered appropriate estimates of the Functional Floodplain extent.

Flood Zone 3a – High probability

The high probability Zone 3a is defined as those areas which are located within the undefended 1 in 100 (or 1% AEP) year flood extent. In the absence of detailed modelling for the 1 in 100 year flood extent, the EA has recommended the use of its national modelling of the 1 in 100 year extent to define Flood Zone 3a for this SFRA.

The EA Flood Zone incorporates the most up-to-date modelling for the three major rivers, including data from the investigations in Table 4 below and the wider area JFLOW modelling. JFLOW is a two-dimensional dynamic flood model for simulation of overland flooding.

Table 4. Flood Zone 3a data sources

Watercourse	Zone 3a Data source
Lee	1 in 100 year undefended outline from the River Lee Mapping & Hydrology Study (Halcrow, 2007)
Roding	1 in 100 year undefended outline from Middle/Upper Roding Section 105 (Jacobs Gibb 2003)
Stort	1 in 100 year undefended outline from the Harlow North SFRA modelling (Faber Maunsell, 2006) and 1 in 100 year undefended outline from the Stort Strategy Model (Atkins 2004)
Other unmodelled tributaries	JFLOW modelling

Flood Zone 2 – Medium probability

The medium probability Zone 2 is defined as those areas located between the undefended 1 in 1000 year (0.1% AEP) and 1 in 100 (1% AEP) flood extents. In agreement with the EA, its national scale modelled Flood Zone 2 defines the extent for this SFRA. The following investigations in Table 5 below, in addition to wider area JFLOW data, have been used by the EA to refine their Flood Zone for the respective rivers.

Table 5. Flood Zone 2 data sources

Watercourse	Zone 2 Data source
Lee	1 in 1000 year undefended outline from the River Lee Mapping and Hydrology Study (Halcrow 2007)
Stort	1 in 1000 year undefended outline from the Harlow North SFRA modelling (Faber Maunsell, 2006)
Other unmodelled tributaries	JFLOW modelling

Flood Zone 1 – Low probability

The low probability Zone 1 is defined as those areas which fall outside the undefended 1 in 1000 year flood extent. For this SFRA this includes all land that is outside of Zone 2 and Zone 3 flood risk areas.

It is important to note that for sites in Epping Forest and Harlow districts lying in Zone 1 and with a size greater than one hectare, it will still be necessary for a developer to produce a site-specific FRA which takes account of all sources of flooding, including surface water, groundwater and sewer sources.

Within Epping Forest District only, any development greater than 235m^2 in Zone 1 will require a FRA. Further, development between 50 to 235m^2 in Zone 1 will require a FRA at varying levels of detail if it falls within EFDC Flood Risk Assessment Zones. Refer to Section 6.2 for further details.

Flood Zone 3a/3b Climate Change

It is important that developers take into account the possible change in flood risk over the lifetime of a development as a result of climate change. PPS25 recommends allowances for the increase in peak rainfall intensity and peak river flows in Table B.2. Further discussion on allowances for climate change can be seen in Section 4.10.

The approach used to define the extent of Zone 3a Climate Change in the study area was to use the 1 in 100 year + 20% defended flood outlines from the various studies listed in Table 6 below.

Table 6. Climate change Flood Zone 3a data sources

Watercourse	Zone 3a Climate Change Data source
Lee	1 in 100 year + 20% defended outline from the River Lee Mapping & Hydrology Study (Halcrow, 2007)
Roding	1 in 100 year + 20% defended outline from Middle/Upper Roding Section 105 (Jacobs Gibb 2003)
Stort	1 in 100 year + 20% defended outline from the Harlow North SFRA modelling (Faber Maunsell, 2006)
Other unmodelled tributaries	Not modelled – no data available

The approach used to define the extent of Zone 3b Climate Change (Functional Floodplain) was to assume that the current Zone 3a (1 in 100 year) would become Zone 3b under climate change. This is generally accepted as the best practicable solution for estimating climate change for the Functional Floodplain when no other modelling data exist. This technique is used by other local authorities in their SFRAs. The data sources used in this approach are listed in Table 7 below.

Table 7. Climate change Flood Zone 3b data sources

Watercourse	Zone 3b Climate Change Data source
Lee	1 in 100 year defended outline from the River Lee Mapping & Hydrology Study (Halcrow, 2007)
Roding	1 in 100 year defended outline from Middle/Upper Roding Section 105 (Jacobs Gibb 2003)
Stort	1 in 100 year defended outline from the Harlow North SFRA modelling (Faber Maunsell, 2006)
Other unmodelled tributaries	Not modelled – no data available

Given the inherent uncertainty over the extent of the climate change for Flood Zone 2, no additional mapping has been undertaken.

Map 5 shows the effect of climate change on the Flood Zones 3a and 3b.

Note that climate change maps are produced by means of hydraulic modelling studies which take account of the presence of flood defences and other structures. They therefore differ from Flood Zone maps which are based on undefended modelling to reflect residual risk. For this reason Flood Zones and climate change impacts have been mapped separately for the purposes of this SFRA.

Also note that there are limited data available for mapping climate change variations for this SFRA and therefore only the major rivers have been mapped. Individual site-specific investigations will need to be completed for tributaries and minor watercourses.

4.5 Surface water flooding

Surface water or pluvial flooding generally occurs when intensive rainfall, often of short duration, is unable to soak into the ground or to be safely passed away from the site. Water then flows over land causing localised ponding or flooding, before entering drainage or sewer systems. Paragraph C6 in PPS25 provides a fuller explanation of surface water flooding.

Surface water flooding incidents are generally related to the performance of the existing drainage infrastructure, with lack of maintenance and inadequate capacity often major causes of flooding. In rural areas surface water drains tend to be simple isolated systems, often linked with Essex County Council (ECC) Highways drainage discharging to open ditches alongside the road. Lack of maintenance, leading to blocked or silted up rural drainage systems, is often sited as one of the main causes of localised surface water flooding in rural areas.

In urban areas surface water drainage systems are a combination of gullies, gully leads, adopted surface water sewers (often owned by utilities companies) and ECC Highways drainage. An increase in the impermeability of urban areas over time has led to many surface water drainage systems being unable to cope adequately and an increased frequency of surface water flooding.

Map 3 shows the location of recorded surface water flooding incidents, based on the Councils' Flood Incident Databases up to 2007. The map shows a wide distribution of surface water flooding incidents throughout the study area, however the majority of incidents occur within the urban areas.

Cautionary note: The Council databases will only contain those instances when assistance was sought. Incidents not reported to the drainage team are not included within the databases.

A significant event occurred in June and July 2006 when severe weather conditions hit Harlow which caused flash flooding as a result of torrential rain and insufficient capacity within the drainage network to deal with the volume of water. The first storm in June 2006 was a 1 in 70-year event and affected 73 properties. The second in July 2006 was a 1 in 80 year event and affected 65 properties. On both occasions there were less than 2 hours warning of the impending storm.

These floods were ostensibly caused by problems with, and maintenance of, drainage systems in the town, and not directly attributable to fluvial flooding. The Council along with other responsible agencies have set out a plan of action to reduce the likelihood of this happening again.

Map 6 shows EA information on Areas Susceptible to Surface Water Flooding. The map carries a heavy disclaimer from the EA and this should be referred to before any assumptions are made from the data. The map shows areas but is not suitable for identifying individual properties that are susceptible to surface water flooding. A site specific flood risk assessment would be required to determine that level of detail.

4.6 Groundwater flooding

Groundwater flooding occurs when water levels in the ground rise above surface elevations. It is most likely to occur in low-lying areas underlain by permeable rocks (aquifers) (PPS25). Paragraph C7 in PPS25 expands on this definition.

Groundwater flooding also occurs where permeable strata lie on top of and are surrounded by impermeable strata. A 'perched water table' develops in the permeable strata and groundwater flow at the surface is often seen at the boundary of the permeable and impermeable strata. A number of channels of the drainage system throughout Epping Forest district have such groundwater 'spring fed' flow at their head. Groundwater fed springs can migrate due to a number of factors including seasonal variability and man-made interventions (such as foundation and basement construction) in the ground. Care should be taken in the use of infiltration drainage systems in areas where the suitable permeable strata are of geographically limited extent as it may contribute to groundwater flooding nearby.

Groundwater flooding is known to occur around Nazeing in Epping Forest District associated with outcrops of the highly permeable Lambeth Group sands and the Kesgrave Sands and Gravels. Water abstraction from these Units may have helped keep groundwater levels historically low and the ceasing of abstraction from a number of boreholes locally could cause levels to rise.

Groundwater flooding has not been a significant issue in Harlow.

Maps 7 and 8 give an indication of the geology throughout the study area and this in turn can give an indication of the likelihood of groundwater flooding.

4.7 Sewer flooding

In urban areas, rainwater is commonly drained into surface water sewers or sewers containing both surface and waste water known as "combined sewers". Flooding can result when the sewer is overwhelmed by heavy rainfall, becomes blocked or is of inadequate capacity, and will continue until the water drains away. Paragraph C8 in PPS25 further expands on this explanation.

The adopted foul and surface water sewer network is extensive in urban areas and less so for rural areas, although a greater extent of the study area is covered by adopted foul water drains operating independently of surface water systems. Thames Water Utilities (TWU) is the sewerage undertaker for Epping Forest and Harlow. There are also areas of large private sewer networks within the study area.

Historical flooding from drainage and sewerage infrastructure in the study area has been identified from Thames Water data. The data received were provided at postcode level, hence no street level information on flooding was available and therefore the use of this data for spatial planning is limited. The total number of properties flooded from overloaded sewers from 1997 to 2007 was recorded. This was further divided into the number of properties flooded by surface water, foul water and combined sewers. Some of these postcode areas straddle the boundaries of the district and some of the properties may well be outside the district boundaries. Because of the difficulty of precisely locating the sewer flooding incidents, they have not been mapped as part of this study.

Map 3 identifies the locations of 57 historic sewer flooding incidents recorded in the Council Flood Incident Databases (see cautionary note in section 4.5 above).

4.8 Flood infrastructure and artificial sources of flooding

Flood defence infrastructure and manmade structures can be overwhelmed or fail for various reasons and lead to flooding. Non-natural sources of flooding can include

reservoirs, canals and lakes where water is retained above natural ground level. Flooding from artificial sources can often occur suddenly and without warning, resulting in fast flowing, deep water that can cause significant threat to life and damage to property. Paragraph C9 in PPS25 provides further information on artificial sources of flooding.

The EA has provided a GIS layer of the National Flood and Coastal Defence Database (NFCDD), listing details of flood defences and structures. The NFCDD is intended to give a reasonable indication of asset condition and should not be considered to contain detailed and accurate data (this would be undertaken as part of a Stage 2 SFRA where the need arises).

Map 9 shows the location of flood defences within the study area (some identified from the NFCDD) along with the location of storm grilles maintained by EFDC and the Environment Agency.

In addition, Map 9 shows areas that are provided a degree of protection against flooding from dedicated flood defences and are referred to as Areas Benefiting from Defences (ABDs) by the Environment Agency. It is essential to realise that defences do not fully remove the risk of flooding to a property and this is discussed in more detail in section 4.9 below.

Map 1 depicts all permanent watercourses and water bodies within the study area. The areas shaded blue in the map are taken from the Ordnance Survey Mastermap. Map 1 also shows Main Rivers coloured red. Note that there are several bodies of standing water, including several fishing lakes, which may also be potential artificial sources of flooding.

4.8.1 Epping Forest District

As a result of a long history of flooding, EFDC has either on its own (at North Weald 1989 and 1993) or in conjunction with the EA (at Loughton 1995 and Thornwood 1997) carried out construction of a series of flood alleviation schemes, all of which include significant flood storage reservoirs (FSR). In addition, within the district there are over 1000 kilometres of watercourses and 62 storm grilles/trash screens overseen either by EFDC or the EA (further details in Appendix 1). The following paragraphs detail the flood defence infrastructure within the District.

Loughton Brook (Staples Road) Flood Storage Reservoir (Design Standard of Protection – 1 in 75 years) was completed in December 1995. It was built to protect Loughton Town centre from flash flooding from the forested catchment area of the Loughton Brook. The reservoir is formed by an earth embankment 140 metres long varying in height from 0 to 8 metres. A reinforced grass overtoppable section 50 metres long acts as a spillway for storms of an intensity greater than was designed for. The pond will store a maximum 47,200 cubic metres of water during the design 1 in 75 year event. The discharge from this pond is controlled by a penstock within a chamber accessed from the top of the embankment. Water level within the reservoir is continuously monitored via a telemetry system.

The pond is located within the Epping Forest Special Area of Conservation and as such the landowner is the City of London Corporation (Conservators of Epping Forest). The reservoir undertaker is the Environment Agency.

Thornwood Brook Flood Storage Reservoir (Design Standard of Protection – 1 in 100 years) was completed in 1998 as part of a two reservoir scheme to protect the

village of Thornwood from flash flooding. The reservoir, situated at the end of Carpenters Arms Lane on the Thornwood Common Brook, is owned and operated by Epping Forest District Council.

The reservoir is formed by a 150 metre long earth embankment, which has a maximum height of 1.8 metres. The reservoir will store a maximum 14,350 cubic metres of water during the design event. The discharge from the reservoir is controlled by a penstock to ensure that the downstream watercourse can accommodate these flows and minimise the risks for residents. Water level within the reservoir is continuously monitored via a telemetry system.

The area of Thornwood Common Brook is managed by EFDC Engineering, Drainage and Water Team (EDWT) in consultation with Countrycare (the Council's countryside management service) to maintain its biodiversity and has now been designated as a Local Nature Reserve.

Cripsey Brook Flood Storage Reservoir, Thornwood (Design Standard of Protection – 1 in 100 years) is situated at the junction of Woodside and Duck Lane in the village of Thornwood and was constructed as part of the same flood alleviation scheme as the Thornwood Brook FSR in 1998. The land is owned by the City of London Corporation (Conservators of Epping Forest). All the flood alleviation structures are managed and operated by the Environment Agency.

Other Flood Alleviation Scheme Works in Thornwood (Design Standard of Protection – 1 in 100 years) downstream of the two reservoirs comprise three culverts located at Woodside, Brookfield (the Old Council Depot), Weald Hall Lane and Weald Hall Place. Of these the culverts at Woodside and Brookfield are owned by Essex County Council and the Weald Hall Place culvert is on privately owned land but operated by Epping Forest District Council.

Church Lane Flood Storage Reservoir, North Weald (Design Standard of Protection – 1 in 50 years) was completed in 1990 to protect North Weald from flooding from the North Weald Brook. It consists of a gravity bypass pipe diversion from an offtake structure at Station Road, running along Church Lane and discharging to the North Weald Brook downstream of the village and a flood storage reservoir with a large twin piped inlet structure at Church Lane to delay the passage of the water until the flows in the North Weald Brook subside.

The flood storage area was formed by basin excavation and some earth embankment to form an oval depression for the temporary storage of floodwater. The reservoir will store a maximum 38,000 cubic metres of water during the design event. The flood storage area is owned and operated by Epping Forest District Council. EFDC Countrycare manages the area of the reservoir very successfully (in conjunction with EDWT) and many rare and unusual wild flowers are now flourishing at the site. Church Lane Flood Storage Reservoir has been classified as a Local Nature Reserve. The bypass culvert is managed by the Environment Agency.

Thornhill Flood Storage Reservoirs, North Weald (Design Standard of Protection – 1 in 75 years, however effectively reduced to 1 in 50 years as online with Church Lane FSR) were completed in 1995 to protect North Weald from flooding caused by water running off the higher ground that used to be the Ongar Radio Station.

New ditches and culverts were excavated and two storage ponds were constructed to the rear of Emberson Way and east of the Village Hall. Both of these ponds are accessed for maintenance via the private road adjacent to the Village Hall.

The outlet pipe from the southern pond discharges into the North Weald Brook near the Village Hall. The discharge from these ponds is controlled by penstocks to ensure that the downstream watercourses can accommodate these flows and minimise the risks for residents. The two ponds in combination are capable of storing 6,300 cubic metres of water. The northern pond was formed by excavation and the material excavated was used to construct a small earth embankment across a valley to form the southern pond. The pond sites are owned and operated by Epping Forest District Council. EFDC Countrycare advise EDWT on environmental aspects and the sites are now designated as Local Nature Reserves.

The channel improvement works were constructed on private land. As the watercourses are Main Rivers, the EA maintains the trash screens covering the inlets to the culverted sections.

Upshire Flood Alleviation Scheme, Waltham Abbey (Design standard of protection 1 in 50 years) was constructed by the EA in 2009-10. The scheme has been designed to reduce flooding from Cobbins Brook to properties in Waltham Abbey. The flood storage area is made up of an earth embankment and upstream storage area. The site is operated and maintained by the EA.

Epping Forest District Council Trash Screens (Storm grilles)

The council owns or maintains a network of 62 trash screens in a split role with the EA. The EA is responsible for 12 grilles on Main Rivers. Most are inclined metal grilles located within the headwall structures at the upstream (inlet) end of critical culverts associated with Flood Alleviation Schemes, Main Rivers, the Ordinary Watercourse network and watercourses that have known flood risk. They are designed to collect large debris and prevent blockage within the culvert itself. The council or EA clears accumulated debris on a monthly or bi-monthly basis dependent on need and after any storm event if required. Refer to Appendix 1 for a full list of storm grilles and the party responsible for clearance.

The assets maintained by the council and EA are located on land owned by the council or common land, or were built by the council on privately owned under its permissive powers under the Land Drainage Act 1991. In addition to the trash screens maintained by the council there may be others in private ownership, the maintenance responsibility for which would rest with the riparian owner.

4.8.2 Harlow

The River Stort has defences along the north and south banks stretching from Honeymead Marsh to Harlow Mill and beyond towards Sawbridgeworth. From Fiddlers Brook west towards the Moorhen the defences are on the south bank. They surround the Moorhen public house and marina (although there is known flooding in this area, particularly the pub car park and Burnt Mill Lane). Defences continue along the north bank of the navigation to Parndon Lock where the navigation meets the river again.

4.9 Residual risk

Paragraph G1 of PPS25 describes residual risk as the risks remaining after applying the sequential approach and taking mitigating actions. PPS25 continues to state that it is the responsibility of those planning development to fully assess flood risk, propose measures to mitigate it and demonstrate that any residual risks can be

safely managed. Flood resistance and resilience measures should not be used to justify development in inappropriate locations.

It is important to realise that flood defences do not completely eliminate the risk of flooding and there will always be a residual risk of flooding. Residual risk can arise due to (but is not limited to):

- the failure of infrastructure, such as a breach or blockage; or
- an extreme flood event that exceeds the design standard of the structure and leads to overtopping; or
- the uncertainties inherent in the prediction of flooding.

Residual risk can in some instances be managed by regular maintenance and inspections, for example by regularly clearing trash screens as part of an existing maintenance regime. However other risks such as overtopping or extreme rainfall events require further consideration. The actual level of residual risk will vary from location to location based on the proximity to the breach or overtopping location, flow routes, water velocity and depth.

Map 9 shows Areas Benefiting from Defences (ABDs) within the two districts. ABDs data come from the Environment Agency and are based on the areas that would flood should infrastructure fail to perform its purpose. Whilst protected from some level of flooding, these areas still have a residual risk and are considered more vulnerable than areas not at risk from flooding and would benefit from additional protection. Where developments are at risk of flooding either flood resilience or resistance measures may need to be adopted. Paragraphs G6-10 in PPS25 provide more information on flood resilience and resistance measures.

4.10 Climate change

It is important that developers take into account the possible change in flood risk over the lifetime of a development as a result of climate change. PPS25 indicates that a 20% increase in peak river flows may see only negligible changes to inundation extents in well defined floodplains, but dramatic changes in very flat areas. However, changes in the depth of flooding under the same allowance will reduce the return period of a given flood. This means that a site currently located within a lower risk zone could in future be re-classified as lying within a higher risk zone. This in turn could have implications for the type of development that is appropriate according to its vulnerability to flooding.

Climate change will also potentially increase the frequency and intensity of localised storms over the district. This may worsen local drainage problems and lead to increases in surface water flooding. It is therefore important that any site specific Flood Risk Assessments take into account climate change.

PPS25 recommends allowances for the increase in peak rainfall intensity and peak river flows in Table B.2. EFDC and Harlow Council require that these allowances are taken into account in any calculations in site specific FRAs. It is vital that future climate change is considered in any assessment of flood risk.

Map 5 shows the effect of climate change on the Flood Zones 3a and 3b.

5. Emergency Planning

5.1 Critical infrastructure

Emergency planning and critical infrastructure data were collected in relation to three main aspects: the location of vulnerable institutions, roads at risk of becoming impassable in a flood event and Environment Agency Flood Warning systems (telemetry sites). These data have been identified in Maps 10 and 11 to enable emergency planners to identify locations where critical infrastructure is exposed to significant flood risk.

Table 8. Emergency Planning Infrastructure (as at Jan 2008) [includes data from Harlow]

Infrastructure	Flood Zone 1	Flood Zone 2	Flood Zone 3a	Flood Zone 3b
Sewage works	7	1		
Hospitals	2			
Doctors Surgeries	30	2		
Sheltered Housing Schemes	9			
Fire Stations	6			
Care Homes	28	1		
EFDC Emergency Rest Centre	42	5	2	2
Schools	42		1	
Police stations	17		3	
Grouped Dwelling Schemes	4		1	
Ambulance Stations	6		1	
Telephone Exchanges	6			

Table 8 shows the distribution of selected emergency planning and infrastructure sites in relation to Environment Agency Flood Zones. Most of the sites here are defined in the PPS25 Vulnerability Classification as 'Highly Vulnerable' and 'More Vulnerable' (see PSS25 Table D2) and would not be permitted in high flood risk zones (3a/3b). The table shows a relatively small percentage of critical infrastructure is located in the high risk Flood Zones. This information has been mapped in Map 10.

A review of Map 11 showing the roads likely to be impassable shows that the main transport links are generally unaffected, except in the most extreme flood events (probabilities less than 1% or greater than 1 in 100 year return periods). Impassable roads have been identified and mapped based on historical incidents and areas where the fluvial Flood Zones overlap roads.

The A414, the main east-west thoroughfare, is potentially impassable during a large (1 in 100 year) event at Chipping Ongar. Roads in close proximity to the River Roding and its tributaries are also likely to be impassable during extreme events. Historically, Nazeing and Waltham Abbey have also had problems with impassable roads, including areas being cut off by flooding in 2000.

5.2 Flood warning

The EA provides a Flood Warning service for areas in the district along the River Lee and River Roding and their tributaries. The EA monitors rainfall and river levels continuously and issues warnings where appropriate to assist in preparedness for flood events.

It is recommended that those people living within Flood Warning areas sign up to the EA Flood Warning Direct service for advanced flood warnings. For more information on Flood Warning Areas, refer to the EA website.

The Flood Warning Area extents can be seen in Map 10.

6. Development Guidance

6.1 Requirements for site specific Flood Risk Assessment

A SFRA is a strategic level document that provides an outline of flood risk. A site specific FRA will be required for most forms of development with the detail being appropriate to the scale of the development and risk of flooding at the site.

PPS25 states that planning applications for development proposals of one hectare or greater in Flood Zone 1 and all proposals for new development located in Flood Zones 2 and 3 should be accompanied by a FRA. In addition, Epping Forest District Council has specific Local Plan policies that may require proposed development falling outside the PPS25 FRA requirements to also submit a FRA. It is the duty of the developer to provide this information in support of a planning application or planning condition. Refer to section 6.2 below for further details.

The aim of a FRA is to demonstrate that proposed development will not be at risk of flooding and will not increase the risk of flooding elsewhere. This includes assessment of mitigation measures required to safely manage flood risk. The FRA also needs to demonstrate that the proposed development will not increase flood risk either upstream or downstream of the site. All sources of flood risk, including surface water runoff, flash flooding and drainage need to be considered. The developer should seek an improvement of overall flood risk to the site and surrounding area and the FRA can be used to demonstrate this.

All proposed development sites require an initial assessment of flood risk. Annex E of PPS25 describes the minimum requirements for a FRA and the PPS25 Practice Guide companion provides further advice. The Environment Agency also provides useful advice on producing a FRA and its current standing advice should be referred to. As well as being proportionate to the degree of risk, a FRA must be appropriate to the scale, nature and location of the development, consider all forms of flood risk, and take into account the impacts of climate change.

Both the Exception Test and Annex E of PPS25 require that a FRA demonstrates that the development will be safe, without increasing flood risk elsewhere. This SFRA classifies safe as a dry access route above the 1 in 100 year plus climate change flood level to and from any residential development and finished floor levels set at least 300mm above this level. To achieve this without increasing flood risk elsewhere, it must be demonstrated that there will be no loss of flood storage and that overland flow routes will not be obstructed. Where access and egress are potential issues, this should be discussed with the LPA and Environment Agency at the earliest stage.

As part of any FRA it may be necessary to calculate volumes and discharge rates of runoff from the site that would be generated by the development. Where this is greater than greenfield runoff from the undeveloped site, in order to prevent increased flood risk downstream it may be necessary to store excess water within the site and discharge it slowly at the greenfield rate. The volume of storage, limiting flow rates and method of storm water detention should be outlined in the FRA. Attenuation storage should be provided to cope with the 1 in 100 year event (plus climate change). EFDC requires calculations on runoff rates, including the greenfield rate, for all development greater than 50m^2.

Re-development of existing sites offers an opportunity to improve the existing runoff regime and reduce flood risk. As far as reasonably practical, maximum runoff rates should be limited to greenfield runoff rates and on-site attenuation utilised as required. As a minimum requirement, the proposed discharge rate should be an improvement on the existing rate.

Chapter 4 of CIRIA C697 The SuDS Manual provides an excellent discussion on the estimation of greenfield runoff rates and volumes. Refer to this for further details on methods of calculation.

6.2 Development within Epping Forest District and EFDC Flood Risk Assessment Zones

Built development will normally increase the area of impermeable ground, meaning water will run off rather than percolate into the ground. Unless carefully sited and designed, the additional surface water run-off (within or outside areas at risk from flooding) can lead to an increased risk of flooding downstream. Damage to, or erosion of, the receiving watercourse can also occur, caused by silt deposition or increased pollutant loads from the increased volume of water and changes to the pattern of flows

Due to a history of flooding within the district, EFDC has taken a proactive approach to reduce flood risk by incorporating stringent policies within the Local Plan (see section 3.6.1). The Council has attempted to minimise the cumulative effect of many minor developments within the district which in combination contribute significantly to increased overall runoff. Consequently, Chapter 14 of the Epping Forest Local Plan Alterations July 2006 deals with flood risk within the district. Of particular reference is Policy U2B (see 3.6.1) which defines Flood Risk Assessment Zones where a FRA may be required for smaller development.

Flood Risk Assessment Zones (FRAZs) are catchments of ordinary watercourses which have been identified by the Council. These may contribute to main river watercourses or where there is a known risk or history of flooding. Map 12 shows the location of the FRAZs. In some instances, FRAZs fall within EA Flood Zone 1 and a FRA will be required for developments less than one hectare in size, whereas this is not a requirement of PPS25.

To enforce Policy U2B, where appropriate, planning conditions requiring a FRA are attached to planning permissions. The size of the development will determine the detail required in the FRA. The following can be used as a rough guide as to whether a FRA will be necessary and the level of detail:

- For development of less than 50m^2 impermeable area, a FRA is not required;

- For development of between 50 – 100m^2 impermeable area, within a FRAZ, a surface water drainage assessment and maintenance details will need to be submitted. Compliance with the principles of SuDS should be demonstrated;

- For development of between 100 – 235m^2 impermeable area, within a FRAZ, a FRA and Management and Maintenance plan will need to be submitted. The assessment shall demonstrate that adjacent properties shall not be subject to increased flood risk and, dependent upon the capacity of the receiving drainage, shall include calculations of any increased storm run-off and the necessary on-site detention;

- For development over 235m^2 impermeable area, a full FRA and Management and Maintenance plan will need to be submitted. The assessment will need to include calculations of the greenfield runoff rate, increased run-off rates and the associated volume of storm detention. The general principles for a FRA listed in Annex E of PPS25 should be used as a minimum requirement.

A reduction in the cumulative impacts of multiple minor developments is the rationale behind Policy U2B and a FRA submitted to the Council as a requirement of a condition should clearly assess surface water runoff and the appropriate mitigation. In particular, calculation of runoff rates and volumes should be provided and surface water attenuation should be discussed in detail. Where calculations are provided, the greenfield runoff rate should also be provided (as discussed in section 6.1 above). Any FRA submitted should meet the minimum requirements in PPS25.

6.3 SuDS – Sustainable Drainage Systems

SuDS is a term used to describe the various approaches that can be used to manage surface water drainage in a way that mimics the natural environment. The management of surface water is considered an essential element of reducing future flood risk to both the site and its surroundings. Indeed reducing the rate of discharge from urban sites to greenfield runoff rates is one of the most effective ways of reducing and managing flood risk and reversing the effects of previously ill-planned development. The integration of SuDS into a site design can also provide broader benefits, including a significant improvement in the quality of runoff discharged from the site, the capture and re-use of site runoff for irrigation and/or non potable uses, and the provision of green space areas offering recreation and/or aesthetic benefits.

Both EFDC and Harlow Council strongly encourage the principles of SuDS on all forms of development. This is particularly important for development sites that lie within FRAZs, including minor development and building extensions. The developer should seek the most sustainable SuDS solution in order to reduce flood risk, improve water quality and improve the environment overall.

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

Table 9. Common SuDS methods

Pervious surfaces	Surfaces that allow inflow of rainwater into the underlying construction or soil.
Green roofs	Vegetated roofs that reduce the volume and rate of runoff and remove pollution.
Filter drain	Linear drains consisting of trenches filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage, to store and conduct water; they may also permit infiltration.
Filter strips	Vegetated areas of gently sloping ground designed to drain water evenly off impermeable areas and to filter out silt and other particulates.
Swales	Shallow vegetated channels that conduct and retain water,

	and may also permit infiltration; the vegetation filters particulate matter.
Basins, Ponds and Wetlands	Areas that may be utilised for surface runoff storage.
Infiltration Devices	Sub-surface structures to promote the infiltration of surface water to ground. They can be trenches, basins or soakaways.
Bioretention areas	Vegetated areas designed to collect and treat water before discharge via a piped system or infiltration to the ground

Underground cellular storage can also be accepted in some circumstances for storage and attenuation of runoff, however there remains the issue of ongoing maintenance responsibility.

Attenuation measures to reduce peak flows or hold back surface water run-off include storage areas (surface or underground) and, where ground conditions permit, infiltration areas or soak ways. In catchment terms, any reduction in the amount of water that originates from any given site is likely to be small. But if applied across the catchment in a consistent way, the cumulative affect of a number of sites could be significant.

Careful consideration needs to be made of the future management of any SuDS features proposed. Each SuDS feature has its own implications with regards to ongoing maintenance, public health and safety and removal and disposal of any entrained waste. Full details of maintenance and management will need to be provided for most developments to show that this has been taken into consideration. As noted in para 3.4.7 above, the County Council as SuDS Approving Body will be responsible for adopting and maintaining systems which have been approved and which serve more than one property.

While various SuDS have been outlined above, it is important to note that infiltration drainage is generally not advisable within the EFDC area due to the highly impermeable nature of most of the underlying geology. This precludes the use of soakaways and some other SuDS techniques in most areas of Epping Forest District. A soil investigation should be undertaken at an early stage for all infiltration methods to ensure that the soil at the site is suitable. Map 13 provides an overview of the soil types within the study area and can be used as a starting point for initial scoping of the suitability of various types of SuDS. Also refer to section 2.2.1.

There are a number of publications available where SuDS design is considered in detail, including Construction Industry Research and Information Association (CIRIA) publications C697 The SuDS manual, C698 Site handbook for the construction of SuDS and C609B Sustainable drainage systems, hydraulic, structural and water quality advice. In addition PPS25 and its Practice Guide companion and EA publications “SuDS An introduction” and “SuDS A guide for developers” are useful starting points.

EFDC holds a record of most SuDS proposed and installed based on information in planning applications.

7. Recommendations

7.1 Climate Change

- The location, layout and vulnerability of appropriate new development schemes, and all associated flood risk, surface water, resilience, safety and related assessments should make full allowance for the potential impact of climate change over the lifetime of the development. The advice of the Environment Agency should be sought to ensure that the most up-to-date guidance is being used.

7.2 Functional floodplain/flood alleviation and storage schemes

- The functional floodplain and sites identified for flood storage or alleviation should be protected from future development;
- Opportunities should be sought to reinstate as floodplain any areas which have been developed through removal, re-design or relocation of buildings and other structures, and this could include land swapping;
- In Areas Benefiting from Defences (ABDs), attention should be paid to the provision of additional protection measures. Where new development is permitted, this must include appropriate resilience and resistance features, and mitigation measures including evacuation plans to address residual risk;
- Permissions for riverside developments should, subject to consultation with appropriate agencies, include provision for developer contributions for refurbishment of assets such as bridges, culverts, walls etc to ensure safety during the lifetime of the development;
- New development should be set back from rivers, with a minimum 8 metre wide undeveloped buffer strip to help attenuate flood waters and allow for maintenance works;
- New development should not involve new, or building over existing, culverts;
- Opportunities to enhance or restore a river corridor should be identified in appropriate applications – eg de-culverting etc. The design of flood storage areas should also take into account the potential for other land uses. Enhancement schemes and appropriate uses include informal recreation and wildlife habitat creation and conservation.

7.3 Other forms of flooding

- Groundwater flooding will continue to be assessed and methods of mitigation will be investigated;
- Surface Water Management Plans should be prepared for areas with known surface water drainage problems;
- Multi-agency working should be encouraged and supported to improve the management of surface water drainage.

7.4 Site allocations

- The Sequential Test will be used to try to ensure that development sites are located in areas with the lowest risk of flooding, giving highest priority to Flood Zone 1;
- If a requirement to apply the Exception Test occurs (ie when insufficient sites in zones of lower flood risk are available), a Level 2 SFRA of potential sites should be undertaken by a suitably qualified engineer to allow timely input to the LDF process.

7.5 Development proposals

- Flood Risk Assessments (FRAs) are required for all proposals in Flood Zones 2 and 3 and for developments greater than 1 ha in Flood Zone 1 (see also section 6.1 of the SFRA);
- Where appropriate, FRAs should also be undertaken for other forms of flooding;
- Epping Forest Council has designated extensive areas as Flood Risk Assessment Zones, and within these areas FRAs will also be required as explained in Policy U2B of the Local Plan Alterations (2006);
- Development proposals will be expected to show a reduction in flood risk onsite and, where appropriate, elsewhere within the catchment. The reduction of runoff to the greenfield runoff rate should be promoted for both greenfield and brownfield sites. Policies should encourage 1 in 100 year (plus climate change impact) attenuation;
- All new development greater than one hectare in size should be required to match greenfield runoff rates, with 1 in 100 year (plus climate change impact) attenuation being mandatory;
- In appropriate cases, developer contributions should be sought for flood risk management measures, including alleviation, storage and related environmental enhancement;
- A sequential approach should be used to locate elements of development according to vulnerability and risk of flooding (eg open space for informal recreation in low-lying waterside areas);
- Safety and resilience should be integral to the overall design of a site (eg dry pedestrian routes to and from residential developments which do not cross the 1 in 100 year (plus climate change) floodplain; liaison with Emergency Planning to assess emergency vehicle access). The same applies to individual buildings – eg finished floor levels should be 300mm above the 1 in 100 year plus climate change flood level;
- Space should be specifically set aside for SuDS, which will be a requirement for all appropriate new development and used to inform the overall site layout. The drainage systems must be appropriate for local soil and geology conditions;
- Opportunities should be pursued to retrofit SuDS in known problem areas, with developer contributions where appropriate;
- In areas at risk of flooding, undercroft or ground floor parking will be preferred to habitable rooms at ground floor level. Restrictions may apply to the provision of ground floor bedrooms;
- The construction of habitable basements in areas at risk of flooding will be discouraged.

7.6 Emergency planning/risk awareness

- The Council's Emergency Plan should be reviewed and updated where required on the basis of the main findings of this SFRA. Any other plans dealing with safe evacuation and access for emergency services during times of flooding for existing and proposed development should also be reviewed;
- Critical infrastructure located in flood zones or other areas of known flooding should be assessed to ensure that there are adequate procedures for access and evacuation;
- Alternative routes for use in emergency situations should be identified;
- In relation to areas identified as being at risk of flooding, the location of vulnerable development and critical infrastructure such as roads should be considered in detail;

- The two Councils should work with the Environment Agency to promote greater public awareness of flood risk and to encourage more people to sign up to the Flood Warning Direct services provided by the EA.

7.7 Monitoring

- The SFRA is a “living” document which will need to be reviewed on a regular basis as updated data and policy guidance become available. Officers believe that a two-yearly review would be appropriate.

8. Abbreviations and Glossary

Disclaimer: The following abbreviations and glossary are for general assistance to the reader and are not intended for detailed legal interpretation.

ADAS Agricultural and Development Advisory Service
CFMP Catchment Flood Management Plan
CIRIA Contstruction Industry Research and Information Association
DEFRA Department for Environment, Food and Rural Affairs
EA Environment Agency
EFDC Epping Forest District Council
FRA Flood Risk Assessment
FRAZ Flood Risk Assessment Zone
LDD Local Development Document
LDF Local Development Framework
LPA Local Planning Authority
NFCDD National Flood and Coastal Defence Database
PPS25 Planning Policy Statement 25
SFRA Strategic Flood Risk Assessment
SuDS Sustainable Drainage Systems

Adoption of Sewers The transfer of responsibility for the maintenance of sewers to a sewerage undertaker.

Annual exceedence probability The estimated probability of a flood of a given magnitude occurring or being exceeded in any year, usually expressed as 1 in 100 chance or 1%.

Antecedent conditions The condition of a catchment area at the start of a rainfall event.

Aquifer A source of groundwater comprising water-bearing rock, sand or gravel capable of yielding significant quantities of water.

Attenuation Reduction of peak flow and increase of the duration of a flow event.

Baseflow The portion of streamflow that comes from groundwater and not surface runoff.

Brownfield site Any land or site that has been previously developed.

Catchment The area contributing runoff or baseflow to a particular point on a watercourse.

Catchment Flood Management Plan A high-level planning strategy through which the Environment Agency works with other key decision-makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.

Climate change Long term variations in global temperature and weather patterns both natural and as a result of human activity, primarily greenhouse gas emissions.

Culvert Covered channel or pipe that forms a watercourse below ground level.

Development The carrying out of building, engineering, or other operations in, on, over or under land or the making of any material change in the use of any buildings or other land.

Discharge Rate of flow of water.

Exception Test A site allocation test that requires that, if development has to be located in an area of flood risk, it must provide wider sustainability benefits that outweigh the flood risk.

Flood defence Infrastructure, such as flood walls and embankments, intended to protect an area against flooding, to a specified standard of protection.

Flooding Inundation by water whether this is caused by breaches, overtopping of banks or defences, inadequate or slow drainage of rainfall, underlying groundwater levels or blocked drains and sewers.

Floodplain Area of land adjacent to a watercourse, an estuary or the sea, over which water flows in time of flood, or would flow but for the presence of flood defences where they exist.

Floodplain compensation The provision of new floodplain storage capacity to replace lost natural floodplain due to development.

Flood probability The estimated probability of a flood of given magnitude occurring or being exceeded in any specified time period.

Flood risk An expression of the combination of the flood probability and the magnitude of the potential consequences of the flood event.

Flood Risk Assessment A study to assess the risk of a site or area flooding, and to assess the impact that any changes or development in the site or area will have on flood risk.

Flood Risk Management Combines the functions of mitigating and monitoring flood risks and may include pre-flood, flood-event or post-flood activities.

Flood storage The temporary storage of excess runoff or river flow in tanks, ponds, basins, reservoirs or on the floodplain.

Fluvial Relating to a river or rivers.

Fluvial flooding Flooding from a river or other watercourse.

Functional floodplain Unobstructed areas of the floodplain where water regularly flows in time of flood. PPS25 defines this as land which would flood with an annual probability of 1 in 20 (5%) or greater.

Greenfield runoff rate The rate of runoff that would occur from the site in its undeveloped (and therefore undisturbed) state.

Groundwater Water in the saturated zone of the ground below the water table.

Groundwater flooding Flooding caused by groundwater escaping from the ground when the water table rises to or above ground level.

Gully Opening in the road pavement, usually covered by metal grates, which allows water to enter conventional drainage systems.

Highways drain A conduit draining the highway. For highways maintainable at the public expense it is vested in the highway authority.

Infiltration Capacity A soil characteristic determining or describing the maximum rate at which water can enter the soil.

JFLOW: A multiscale two-dimensional dynamic flood model.

Local Planning Authority Body responsible for planning and controlling development, through the planning system.

Main river A watercourse designated on a statutory map of Main Rivers maintained by Defra on which the Environment Agency has permissive powers to construct and maintain flood defences and to ensure the free flow of water.

Ordinary watercourse All rivers, streams, ditches, drains, brooks, cuts, dykes, sluices, sewers and passages which are not designated Main River, a private drain or a public sewer. Local authorities have similar permissive powers on ordinary watercourses as the Environment Agency has on Main Rivers.

Overland flow flooding Flooding caused by surface water runoff when rainfall intensity exceeds the infiltration capacity of the ground, or when soil is so saturated that it cannot accept anymore water.

Pluvial flooding Surface flooding caused by rain.

Precautionary principle The approach, to be used in the assessment of flood risk, which requires that the lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to avoid or manage flood risk.

Probability A measure of the chance that an event occurs. The probability of an event is typically defined as the relative frequency of occurrence of that event, out of all possible events.

Protected floodplain Natural floodplain prevented from flooding by defences.

Residual risk The risk that remains after risk management and mitigation. It may include, for example, risk due to very severe storms (above design standard) or risks from unforeseen hazards.

Return period The long-term average period between events of a given magnitude which have the same annual exceedence probability of occurring. Generally replaced by the term Annual Exceedence Probability.

Riparian owner A person who owns land on the bank of a watercourse or body of water and is usually responsible for maintenance of the watercourse.

Runoff The flow of water from an area on the catchment surface, caused by rainfall.

Sequential Test A risk based approach to assessing flood risk, which gives priority to sites in order of increasing flood risk.

Sewer flooding Flooding caused by the blockage or overflowing of sewers or urban drainage systems.

Strategic Flood Risk Assessment An assessment of flood risk carried out for planning policy purposes.

Sustainable drainage system A sequence of management practices and control structures, often referred to as SuDS, designed to drain surface water in a more sustainable manner than some conventional techniques. Typically, these techniques are used to attenuate rates of runoff from development sites.

Sustainable development Development which meets the needs of the present without compromising the ability of future generations to meet their own needs.

Urban creep The process whereby the impermeability of the urban area increases over time, due to modifications to individual properties.

Vulnerability Refers to the resilience of particular groups, people, properties and the environment, and their ability to respond to hazardous conditions. For example, elderly people may be less able to evacuate in the event of a rapid flood than young people.

Water table The level of groundwater in soil and rock, below which the ground is saturated.

Wetlands An area where saturation or repeated inundation of water is the determining factor in the nature of the plants and animals living there.

9. References

Broxbourne Borough Council SFRA (December 2007)

Ciria Publication C609, Sustainable Drainage Systems (2004)

Ciria Publication C697, The SuDS Manual (2007)

East Herts District Council SFRA (November 2008)

Epping Forest District Local Plan Alterations 2006

Flood Studies Report, Institute of Hydrology, 1975

Harlow Local Plan Replacement 2006

London Borough of Enfield SFRA (February 2008)

PPS25: Development and Flood Risk (December 2006)

PPS25: Practice Guide (December 2009)

Thames Region Catchment Flood Management Plan (CFMP): Summary Document, Environment Agency, January 2007

The Design of Field Drainage Pipe Systems, ADAS Reference Book 345, 1980

The Pitt Review: Lessons Learned from the 2007 Floods (June 2008)

10. Appendices

Appendix 1 Storm grille locations in Epping Forest District

Storm grille number	Location	Responsibility for clearance
1	Meadow way, Lower Sheering	EFDC
2	Crown Close, Sheering	EFDC
3	Campions Hill, Sheering Rd., Sheering	EFDC
4	Hobbs Cross, Harlow	EFDC
5	Rear of 66 Parkfields, Roydon, access besides no.48	EFDC
6	Opp. "Beehive" Harlow Rd., Moreton	EFDC
7	Adj. "Fernhurst" Epping rd., Roydon	EFDC
8	Opp. Meadgate Rd., Sedge Green, Nazeing	EFDC
9	Middle Street / Perry Hill, Nazeing	EFDC
10	Adjacent "Silverdale" Hoe Lane, Nazeing	EFDC
11	Opp. St Andrews Church, Vicarage Lane, North Weald	EA
12	South of STW, Church Lane, North Weald	EFDC
13	North of STW, Church Lane, North Weald	EFDC
14	Rear of 244 High Road, North Weald	EA
15	Rear of 104 - 11- Thornhill, North Weald (2 No.)	EA
16	Rear of 33 Emberson Way, North Weald (Pond)	EA
17	Thornwood FAS, Carpenters Arms Lane, Thornwood	EFDC
18	Adjacent 41 Duck Lane, Thornwood	EFDC
19	Thornwood FAS, Weald Hall Place Farm, Thornwood	EFDC
20	Beecroft, Woodside, Thornwood	EFDC
21	Station Road/High Road, North Weald, plus overspill	EA
22	Rear of 13 Dukes Close, North Weald	EFDC
23	Pike Way junction with High Road, North Weald	EA
24	Rear of 46 High Road, North Weald	EA
25	Rear of 46 High Road, North Weald	EA
26	100 m North L.T. line Coopersale Common, Coopersale	EFDC
27	Adjacent Croft Cottage, Fairfield Road, Ongar	EFDC
28	Outside 92 Crooked Mile, Waltham Abbey	EFDC
29	Outside 14 Stanway Road, Waltham Abbey	EFDC
30	Rear of 8 Blackmore Court, Waltham Abbey	EFDC
31	Rear of 8 Blackmore Court, Waltham Abbey	EFDC
32	Forest Close, High Beach	EFDC
33	Dear Sanctuary, Loughton Lane, Theydon Bois	EFDC
34	Opposite Marshfield Garage, Sewardstone Road, Waltham Abbey	EFDC
35	Junction of Englands Land & Pyrles Lane, Loughton	EFDC
36	Outside 137 Ongar Road, Abridge (Hillmans Brook)	EA
37	Opposite entrance to Waters Farm,Ongard Road, Abridge	EFDC
38	Loughton Brook FAS, Shaftesbury, Loughton	EA
39	Downstream Loughton Brook FAS, Shaftsbury, Loughton (2 No.)	EA
40	Junction High Beech Road & Smarts Lane, Loughton	EFDC
41	Rear of 5 Forest View Road, Loughton	EFDC
42	Near Nursery Road end, Connaught Avenue, Loughton	EFDC
43	Adjacent 21 Clifton Road, Loughton	EA
44	Abridge Cricket Club, Hoe Lane, Abridge	EFDC
45	Rear of 25 Alderwood Drive, Abridge	EFDC
46	At pond opposite Spring Grove, High Road, Loughton	EFDC
47	Outside 135 Highwood Lane, Loughton	EFDC
48	Opposite " Brandons", Gravel Lane, Chigwell	EFDC
49	Pudding Lane, 80 metres south of Abridge Road, Chigwell	EFDC
50	West of Transco Depot, Roding Lane, Chigwell	EFDC
51	Opposite Hop Pole Farm, Hoe Lane, Lambourne End	EFDC
52	Opposite 48 Forest Edge, Buckhurst Hill	EFDC
53	Opposite 70 Forest Edge, Buckhurst Hill	EFDC
54	Opposite 120 Forest Edge, Buckhurst Hill	EFDC
55	Junction of Froghall Lane and Manor Road, Chigwell (2 No.)	EFDC
56	Junction Bumbles Green Land and Roundabout, Bumbles Green (3 No.)	EFDC
57	Parsloe Road, Jacks Hatch	EFDC