

Technical Study

Level 1 Strategic Flood Risk Assessment



November 2008

www.eastherts.gov.uk/sfra

Table of Contents

1	INTRODUCTION	5
1.1	Aims and Scope	5
1.2	The Sequential Test and the Exceptions Test	7
1.3	Description of East Herts District	8
1.4	The Rivers of East Herts.....	8
1.5	The River Lee and Stort Catchments.....	9
1.6	Geology and hydrology.....	11
2	THE POLICY FRAMEWORK	12
2.1	Overview.....	12
2.2	The European Policy Framework	13
2.2.1	The Water Framework Directive	13
2.2.2	The Habitats Directive	13
2.3	Planning Policy Framework	13
2.4	National Policy	14
2.5	The Regional Spatial Strategy	16
2.6	Local Planning Policy.....	17
2.6.1	East Herts Local Plan.....	17
2.6.2	East Herts Planning Obligations SPD	17
2.6.3	East Herts Landscape Character Assessment SPD.....	18
2.6.4	East Herts Local Development Framework	18
2.6.5	East Herts Local Development Scheme	18
2.6.6	Rye Meads Water Cycle Strategy	18
2.6.7	Strategic Housing Land Availability Assessment.....	20
2.7	Environment Agency Policy	21
2.7.1	Thames Catchment Flood Management Plan	21
2.7.2	Flood Risk Management Strategies	24
2.8	East Herts Land Drainage Policies	26
2.9	Hertfordshire Biodiversity Action Plan (BAP)	27
2.10	Funding Mechanisms for Flood Infrastructure	27
2.10.1	Planning Obligations	27
2.10.2	Community Infrastructure Levy	27

3	DATA COLLECTION, METHODOLOGY, AND MAPPING	29
3.1	List of Maps	29
3.2	Data Collection Process	30
3.3	Stakeholder involvement	31
3.4	List of Data Sources	32
3.5	Climate Change	33
3.6	Flood Defence Infrastructure	33
3.7	Fluvial (River) Flooding.....	36
3.7.1	Requirements.....	36
3.7.2	Historic River Flooding	37
3.7.3	Floodplain modelling and mapping.....	38
3.8	Sewer Flooding.....	43
3.9	Surface Water Flooding	44
3.10	Groundwater Flooding	45
3.11	Artificial Sources	46
3.12	Residual Risk.....	47
3.13	Emergency Planning.....	48
3.14	Flood Risk Assessments	48
3.15	Development in neighbouring authorities.....	49
4	RECOMMENDATIONS AND GUIDANCE	50
4.1	Requirement for Flood Risk Assessment.....	50
4.2	Defining “safe” development.....	51
4.3	Reducing Flood Risk through Spatial Planning.....	52
4.4	Reducing Flood Risk through Mitigation	54
4.5	Reducing Flood Risk through Sustainable Drainage	55
4.6	Reducing Flood Risk through Improving the River Environment	57
4.7	Reducing Flood Risk through Improving Emergency Planning.....	58
4.8	Reducing Flood Risk through the Council’s Land Drainage function.....	59
4.9	Location-specific Recommendations	60
5	EMERGENCY PLANNING	61
5.1	Flood Warning System	61
5.2	Review of Critical Infrastructure	62
5.3	Emergency Planning Recommendations.....	63

6	CONCLUSIONS	65
6.1	Site Allocation Process	65
6.2	Council Policy	65
6.3	Emergency Planning.....	66
6.4	Update and Review of the SFRA.....	66

Appendices

Appendix A: Sewer Flooding.....	67
Appendix B: Landscape Character Assessment SPD.....	68
Appendix C: East Herts Council Flood Database records.....	70
Appendix D: The SUDs Hierarchy.....	71
Appendix E: Epping Forest Flood Risk Zones	72
Appendix F: References and Relevant Studies.....	74
Appendix G: East Herts Flood Warning/Flood Watch Areas.....	75
Appendix H: Abbreviations/Acronyms.....	78
Appendix I: Glossary.....	79

List of Maps

Map 1	River Catchments Affecting East Herts
Map 2	Watercourses
Map 3	Solid (Bedrock) Geology
Map 4	Drift Geology
Map 5	Flood Zones 2/3a/3b
Map 6	Climate Change
Map 7	Flood Defences
Map 8	Emergency Planning
Map 9	Historic Flooding
Map 10	Flood Risk Assessments

1 INTRODUCTION

1.1 Aims and Scope

A Strategic Flood Risk Assessment is one of three types of Flood Risk Assessment set out in *Planning Policy Statement 25: Development and Flood Risk* (PPS25)

Table 1: Types of Flood Risk Assessment

Regional Flood Risk Appraisal (RFRA)	Strategic Flood Risk Assessment (SFRA)	Flood Risk Assessment (FRA)
RFRA provides a broad overview of flood risk issues across a region. They should influence spatial allocations for growth in housing and employment as well as to identify where flood risk management measures may be required at a regional level to support the proposed growth. It will highlight key areas where a more detailed study may be required at sub-regional level.	SFRAs provide an assessment of all types of flood risk to inform land use planning decisions. The SFRA will enable the LPA to: apply the Sequential Test; allocate appropriate sites for development; and identify opportunities for reducing flood risk. SFRAs should carefully consider the implications of climate change.	FRAs are site or project specific. Initially, all types of flood risk associated with a development should be considered, with any significant sources of risk subsequently assessed in detail. A FRA should outline the management of the risk to an acceptable level, considering climate change and addressing any residual risk issues.
Responsibility: RFBs either alone or with LPAs and other Stakeholders (a RFRA has yet to be produced for the East of England).	Responsibility: LPAs, either alone or in partnership with other LPAs and stakeholders.	Responsibility: All those proposing new developments for which an FRA is required.

Source: *PPS25 Practice Guide* (June 2008) page 37

The Scope of a Level 1 SFRA is set out in Paragraph E5 of PPS25. It should be sufficiently detailed to allow application of the Sequential Test (annex D table D.1 of PPS25 and **Section 1.3** below) and to identify whether development can be allocated outside high and medium flood risk areas, based on all sources of flooding, not just river and coastal, or whether application of the Exception Test is necessary. The information may also be used to assess how any environmental objectives relating to flooding, as defined in the Sustainability Appraisal, may be affected by additional development. A Level 1 SFRA should principally be a desk-based study making use of existing information.

Key outputs from the Level 1 SFRA are as follows (see *PPS25 Practice Guide*, pages 46-7):

- plans showing the LPA area, Main Rivers, ordinary watercourses and flood zones, including the functional floodplain (as defined in annex D table D.1 of PPS25), across the local authority area, as well as all previously allocated development sites (or sites to be considered in the future);
- an assessment of the implications of climate change for flood risk at allocated development sites over an appropriate time period;
- areas at risk from other sources of flooding such as surface water and groundwater flooding (N.B. the Environment Agency Flood Map only shows rivers and tidal flood risk);
- flood risk management measures, including location and standard of infrastructure and the coverage of flood warning systems;
- locations where additional development may significantly increase flood risk elsewhere through the impact on existing sources of flooding, or by the generation of increased surface water run-off (a Surface Water Management Plan may be needed);
- guidance on the preparation of FRAs for allocated development sites;
- guidance on the likely applicability of sustainable drainage systems (SUDS) techniques for managing surface water run-off at key development sites.

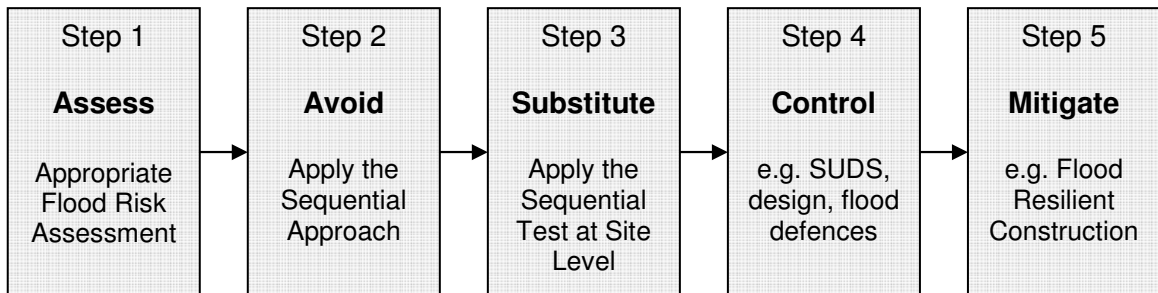
Where the Level 1 SFRA demonstrates that land in Flood Zone 1 (taking climate change into account) cannot accommodate the necessary development, then the Exception Test needs to be applied. A more detailed Level 2 SFRA will need to be carried out, including further data collection and/or analysis, as set out in Paragraph E6 of PPS25 and pages 48-52 of the *PPS25 Practice Guide*.

East Herts Council is currently (2008) at an early stage in the preparation of its Local Development Framework. It is anticipated that the Core Strategy for the District will be adopted in 2011. In accordance with PPS12: *Local Spatial Planning*, it is expected that the Core Strategy will identify a number of "Strategic Sites" or land allocations. Following on from the Core Strategy will be a Site Allocations DPD which will contain the remainder of the site allocations within the District. For allocations in both DPDs the Sequential Test will be applied using the information in this Level 1 SFRA. If it appears that the Council is unable to allocate certain sites in accordance with the Sequential Test, a Level 2 SFRA will then be required.

1.2 The Sequential Test and the Exceptions Test

The Sequential Test is a decision-making tool designed to ensure that sites at little or no risk of flooding are developed in preference to areas at higher risk. The Sequential Test forms stages 2-3 in the Flood Risk Management Hierarchy:

Figure 2: The Flood Risk Management Hierarchy



Source: PPS25 Practice Guide (Page 31)

Application of the sequential approach to spatial planning reinforces the most effective risk management measure of all – that of avoidance. Application of the approach from as early as possible in the plan-making process, and particularly application of the Sequential Test at the Local Development Document (LDD) level, will help ensure that development including regional housing targets can be safely and sustainably delivered and developers do not waste their time promoting proposals which are inappropriate on flood risk grounds.

The Exceptions Test consists of three parts, as detailed in paragraph D9 of PPS25. For the Exceptions Test to be passed:

- a) it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared;
- b) the development should be on developable previously-developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously-developed 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.

PPS25 paragraphs 16-17 and Annex D cover the Sequential and Exceptions Tests. Further information, is available in Chapter 4 of the *PPS25 Practice Guide* (June 2008), including information on applying the sequential test to Local Development Documents, individual planning applications and windfall sites.

1.3 Description of East Herts District

The District of East Hertfordshire covers an area of 477 square kilometres (184 square miles) and comprises approximately a third of the area of Hertfordshire. It is predominantly a rural District, with attractive towns and villages set amongst a rolling landscape. Bishop's Stortford, Hertford, Ware and Sawbridgeworth are the four main towns in the District. The Metropolitan Green Belt, which contains these towns, covers the southern third of the District. The northern two thirds of the District are classified as Rural Area Beyond the Green Belt. There are in addition numerous other villages and hamlets. Areas of nature conservation are equally abundant. The District is home to a population of just under 129,000 (2001 census).

Map 1: River Catchments Affecting East Herts shows that the District falls entirely within Lee and Stort catchments. However, the catchment system within the District is complex, consisting of a number of tributaries of the Lee. Three of these tributaries (the Mimram, Rib and Beane) converge with the Lee in Hertford. The Ash joins the Lee at Amwell south of Ware and the Stort joins the Lee at Rye Meads in the southernmost part of the District before passing into Broxbourne. The catchment is predominantly rural and consists of woodlands, arable and horticultural lands as well as grasslands.

1.4 The Rivers of East Herts

Map 2: Watercourses shows the principal rivers and their tributaries, together with other bodies of water. Each of the following rivers flows through East Herts District for part or all of its length:

The **River Lee** rises just north of Luton and flows to the south of Welwyn Garden City before entering East Herts and into Hertford from the south-west, to the north of the B158.

The **River Mimram** runs north of Welwyn Garden city and passes south of Tewin running into Hertford, joining the Lee near Hertford football club south-west of the town centre.

The **River Beane** starts in North Herts district and passes to the east of Stevenage, through Walkern and Watton at Stone before entering Hertford from the north, joining the Lee at Hartham Common. Three groundwater pumping stations are located adjacent to the River Beane, south-east of Aston.

The **River Ash** rises within the district south of Meesden and flows through Brent Pelham, Furneux Pelham, Little Hadham, Much Hadham and enters the River Lee south of Ware at Amwell nature reserve. The area is principally rural, with a land use of mostly woodland, arable

production and grazing. There are several small villages situated along the River Ash but no major urban areas.

The **River Rib** rises north of the district and flows through Chipping and Buntingford, then west of the A10, crossing under the A10 south of Braughing. The river then passes along the eastern edge of Puckeridge and under the A120 before passing through Standon. The river meanders south through countryside, passing back under the A10 and between Thundridge and Wadesmill, finally entering the Lee east of Hertford, about 300 metres downstream of the confluence of the Beane and the Lee.

The **River Quin** is a tributary of the Rib, flowing east of the B1368 east of Hare Street and through Braughing, entering the Rib south of Braughing.

The **River Stort** rises to the east of Royston and passes through Bishop's Stortford, Sawbridgeworth and along the Harlow boundary through Roydon and joins the Lee at Rye Meads.

More detailed descriptions of the separate river catchments are available in East Herts Council's Landscape Character Assessment Supplementary Planning Document (see **Section 2.6.3** below).

1.5 The River Lee and Stort Catchments

The Environment Agency manages rivers on a catchment basis. East Herts lies within the River Lee and Stort catchments, which form part of the wider Thames River Basin. As **Map 1** illustrates, the River Lee rises just north of Luton. The confluence of the Lee with the Thames is 2.5 km upstream of the Thames Barrier, at Bow Creek.

Outside of the urban areas the catchments of both rivers are characterised by open farmland, predominantly for arable use, and chalk streams of high ecological value. The rivers in East Herts are primarily characterised by wide and undeveloped floodplain which provides a significant role in providing natural flood storage within the wider catchment.

Within the study area the Lee Valley Special Protection Area (SPA) and the Lee Valley Ramsar sites are the sites affected by the Habitats Directive. The presence of Biodiversity Action Plan species, such as the Water Vole and White Clawed Crayfish give the area further high ecological status. The catchments of both the Lee and Stort contains several Sites of Special Scientific Interest (SSSIs) and includes part of the Lee Valley Special Protection Area (SPA).

The River Lee Catchment

For strategic planning purposes the EA has divided the Lee into two main parts, the Upper and Lower Lee. The Upper Lee is mainly rural, with arable farming the most common land-use. However, as **Map 1** illustrates, there are also several major urban areas in the catchment including Luton, Stevenage, Harpenden, Welwyn Garden City, Hatfield, Hertford and Ware.

The river character changes south of Hertford, where it becomes navigable and increases in size significantly with the flows from the main tributaries. The Lower Lee flows through an increasingly urbanised environment, including Waltham Abbey, Grange Park, Edmonton, Walthamstow, Chingford, Hackney and Stratford.

The Upper Lee catchment covers the majority of the study area that drains into the River (Lower) Lee from its source 'Five Springs' in Leagrave north of Luton, downstream to Feildes Weir, north east of Hoddesdon. The Upper Lee catchment consists of five large rivers including the Mimram, Beane, Ash, and Rib. It covers an area of 1036 km² incorporating parts of Hertfordshire, Essex and Bedfordshire.

The River Stort Catchment

The River Stort rises in Uttlesford District near the village of Langley. In its upper reaches the Stansted Brook flows through Elsenham and Stansted Mountfichet and joins the Stort on the border with East Herts District. Several tributaries of the Stort flow through Uttlesford District, the most significant being Pincey Brook, which flows past Takeley and Hatfield Broad Oak, then through the northern part of Epping Forest District to join the River Stort south of Sawbridgeworth. Great Hallingbury Brook rises south of Stansted Mountfichet and joins the Stort at Thorley Street to the south of Bishop's Stortford. For more detailed descriptions together with maps, please refer to the Uttlesford District SFRA.

1.6 Geology and hydrology

The district has a large and diverse topography with many variations in soil type. Generally speaking the north and east has a heavy clay soil which is impermeable. Following storm events it is thus hard for surface water to drain away. Whilst clay soils may limit the opportunities to utilise Soakaways, a wide range of alternative SUDS systems are available to reduce runoff from new developments.

In the south east of the catchment the hydrology is primarily influenced by unconfined chalk, which is overlain by London Clay and Reading Beds. In the unconfined chalk area, winter rainfall recharges the groundwater where it is released slowly into the chalk streams. This provides a relatively high baseflow with a much smaller proportion of flow coming from runoff.

Many of the chalk streams have winter bourne sections that are prone to drying up. Where an impervious layer of clay covers the chalk, rainfall cannot percolate into the ground and, instead, runs off directly to the surface water system. This is a much faster response to rainfall and makes the clay catchments such as the Stort and Ash relatively flashy.

Within this Level 1 SFRA are included 2 maps which provide information about the geology of East Herts:

- **Map 3: Solid (Bedrock) Geology.** Solid Geology is the geological name for bedrock geology.
- **Map 4: Drift Geology** refers to the material deposited by glaciers on top of the bedrock. This may include boulder clay and other forms of glacial drift in the recent past.

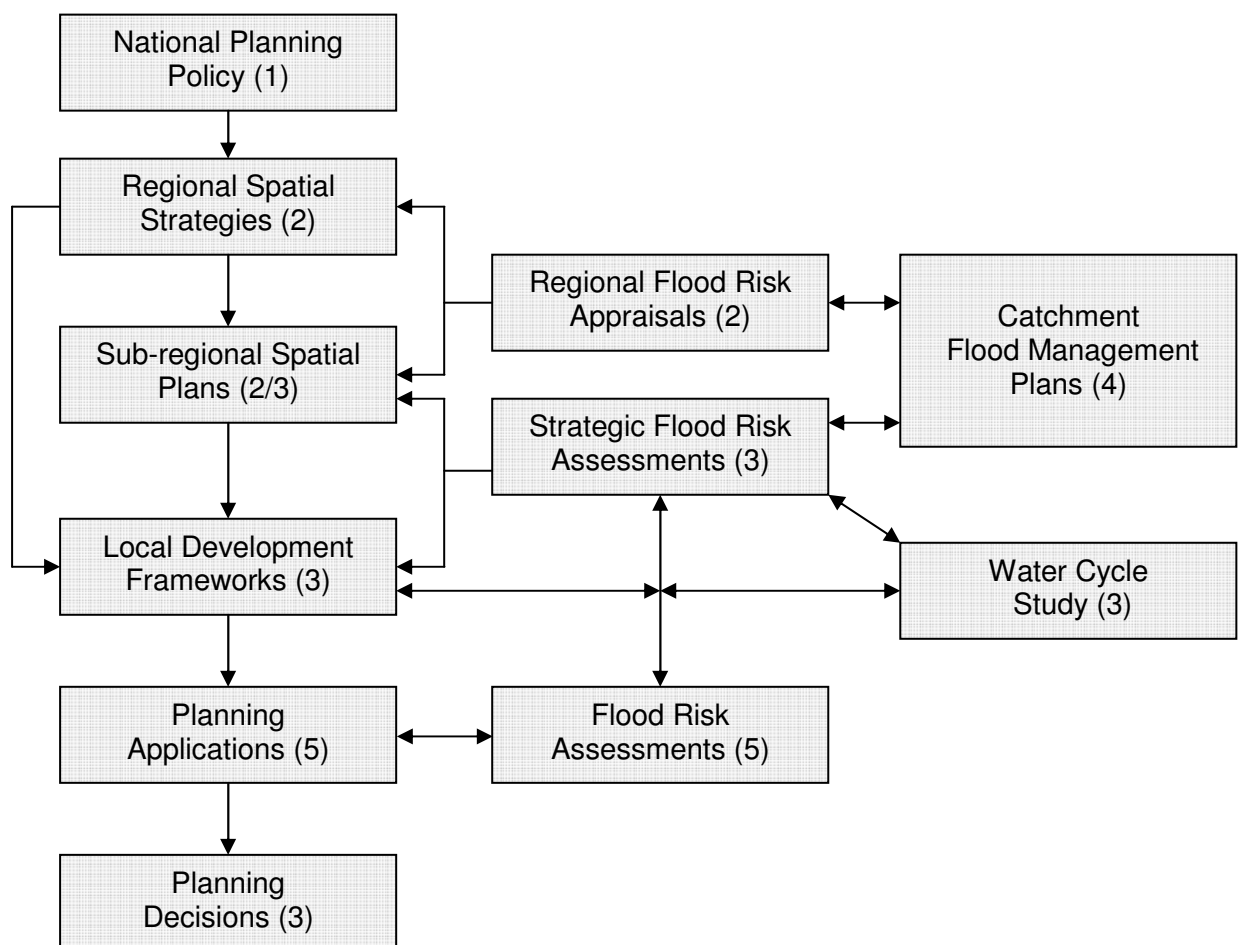
"Drift" geology is often more important than "solid" geology when considering building works, drainage, siting water boreholes, sand & gravel resources, soil fertility, and many other issues. Reference to drift geology is made below in relation to Sustainable Urban Drainage Systems (SUDS – see **Section 4.5**) and Groundwater flooding (**Section 3.9**)

2 THE POLICY FRAMEWORK

2.1 Overview

“Policy” is taken to refer both to Statutory Planning Policy and also to the policy in respect of flooding issues established by the Environment Agency through the various studies and strategies produced. Figure 3 below illustrates the configuration of policies in relation to Flood Risk management.

Figure 3: Key documents in the Spatial Planning Process and their Links with other key strategies for managing flood risk



Responsibilities: 1 = National Government; 2 = Regional Government; 3 = Local Planning Authority (LPA); 4 = Environment Agency; 5 = Developer

Source: PPS25 Practice Guide (Page 8)

Existing policy has been taken into account in establishing further recommendations for local policy in **Section 4** below.

2.2 The European Policy Framework

2.2.1 The Water Framework Directive

The European Water Framework Directive sets out a strategy for protecting and enhancing the quality of groundwater, rivers, lakes, estuaries and coasts. The Rye Meads Water Cycle Strategy provides further details of the assessment of water quality for the rivers in the District in accordance with the Water Framework Directive.

2.2.2 The Habitats Directive

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. They are called 'Natura 2000' sites. These sites include:

- Special Areas of Conservation (SACs) - support rare, endangered or vulnerable natural habitats and species of plants and animals (other than birds)
- Special Protection Areas (SPAs) – support significant numbers of wild birds and their habitats.

In the UK, the Habitats Directive is implemented by the Conservation (Natural Habitats) Regulations (1994), more commonly known as the Habitats Regulations.

2.3 Planning Policy Framework

The English planning system has a comprehensive hierarchy of policies and plans, beginning with national guidance which provides a broad framework for regional plans through to development plans at the local level. Development plans are intended to provide clear guidance for prospective developers. They are prepared following community and stakeholder involvement and debate. They are intended to reconcile conflicts between the need for development and the need to protect the wider built and natural environment.

Responding to the requirements of the Planning and Compulsory Purchase Act 2004, the Government is implementing reforms to the planning system with Planning Policy Statements (PPS) replacing Planning Policy Guidance (PPG), Regional Spatial Strategies (RSS) replacing Regional Planning Guidance (RPG) and Local Development Frameworks (LDF) replacing Structure and Local Plans.

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

2.4 National Policy

Planning Policy Statement 1: Delivering Sustainable Development (2005) PPS1 sets out the Government's objectives for the planning system. It confirms that good planning should deliver the right development in the right place and time, and protect the environment. It identifies sustainable development as the core principle underpinning planning.

Planning Policy Statement 1: Planning and Climate Change – Supplement to PPS1 (2007)

The supplement requires that in selecting suitable sites for development, LPAs take into account known physical and environmental constraints on the development of land such as sea level rises, 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)

Planning Policy Statement 3: Housing (2007)

PPS3 requires that Local Planning Authorities should, working with other stakeholders, set out the criteria to be used in identifying the broad locations and specific sites for housing development, taking into account flood risk (including climate change) and other constraints. In this context, the key role of the SFRA is to help determine whether potential sites identified in the evidence base are suitable to be allocated for housing as part of the subsequent plan-making stages

Planning Policy Statement 9: Biodiversity and Geological Conservation (2005)

PPS9 sets out policies on protection of biodiversity and geological conservation through the planning system. The broad aim is that development should have minimal impacts on biodiversity and geological conservation interests and enhance them where possible. Appropriate weight should be attached to the need to protect international and national designated sites when considering site allocations.

Planning Policy Statement 12: Local Spatial Planning (2008)

PPS12 explains that Local Spatial Planning aims, *inter alia*, to create a positive framework for action on climate change and to achieve sustainable development. It emphasizes that coordinated delivery strategies are essential to the preparation of Core Strategies, and that they should be based on sound evidence.

Planning Policy Statement 25: Development and Flood Risk (2006)

PPS25 sets out a plan led approach to flood risk. It confirms that all forms of flooding and their impact on the natural and built environment are material planning considerations. It clarifies the sequential test that matches types of development to degrees of flood risk and strengthens

the requirement to include flood risk assessment at all levels of the planning process. Regional planning bodies and local planning authorities (LPA) should, inter alia, reduce flood risk by safeguarding land that is required for current and future flood management e.g. conveyance and storage of flood water and flood defences. It also identifies the need for LPAs to undertake SFRAs to inform the development of their Local Development Frameworks (LDFs).

The Town and Country Planning (General Development Procedure) Order 1995 (as amended)

Amendments to the Town and Country Planning (General Development Procedure) Order 1995 came into force on 1 October 2006 (Circular 01/2006) introducing further requirements for LPA to consult the Environment Agency before determining applications for development in flood risk areas.

LPA are required to consult the Environment Agency before granting planning permission for development, other than minor development, which is to be carried out on land:

- In an area within Flood Zone 2 or 3;
- In an area within Flood Zone 1 which has critical drainage problems and which has been notified for the purpose of this provision to the LPA by the Environment Agency;
- Any development on land of one hectare or more;
- Involving the carrying out of works or operations in the bed of, or within 20 metres of the top of a bank or a main river which has been notified to the LPA by the Environment Agency as a main river;
- Involving the culverting or control of flow of any river or stream.

The Environment Agency has prepared standing advice to guide decisions on individual planning applications.

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

To safeguard against inappropriate development in flood risk areas, the Direction introduces a requirement for LPA 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 advice.

2.5 The Regional Spatial Strategy

The East of England Plan or Regional Spatial Strategy (RSS) was published in May 2008. Together with the Local Plan/Local Development Framework produced by the Districts, it forms the Statutory Development Plan.

The East of England Plan requires the provision of 12,000 new dwellings in the period April 2001 – to March 2021, with 2140 built in the period April 2001- March 2006, leaving a deficit of 9860 still to build by the end of the plan period. In addition, Harlow District is required to plan for 16,000 new dwellings, including urban extensions in East Herts and Epping Forest Districts.

Policy *WAT4: Flood Risk Management* prioritises the defence of existing properties from flooding and the location of new development in areas that have little or no risk from flooding. Paragraph 10.14 of the supporting text requires SFRA's to take into account the impact of climate change. Paragraph 10.17 states that "in preparing guidance about sustainable drainage systems local authorities should address the adoption of such systems by the relevant body and long-term liability issues".

In addition, Policy *ENV1: Green Infrastructure* recognizes the contributions of Green Infrastructure towards flood alleviation, including the Lea Valley Regional Park. Policy *ENV3: Biodiversity and Earth Heritage* promotes the restoration and re-establishment of habitats and wildlife corridors.

2.6 **Local Planning Policy**

2.6.1 **East Herts Local Plan**

East Herts Local Plan was adopted in 2007 and covers the period 2007-2011. The Local Plan contains 2 policies relating to flooding:

ENV19 Development in Areas Liable to Flood

- (I) Proposals for development, including raising of land, in the flood plains and washlands will not be permitted if they would:
- (a) materially impede the flow of flood water;
 - (b) increase the risk of flooding elsewhere;
 - (c) reduce the capacity of floodplains/washlands; or
 - (d) increase the risk to people or property from flooding.
- (II) Applicants will be required to submit a Flood Risk Assessment in conjunction with their planning application where the Council deems this necessary.

ENV21 Surface Water Drainage

- (I) Where appropriate and relevant, all development proposals will be expected to take into consideration Best Management Practices to surface water drainage, as advocated by the Environment Agency. Where applicable, planning obligations (or as subsequently revised) may be sought to ensure the on-going maintenance of such practices, including off-site provision.
- (II) Proposals that do not take sufficient account of such techniques and/or are detrimental to the effectiveness of existing schemes based on such techniques, will be refused.

2.6.2 **East Herts Planning Obligations SPD**

East Herts Council has produced a *Planning Obligations Supplementary Planning Document* (October 2008) which supports Local Plan Policy *IMP1: Planning Conditions and Obligations*. Section 3.8 of the SPD supports Local Plan Policy *ENV21: Surface Water Drainage* and contains details of developer contributions towards the maintenance of Sustainable Urban Drainage Systems (SUDS) which may have been adopted by the Council as a result of the development. The SPD is available at www.eastherts.gov.uk/planningobligations

2.6.3 East Herts Landscape Character Assessment SPD

Detailed descriptions of the riparian landscape, including topography, hydrology, geology and soils are available in the Council's *Landscape Character Assessment Supplementary Planning Document* (September 2007), available online at www.eastherts.gov.uk/localplan. Key recommendations of relevance to the SFRA/Water Cycle Strategy and planning policy are contained in **Appendix B**.

2.6.4 East Herts Local Development Framework

East Herts Council is currently in the early stages of preparing its Local Development Framework (LDF). The LDF will replace the Local Plan. PPS12 requires that Core Strategies run for 15 years from adoption, and the East Herts LDF will run to 2026 at least. During 2008 the Council has been consulting and evidence gathering in preparation for publication and formal consultation on the Issues and Options document, likely to occur in 2009. This will be followed by a Preferred Options consultation, with adoption of the Core Strategy in anticipated in 2011.

The SFRA will form a key part of the evidence base underpinning the LDF. It will be used in particular in the allocation of land for development, and therefore will be a key consideration in the Site Allocations Development Plan Document (DPD) and the Core Strategy, but its impact will be felt across the LDF.

2.6.5 East Herts Local Development Scheme

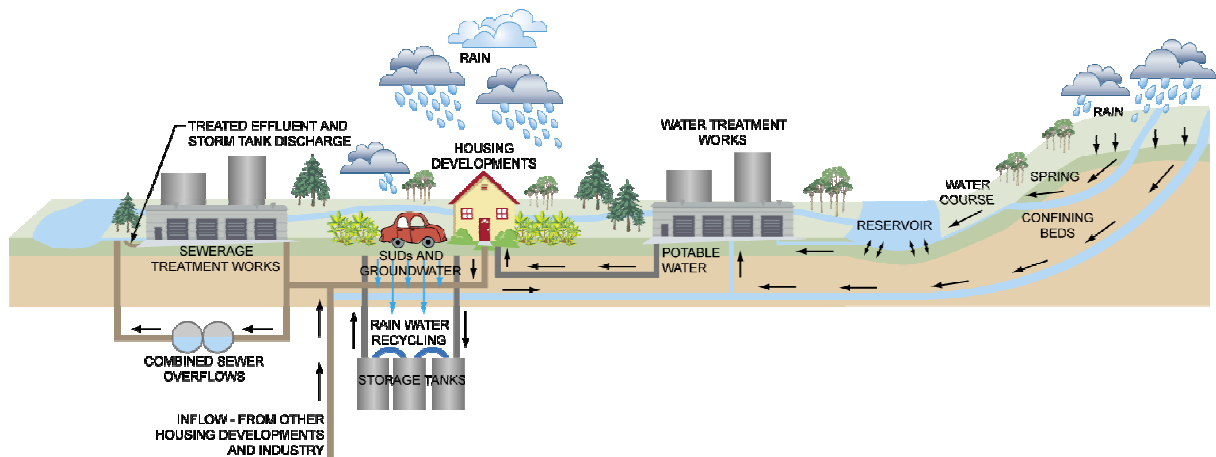
An updated Local Development Scheme (LDS) for the District will be published next year. This will provide a detailed timetable and project plan for the preparation and eventual adoption of Development Plan Documents under the Local Development Framework. Policies relating to Flood Risk and water management will be contained within the DPDs set out in the LDS.

2.6.6 Rye Meads Water Cycle Strategy

The Strategy was commissioned by a group of seven Local Planning Authorities including East Herts as a key part of the evidence base to deliver robust Local Development Frameworks, and in compliance with RSS policy *WAT 2: Water Infrastructure* and paragraph 10.8. The Strategy will recommend viable infrastructure options to accommodate planned growth and ensure that water infrastructure is not a limiting factor to the growth of the area. The strategy area is defined by the settlements served by Rye Meads Waste Water Treatment Works (WwTW) located in the far south of the District, and includes Hertford, Ware, Sawbridgeworth but not Bishop's Stortford, Buntingford or Puckeridge/Standon, which are served by separate WwTW.

As illustrated in the diagram below, the Water Cycle Strategy will consider flood risk as part of the wider Water Cycle. It will draw on the findings of the SFRAs in each of seven separate Districts.

Figure 4: The Urban Water Cycle



Source: *Rye Meads Water Cycle - Scoping Report* (Halcrow, 2007)

The demand for clean water supply and sewage treatment can be expected to increase in proportion to the number of new homes being built, as can the risk of flooding if suitable mitigation measures are not provided. It will not be sustainable to continue to develop new homes, employment land and community infrastructure at the scale proposed in the East of England Plan without due consideration of how to address factors such as urban drainage and flood risk, water resource, water supply, sewerage infrastructure, sewage treatment and water quality.

The study identifies that the East of England is the driest region in the country and generally low-flows are caused by over-abstraction of water. This situation is likely to be exacerbated by further development.

In terms of flood risk, the draft study identifies that the two principal challenges related to flood risk from development growth across the study area are:

- Potential development within existing flood risk areas; and
- Increased risk of surface water runoff created by hard surfacing at new developments.

2.6.7 Strategic Housing Land Availability Assessment

The SFRA should be completed in time to inform the development of options for the allocation of land for development. For housing, this should be done through the Strategic Housing Land Availability Assessment (SHLAA). The Council's *Housing Capacity Assessment* (Entec, 2007) provides the first step in identifying sites which may form the basis of the SHLAA. The Housing Capacity Assessment identifies several constraints including flood zones identified through the Environment Agency's Flood Zone maps.

2.7 Environment Agency Policy

2.7.1 Thames Catchment Flood Management Plan

Catchment Flood Management Plans (CFMP) are documents which provide a strategic overview of flood risk management issues for specific river catchments. CFMPs are a long term plan for the next 50-100 years, and provide the basis for Flood Risk Management investment plans. CFMPs are required for all river catchments across the country and are being undertaken by the Environment Agency.

The Thames Region Catchment Flood Management Plan (CFMP) is a high-level 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. The Thames CFMP was the first CFMP to be signed-off, and was finalised in summer 2008. The CFMP outlines proposed flood risk management policies for the Thames Region. It takes into account the likely impacts of climate change and future development across the region. The plan does not propose specific or detailed measures but identifies where further work is needed.

The Thames Region CFMP provides four main policy messages:

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

CFMP Policy Units

The Thames CFMP covers the whole of the Thames river basin, and is made up of 43 individual policy units. The policy units relate to specific sections of river, and identifies:

- The nature of flood risk within the specific policy unit.
- Key messages for each policy unit.
- What needs to be undertaken in the future to reduce flood risk.

East Herts council is covered by two CFMP Policy units: Upper Lee policy unit; and Middle Lee and Stort policy unit. The key characteristics of both policy units are described in the table below.

Figure 5: CFMP messages for East Herts

Upper Lee	Middle Lee and Stort
Narrow floodplains towards the headwater of the catchment.	Extensive downstream floodplains, flooding occurs following prolonged rainfall
Wide downstream floodplains.	The extensive floodplains provide some natural storage and reduce risk to urban areas (e.g. Hertford and Ware)
Approx 2000 properties are in Flood Zone 2 and are at risk from a 1 in 1000 annual probability event (0.1% AEP fluvial flood)	Environmentally designated sites, sensitive to water level and flow management
Properties at risk are widely distributed across the policy unit.	Much flood risk downstream of policy unit, interventions in the Middle Lee and Stort may help reduce flood risk downstream
Changes in flood flow and level have a big impact on number of properties at risk.	Development pressure in Harlow and along M11 corridor
	Attenuating water in the Middle Lee or Lower Stort could be part of a longer-term option to reduce flood risk in the Lower Lee

Upper Lee Policy Unit

The River Lee flows from Luton through to the Thames at Bow Creek. The Upper Lee comprises the rivers in the Lee basin upstream of the confluence of the Lee and Stort. Rivers included in the Upper Lee Policy Unit include the Mimram, Beane, Rib, Ash and Stort. In this policy unit, 1,080 properties are at risk from a 1% flood. The tributaries of the Lee are predominantly rural, and flood risk on these watercourses is dispersed.

Flooding in the Upper Lee results from fluvial and groundwater sources. Flood risk is currently managed by conveying flows through the catchment, however, in-channel blockages or constrictions can cause localised flooding as can flood water's exceeding channel capacity.

There are limited opportunities to build flood alleviation schemes within this policy unit. As such using spatial planning to reduce flood risk is of great importance as is flood resilience measures at the individual property level.

Middle Lee and Stort Policy Unit

Clusters of properties are at risk within this policy unit in Hertford, Ware, Bishops Stortford and Sawbridgeworth:

- In Bishops Stortford properties at risk of flooding are located alongside the Stort. Opportunities to influence the nature and character of built development within this town is the most effective means of reducing risk, as no space is available for raised flood defences.
- Four rivers run through Hertford, these rivers are either natural, canalised, navigations or diverted watercourses. There are some measures available to reduce flood risk in Hertford and these are being explored through an FRM strategy.

Within this policy unit there are sites available which could be used to provide future flood storage to reduce flood risk downstream but with some local benefits to the towns of Hertford and Ware. There is a degree of uncertainty associated with the pursuit of these flood storage schemes, it will depend upon the approach we decide to take to manage flood risk in the Lower Lee, and this is currently being explored through a Flood Risk Management Strategy (FRMS).

Main Policy Messages from both Policy Units

The flood risk management approach recommended for these two policy units are as follows:

- The floodplain is our most important asset in managing flood risk.
- Maintain the capacity of the natural floodplain to retain water and maintain the conveyance of watercourses in the towns and villages to reduce flood risk and provide environmental benefit.
- Safeguard the natural floodplain from inappropriate development.
- Refurbishment of buildings and redevelopment of industrial areas in the floodplain offers the opportunity to increase the resilience of these areas.
- Safeguard land for future flood storage schemes.
- Appropriate storm attenuation measures should be incorporated into new development.
- Rigorous application of PPS25.
- Encourage flood resilience and resistance measures at the individual property level.
- Restore channel and re-establish water meadows.

2.7.2 Flood Risk Management Strategies

The Environment Agency advocates a strategic approach to flood risk management on a 'whole catchment' basis. General objectives of Flood Risk Management Strategies (FRMS) include the following:

- To describe the catchment flood risk;
- To explain structural options;
- To review non-structural flood risk management options;
- To provide a framework for implementation of viable future maintenance and other management options to reduce the flood risk to people and property.

A number of flood risk management strategies have been undertaken by the Environment Agency within the Thames Region, encompassing many of the river systems within the study area. Most notably, these include the *Hertford Flood Risk Management Strategy*, and the *Ash Flood Risk Management Strategy*. In addition, the *Upper Lee* and *Lower Lee Flood Risk Management Strategies*, although primarily focused on Luton-Stevenage and London respectively, include some key considerations for East Herts District.

Lower Lee Flood Risk Management Strategy (2008)

The Lower Lee Flood Risk Management Strategy covers the area downstream of Hertford to the mouth of Lee at Bow Creek. The study considered a significant number of options for flood risk reduction within the Lower Lee catchment. These options included replacement of Flood Relief Channel Structures, construction of new upstream flood storage areas (including at Hertford), operational changes to the Flood Relief Channel (control at Fieldes Weir) and local protection at critical locations on the main channel.

Furthermore a number of non-structural solutions to flood risk management were proposed such as preventing development on the flood plain, improved flood resilience, protecting and extending the network of water and wetlands habitats, and promotion of Sustainable Urban Drainage (SUDS).

Given the low cost-benefit ratios for the identified structural schemes a package of short and long-term structural and non-structural measures were recommended.

Hertford Flood Risk Management Strategy (ongoing)

The Lower Lee Flood Risk Management Strategy identified that the complexity of flooding issues in Hertford would require a separate study. As a result, Halcrow Group Ltd has been recently commissioned by the Environment Agency to undertake a pre-feasibility study, with

the aim of reviewing the existing flood outlines and associated property damages in Hertford town and identifying possible options for alleviation. Five rivers run through Hertford, forming a complicated system for flood risk management. The five rivers (River Lee, Mimram, Beane, Brickendon Brook and the Gulphs) include sections of natural channel, canalised river, navigations and diverted watercourses.

Any future review of this SFRA will need to take account of the findings of the Halcrow study.

River Ash Flood Risk Management Strategy (2006)

Following a flood event in October 2001 which affected properties in Furneux Pelham, Clapgate, Little Hadham, Hadham Mill and Mardocks Mill, the Environment Agency commissioned Atkins in January 2003 to commence the River Ash Flood Risk Management (FRM) Strategy Study. The Environment Agency's *Summary and Conclusions Report* on phase 2a of the Strategy Study (August 2006) contains several recommendations of relevance to planning:

- *Sustainable Urban Drainage Systems (SUDS)*
As explained further in greater detail below, SUDS help to ensure that any new developments do not result in water entering rivers more quickly resulting in an increase in flood flows. SUDS offer a number of benefits compared to traditional drainage systems, such as : reducing potential for flooding downstream of developed areas, improved water quality and enhanced biodiversity in watercourses, development potential in areas where the existing surface water and sewer system may already be at capacity.
- *Flood Storage Areas*
The Strategy Study also identified three potential Flood Storage Areas (FSAs) that would store flood water and so retain flood flows within the river channel at Little Hadham. This structural option would entail the creation of three bunds across the valley floor.
- *Landscape designations*
The Strategy study draws on the aspects of the Council's *Landscape Character Assessment Supplementary Planning Document* (September 2007) and draws attention to flood risk implications of the recommendation to: *Encourage the establishment of buffer zones along the river, to absorb herbicide, pesticide and fertilizer run-off and to create wildlife refuges. Where possible, link these to the wider landscape via field margins, hedges or woodland, as appropriate.*

2.8 East Herts Land Drainage Policies

The Council employs a small team of Engineers to co-ordinate and manage the Municipal engineering functions within the District which includes activities associated with its role as the Land Drainage authority. The Engineers work with their colleagues in the Environment Agency, Hertfordshire County Council, Thames Water, Herts Highways and other stakeholders and partner organisations. In addition, the Council engages external contractors to provide a regular drainage maintenance service. The responsibilities of the Engineers as regards Land Drainage include:

- Maintenance of privately-owned drainage infrastructure including trash grilles (in association with riparian owners);
- Managing Ordinary Watercourses on behalf of the Environment Agency;
- Commenting and advising on individual planning applications
- Providing advice on Sustainable Urban Drainage (SUDs);
- All activities associated with Land Drainage for ordinary watercourses such as flood investigations/ advice and associated enforcement action.

In addition, the Land Drainage Team is able to provide advice on delivery of structural and non-structural options such as provision of flood storage areas and use of the natural floodplain. This may be an important aspect of implementation of some of the recommendations of the Flood Risk Management Strategies outlined above.

East Herts Council's Engineers' new policy for SUDs means that, subject to agreement of a suitable sum in respect of maintenance, the Council is in principle prepared to adopt and maintain such features for residential and commercial developments in order that a reduction in flood risk can be achieved.

In order to further reduce risk of flooding in the district it is also proposed that East Herts Council will commence work on the introduction of a new policy to identify flood risk assessment zones that are associated with ordinary watercourses and other such vulnerable areas (see **Appendix E: Epping Forest Flood Risk Zones**).

2.9 Hertfordshire Biodiversity Action Plan (BAP)

The Hertfordshire BAP identifies 30 Key Biodiversity Areas (KBAs) of which the following are located along the rivers of East Herts.

13. River Ash Valley – woodlands and wetlands
14. Stort Valley – grasslands and wetlands
15. Lee Valley – wetlands
16. Rib Valley – wetlands and woodlands
17. Lower Mimram/Lower Beane/Bramfield Plateau – wetlands and woodlands

In terms of the future growth agenda for the District, it is recommended that the identified KBAs provide suitable natural floodplains/wetlands able to accommodate flood water at peak periods and alleviate downstream flood impacts. Biodiversity and flooding concerns may thereby also be addressed. This addresses the East of England Plan requirements for Green Infrastructure (Policy ENV1) and Biodiversity (Policy ENV3)

2.10 Funding Mechanisms for Flood Infrastructure

Funding flood defences and other facilities such as Sustainable Urban Drainage Systems (SUDS) is likely to be an important policy consideration.

2.10.1 Planning Obligations

Funding flood defences and other facilities is likely to be an important policy consideration. Circular 05/2005 provides for S106 planning obligations to be sought where they meet the tests set out in the Circular. Such obligations are intended to secure contributions from developers to address the impact of new development, without which such development would not be permitted. Such impacts can include flood water conveyance and storage and flood defences.

As noted above, East Herts Council has an adopted Planning Obligations Supplementary Planning Document (SPD) which supports policy *ENV21: Surface Water Drainage*. Section 3.8 of the SPD provides examples of the types of SUDS which may be required and an explanation of the maintenance operations involved. The SPD explains that the Council is prepared to adopt and maintain SUDS, but in cases where developers request Council adoption, a commuted sum in respect of maintenance for between 10 and 30 years may be required.

2.10.2 Community Infrastructure Levy

The Community Infrastructure Levy (CIL) is a new charge which local authorities in England and Wales will be empowered, but not required, to charge on most types of new development in their area.

CIL charges will be based on simple formulae which relate the size of the charge to the size and character of the development paying it. The proceeds of the levy will be spent on local and sub-regional infrastructure to support the development of the area. Community Infrastructure Levy may include a range of items including flood defences. There remain uncertainties over the date at which the new powers and guidance on CIL is provided and therefore when CIL funding will become available in East Herts.

3 DATA COLLECTION, METHODOLOGY, AND MAPPING

The objective of this Level 1 SFRA is to collect, collate and review all currently available information relating to flooding in the study area. This information is presented in a format which will enable East Herts Council to apply the sequential test. This Test must be applied to determine the potential sites for development and, where necessary, identify sites that will require the Exception Test.

It is useful to review the data collection process in order to identify gaps in the data/information. Additional requirements that may be needed to meet the objectives of a Level 2 SFRA can then be identified.

The methodology of how these maps were produced is detailed in the following section in addition to the source of data used.

3.1 List of Maps

This section provides a clear description of what data has been used for the purpose of strategic flood risk mapping. It is based on the findings of the data collection and review exercise which included an assessment of suitability (see **Section 4**).

As a result of the data collection process large-scale flood risk maps have been produced as part of this SFRA.

Map 1	River Catchments Affecting East Herts
Map 2	Watercourses
Map 3	Solid (Bedrock) Geology
Map 4	Drift Geology
Map 5	Flood Zones 2/3a/3b
Map 6	Climate Change
Map 7	Flood Defences
Map 8	Emergency Planning
Map 9	Historic Flooding
Map 10	Flood Risk Assessments

It is important to note that the data collected on historical flooding is not exhaustive and since the data is based on historical events rather than predictive modelling (and therefore may not represent very rare events) the full extent of these flooding mechanisms may not have been captured. During future updates to the SFRA, additional reviews and consultations should be undertaken to ensure that the best information is used to inform site allocations.

3.2 Data Collection Process

The study area falls within the Environment Agency's North East Thames region and is administered by the Hatfield office, the point of contact for the provision of data for the catchments within the study area.

The Environment Agency is the principal source of data regarding fluvial flooding (see **Section 3.3** below). The Environment Agency supplied flood outlines and flood zone mapping data to the Council, which have been used in the production of **Map 5: Flood Zones 2, 3a and 3b**, and **Map 6: Climate Change**. A full list of materials received from the Environment Agency for use in this SFRA is provided in **Section 3.4** below.

In addition, the Environment Agency supplied GIS shapefiles from the National Flood Defence Database (NFCDD) for the District. Given the large number of structures within East Herts, the Land Drainage officer reviewed the data and selected structures of particular significance for the purposes of this SFRA. These selected structures are shown on **Map 7: Flood Defences**.

The Council's Flood Incident Database

East Herts Council is the Drainage Authority for the District (see **Section 2.8** above). As part of its maintenance remit the Land Drainage Officers maintain records of flooding incidents related to drainage. As part of the collection process for this SFRA, these records were drawn together into a database format. This entailed drawing together records from a variety of sources including the local knowledge of former drainage officers at the Council. The database contains the following information:

- File reference
- Ordnance Survey grid reference
- River catchment
- Approximate date of incident
- File details
- Address
- Category of flooding (Main River, Ordinary Watercourse, Principal Watercourse, Highway, Surface Water, Ground Water, Foul Water, Pond)
- Officers' comments

Records for the period 1993 to October 2007 were then mapped (**Map 9: Historic Flooding**). **Appendix C** tabulates the records within the database that have been mapped. The table shows that approximately a third of the incidents relate to Ordinary Water Courses. Many incidents are attributed to multiple causes.

CAUTIONARY NOTES:

- The database and points plotted on **Map 9** show historic flooding incidents which may have been resolved (e.g. a blocked drain or sewer). Therefore while the information provided may be a useful indicator of the need for further checks (for example through a developer FRA), it should not in itself be seen as denoting a flooding problem;
- the Council's drainage service responds to reported flooding incidents, therefore unreported incidents are not included within the database.

3.3 Stakeholder involvement

Within East Herts Council, the following stakeholders were involved:

- Planning Policy
- The GIS Manager
- The Land Drainage Team
- The Head of Community Safety (Emergency Planning)

Several meetings with the staff from the Environment Agency's Hatfield office were held during the drafting and production of the SFRA, including advice on the overall content and structure of the document, together with review of the data supplied by the Agency.

A meeting with the Environment Agency's Flood Defence Inspector for East Herts District was held in August 2007 in order to identify areas of flood risk. The Flood Defence Inspector indicated areas of significant flood risk within the District. These areas are plotted onto **Map 9: Historic Flooding as "Areas at Risk of Flooding"**.

3.4 List of Data Sources

Information and data was requested from the stakeholders below. The data collected was integrated within a GIS system where possible, and reviewed to establish a baseline data set and identify missing data.

East Herts Council

- OS Tiles: 50k raster images
- East Herts Local Plan Second Review (April 2007)
- East Herts Landscape Character Assessment Supplementary Planning Document (September 2007)
- Rye Meads Water Cycle Strategy draft Report (Hyder Consulting)
- Location of storm grilles/trash screens
- Location of Critical Ordinary Watercourses
- Location of Roads at Risk of becoming impassable

At the request of the Environment Agency, East Herts Council commissioned a survey of the River Rib, a copy of which was deposited with the Survey team at the Environment Agency's Reading Office (Capital Surveys, August 2008). This survey will inform detailed mapping of the River Rib which can then be used in a Level 2 SFRA.

Thames Water

- List of postcode areas flooded by foul, surface water or combined sewers

British Waterways

- Location of structures maintained by British Waterways

Hertfordshire Highways

- General details on the service provided and maintenance activities

Hertfordshire Biological Records Centre

- Hertfordshire Biological Action Plan (BAP)

Environment Agency

- Environment Agency detailed hydraulic models for the following rivers: Beane, Ash, Lea, Stort. For further details see Table 4 below;
- Hydrology e.g the main and ordinary watercourses, location and information;
- NFCDD (National Flooding and Coastal Defence Database) data e.g flood storage areas, banks and structures;
- Environment Agency Flood Zone Maps and detailed modelled outlines;
- Thames Region Catchment Flood Management Plan (CFMP) Summary (July 2007);
- Lower Lee Flood Risk Management (FRM) Strategy;
- Hertford Flood Risk Management Strategy (FRM) inception report (June 2008);

- River Ash Flood Risk Management Strategy and Study Phase 2a Summary and Conclusions Report (August 2006);
- River Beane Flood Risk Study Inception Report (August 2003);
- Site-specific Flood Risk Assessments (FRAs) up to February 2008.
- Flood Warning Areas and Flood Watch Areas.

3.5 Climate Change

It is essential that developers consider the possible change in flood risk over the lifetime of the development as a result of climate change, using the climate change allowances depicted in PPS25 (Table B2 – reproduced on **Map 6** within this SFRA). The likely increase in flow over the lifetime of the development should be assessed. In addition, climate change will also potentially increase the frequency and intensity of localised storms over the District. This may exacerbate localized drainage problems. It is important therefore that both the site based detailed Flood Risk Assessment and the Surface Water Flood Risk Assessment¹ (i.e. prepared by the developer at the planning application stage) take due consideration of climate change.

Further explanation of modelling and mapping of the effects of climate change is provided in **section 3.7.3 below**.

3.6 Flood Defence Infrastructure

The Environment Agency has provided a GIS layer of the National Flood and Coastal Defence Database (NFCDD), listing details of structures and flood defences. This database aims to provide the following information:

- The location, composition and condition of fluvial defences and watercourses referenced to identified risk areas;
- The types of asset (i.e. property, infrastructure, environmental) at risk within identified risk areas, including those protected by fluvial, tidal and coastal defences);
- The NFCDD details the asset reference, the defence location, level of protection provided by the structure and the geographic extent of the structure/defence. The NFCDD is used to identify where structures may cause increased risk of flooding during a blockage scenario and/or could benefit from replacement or removal. The NFCDD is a good starting point for identifying significant flood defences and potential areas benefiting from defence, but the quantity and quality of information provided differs considerably between structures. The NFCDD is intended to give a reasonable indication of the condition of an asset and should not be considered to contain consistently detailed and accurate data (this would be

¹ For further information on surface water and FRAs see PPS25 *Practice Guide* paragraphs 5.43-5.51. Paragraph 5.45 states that FRAs *should show how surface water management is functioning on the site at present and how it is to be undertaken in the new development*.

undertaken as part of a Level 2 SFRA where the need arises). The NFCDD includes details of 274 defences and 768 structures within East Herts District.

Whilst PPS25 ignores the presence of defences in Flood Zone 3a and 2, it is still important to recognize and acknowledge the locations of flood defences and the residual risk associated with defence failure.

Map 7 shows the location of flood defences (identified from the NFCDD) together with the location of principal storm grilles maintained by East Herts Council.

The 1947 floods prompted the Lee Flood Relief Channel (RLFRC) project that runs from Hertford through Ware and into Borough of Broxbourne. Notable assets on this include the Hertford Basin side spill weir, Ware lock and Hardmead and Stanstead radial gates. The RLFRC was originally designed to provide a 1 in 70 level of service although this has diminished to 1 in 50 as rainfall depths have increased and it is therefore important that developments do not contribute additional flow to the channel.

Flood Defence Consent

Rivers are sub-divided into two different categories: Main Rivers and Ordinary Watercourses. Main Rivers are rivers which are designated as 'Main Rivers' by DEFRA. If a watercourse is not a Main River then it is called an Ordinary Watercourse and is usually maintained by a Local Authority. Main Rivers and Ordinary Watercourses are covered by different sets of legislation as follows:

Main Rivers - Under the terms of the Water Resources Act (1991) and the Land Drainage Byelaws (1981) the prior written consent of the Agency is needed for certain works in, over, under or within 8 metres of a Main River. Consent is therefore needed for works on a river bank and within or over/under a watercourse.

Ordinary Watercourses - Under Section 23 of the Land Drainage Act 1991 the prior written consent of the Agency is needed for certain works which may affect the flow of an Ordinary Watercourse e.g. a culvert, a weir, or a bridge, or for erosion protection.

Ordinary Watercourses

Following the major flooding in the winter of 2000/2001, the Council's engineering team carried out detailed surveys of the many watercourses throughout the district. This work, together with historical flooding information, provided data for the Environment Agency's River Defence Survey (RDS). East Herts Council's Land Drainage Team identified over 150 principal watercourses and noted the condition of their associated assets i.e. culverted pipes, bridges, grilles, headwalls, access chambers etc. The Land Drainage Team intends to carry out

this survey regularly to update flood risk information and include other structures significant to flooding defence.

As a result of the River Defence Survey exercise and using Environment Agency criteria, the Council agreed with the Environment Agency that 17 of the watercourses (approximately 16.5km) were to be defined as critical ordinary watercourses (COWs). In 2006 these were then en-mained by the EA to be re-classified as main rivers. Any rivers that were not en-mained as part of this process are classed as ordinary watercourses.

The Council has retained its permissive powers over all remaining ordinary watercourses, which involves small streams and ditches which are less likely to cause severe flooding of property.

Main Rivers

Within East Herts Main River flooding poses the greatest flood risk, particularly in the river corridors running through the urban areas of Hertford, Ware and Bishop's Stortford. The table in Appendix C shows that many of the flood incidents recorded in the East Herts Flood Incident database are classified as Main River events. **Map 9: Historic Flooding** shows the Historic Flood Extents provided by the Environment Agency, and described in **Section 3.7.2** below. As mentioned above, 17 watercourses were reclassified as Main Rivers in 2006 and these are maintained by the Council as Land Drainage Authority. The location of these is shown on **Map 2**.

Areas Benefiting from Defences (ABDs)

Areas that are provided a degree of protection against flooding from dedicated flood defences are referred to as "Areas Benefiting from Defences" by the Environment Agency. The areas benefiting from defences within East Herts District are depicted on **Map 7**.

It is essential to recognize that defences do not fully remove the risk of flooding to properties within the District. There is always a risk of system malfunction, overtopping and/or structural failure. Whilst the risk of flooding from rivers may be reduced through the presence of defences, it is also important to remember that localised flooding (i.e. resulting from local catchment runoff and/or sewer system failure following heavy rainfall) may flood properties within defended areas.

3.7 Fluvial (River) Flooding

PPS25 describes fluvial flooding as follows:

Rivers flood when the amount of water in them exceeds the flow capacity of the river channel. Most rivers have a natural floodplain into which the water spills in times of flood. Flooding can either develop gradually or rapidly according to how steeply the ground rises in the catchment and how fast water runs off into surface watercourses. In a large, relatively flat catchment, flood levels will rise slowly and natural floodplains may remain flooded for several days, acting as the natural regulator of the flow. This is a function that the planning system should promote and enhance. In small, steep catchments, local intense rainfall can result in the rapid onset of deep and fast-flowing flooding with little warning. Such “flash” flooding, which may only last a few hours, can cause considerable damage and possible threat to life. Land use, topography and the form of local development can have a strong influence on the velocity and volume of water and its direction of flow at particular points. Flooding can occur when culverts and bridges are blocked by debris (PPS25: Development and Flood Risk, Paragraph C6).

3.7.1 Requirements

For the purpose of the Level 1 SFRA to assist in the completion of the Sequential Test, definitions of the extent of Flood Zones 2, 3a and 3b are required. **Map 5** defines the geographical extent of Flood Zones 2, 3a and 3b for East Herts District. The definitions of flood zones are provided in Table 1 below:

Table 1: Fluvial Flood Zone Definitions (PPS25, Table D1)

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 the 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	High probability
Flood Zone 3b	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 (0.15) flood or otherwise defined by the Local Planning Authority. This zone comprises land where water has to flow or be stored in times of flood.	Functional floodplain

3.7.2 Historic River Flooding

Three sources of data have been mapped regarding historic river flooding:

- Records from the East Herts Flood Incident Database (identified as “Main River” flooding events on **Map 9**);
- Records obtained from the Environment Agency’s Flood Defence Inspector for East Herts (identified as “Areas at Risk of Flooding” on **Map 9**);
- Historic Flood extents provided by the Environment Agency. These are shown in **Table 2** below and are illustrated on **Map 9**.

Table 2: Historic Flood Extents (Environment Agency data)

RIVER	YEAR
Rib	1993,2001
Ash	1993,1998,1999,2000,2001
Stort	1993, Oct 2000, Nov 2000, Feb 2001, Oct 2001, 2002,2003
Lee	1993,2000, 2002
Beane	1978,1979, 1993,2000, 2003
Mimram	1993,1997

It should be noted that the flood zone maps ignore the presence of defences, such as embankments and walls which are however identified on **Map 7**. The flood zone maps do not provide information on flood depth, speed or volume of flow. However, in Flood Zone 3b, the Functional Floodplain does take into account the presence of flood defences.

All three data sources indicate that river flooding is of concern in the river corridors through all the major settlements in the District, including Bishop’s Stortford, Hertford, Ware, Buntingford, Sawbridgeworth and Stanstead Abbots. In addition, parts of Watton-at-Stone, Little Hadham, and Standon have been indicated as areas at high risk of river flooding.

3.7.3 Floodplain modelling and mapping

The Environment Agency Flood Zone map is available on the Environment Agency website at www.environment-agency.gov.uk. The underlying data and mapping is continuously being improved as new studies are undertaken, detailed hydraulic models are constructed and more flooding data and information becomes available.

The Environment Agency sends updated GIS shapefiles included the latest flood outlines to Local Authorities in order to enable them to apply PPS25 (including the sequential and exceptions tests) to planning applications.

Hydraulic modelling outputs are used as the data source for flood zone and climate change mapping described below.

Zone 3b – Functional Floodplain

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

- Land subject to flooding in the 20 year event;
- Land which provides a function of flood conveyance of flood storage, through natural processes or by 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. (See PPS25 Companion Guide 'Living Draft' February 2007, page 69).

The approach used to map Zone 3b for each watercourse is summarised in **Table 5**.

Table 3: Flood Zone 3b Data Source

Watercourse	Zone 3b Data source
Lee	1 in 20 year defended outline from the River Lee Mapping & Hydrology Study (Halcrow, 2007).
Ash	1 in 20 year defended outline from the River Ash Strategy modelling (Atkins, 2006).
Quin	1993 and 2001 Historic Flood event.
Rib	Downstream of Wadesmill gauging station: 1 in 20 year defended outline from the River Lee Mapping & Hydrology Study (Halcrow, 2007). Upstream of Wadesmill gauging station: 1993 and

Watercourse	Zone 3b Data source
	2001 Historic Flood event used, Rib modelling to be added when available.
Mimram	1 in 20 year defended outline from the River Lee Mapping & Hydrology Study (Halcrow, 2007) used up to Panshanger Airfield.
Beane	1 in 20 year defended outline from the River Beane Mapping Study (Halcrow, 2008) and 1993 and 2001 Historic Flood event.
Stort	<p>Downstream of Harlow: 1993 and 2001 Historic Flood Events and 1 in 20 year defended outline from the Lower Stort Section 105 modelling (Peter Brett Associates, 2000).</p> <p>Between Harlow and Bishop's Stortford (A120): 1993 and 2001 Historic Flood Events and 1 in 20 year defended outline from the Middle Stort Mapping Study (Faber Maunsell, 2007).</p>
Other unmodelled tributaries	1993 and 2001 Historic Flood event has been used for the whole district - the two worst flood events in the last 20 years.

For the River Stort the Environment Agency recommended that the functional floodplain should be mapped as the 2001 flood event. This was for two reasons: firstly, because this had been observed on the ground, and secondly because it was possible to assign greater confidence to this mapped flood event than the detailed mapping. Following this advice East Herts Council decided to merge the 1 in 20 year flood outline with the 2001 event. Similarly, it was also decided to incorporate the 1993 event into the revised and extended flood outline, which extended the floodplain outline, notably along the River Beane in Hertford.

In central Bishop's Stortford the Environment Agency advised that a local Flood Risk Assessment of the Bishop's Stortford Goods Yard conducted in 2005 indicated that the local flooding of the southern part of the Goods Yard during the 2001 flood event site was due to lack of maintenance of the drains on the (disused and vacant) site. The Environment Agency confirmed that the Goods Yard site could be omitted from the functional floodplain and the original Flood Zone 3b could be retained along the site boundary.

Zone 3a – High Probability

The High Probability Zone 3a is defined as those areas within the study area which are situated within the undefended 1 in 100 year (or 1% AEP) flood extent (see Table 1 in **Section 3.7.1**). A number of approaches have been used to define the extent of Zone 3a, including the use of detailed hydraulic modelling studies and Environment Agency’s Flood Map based on a relatively coarse national computer model. The approach used to map Zone 3a is summarised in **Table 4**:

Table 4: Zone 3a Data Source

Watercourse	Zone 3a Data source
Lee	1 in 100 year undefended outline from the River Lee Mapping & Hydrology Study (Halcrow, 2007).
Ash	1 in 100 year undefended outline from the River Ash Strategy modelling (Atkins, 2006).
Quin	Improved 100 year JFLOW using LiDAR data (2006).
Rib	Downstream of Wadesmill gauging station: 1 in 100 year undefended outline from the River Lee Mapping & Hydrology Study (Halcrow, 2007). Upstream of Wadesmill gauging station: Improved 100 year JFLOW using LiDAR data (2006).
Mimram	Downstream of Panshanger Gauging Station: 1 in 100 year undefended outline from the River Lee Mapping and Hydrology Study (Halcrow, 2007). Upstream of Panshanger Gauging Station: Original JFLOW (2004)
Beane	1 in 100 year undefended outline from the River Beane Mapping Study (Halcrow, 2008).
Stort	Downstream of Harlow: 1 in 100 year undefended outline from the Harlow North SFRA modelling (Faber Maunsell, 2006). Between Harlow and Bishop’s Stortford (A120): 1 in 100 year undefended outline from the Middle Stort Mapping Study (Faber Maunsell, 2007).
Other tributaries	Combination of Original JFLOW (2004) and Improved JFLOW using LiDAR.

Zone 2 – Medium Probability

The medium probability Zone 2 is defined as those areas which are situated between the undefended 1 in 1000 year (or 0.1% AEP) and 1 in 100 year (1% AEP) flood extents. A number of approaches have

been used to define the extent of Zone 2, including the use of detailed hydraulic modelling studies and Environment Agency's Flood Map based on a relatively coarse national computer model.

Table 5: Zone 2 Data Source

Watercourse	Zone 2 Data source
Lee	1 in 1000 year undefended outline from the River Lee Mapping & Hydrology Study (Halcrow, 2007).
Ash	1 in 100 year undefended outline from the River Ash Strategy modelling (Atkins, 2006) <u>plus</u> 1 in 1000 year Original JFLOW (2004) where larger.
Quin	Improved 1000 year JFLOW using LiDAR data (2006).
Rib	Downstream of Wadesmill gauging station: 1 in 1000 year undefended outline from the River Lee Mapping & Hydrology Study (Halcrow, 2007). Upstream of Wadesmill gauging station: Improved 100 year JFLOW using LiDAR data (2006) (will be superseded by Rib mapping when available).
Mimram	Downstream of Panshanger Gauging Station: 1 in 1000 year undefended outline from the River Lee Mapping and Hydrology Study (Halcrow, 2007). Upstream of Panshanger Gauging Station: Original JFLOW (2004).
Beane	1 in 1000 year undefended outline from the River Beane Mapping Study (Halcrow, 2008).
Stort	Downstream of Harlow: 1 in 1000 year undefended outline from the Harlow North SFRA modelling (Faber Maunsell, 2006). Between Harlow and Bishop's Stortford (A120): 1 in 1000 year undefended outline from the Middle Stort Mapping Study (Faber Maunsell, 2007).
Other tributaries	Combination of Original JFLOW (2004) and Improved JFLOW using LiDAR.

Zone 1 – Low Probability

The Low Probability Zone 1 is defined as those areas which are situated outside of the undefended 1 in 1000 year flood extent. For the purpose of the SFRA maps, this includes all land that is outside of Zone 2 and Zone 3 flood risk areas. It is important to note that for sites 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 (see **Section 4.1**).

Climate Change

Current guidance on incorporating climate change effects into flood risk assessments is as follows:

Table 6: Climate Change Guidance (source: PPS25)

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	+5%	+10%	+20%	+30%
Peak river flow	+10%	+20%		
Offshore wind speed	+5%		+10%	
Extreme wave height	+5%		+10%	

The following approaches have been used to map the impacts of climate change on Flood zone 3a (Functional Floodplain) and Flood Zone 3b (High probability). Given the inherent uncertainty over the extent of the climate change for Flood Zone 2, no additional mapping has been undertaken.

Table 7: Climate Change mapping

Watercourses	Climate Change Assumptions (Flood Zone 3a)
Lee	1 in 100 year + 20% defended outline from the River Lee Mapping & Hydrology Study (Halcrow, 2007).
Ash	1 in 100 year + 20% defended outline from the River Ash Strategy Modelling (Atkins, 2006).
Rib	Downstream of Wadesmill: 1 in 100 year + 20% defended outline from the River Lee Mapping & Hydrology Study (Halcrow, 2007). Upstream of Wadesmill gauging station: Improved 100 year JFLOW using LiDAR data (2006) used as surrogate (will be superseded by Rib mapping when available).
Beane	1 in 100 year + 20% defended outline from the Beane Mapping Study (Halcrow, 2008).
Stort	Downstream of Harlow: 1 in 100 year + 20% defended outline from the Harlow North SFRA modelling (Faber Maunsell, 2006). Between Harlow and Bishop's Stortford (A120): 1 in 100 year + 20% defended outline from the Middle Stort Mapping Study (Faber Maunsell, 2007).

Note: For all other watercourses and tributaries where modelled climate change outlines are not available, the climate change scenario (Flood Zone 3a) is taken to be the same as Flood Zone 2, current scenario.

3.8 Sewer Flooding

PPS25 describes Sewer Flooding as follows:

In urban areas, rainwater is frequently 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. When this happens to combined sewers, there is a high risk of land and property flooding with water contaminated with raw sewage as well as pollution of rivers due to discharge from combined sewer overflows. (PPS25: Development and Flood Risk, paragraph C8).

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 district is covered by adopted foul/waste water drains operating independently of surface water systems. Thames Water is the sewerage / water company for East Herts. It is rare for foul/waste sewer surcharging events to occur and these are usually very quickly attended to by Thames Water.

Management of the adopted storm/foul water sewer network within the study area is the responsibility of Thames Water. As there are no internal drainage boards situated within the study area, East Herts Council acts as Land Drainage Authority in conjunction with the Environment Agency. Individuals and organisations may be responsible for private drainage systems on private land that discharge either into a watercourse or public sewer. In cases where the ownership or responsibility for drainage is unclear, lack of maintenance can lead to localised flooding issues. The Land Drainage Team will monitor all incidents which are reported to them.

The data collected from Thames Water is reproduced in **Appendix A**. The data spans a period of 10 years (1997 to 2007) and therefore future updates to the SFRA should ensure that the most recent data is used. Furthermore, Thames Water only provide sewer flooding record at a relatively coarse resolution (first part of the post code e.g. SG13) which limits the use of the data for the purpose of spatial planning.

Map 9 identifies the locations of historic sewer flooding incidents. This is based on East Herts Council’s Flood Incident Database (see “Cautionary Note” in **Section 3.2** above).

3.9 Surface Water Flooding

PPS25 describes surface water flooding as follows:

Intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems can run quickly off land and result in local flooding. In developed areas, this flood water can be polluted with domestic sewage where foul sewers surcharge and overflow. Local topography and built form can have a strong influence on the direction and depth of flow. The design of development down to a micro-level can influence or exacerbate this. Overland flow paths should be taken into account in spatial planning for urban developments. Flooding can be exacerbated if development increases the percentage of impervious area (PPS25: Development and Flood Risk, Paragraph C6).

In rural areas, surface water drains tend to be informal and isolated systems and can be as basic as a gully or roadside grip draining to a open channel parallel to the road. Sometimes a soakaway will be utilised where there are no roadside ditches. Such informal systems are usually unmapped and of unknown origin as they were probably an adaptation of a drain that existed before the roads were adopted. It is rare to have an extensive SW drain network outside the urban areas. As such surface water flooding in these areas varies in scale and extent but does not generally affect large population centres or transport networks.

In urban areas the surface water system is a collection of gullies, gully leads and adopted surface water sewers (owned by Thames Water Utilities) and other drains owned by Herts Highways. The Thames Water system is generally well mapped and monitored. However, Highways drains are less well mapped and maintenance therefore tends to be reactive. The nature of the extensive usage both by highways and by adjacent properties and land owners means that it frequently becomes subject to surcharging and can affect the highway and neighbouring land.

Occasional incidents of flooding have occurred that are directly attributable to lack of maintenance of the surface system. Generally the District Council maintain the channel and sweep the top surface of the gully pot, the Highway Authority maintain the gully and gully lead, and the water authority maintains the surface sewer. Herts Highways as an agent of the County Council has responsibility for maintenance of the existing highway drainage network and the improvement and upgrading of the system as a result of new developments. It has been identified that highway drainage problems relate to;

- Maintenance of gullies;
- Reliance on outlets into watercourses for surface water drainage;
- Urban extensions that also relay on drainage into watercourses;
- Reliance on soakaways where there is a lack of available positive drainage outfalls.

Map 9 shows the location of recorded surface water flooding incidents within the District, based on the Council's Flood Incident Database (see "Cautionary Note" in **Section 3.2** above). The map shows that recorded surface water flooding incidents are distributed widely throughout the District. Most of these appear to be isolated incidents, although multiple incidents have been recorded in central Buntingford and the Hockerill area of Bishop's Stortford.

The Environment Agency holds no records of historical surface water flooding, however a monitoring system has recently been set up, which will provide a useful resource for future updates to the SFRA.

3.10 Groundwater Flooding

PPS25 describes groundwater flooding as follows:

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). These may be extensive, regional aquifers, such as Chalk or sandstone, or may be localised sands or river gravels in valley bottoms underlain by less permeable rocks. Water levels below the ground rise during wet winter months, and fall again in the summer as water flows out into rivers. In very wet winters, rising water levels may lead to the flooding of normally dry land, as well as reactivating flow in 'bournes' – intermittent streams that only flow for part of the time, when groundwater levels are high. The Chalk shows some of the largest seasonal variations in groundwater level, and is the most extensive source of groundwater flooding. Groundwater flooding may take weeks or months to dissipate because groundwater flow is much slower than surface flow and water levels thus take much longer to fall (PPS25: Development and Flood Risk, Paragraph C7).

Map 9 shows the location of reported groundwater flooding incidents. Groundwater flooding and highways flooding data was gathered from the East Herts Flood Incident Database (see "Cautionary Note" in **Section 3.2** above). It should be noted that the "highways flooding" incidents shown on Map 9 should be differentiated from the "roads at risk of becoming impassable" on **Map 8: Emergency Planning** (see **Section 3.12: Emergency Planning**).

Isolated ground water flood events have occurred but these are rare and tend to affect small areas or individuals gardens. It has been noted that many previously dormant springs become active as a result of nearby construction or groundwork operations.

The Environment Agency records groundwater flooding incidents (since 2000). The extent of this information is limited for this SFRA. However, the Environment Agency database will provide a useful source of flood history data for updates to the SFRA.

3.11 Artificial Sources

PPS25 describes this source of flooding as follows:

Non-natural or artificial sources of flooding can include reservoirs, canals and lakes where water is retained above natural ground level, operational and redundant industrial processes including mining, quarrying and sand and gravel extraction, as they may increase floodwater depths and velocities in adjacent areas. The potential effects of flood risk management infrastructure and other structures also need to be considered. Reservoir or canal flooding may occur as a result of the facility being overwhelmed and/or as a result of dam or bank failure. The latter can happen suddenly resulting in rapidly flowing, deep water that can cause significant threat to life and major property damage. Industrial flooding can also occur when pumping ceases and groundwater returns to its natural level, for example in former mineral workings and urban areas where industrial water abstraction is reduced from its former rate. Some of this flooding may be contaminated (PPS25: Development and Flood Risk, Paragraph C9).

Section 3.6 above details the various types of Flood Defence Infrastructure within the District, including Ordinary Watercourses and Areas Benefiting from Defences (ABDs). This data is sourced from the National Flood and Coastal Defence Database (NFCDD).

Map 7 shows the location of the many Storm Grilles/trash screens which are maintained by East Herts District Council. Failure to maintain and clear the storm grilles on a regular basis could cause localised flooding incidents. The map also shows Areas Benefiting from Defences (ABDs – see **Section 3.6** above), which are primarily located in Great Amwell and Stanstead Abbots. Finally, **Map 7** also shows the location of Environment Agency flood defences, which are located along the Lee and Stort Navigations, but also elsewhere in Hertford, Ware, Buntingford, Standon, Furneux Pelham, and Little Hadham.

Map 2 depicts all permanent watercourses within the District. The areas shaded blue are taken from the Ordnance Survey Mastermap. It can be seen that within East Herts District there are a number of bodies of standing water, particularly upstream of Hertford along the Mimram, downstream of Ware along the Lee (the area of Amwell Quarries and Rye Meads) and the Westmill fishing lakes on the River Rib north of Hertford. It should also be noted that the New River, which begins at Kings Meads (between Hertford and Ware) runs alongside the A1170 through Ware and could in theory pose a flood risk in the event of structural failure. Map 7 also shows the location of the 17 watercourses reclassified as Main Rivers in 2006 and maintained by East Herts Council, as described in **Section 3.6** above.

3.12 Residual Risk

Paragraph G1 of PPS25 describes residual risk as follows:

The risks remaining after applying the sequential approach and taking mitigating actions are known as the residual risks. 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 essential that the risk of flooding is minimised over the lifetime of the development in all instances. It is important to recognise however that flood risk can never be fully mitigated, and there will always be a residual risk of flooding.

This residual risk is associated with a number of potential risk factors including (but not limited to):

- a flooding event that exceeds that for which the flood risk management measures (for example, upstream storage) have been designed;
- general uncertainties inherent in the prediction of flooding;
- local risks, such as local infrastructure (reservoirs, ponds etc).

Some residual risks would be related to unplanned failures resulting from debris blocking a defence structure asset and are therefore managed as part of an existing maintenance regime.

Other risks such as overtopping of a defence asset would require further consideration. These Areas Benefiting from Defences (ABDs) as shown on **Map 7: Flood Defences** are considered more vulnerable and would benefit from additional protection. Developers should liaise closely with Environment Agency and East Herts Council planners / Land Drainage Team if they are proposing construction works in these areas.

Where developments are at a risk of flooding either resilience or resistance adaptations may need to be constructed (PPS25 Paragraphs G6-G10). A resilience defence would involve such improvements as tiled floors and higher level power points and sockets whereas resistance would concentrate more on external protection of a structure like gates and flood barriers on external openings.

3.13 Emergency Planning

Emergency planning data was gathered in respect of three principal aspects:

- The location of vulnerable institutions (including institutions requiring rapid evacuation in case of flood, such as schools, hospitals and residential/nursing homes; critical support infrastructure such as sewage treatment plants and power stations; and emergency services such as fire stations, police stations, hospitals, GP surgeries);
- Roads at risk of becoming impassable in a flood event;
- Environment Agency Flood Warning systems (including the location of telemetry stations and Environment Agency Flood Warning Areas. For more information see **Section 6** on Emergency Planning below).

This data was collected from the following sources:

- A list of schools was supplied by the County Council as Local Education Authority;
- *Project Unicorn*, a collaborative project involving the Flood Hazard Research Centre (Middlesex University), the Environment Agency and Hertfordshire County Council (for further information see Section 6 on Emergency Planning below);
- The list of residential/nursing homes was taken from www.carechoices.co.uk;
- The list of Sewage Treatment Plants was taken from the *Hertfordshire Minerals and Waste Development Framework: Waste Site Allocations Preferred Options* (January 2008);
- Roads at risk of becoming impassable were compiled by East Herts Council Land Drainage team and confirmed by reference to highways flooding data within the East Herts Flood Database (see **Section 3.1** above);
- The location of Environment Agency Flood Warning Areas and Telemetry Stations were provided by the Environment Agency.

3.14 Flood Risk Assessments

The Environment Agency provided a GIS shapefile of the location of Flood Risk Assessments (FRAs) undertaken in the District up to February 2008. There are 71 in total. **Map10** shows that they are concentrated primarily in flood zone three within the urban areas of Bishop's Stortford, Hertford and Ware.

3.15 Development in Neighbouring Authorities

As part of the SFRA it was essential to consult with neighbouring authorities where rivers cross council boundaries in order to identify any development/ growth areas which may impact on flood risk within East Herts.

Table 8: Development in neighbouring Authorities

Local Planning Authority	SFRA Status	Issues/growth areas
Broxbourne	Level 1 complete (December 2007)	Identifies cross-boundary Flood Storage Areas partly in East Herts (Broxbourne SFRA Section 6.2)
Stevenage	On-going	Potential increased run-off and flash flooding due to major development planned north and west of Stevenage.
Welwyn Hatfield	Level 1 almost complete	Development may increase runoff to Mimram and Lee
Uttlesford	Level 1 complete (March 2008)	Proposed development at Stansted Mountfichet and at Elsenham lie within the Stort catchment.
Harlow	On-going	Harlow regeneration and growth will entail significant development and run-off to the River Stort with possible consequences for the Stort and lower downstream in the Lee.
Epping Forest	On-going	

4 RECOMMENDATIONS AND GUIDANCE

4.1 Requirement for Flood Risk Assessment

In general planning applications for development proposals of 1 hectare or greater in Flood Zone 1 and all proposals for new development, other than minor development, located in Flood Zones 2 and 3 should be accompanied by a site-specific Flood Risk Assessment (FRA). The Environment Agency must also be consulted for any development proposal that is within 20 metres of a main river. The Environment Agency Flood Risk Matrix, available at the internet address provided below, clearly describes the circumstances for which the Environment Agency should be consulted:

<http://www.pipernetworking.com/floodrisk/matrix.html>

Where the proposed development site is identified as being subject to flood risk, the FRA should identify and assess the risk of all forms of flooding to and from the development and demonstrate how these risks will be managed. The minimum requirements for flood risk assessment are described in Annex E of PPS25. Further guidance is provided by the Practice Guide companion to PPS25. The FRA must be appropriate to the scale, nature and location of the development, and consider all possible sources of flood risk, the effects of flood risk management infrastructure and the vulnerability of those that could occupy and use the proposed development.

One of the requirements of both the Exception Test and Annex E of PPS25 is that a FRA demonstrates that the development will be safe, without increasing flood risk elsewhere. **Section 4.2** below defines the meaning of 'safe' and this should be referred to when undertaking the Exceptions Test.

Depending on the size and location of the development the requirements for surface water drainage systems will need to be discussed with the Environment Agency and/or East Herts Council's Land Drainage Team. Consideration should be given to whether a "Greenfield runoff approach" to the assessment of source control is appropriate. This method is generally satisfactory in the cases where the development is relatively small, isolated from other planned sites and the runoff processes are fully understood.

The FRA should then conclude with an assessment of the scale of the impact, and the recommended approach to controlling surface water discharge from a proposed development.

The recommendations in this Section (**Section 4**) should be adhered to by developers when undertaking site-specific Flood Risk Assessments (FRA) or planning developments close to watercourses as this provides the minimum requirements for site specific FRAs

4.2 Defining “safe” development

PPS25 (Paragraph 5) requires that where development is permitted in flood risk areas that it is safe, for the lifetime of the development (Paragraph 2), taking into account climate change. Demonstration that developments in such areas are safe will be required in order to comply with part C of the Exceptions Test. Paragraph 8 requires that where important to the overall safety of a proposed development, safe access and escape is available to and from new development in flood risk areas.

PPS25 does not define the meaning of the word ‘safe’. This SFRA defines ‘safe’ as follows:

- Dry access for ‘more’ and ‘highly vulnerable’² uses, unless otherwise defined in an SFRA in agreement with the Environment Agency;
- Dry escape for residential dwellings should be up to the 1 in 100 year event taking into account climate change;
- ‘Safe’ should preferably be dry for other uses such as educational establishments, hotels and ‘less vulnerable’ land use classifications.

If dry escape cannot be provided, developers should demonstrate that depths and velocities of flood water will be acceptable to everyone (including all ages and physical ability).³

Where access and egress is a potential issue this should be discussed with the Council and the Environment Agency at the earliest stage (pre-application), as this can affect the overall design of the development. It can be difficult to ‘design-in’ satisfactory escape routes retrospectively. Access considerations should include the voluntary and free movement of people during a flood, as well as the potential for evacuation and rescue by the emergency services during more severe conditions. For further information see Section 4.47 – 4.61 of the PPS25 Practice Guide.

² Table D2 within PPS25 (pages 25-26) provides definitions of the various levels of flood risk vulnerability classification

³ ‘The Flood Risk to People’ FD 2320 calculator at www.hydres.co.uk provides a framework for assessment. At present the Environment Agency will advise whether FRAs have utilised the flood risk to people calculator and correctly interpreted it for the site in question.

4.3 Reducing Flood Risk through Spatial Planning

The risk-based Sequential Test should be applied at all stages of planning. Its aim is to steer new development to areas at the lowest probability of flooding (Zone 1). The Sequential Test is described in Annex D of PPS25, it defines what types of development are appropriate in each of the four Environment Agency Flood Zones and under what circumstances the Exception Test should be applied. The acceptability of any development proposed in a recognised flood zone depends on its flood risk vulnerability or flood zone compatibility (See Table D.3 of PPS25).

Local planning authorities shall prioritise the allocation of land for development in ascending order from Flood Zone 1 to 3. Only where there are no reasonably available sites in Flood Zones 1 or 2 should decision makers consider the suitability of Flood Zone 3, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required. The following recommendations explain how flood risk can be reduced through the spatial planning process at both the strategic planning policy level and at the site level.

Spatial Planning Policy recommendation	Strategic Level	Site Level	Both
SP1: Ensure that new development achieves the goals of the Thames Catchment Flood Management Plan			✓
SP2: Ensure that all new development achieves a positive reduction in flood risk both onsite and downstream.			✓
SP3: Define the functional floodplain and protect Greenfield functional floodplain from future development in order to maintain its capacity.			✓
SP4: Seek opportunities to reinstate areas of functional floodplain which have been previously developed (e.g. sequential approach to site layout, reduction in building footprint, replacement of solid building with building on stilts, reduction in vulnerability classification).			✓
SP5: Safeguard sites which have been identified for flood storage/flood alleviation from future development.			✓
SP6: Identify long-term opportunities for land-swapping.	✓		
SP7: Reduce flood risk from and to new development through rigorous applications of the Sequential Test. Ensure that the vulnerability classification of the development is appropriate for the flood zone, and that flood			✓

Spatial Planning Policy recommendation	Strategic Level	Site Level	Both
risk is reduce through the site layout and design.			
SP8: Reduce flood risk through site layout and design, applying the sequential approach at the site level (e.g. use of low-lying ground in waterside areas for recreation, amenity and environmental purposes can provide an effective means of flood risk management).			✓
SP9: Appropriate Flood Risk Assessments should be undertaken for all developments in Flood Zones 2 and 3, and developments greater than 1ha in Flood Zone 1. In order to assess the risk of flooding to the development and apply appropriate flood mitigation.		✓	
SP10: Appropriate Flood Risk Assessments should also be undertaken for all 'other sources' of flooding.		✓	
SP11: The vulnerability of the development to flooding over the lifetime of the development must be considered including the potential impacts of climate change.			✓
SP12: Discourage the use of habitable basements in flood affected areas.			✓
SP13: Where necessary assess impacts of culvert blockage.		✓	
SP14: Identify sites where developer contributions could be used to help fund future flood risk management schemes ⁴ .			✓

⁴ Developer defences cannot however be used to justify development in unsustainable locations.

4.4 Reducing Flood Risk through Mitigation

When undertaking a Flood Risk Assessment there exist a range of mitigation techniques available to reduce flood risk both to the development and downstream. The following recommendations explain how flood risk can be reduced through the spatial planning process at both the strategic planning policy level and at the site level.

Mitigation Policy Recommendation	Strategic Level	Site Level	Both
M1: Promote flood resilience/resistance measures at the individual property level ⁵ . Flood resilience and flood resistance measures for home improvement grants should be introduced where identified by EHDC environmental health and engineers to upgrade existing dwellings (Pitt Review recommendation 12).			✓
M2: Ensure all new development is designed to be 'safe', in that residential developments should be afforded dry access to and from the development without crossing through flood water			✓
M3: Ensure that finished floor levels on new developments are raised 300mm above the 1 in 100 year plus climate change flood level.			✓
M4: Areas Benefiting from Defences (ABDs – map 7) are at particular risk due to breach or overtopping, resulting in the rapid on-set of fast-flowing, deep water flooding with little or no warning. Ensure development behind defences reduces residual risk through appropriate mitigation and evacuation plans.		✓	
M5: Ensure that lost floodplain is compensated for through on-site level for level and volume for volume floodplain compensation.			✓
M6: Ensure the preservation of flood flow routes.			✓
M7: Assess/mitigate the impacts of groundwater flooding.		✓	

⁵ It should be noted that flood resilience/resistance measures cannot be used to justify development in unsustainable locations.

4.5 Reducing Flood Risk through Sustainable Drainage

Sustainable Drainage Systems (SUDS) is a term used to describe a suite of drainage techniques which can be used to improve the drainage system and reduce flood risk. The purpose of SUDS is to recreate the drainage characteristics of the catchment in its natural state. In addition to controlling flood risk, integrated management of surface water has potential benefits, including improved water quality and a reduction of water demand through grey water recycling.

Surface water drainage assessments are required where proposed development may be susceptible to flooding from surface water drainage systems. The potential impact upon areas downstream of the development, including the impact on a receiving watercourse, also needs careful consideration.

Maps 3 and 4 provide an indication of the geology throughout the District and this information can be used by developers in initial scoping work on the suitability of types of Sustainable Urban Drainage Systems at particular sites (see **Section 1.6** above).

The SUDS Manual (2007) provides comprehensive advice on the implementation of SUDS in the UK. See www.ciria.org/suds. Further information regarding SUDS is available in the PPS25 Practice Guide (Chapter 5: *Managing Surface Water*) and the Environment Agency Thames Region Publication *SUDS – A Practical Guide* (2006).

The following recommendations explain how flood risk can be reduced through the spatial planning process at both the strategic planning policy level and at the site level.

Sustainable Drainage Policy Recommendations	Strategic Level	Site Level	Both
SUD1: SUDS systems must be included in all new development where technically possible, in preference to positive connections to mains drainage (which can cause flooding issues). These must be appropriate to the local soil and geology are utilized, adopted and maintained.			✓
SUD2: The Environment Agency's SUDS hierarchy shall be used to ensure that the most sustainable SUDS solutions are utilized (see Appendix D).			✓
SUD3: A Surface Water Flood Risk Assessment must be undertaken for all developments greater than 1 ha in size.			✓
SUD4: Reduce surface water runoff from new development so that Greenfield discharge rates and 1 in 100 year attenuation taking into account climate change shall be achieved on all developments greater than 1 ha in size.			✓
SUD5: Opportunities should be sought to retrofit Sustainable Urban Drainage Systems (SUDS) in known problem areas to help reduce surface water flood risk. Seek developer contributions to fund this retrofitted SUDS scheme.	✓		
SUD6: In those areas identified as having a surface water flood risk problem seek opportunities to undertake a Surface Water Management Plan.	✓		
SUD7: Introduce a consistent approach towards paving over front gardens in existing and new developments.			✓

Note on porous paving

The Town and Country Planning (General permitted Development) (Amendment) (No.2) (England) Order 2008 Class F conditions states that when laying a hard surface within the curtilage of a dwellinghouse, "either the hard surface shall be made of porous materials, or provision shall be made to direct run-off water from the hard surface to a permeable or porous area or surface within the curtilage of the dwellinghouse".

4.6 Reducing Flood Risk through Improving the River Environment

The government's flood risk strategy *Making Space for Water* highlights the importance of making room for water alongside watercourses, as a measure of reducing flood risk, but also as a means of providing habitat benefit and an improved public amenity resource. The following recommendations explain how flood risk can be reduced through the spatial planning process at both the strategic planning policy level and at the site level.

River Environment Recommendations	Strategic Level	Site Level	Both
RE1: When designing flood storage areas ensure that these are designed to be used for multiple purposes such as nature conservation and recreation.			✓
RE2: At the site level adopt a sequential approach to site design, to ensure that highest risk areas are used for green space or car parking.		✓	
RE3: Identify sites where developer contributions could be used to help enhance the water environment and reduce flood risk.			✓
RE4: Seek opportunities to make space for water to accommodate climate change.			✓
RE5: At the District level undertake a river restoration action plan to help target priority sites for deculvert and river restoration/wetland restoration.	✓		
RE6: At the site level ensure that whenever feasible rivers are restored and deculverted.			
RE7: Maintain an 8 metre wide undeveloped buffer strip alongside all rivers to enable future maintenance work and to make space for wildlife.			✓
RE8: New developments next to rivers should assess the condition of existing assets (e.g. bridges, culverts, river walls) and undertake refurbishments/renewals to ensure the lifetime is commensurate with lifetime of the development.		✓	

4.7 Reducing Flood Risk through Improving Emergency Planning

PPS25 and the 2007 summer floods have highlighted the importance of considering flood risk when developing emergency plans. This SFRA has found that flood risk has some important implications on emergency planning within this area, as such the following recommendations explains the need to consider this issue in greater depth at the strategic and site level.

Emergency Planning Recommendations	Strategic Level	Site Level	Both
EP1: Improve flood awareness and emergency planning; update floodplains in the light of the SFRA findings to determine suitability of refuge centres and evacuation routes.	✓		
EP2: Ensure site specific emergency plans (including evacuation and flood warning plans) are approved by emergency planners and emergency services (PPS25 Practice Guide Section 7.21-7.31).		✓	
EP3: East Herts Council Head of Community Safety & Licensing in association with the Land Drainage Team should encourage businesses to take up property flood resistance and resilience measures (Pitt Review recommendation 13) (as part of the Civil Contingencies Act 2004)			✓

4.8 Reducing Flood Risk through the Council's Land Drainage function

East Herts Land Drainage Function Recommendations	Strategic Level	Site Level	Both
<p>LD1: The Land Drainage Team should consider formalising the existing reporting and liaison process between EHC, Herts Highways and Thames Water by setting up a form of Surface Water Management Plan (SWMP – See PPS25 Paragraph 6 and PPS 25 <i>Practice Guide</i> Section 5). As part of the SWMP, EHC engineers will continue to keep and maintain the mapping and data sources showing sewer drain watercourse and other drainage information.</p>	✓		
<p>LD2: EHC Land Drainage Team should consider mapping and data collection in respect of the entire drainage network and subsequently be in a position to achieve modelling of the data as and when required. (Pitt review recommendation 16: mapping data collection and data management). This could be used to inform the SWMP.</p>	✓		
<p>LD3: Look at future opportunities to pursue the Flood Risk Assessment Zone approach pioneered by Epping Forest District Council to reduce flood risk locally and achieve consistency across the region. See Appendix E for further explanation of the zonal approach employed by Epping Forest District Council</p>	✓		

Note on the right of developers to connect to mains drainage

In some cases, connection of new residential/commercial development to mains drainage may increase risk of surcharging events at culverts and sometimes open channels where volume capacity is exceeded. The Council always asks for calculations to be forwarded proving that sufficient capacity exists for any new development. This is a particular problem within Hertford, Ware, Sawbridgeworth and Bishops Stortford. Legislation may be introduced to remove the automatic right to connect. Where reasonable and practical, the Council will seek to encourage the use of SUDS systems in preference to mains drainage connections (see **Section 4.5**)

4.9 Location-specific Recommendations

Through analysis of national and local policy documents, and through assessment of the flood risk evidence assimilated as part of this SFRA, it was possible to establish some local policy recommendations for East Herts District to help address some specific issues that have been identified as part of this SFRA and through review of the Environment Agency's Catchment Flood Management Plan policy units. The following recommendations explain how flood risk can be reduced at both the strategic planning policy level and at the site level.

Location-specific Recommendations	Strategic Level	Site Level	Both
<p>LS1: In Hertford, Ware, Bishop's Stortford and Sawbridgeworth there are clusters of properties close to the river which are at risk of flooding. There is insufficient space to build defences to protect these properties. As such, redevelopment of these areas where appropriate offers the opportunity to reduce flood risk, make space for water and reduce the vulnerability classification of future redevelopment in these locations.</p>			✓
<p>LS2: In Bishop's Stortford, use the 2001 flood outline to represent the functional floodplain to provide a positive means of reducing flood risk throughout the town.</p>			✓
<p>LS3: Work with the Environment Agency to explore opportunities to store floodwater within flood meadows on the rivers Lee and Stort to reduce flood risk downstream. Safeguard identified flood storage areas from future development.</p>	✓		

5 EMERGENCY PLANNING

5.1 Flood Warning System

The current flood warning service in East Herts is operated by the Environment Agency. The Agency monitors rainfall and river levels 24 hours a day at a number of Flood Warning telemetry stations throughout the District and uses this information to forecast the probability of flooding. Flood warnings are issued using a set of four codes, each indicating the level of risk with respect to flooding. The warnings issued are Flood Watch, Flood Warning, Severe Flood Warning and All Clear. A Flood Warning is issued if property is expected to flood and a Severe Flood Warning if there is extreme danger to life. The 'All Clear' is issued to indicate receding flood waters.

The on-going National Flood Risk Area/Flood Warning Area Project being undertaken by the Environment Agency is working towards refining the flood warning areas, thus providing a more targeted flood warning service to local communities.

- **Flood Risk Areas** represent areas of similar land use, with the same return period, and floods from the same scenario;
- **Flood Warning Areas** consist of one or more flood risk areas that make up a distinct community (i.e. flood warnings related to Hertford, rather than issued to certain rivers)
- **Flood Watch Areas** are large areas containing several Flood warning areas. Messages to everyone within Flood Zone 2. Very general messages and do not relate to property flooding

On 28th August 2008 new Flood Warning and Flood Watch Areas were made live for the rivers Lee and Stort. The rivers Mimram, Beane, Rib and Ash will go live in August 2009. These improvements will provide more accurate and area specific information for use by the East Herts and Hertfordshire County Council's emergency planning teams, local communities and emergency services. The Flood Warning Areas and Flood Watch Areas are included in **Appendix G**. The Environment Agency Flood Warning Areas are shown on **Map 8: Emergency Planning**.

Within each area the Environment Agency promotes those within Flood Zone 2 to sign up to the Floodline Warnings Direct service (FWD – call 0845 988 1188⁶). The FWD service enables individuals, emergency services, local authority emergency planners and response teams to be effectively warned by delivering warnings simultaneously via telephone, mobile, pager, fax, email, SMS text messaging, and radio.

⁶ Or visit www.environment-agency.gov.uk/subjects/flood

In areas where there is a good network of telemetry stations the full FWD service (high level service) is available. However, some areas do not have a good coverage such as the furthest extents of rivers or small tributaries, and only have a low level of flood warning service, which consists of broadcast messages through the media. The Environment Agency advise that people who live in or near areas with a low level of flood warning service register to receive flood watch messages for the wider catchment. Although the warnings they receive will not represent exactly what is happening on these watercourses, they will provide an indication of what is happening in the local area.

5.2 Review of Critical Infrastructure

Map 8: Emergency Planning shows the location of critical infrastructure within the District, including Sewage Treatment Plants, hospitals, Fire stations, GP surgeries, and ambulance stations. Map 8 depicts vulnerable uses including schools and residential/nursing homes. Map 8 also shows roads at risk of becoming impassable in a flood event. Based on a review of Map 8, the following observations may be made:

- **Most of the A-roads in the district are vulnerable** to extreme flood incidents, including the A414 west to Hatfield and east to Harlow, the A120 at Little Hadham, and the A602 Stevenage road. In Bishop's Stortford, the A1059 and A1250 would be severely affected by a major flood. The disruption would also extend westwards into Bridge Street. This could affect the ability of emergency services to attend flood incidents, and affect the viability of evacuation routes;
- **Residential and nursing homes:** within East Herts District there are 2 residential and 2 nursing homes at risk of flooding in East Herts. These are located in Hertford, Ware, Buntingford and Stanstead Abbots;
- **Schools in East Herts:** there are three schools in the floodplain within the District, including one primary school and nursery. In terms of emergency planning, there is a potential major hazard if young children are involved in dangerous flood waters;
- **Sewerage Infrastructure risk:** sewage treatment infrastructure is typically located within the flood plain because of the requirement for gravity to convey effluent. The risks associated with flooding of sewage treatment works include contamination of the drinking water supply and water-borne disease. Within East Herts, Sewage Treatment Works identified as being at risk include Rye Meads to the south of the District. In addition, the Little Hallingbury Pumping Station to the south of Bishop's Stortford and the Sewage Treatment works on the Rib at Buntingford, and the River Ash at Furneux Pelham and north of Widford are identified as being at risk.

5.3 Emergency Planning Recommendations

It is recommended that the Council's Emergency Plan is reviewed and updated in light of the key findings from the SFRA.

The SFRA findings and the infrastructure and flood risk map will be of value to two main users:

a) Emergency Planning (District and County Level)

Emergency Planning at both the County and the District level can use the SFRA findings and map to inform the Council's Emergency Response Plan to ensure that safe evacuation and access for emergency services is available during times of flood both for existing developments and those being promoted as possible sites within the LDF process. The SFRA findings can also be used to inform the proposed County-wide emergency plan specifically for flooding which will be built on the 'lessons learnt from the Summer 2007 floods' published by Defra. In addition, the Emergency Planners should be aware of the location of the schools and nursing/rest homes within the District which may be at highest risk and may require priority evacuation in a flood event.

b) Development Control

Development Control at the District will use the SFRA findings and map to locate new development in 'safe locations'. This includes both allocated and non-allocated sites (windfall sites). For example if a new hospital or care home ('more vulnerable' use) is required, the map can be used to ensure that it is located in a low flood risk area and that there would be safe evacuation and access for emergency services during a flood.

Safety of New Development

It is also recommended that procedures should be established for the review of planning applications for proposals identified as being at high risk of flooding. Ideally this should entail review of plans by the Emergency Planning teams at the District and County Councils. Emergency Guidance on the preparation of Flood Warning and Evacuation Plans is provided in the PPS25 Practice Guide, paragraphs 7.23 – 7.31:

Flood Evacuation and Warning Plans Should include:

How flood warning is to be provided, such as:

- availability of existing flood warning systems;
- rate of onset of flooding and available flood warning time; and
- how flood warning is given.

What will be done to protect the development and contents, such as:

- how easily damaged items (including parked cars) will be relocated;
- the availability of staff/occupants/users to respond to a flood warning, including preparing for evacuation, deploying flood barriers across doors etc; and
- the time taken to respond to a flood warning.

Ensuring safe occupancy and access to and from the development, such as:

- occupant awareness of the likely frequency and duration of flood events;
- safe access to and from the development;
- ability to maintain key services during an event;
- vulnerability of occupants, and whether rescue by emergency services will be necessary and feasible; and
- expected time taken to re-establish normal use following a flood event (clean-up times, time to re-establish services etc.).

Source: PPS25 Practice Guide Figure 7.2

It is also recommended that Emergency Planners liaise with the Environment Agency in respect of the developing situation with regard to provision of advice on acceptable depths and velocities of flood water at new development, for example using the Flood Risk to people calculator at www.hydres.co.uk (see **Section 4.2** above). The roles and responsibilities of competent authorities are under review and this situation should be monitored and a response prepared.

East Herts Council Head of Community Safety and Licensing in association with the Land Drainage Team should encourage businesses to take up property flood resistance and resilience measures (Pitt Review recommendation 13) (as part of the Civil Contingencies Act 2004).

6 CONCLUSIONS

6.1 Site Allocation Process

It is recommended that the outputs from this study are used as an evidence base from which to direct new development to areas of low flood risk (Flood Zone 1). Where development cannot be located in Zone 1, the Council should use the flood maps to apply the Sequential Test to their remaining land use allocations.

Where the need to apply the Exception Test is identified, due to there being an insufficient number of suitable sites for development within zones of lower flood risk, the scope of the SFRA will need to be widened to a Level 2 assessment. The need for a Level 2 SFRA cannot be fully determined until the Council has applied the Sequential Test. It is recommended that as soon as the need for the Exception Test is established, Level 2 SFRA (s) are undertaken by a suitably qualified engineer so as to provide timely input to the overall LDF process.

It is recommended that when the SFRA is updated, the Local Development Frameworks (including site allocations) of neighbouring Councils are consulted (in terms of potential growth/development areas) to provide a more robust assessment of off-site impacts on flood risk in the District of East Herts.

6.2 Council Policy

It is recommended that the policy and guidance notes provided in the SFRA are used to inform the Council's flood risk management policies for both allocated and non-allocated (windfall) sites.

As a minimum, the Council's flood risk management policy documents should include the following (these core policies are in accordance with the Thames CFMP)

- Locate new development in the least risky areas, giving highest priority to Flood zone 1 and the use of the principles of the Sequential Approach to guide the form, layout and use of any development site to reduce flood risk
- Ensure that all new development is 'safe', meaning that dry pedestrian access to and from the development is possible without passing through the 1 in 100 year plus climate change floodplain, and emergency vehicular access, is possible;
- Prevent the development of Greenfield sites located within the functional floodplain and seek flood risk reduction on the redevelopment of existing Brownfield sites (for example for reducing existing building footprints or raising buildings on stilts)

- Promote the use of sustainable urban drainage systems in all flood zones to achieve Greenfield discharge rates on both Greenfield and Brownfield sites
- Promote multi-agency working (between Hertfordshire Highways, the Environment Agency, and East Herts District Council) to improve the management of flood risk from land/surface water drainage sources. Site-specific FRAs and planning applications for major developments should be passed to Hertfordshire Highways to identify opportunities for improving existing surface water assets through developer contributions.

6.3 Emergency Planning

It is recommended that the Council's Emergency Plan is reviewed and updated in light of findings of the SFRA to ensure that safe evacuation and access for emergency services is possible during times of flood both for existing development and those being promoted as possible sites within the LDF process. It is further recommended that the Council work with the Environment Agency to promote the awareness of flood risk and encourage communities at risk to sign-up to the Environment Agency Flood Warning Direct service.

6.4 Update and Review of the SFRA

The SFRA should be retained as a 'living' document and reviewed on a regular basis in light of better flood risk information and emerging policy guidance. It is recommended that outputs from the following studies are used to update future versions of the SFRA report and associated maps:

- The River Rib Mapping and Modelling Study (due in 2009)
- Neighbouring LPA SFRA's (including Stevenage, Welwyn Hatfield)
- The Rye Meads Water Cycle Strategy (due at the end of 2008) will provide further evidence base for particular sources of flooding such as surface water flooding (development of a surface water management plan)

Appendix A: Sewer Flooding

Postcode - first four digits only	Total number Properties flooded from overloaded sewer in last ten years	Total number properties flooded by surface water from overloaded sewers in last ten years	Total number properties flooded by foul water from overloaded sewers in the last ten years	Total number properties flooded by Combined overloaded sewers in the last ten years
SG1_6				
SG2_7				
SG3_6				
AL6_0				
SG14_2				
SG13_8				
SG9_9	2		2	
SG11_1				
SG14_3	2	2		
SG14_1	1		1	
SG12_7	40		40	
SG12_8	1			1
SG13_7				
EN10_7				
SG10_6				
SG9_0				
SG11_2				
SG12_9				
CM19_5	6			6
CM23_1				
CM23_2	1	1		
CM23_3	6	1	5	
CM23_5				
CM23_4				
CM21_0				
CM21_9				
TOTAL	59	4	48	7

Source: Thames Water (August 2007)

Appendix B: Landscape Character Assessment SPD

The key recommendations from the East Herts Landscape Character Assessment Supplementary Planning Document (September 2007) of relevance to the SFRA are as follows:

- a) encourage linkages between the different wetland habitats along the river valley to create a “necklace of interconnected wetland habitats, in line with the Hertfordshire *Biodiversity Action Plan* (BAP);
- b) Promote the use of reservoirs for water storage and nature conservation interest rather than groundwater abstraction. Ensure that reservoirs are designed to contribute to local landscape character;
- c) Resist development that could lower the water table within river valleys and affect wetland habitats;
- d) Protect the area from development that would alter its character visually or environmentally, such as culverting, impact on floodplain or water table, loss of water meadows or storage ponds (including wet grassland, valley or floodplain woodland and grazing marsh e.g. in Quin Valley or Upper Ash Valley);
- e) Encourage the Environment Agency to ensure that any new flood alleviation works are designed to complement the landscape and biodiversity of the area;
- f) Encourage a reversion to pastoral grazing within the floodplain where this is possible and practicable;
- g) Resist any development within or adjacent to the floodplain which could damage the ecological interest of the river;
- h) Restore open ditches and discourage enclosing existing open drainage systems;
- i) Enhance and create wetland landscape features such as reedbeds, ponds, scrapes and pollarded willows;
- j) Ensure that mineral extraction does not affect the water table within the parkland, with potential consequent impact on vegetation.

The riparian landscape areas together with recommendations from the list above are identified in the table below.

River	Area no.	Landscape Character Analysis SPD areas	Key Strategies
Lee	65	Middle Lee Valley West	a
	77	Kingsmead and Hartham Common floodplain	a, d
	79	Amwell floodplain	a, c,
	80	Rye Meads	e, f
Mimram	43	Mimram Valley Parklands	a
	44	Panshanger Parkland	j
Mimram/Lee	66	Cole Green and Hertingfordbury	b
Stort	82	River Stort	a, g
	151	Stort Meads	d, h, i
Beane	39	Middle Beane Valley	n/a
	68	Lower Beane Valley	a, c
Rib	75	Lower Rib Valley	a, f
	90	Middle Rib Valley	a,
	91	Upper Rib Valley	a, i,
	142	High Rib Valley	i
	145	Quin Valley	c, d, i
Ash	87	Middle Ash Valley	a, i
	93	Hadhams Valley	n/a
	147	Upper Ash Valley	c, d, f

Source: Landscape Character Assessment Supplementary Planning Document (September 2007)


Appendix C: East Herts Council Flood Incident Database records

Category	Ash	Beane	Lee	Mimram	Rib	Stort	TOTAL
FW		2	1			1	4
GW	1		2	1		3	7
H	3	2	6	2	4	15	32
H & SW		1					1
H & MR		1					1
H & OWC	1					1	2
HW			1				1
MR	15	14	7		10	7	53
Pond					3		3
OWC	13	11	20	3	26	20	93
OWC & FW						1	1
OWC & H						2	2
OWC & HW						1	1
OWC & Pond	1						1
PWC	1		9			16	26
PWC & FW			1				1
PWC & SW						1	1
SW	5	7	7	1	9	13	42
SW & FW		1	14	1		2	18
SW & H			1				1
SW & H & FW						1	1
TOTAL	40	39	69	8	52	84	292

Date range: 1993 to October 2007

FW = Foul water
 GW = Ground Water
 PWC = Principal Water Course
 OWC = Ordinary Water Course
 SW = Surface Water
 H = Highway
 MR = Main River

Appendix D: The SUDs Hierarchy

Most Sustainable	SUDS technique	Flood reduction	Pollution reduction	Landscape and wildlife benefit
	Living roofs	✓	✓	✓
	Basins and ponds <ul style="list-style-type: none"> • Constructed wetlands • Balancing ponds • Detention basins • Retention ponds 	✓	✓	✓
	Filter strips and swales	✓	✓	✓
	Infiltration devices <ul style="list-style-type: none"> • Soakaways • Infiltration trenches and basins 	✓	✓	✓
	Permeable surfaces and filter drains <ul style="list-style-type: none"> • Gravelled areas • Solid paving blocks • Porous paviers 	✓	✓	
	Tanked systems <ul style="list-style-type: none"> • Over-sized pipes/tanks • Storms cells 	✓		
	Least Sustainable			

Source: *SUDS A Practical Guide* (Environment Agency Thames Region 2006)

Appendix E: Epping Forest Flood Risk Zones

For reference, the approach taken by Epping Forest District Council is provided as an example of a best-practice approach to Flood Risk Assessment.

Flood Risk Assessment Zones are catchments of Ordinary Watercourses which have been identified by Epping Forest Council. These may contribute to Main River watercourses or where there is a known risk or history of flooding. Within these zones any development in excess of 50m² (other than house extensions) will require a Flood Risk Assessment. For sites outside FRA zones, any development in excess of 235m² will also require a flood risk assessment.

Should an FRA be required within an FRA Zone an appropriate Condition will be attached to any Planning Consent that may be granted. The full list of standard conditions is provided in the table below

Application type	Condition
Development between 50 – 100m ² , in a FRA Zone	“A flood risk assessment shall be submitted to and approved by the Local Planning Authority prior to commencement of the development. The assessment shall demonstrate compliance with the principles of Sustainable Drainage Systems (SuDS). The approved measures shall be carried out prior to first occupation of the building hereby approved and shall be adequately maintained. Reason: Since the development, though of a minor nature, is located in a PPG25 Flood Risk Assessment Zone.”
Development of between 100-235m ² in a FRA Zone.	“A flood risk assessment shall be submitted to and approved by the Local Planning Authority prior to commencement of the development. The assessment shall demonstrate that adjacent properties shall not be subject to increased flood risk and, dependant upon the capacity of the receiving drainage, shall include calculations of any increased storm run-off and the necessary on-site detention. The approved measures shall be carried prior to the first occupation of the building hereby approved and shall be adequately maintained. Reason: Since the site is located within a PPG25 Flood Risk Assessment Zone and since there is a need to achieve discharge rates without increasing risk to others.”

Application type	Condition
Development over 235m ² in a FRA Zone.	<p>“A flood risk assessment shall be submitted to and approved by the Local Planning Authority prior to commencement of development. The assessment shall include calculations of increased run-off and associated volume of storm detention using Windes or other similar programme. The approved measures shall be undertaken prior to the first occupation of the building hereby approved and shall be adequately maintained.</p> <p>Reason: Since the site is located within a PPG25 Flood Risk Assessment Zone and is of a size where it is necessary to avoid generating any additional flood risk downstream of the storm drainage outfall.”</p>
Development over 235m ² but not within a FRA Zone	<p>“A flood risk assessment shall be submitted to and approved by the Local Planning Authority prior to commencement of development. The assessment shall include calculations of increased run-off and associated volume of storm detention using Windes or other similar programme. The approved measures shall be undertaken prior to the first occupation of the building hereby approved and shall be adequately maintained.</p> <p>Reason: The development is of a size where it is necessary to avoid generating any additional flood risk downstream of the storm drainage outfall.”</p>

In addition, a note is applied to **all** planning permissions whatever the size of the development stating:

The Council encourages all developers to follow the principles of Sustainable Drainage Systems (SUDS) in designing facilities for rainwater run-off. Furthermore, if storm drainage is to discharge to an existing ditch or watercourse, Land Drainage Consent is required from the Council under its byelaws.

The following are optional notes added to any decision providing advice to applicants:

Epping Forest Land Drainage Note 1: The site is within an indicative flood plain and it is recommended that the design of the properties includes provision of flood resistant features such as raised thresholds and elevated air-bricks. The design of the electrical installation should also be appropriately modified.

Epping Forest Land Drainage Note 2: Under the Land Drainage Byelaws of this Council, Land Drainage Consent is also required before any work commences. Please contact the Land Drainage team for application forms. The grant of planning permission does not imply the automatic grant of Land Drainage

Appendix F: References and Relevant Studies

PPS25: *Development and Flood Risk* (December 2006)
PPS25 Practice Guide (June 2008)
Thames Region Catchment Flood Management Plan (CFMP): Summary Document, Consultation, Environment Agency, January 2007
Rye Meads Water Cycle Study (Hyder Consulting, 2008)
The Pitt Review: Lessons Learned from the 2007 Floods (June 2008)
DEFRA: *Making Space for Water* (Consultation 2008)

Flood Risk Management Strategies (FRMS)

Hertford FRMS (pre-feasibility study commenced May 2008)
River Ash FRMS: Summary & Conclusions Report (2006)
River Beane FRMS

Strategic Flood Risk Assessments of Neighbouring LPAs

Uttlesford District Council SFRA (March 2008)
Broxbourne District Council SFRA (December 2007)
Stevenage Borough Council SFRA (forthcoming)
Welwyn Hatfield District Council SFRA (forthcoming)
Harlow District Council SFRA (forthcoming)
Epping Forest District Council SFRA (forthcoming)

Mapping and Modelling Studies

Lee Hydrology and Mapping Study (Halcrow, 2007)
Ash Strategy Model (Atkins, 2006)
Stort Strategy Model (Atkins, 2004)
Beane remodelling (Atkins, April 2008)
Lower Stort flood study (Peter Brett Associates, 2000, amendments to hydrology by Atkins in 2005)
Middle Stort Flood Mapping (Faber Maunsell, 2007)
River Rib Survey (Capital Surveys 2008)
River Rib Mapping and Modelling (2009)

SUDS

CIRIA publication C697, *The SUDS Manual* (2007)
SUDS – A Practical Guide. Environment Agency Thames Region (October 2006)

Flood Resilience

Improving the Flood Performance of New Buildings: Flood Resilient Construction (May 2007) RIBA Publishing
http://www.planningportal.gov.uk/uploads/br/flood_performance.pdf

Emergency Planning

Local Flood Warning Plan for the County of Hertfordshire (June 2008)
Herts Multi-Agency Strategic Flood Plan, Hertfordshire Resilience (May 2008)
East Herts Emergency Plan (2007)

Appendix G: East Herts Flood Warning/Flood Watch Areas

Note: bold text denotes a Flood Watch Area; text not in bold denotes a Flood Warning area (see **Section 5.1** for an explanation)

Target Area code	Target Area Name	Target area description	Quick Dial Code
062WAF46MidLee	The River Lee at Hertford	The River Lee at Hertford including Lemsford, Hatfield, Ware and Stanstead Abbots	172806
062FWF46Lemsford	The River Lee from Lemsford to Hertford	The River Lee from Lemsford to Hertford including Welwyn Garden City, Hatfield and Mill Green	172805
062FWF46Hertford	The River Lee at Hertford and Ware	The River Lee at Hertford and Ware including Stanstead Abbots	172804
062WAFN01	River Ash (Herts) Catchment	River Ash and its tributaries from Meesden to Ware	011221421
062FWF501	River Ash and its tributaries from Meesden to Much Hadham	River Ash from Meesden to Much Hadham, including The Pelhams and Little Hadham	011221421
062FWF502	River Ash and its tributaries from Much Hadham to Ware	River Ash from Much Hadham to Ware, including Widford and Wareside	011221421
062WAFN02	River Beane Catchment	River Beane, Dane End Tributary, Stevenage Brook and their tributaries	01122132
062FWF481	River Beane and its tributaries from Roe Green to Watton-at-Stone	River Beane and its tributaries from Roe Green to Watton-at-Stone, including Weston, Cottered, Walkern and Aston	01122132
062FWF482	River Beane and Dane End Tributary from Watton-at-Stone to Hertford	River Beane and Dane End Tributary from Watton-at-Stone to Hertford, including, Dane End, Sacombe	01122132

Target Area code	Target Area Name	Target area description	Quick Dial Code
		Village Stapleford and Waterford	
062FWF483	Stevenage Brook from Stevenage to Watton-at-Stone	Stevenage Brook from Stevenage to Watton-at-Stone including Bragbury End	01122132
062WAFN03	River Mimram Catchment	River Mimram and its tributaries from Whitwell to Hertford	01122131
062FWF471	River Mimram and its tributaries from Whitwell to Codicote	River Mimram and its tributaries from Whitwell to Codicote including Codicote Bottom	01122132
062FWF472	River Mimram and its tributaries from Codicote to Hertford	River Mimram and its tributaries from Codicote to Hertford, including Welwyn, Tewin and Hertingfordbury	01122133
062WAFN04	River Rib Catchment	River Rib, the River Quin and their tributaries	011221422
062FWF491	River Rib and its tributaries from Therfield to Puckeridge	River Rib and its tributaries from Therfield to Puckeridge including, Chipping, Buntingford and Westmill	011221422
062FWF492	River Rib and its tributaries from Puckeridge to Hertford	River Rib and its tributaries from Puckeridge to Hertford, including Standon, Latchford, Barwick, Thundridge and Wadesmill.	011221422
062FWF493	River Quin and its tributaries from Barkway to Puckeridge	River Quin and its tributaries from Barkway to Puckeridge, including Great Hormead and Braughing	011221422

Target Area code	Target Area Name	Target area description	Quick Dial Code
062WAF51Stort	The River Stort and Stanstead Brook Catchment	The River Stort, Stanstead Brook and their tributaries from Clavinging to Hoddesdon including Stanstead Mountfitchet, Bishop's Stortford, Sawbridgeworth and Harlow	172126
062FWF51Claverin	The River Stort at Clavinging and Manuden	The River Stort at Clavinging and Manuden	172121
062FWF51StnMtFit	The Stanstead Brook at Stanstead Mountfitchet	The Stanstead Brook at Stanstead Mountfitchet	172122
062FWF51Bishop	The River Stort at Bishop's Stortford	The River Stort at Bishop's Stortford including Spellbrook	172123
062FWF51Sawbridg	The River Stort at Sawbridgeworth	The River Stort at Sawbridgeworth	172124
062FWF51Harlow	The River Stort at Harlow	The River Stort at Harlow including Roydon	172125

Source: Environment Agency Flood Incident Management Team (October 2008)

Floodline telephone number: 0845 988 1188

Appendix H: Abbreviations/Acronyms

AEP	Annual Exceedence Probability
CFMP	Catchment flood management plan
CIRIA	Construction Industry Research Information Association
COW	Critical Ordinary Watercourse
Defra	Department for Environment, Food and Rural Affairs
DC	Development Control
DETR	Department for Environment, Transport and the Regions
EA	Environment Agency
EFRA	Exceedence flood risk assessment
FRA	Flood Risk Assessment (site-specific)
FRMS	Flood risk management strategy
GDPO	1995 Town and Country Planning (General Development Procedures) Order 1995
GPDO	General Permitted Development Order (England) (Amendment) Regulations 2008
GIS	Geographical Information System
IUD	Integrated Urban Drainage
IUDM	Integrated Urban Drainage Management
LDD	Local development document
LDF	Local development framework
LiDAR	Light Detection and Ranging.
LPA	Local Planning Authority
LRF	Local Resilience Forum
NFCDD	National Flood and Coastal Defence Database
Ofwat	Water Services Regulation Authority
PPG	Planning Policy Guidance Note
PPS	Planning Policy Statement
PINS	Planning Inspectorate
RBMP	River Basin Management Plan
RSS	Regional Spatial Strategy
SA	Sustainability Appraisal
SAC	Special area for conservation
SEA	Strategic Environmental Assessment
SFRA	Strategic Flood Risk Assessment
SHLAA	Strategic Housing Land Availability Assessment
SPA	Special protection area
SPD	Supplementary Planning Document
SUDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
UKCIP	UK Climate Impact Programme
WFD	Water Framework Directive

Appendix I: Glossary

Annual exceedence probability The estimated probability of a flood of given magnitude occurring or being exceeded in any year. Expressed as, for example, 1 in 100 chance or 1 per cent.

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

Aquifer An underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt, or clay) from which groundwater can be usefully extracted using a water well.

Attenuation Reduction of peak flow and increased duration of a flow event.

Bourne See winterbourne.

Catchment Flood Management A strategic planning tool through which the Environment Agency will seek Plans (CFMP) to work with other key decision-makers within a river catchment to identify and agree policies for sustainable flood risk management.

Climate change Long-term variations in global temperatures and weather patterns, both natural and as a result of human activity. See Appendix B of PPS25.

Design event A historic or notional flood event of a given annual flood probability, against which the suitability of a proposed development is assessed and mitigation measures, if any, are designed.

Design event exceedence Flooding resulting from an event which exceeds the magnitude for which the defences protecting a development were designed – see residual risk.

Design flood level The maximum estimated water level during the design event.

Drift Geology refers to the material deposited by glaciers on top of the bedrock. This may include boulder clay and other forms of glacial drift in the recent past.

Exceedence flood risk assessment A study to assess the risk of a site or area being affected by exceedence flow, and to assess the impact that any changes made to a site or area will have on the exceedence flood risk.

Exceedence flow Excess flow that emerges on the surface once the conveyance capacity of a drainage system is exceeded.

Flash flooding In small, steep catchments, local intense rainfall can result in the rapid onset of deep and fast-flowing flooding with little warning. Such “flash” flooding, which may only last a few hours, can cause considerable damage and possible threat to life.

Flashy Liable to flash flooding

Flood action group Local community groups who aim to ensure that all authorities work closely together to manage flood risk and to deliver an action plan to minimise flood risk within their area.

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

Flood and Coastal Defence The Environment Agency, local authorities and Internal Drainage Boards Operating Authorities with legislative powers to undertake flood and coastal defence works.

Flooding Direction A Direction made under the Town and County Planning (Flooding) (England) Direction 2006 whereby a local planning authority must refer a planning application through the regional Government Office to determine whether it should be called-in for a decision by the Secretary of State, where it is proposed to grant planning permission in the face of a sustained objection by the Environment Agency.

Flood effect mitigation All measures to reduce the effect of flooding on a building and its occupants including flood avoidance, flood resistance and flood resilience.

Flood Map A map produced by the Environment Agency providing an indication of the likelihood of flooding within all areas of England and Wales, assuming there are no flood defences. Only covers river and sea flooding.

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

Flood risk management strategy A long-term approach setting out the objectives and options for managing flood risk, taking into account a broad range of technical, social, environmental and economic issues.

Flood risk Assessment A study to assess the risk to an area or site from flooding, now and in the scales of assessment) future, and to assess the impact that any changes or development on the site or area will have on flood risk to the site and elsewhere. It may also identify, particularly at more local levels, how to manage those changes to ensure that flood risk is not increased. PPS25 differentiates between regional, subregional/strategic and site- specific flood risk assessments.

Flood risk management measure Any measure which reduces flood risk such as flood defences.

Flood Zone A geographic area within which the flood risk is in a particular range, as defined within PPS25.

Fluvial Flooding caused by rivers.

Foul Water Sewers Sewers designed to take foul water from toilets, sinks, washing machines, baths etc and connect to a water treatment and cleaning facility such as a sewage works.

Gauging Stations See Telemetry Stations.

Greenfield land Land that has not been previously developed.

Highway Drains Older types of highway drain make use of road gullies and small diameter pipes draining into rivers, watercourses, soakaways and adopted surface water sewers. Modern highway drains may make more use of SUDS technology, filtration and attenuation and are therefore less likely to surcharge.

LiDAR: Light Detection and Ranging. This is an airborne surveying technique which uses a laser to measure the distance between the aircraft and the ground. This technique results in the production of a terrain model which can be used for analysing flood risk.

JFLOW a modelling technique using flow data and a Digital Elevation Model (such as LiDAR) to map the path of water across the DEM. As a result of this process flood extents are produced, which are then used to define the Flood Zones. This modelling is not a detailed local assessment, it is used to give an indication of areas at risk from flooding. JFLOW was used in 2004 to create the Environment Agency's national Flood Map. This data is gradually being updated as more detailed modelling is undertaken of catchments.

Local Development Framework (LDF) A non-statutory term used to describe a folder of documents which includes all the local planning authority's Local Development Documents (LDDs). The local development framework will also comprise the statement of community involvement, the local development scheme and the annual monitoring report.

Local Development Documents All development plan documents which will form part of the statutory development plan, as well as supplementary planning documents which do not form part of the statutory development plan.

Local Resilience Forum A group required under the Civil Contingencies Act, 2004 who are responsible for the co-ordination of emergency planning within local areas.

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.

Major development A major development is

- a) where the number of dwellings to be provided is ten or more, or the site area is 0.5 Ha or more or
- b) non-residential development, where the floorspace to be provided is 1,000m² or more, or the site area is 1 ha or more.

Ordinary watercourse All rivers, streams, ditches, drains, cuts, dykes, sluices, sewers (other than public sewer) and passages through which water flows which do not form part of a Main River. Local authorities and, where relevant, Internal Drainage Boards have similar permissive powers on ordinary watercourses, as the Environment Agency has on Main Rivers.

Permitted development rights Qualified rights to carry out certain limited forms of development without the need to make an application for planning permission, as granted under the terms of the Town and Country Planning (General Permitted Development) Order 1995.

Planning Policy Statement (PPS) A statement of policy issued by central Government to replace Planning Policy Guidance notes.

Pluvial Flooding caused by rain.

Precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

Previously-developed land Land which is or was occupied by a permanent structure, including the (often referred to as brownfield land) curtilage of the developed land and any associated fixed surface infrastructure (PPS3 annex B)

Regional Spatial Strategy (RSS) A broad development strategy for a region for a 15 to 20 year period prepared by the Regional Planning Body.

Reservoir (large raised) A reservoir that holds at least 25,000 cubic metres of water above natural ground level, as defined by the Reservoirs Act, 1975.

Resilience Constructing the building in such a way that although flood water may enter the building, its impact is minimised, structural integrity is maintained and repair, drying & cleaning are facilitated.

Resistance Constructing a building in such a way as to prevent flood water entering the building or damaging its fabric. This has the same meaning as flood proof.

Return period The long-term average period between events of a given magnitude which have the same annual exceedence probability of occurring.

Residual risk The risk which remains after all risk avoidance, reduction and mitigation measures have been implemented.

River basin management plan A management plan for all river basins required by the Water Framework Directive. These documents will establish a strategic plan for the long-term management of the River Basin District, set out objectives for waterbodies and, in broad terms, what measures are planned to meet these objectives, and act as the main reporting mechanism to the European Commission.

Run-off The flow of water from an area caused by rainfall.

Section 106 Agreement Section 106 of the Town and Country Planning Act 1990 (as amended) allowing local planning authorities to negotiate arrangements whereby the developer makes some undertaking if he/she obtains planning permission. These are known interchangeably as planning agreements, planning obligations or planning gain.

Section 106 (Water Industry A key section of the Water Industry Act 1991, relating to the right of Act 1991) connection to a public sewer.

Solid Geology the common geological name for bedrock geology.

Standard of protection The design event or standard to which a building, asset or area is protected against flooding, generally expressed as an annual exceedence probability.

Storm Grilles Any of a number of structures usually fitted to bridges or culvert inlets to collect large debris flowing along a watercourse and prevent it entering or jamming within the culvert or bridge opening. Some grilles are fitted to outlet points of culverts for safety /security purposes. Also known as “Trash Screens”.

Strategic Environmental Assessment European Community Directive (2001/42/EC) on the assessment of the (SEA) Directive effects of certain plans and programmes on the environment.

Surcharge uncontrolled flooding from drainage infrastructure.

Surface Water Flood Risk Assessment FRAs should show how surface water management is functioning on the site at present and how it is to be undertaken in the new development. See Paragraphs 5.43-51 of the PPS5 *Practice Guide*.

Surface Water Management Plan Plans which promote a coordinated strategic approach to managing surface water drainage and reducing flood risk. They should reflect the future proposals of all key stakeholders and provide a clear delivery plan. They may also provide a way to integrate the requirements of forthcoming River Basin Management Plans (RBMP) into development planning. SWMPs should focus on managing flood risk and optimising the provision of SUDS. For further information see the PPS25 *Practice Guide* (pages 97-101)

Surface Water Sewers Part of a formalised, regulated and mapped network of sewers which are connected to other drainage networks such as rivers, watercourses, and highway drains.

Sustainable Drainage Systems (SUDS) A sequence of management practices and control structures, often referred to as SUDS, designed to drain water in a more sustainable manner than some conventional techniques. Typically these are used to attenuate run-off from development sites.

Sustainability Appraisal An integral part of the plan-making process which seeks to appraise the economic, social and environmental effects of a plan in order to inform decision-making that aligns with sustainable development principles.

Telemetry Stations The Environment Agency has more than 16,000 monitoring sites which provide data on rainfall, river level and flow, groundwater level, tides, wind speed and direction, pumping station and sluice gate operation, building security and automatic environmental monitoring. Also known as Gauging Stations.

Trash Screens See Storm Grilles.

Vulnerability Classes PPS25 provides a vulnerability classification to assess which uses of land may be appropriate in each flood risk zone.

Washland An area of the floodplain that is allowed to flood or is deliberately flooded by a river or stream for flood management purposes.

Water Framework Directive A European Community Directive (2000/60/EC) of the European Parliament and Council designed to integrate the way water bodies are managed across Europe. It requires all inland and coastal waters to reach “good status” by 2015 through a catchment-based system of River Basin Management Plans, incorporating a programme of measures to improve the status of all natural water bodies.

Windfall sites Sites which become available for development unexpectedly and are therefore not included as allocated land in a planning authority’s development plan.

Winterbourne A stream or river that is dry through the summer months. Winterbournes generally form in areas where there is chalk (or other porous rock) downland bordering clay valleys or vales. When it rains the chalk, which is porous, holds water in its aquifer, releasing the water at a steady rate. During dry seasons the water table may fall below the level of the stream's bed, causing it to dry out.