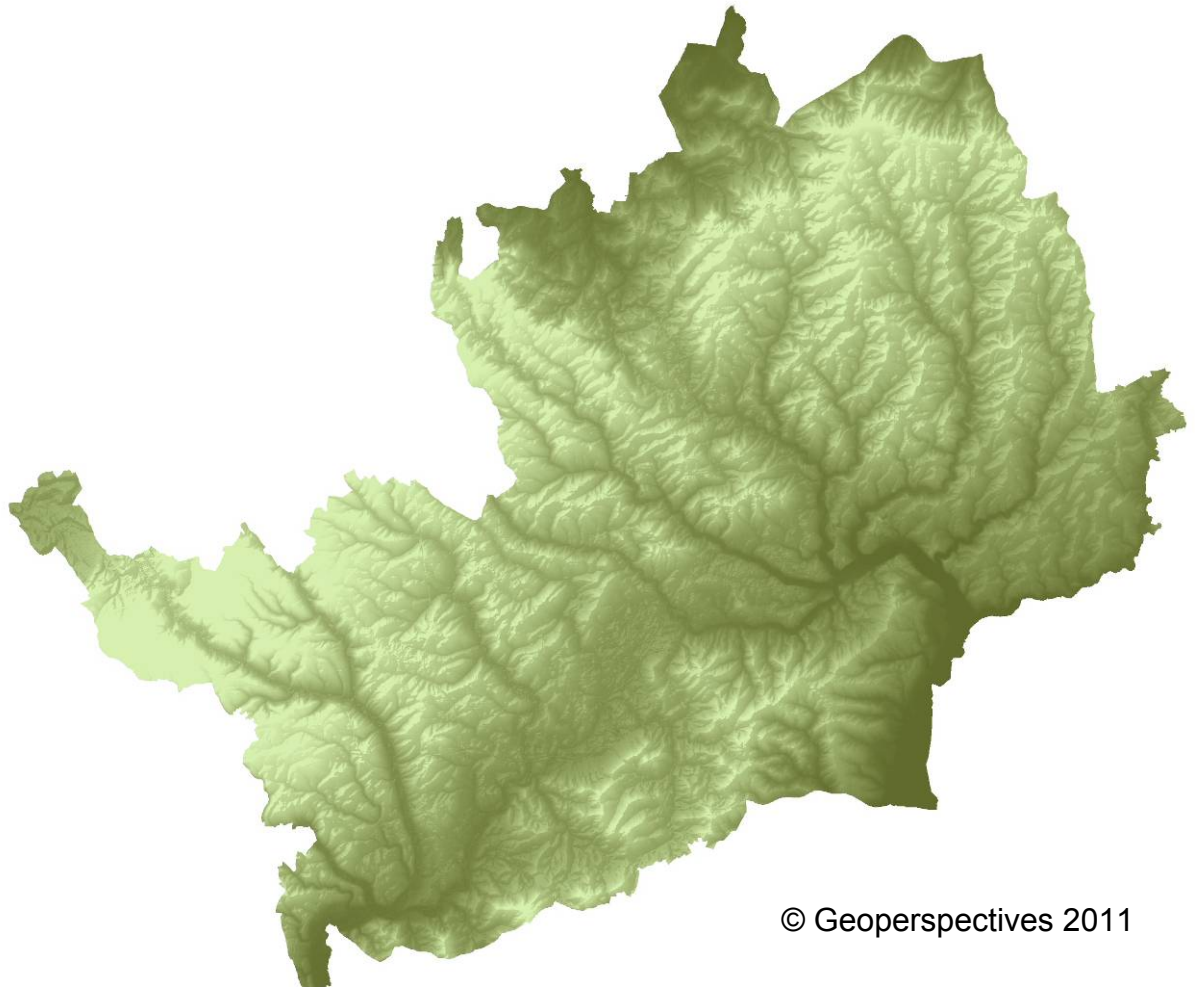


Hertfordshire County Council  
Preliminary Flood Risk Assessment



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June 2011



## **Executive Summary**

This report gives an overview of local flood risk in Hertfordshire based on a review of records of flooding and data derived from modelling of potential future flooding. It has been prepared by Hertfordshire County Council as part of a submission to meet the requirements of the Flood Risk Regulations (2009). The Regulations together with the related Flood Risk Management Act 2010 identify Hertfordshire County Council as Lead Local Flood Authority (LLFA) and require the council to develop a Preliminary Flood Risk Assessment (of sources of local flood risk - surface water, ordinary watercourses and groundwater) and subsequently a strategy for the management of local flood risk.

Records were reviewed that had been collated from a range of sources including the Environment Agency, district councils, water companies and local highway authorities. They showed that flooding has occurred in Hertfordshire from a range of sources, at various times and at locations distributed widely across the county. However as there has been no standardised methodology for recording information about flooding it is not possible to map flood extents or determine the consequences of the majority of the past events.

Data provided by the Environment Agency, produced to a national methodology determined by Defra, was used to assess future flood risk and for the review and identification of Flood Risk areas.

The historical data was of limited use however the surface water modelling made available by the Environment Agency was used to calculate the potential future risk of flooding – based on this national modelling it is estimated that approximately 53,400 properties in Hertfordshire could potentially be at risk of flooding to 0.3m in a 1 in 200 year rainfall event.

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## 1. Introduction

The administrative area of Hertfordshire is located in the south east of the United Kingdom, immediately to the north of London. Hertfordshire County Council is the Lead Local Flood Authority (LLFA) for the area.

The scope of this report relates to local flood risk from surface water, ordinary watercourses and ground water and it has been produced as part of a preliminary assessment of local flood risk as required by the Flood Risk Regulations 2009, which in turn will form part of the Environment Agency submission to the EU to meet the requirements of the European Floods Directive. It will support the identification of areas where flood risk is deemed to be significant on a national scale – Flood Risk Areas. Flooding arising solely from main rivers and large raised reservoirs will not be considered as those sources have been assessed by the Environment Agency (together with flood risk from the sea which has no direct implications for Hertfordshire as the county has no coastline and is landlocked).

The Preliminary Flood Risk Assessment (PFRA), comprising this document and the supporting spreadsheet (annexes 2 and 3) represents the first stage of the requirements of the Regulations. The PFRA process is aimed at providing a high level overview of historical and future flood risk from local flood sources, including surface water, groundwater, ordinary watercourses and canals. Flooding from the sewerage system will also be included when caused by rainwater entering or affecting the system. Instances where local sources are impacted by interactions with flooding from main rivers and reservoirs will also be included. Flooding associated with the sea, main rivers and reservoirs is the responsibility of the Environment Agency and does **not** need to be considered by the LLFA as part of the PFRA, unless it is considered that it may affect flooding from one of the sources listed above.

The PFRA is a high-level screening exercise and must therefore consider floods which have significant harmful consequences for human health, economic activity, the environment and cultural heritage. The PFRA identifies such areas and if they are considered to be nationally significant, as defined by Defra, they are highlighted as 'Flood Risk Areas'. Flood Risk Areas warrant further examination and management through the production of flood risk and flood hazard maps and flood risk management plans.

### 1.1 Introduction to the study area

With over a million inhabitants in an area of 1642 km<sup>2</sup>, Hertfordshire is one of Britain's most densely populated counties. It is characterised as a county of small towns with no single predominant settlement – the populations of five largest towns range from 91,000 in Watford to 43,000 in Welwyn Garden City (2001 census data). At the time of this census the total population for the county was calculated as 1,033,977 with about 65% of people living in the fifteen largest towns (each with a population of over 20,000) and 80% of the population in settlements with over 4,000 residents.

The towns are fairly evenly dispersed through the south, west and central areas along with the northern and eastern fringes. The central north eastern area of the county is less densely populated and more rural in character. The character of the settlements is varied with some areas having evolved over many years and others growing rapidly during the 20<sup>th</sup> century. Letchworth and Welwyn were established as Garden Cities in 1903 and 1920; the 1950's saw the expansion of, Hatfield, Hemel Hempstead, Stevenage and Welwyn as New Towns and there were major post war housing developments in Borehamwood and South Oxhey to accommodate people relocating from London.

Around 25% of the working population commute into London and almost the same number again commute into Hertfordshire from elsewhere. The county has six major employment centres: Watford, Hemel Hempstead, Welwyn Garden City, Stevenage, Hatfield and Borehamwood.

The larger settlements are linked to the capital by rail either by regional routes or the East, West and Midland mainlines. There is a extensive network of roads through the county, Hertfordshire County Council maintains 4,943 km of highway, in addition there are a number of major routes such as the M1, M25 and A1(M) running through the county which are managed by the Highways Agency.

Approximately 60% of the land area of the county is farmed and of that just over 68% is linked to arable crop production. The majority of the agricultural land is classified as grade 3 and approximately 10% is grade 2, no areas of grade 1 land have been identified at a strategic scale.

Geology is relevant to flood risk as it ultimately determines how water flows through and potentially under an area, and the underlying substrate helps give rise to landform and soils. In Hertfordshire this ranges from the largely impermeable clay of the London Basin to extensive water bearing chalk lands which are exposed as the Chiltern Hills in the west and north of the county. Large areas of the chalk are covered by more recent river and glacial deposits which are a mixture of clays and gravels. The Reading Beds (also clays and gravels) which were deposited over the chalk have largely been eroded apart from some outlying hills such as the one on which St Albans stands. Glacial clays and gravels overlie much of the north-east of Hertfordshire, and river gravels occupy the Vale of St Albans and many of the river valleys. The chalk holds an important stored source of water for the public water supply and is designated as a principal aquifer.

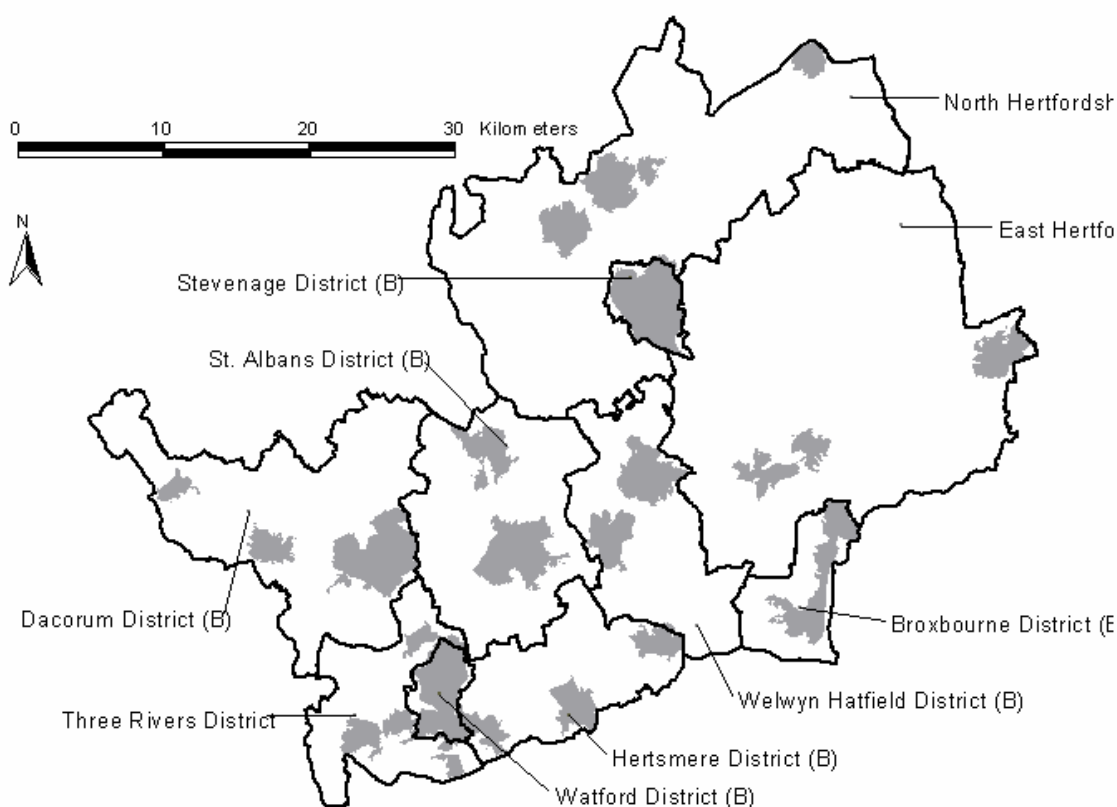
The majority of the county drains southwards towards the Thames via the Colne valley in the west and the Lee valley in the east. This can be seen from the cover illustration, which shows the topography of Hertfordshire, The darker area illustrated at the north of the county drains northwards into the Great Ouse and the dark area at the extreme west is part of the Thame catchment.

There are 43 Sites of Special Scientific Interest (SSSIs) in Hertfordshire, 2 Special Areas for Conservation (SACs) - Chilterns Beechwoods and Wormley Hoddesdon Park Woods. The importance of the Lee Valley for over wintering birds is recognised through designation as a RAMSAR site and Species Protection Area (SPA). Elements of the county's historic environment are designated there are over 660 listed buildings which are grades 1 and 2\*, there are no World Heritage Sites

## 1.2 Administrative Areas

There are 10 district authorities in Hertfordshire (see figure 1) they vary in size (both area and population) and character; some are totally urban others have a more rural character.

Figure 1 Map of administrative areas



Hertfordshire is in two Environment Agency Regions the majority of the county is in the South East Region (formerly Thames) the remainder (about 14% by area) is in Anglian Region. Hertfordshire has a representative on the Thames Regional Flood and Coastal Committee and shares representation with Buckinghamshire and Northamptonshire on the Anglian Central RFCC one of three covering the Anglian Region.

There are 9 Lead Local Flood Authorities which adjoin Hertfordshire:–

- 3 shire counties (Buckinghamshire, Essex, and Cambridgeshire)
- 2 unitary authorities (Luton, Central Beds)
- 4 London boroughs.

The London boroughs are part of the Drain London partnership which is coordinating flood risk management across Greater London and the 33 authorities are organised into 8 sub groups – three of which border Hertfordshire. The authorities and groups [ ] are - Hillingdon [1], Harrow [2], Barnet [2], Enfield [4].

Two utility companies provide the wastewater services for Hertfordshire; the majority of the county is covered by Thames Water with Anglian Water providing services in the north east of the county. (Veolia Water Central provides the public water supply for the majority of the county - although the company does not deal with wastewater they will have relevant experience of groundwater as much of the water comes from the chalk aquifer).

### **1.3 Aims and Objectives**

The aim of this PFRA is to develop a strategic assessment of local flood risk across Hertfordshire based on information from past floods and modelling of the potential impact of future flooding. The process will inform the development of a strategy for the management of local flood risk.

- Records of historic flooding from surface runoff, groundwater and ordinary watercourses will be collated and assessed to help with understanding past forms of flooding.
- Data sources that will help with mapping potential future flood risk will be identified.
- A PFRA report which satisfies the requirements of the Flood Risk Regulations 2009 will be produced.
- The national assessment of indicative Flood Risk Areas will be reviewed and if applicable additions and amendments will be suggested and justified in the light of local circumstances.

## **2. Lead Local Flood Authority responsibilities**

The responsibilities of the LLFA are defined through the Flood Risk Regulations 2009 and the Flood and Water management Act 2010.

The overarching role is the co-ordination of local flood risk management involving flooding surface water, ordinary watercourses or groundwater. A key component of this will be the preparation, implementation and review of a local Flood Risk Management Strategy. This process started in May 2011 and the first strategy will be published in the second quarter of 2012.

To support this work there are duties and powers linked to improving sources of information about local flood risk. The authority will be developing and maintaining a register of features and structures that make a significant contribution to local flood risk management. Hertfordshire as Lead Local Flood Authority also has powers giving it discretion to investigate flooding events which are not being investigated by other authorities. This will help improve the quality of records and promote better understanding of flooding mechanisms.

It is anticipated that by the end of 2012 the LLFA will have duties and powers relating to potential new sources of flood risk. Mechanisms will need to be put in place for consenting of works associated with ordinary watercourses. New development will need to comply with a new system of drainage consents and the presumption will be that Sustainable Urban Drainage (SUDs) techniques will be applied where feasible. Arrangements will also have to be put in place for the adoption and maintenance of SUDs serving a number of properties above a defined threshold.

The LLFA will not be acting alone the Flood and Water Management Act 2010 defines a number of bodies, authorities and organisations as Risk Management Authorities (listed in figure 2) which will be engaged in the development of the local strategy and implementation of flood risk management activity. Effective strategic and operational partnerships will need to be formed to coordinate activity across a wide range of activities for example; land use planning, development control, and flood risk management - at the same time integrating the interests of public bodies, private companies and communities.

Figure 2 below sets out the authorities and bodies in Hertfordshire that will form the core of future partnerships.

## **2.1 Governance and Communication**

The Lead Local Flood Authority role of Hertfordshire County Council is coordinated by the Environmental Resource Planning team in the Environment and Commercial Services Department. Elected members of the authority have received reports through the Environment and Planning Cabinet Panel (now Environment, Economy and Community Safety Cabinet Panel). Members have been briefed on the new powers relating to scrutiny of local flood risk management activity that have been made available through the Flood and Water Management Act 2010 legislation.

Reports on the development of local flood risk management have been presented to officers representing the Hertfordshire district planning authorities at meetings of the Hertfordshire Planning Group and to district elected member representatives at a meeting of the Hertfordshire Infrastructure and Planning Partnership.



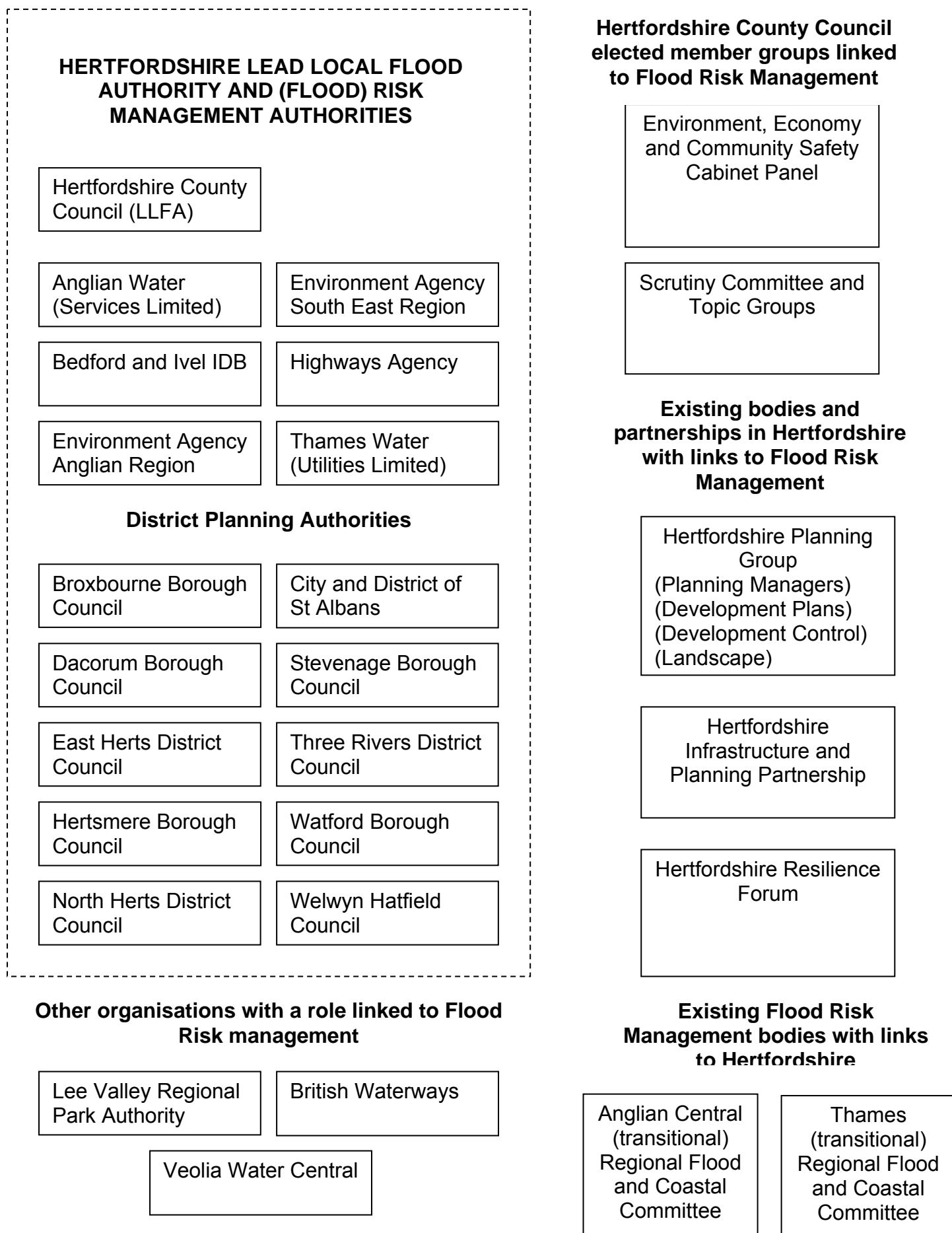
An informal network of local authority officers, contractors, consultants and others with an interest in flood risk management has been used to brief a wider audience on a range of topics including modelling and assessing flood risk and a system for mapping flood risk management assets.

## **2.2 Communication with the Public**

Effective communication with the public is an essential component of local flood risk management. Individuals and communities need to understand the potential for flooding so that they can take appropriate measures to reduce risk.

It is planned to have public involvement in the development of the local flood risk management strategy and the strategy itself will inform how partners should involve and work with communities in future flood risk management activity.

Figure 2



### **3. Methodology and data review**

The PFRA is a strategic assessment of flooding and one of the potential outcomes is the identification of areas where flood risk is potentially at a level of significance that further investigation needs to be carried out and if found necessary measures to manage this risk are put in place through the development of flood risk hazard maps and management plans.

#### **Assessing Historic Flood Risk**

The data that would identify areas of historic flooding at this level of significance has largely been collected and collated in the past for the production of Strategic Flood Risk Assessments produced by the district planning authorities and Hertfordshire County Council. The information was readily available and can be accessed through the relevant local authority websites. This has been supplemented with information collected during the development of Surface Water Management Plans in the district authority areas of St Albans and Watford. Hertfordshire Highways the organisation which manages the highway network for the county council records reports of flooding and works related to flooding, on a database.

The sources of information have been summarised in table 2 this includes an indication of availability and the date of publication.

A composite map of the past flooding events has not been produced because of the variability of the data and because none of the events were considered significant – however it has been reviewed geographically using the maps published with the SFRAs.

#### **Assessing Future Flood Risk**

Identification of Flood Risk Areas needs to take account of flooding that could potentially occur in the future. This will be based on a review of the Flood Map for Surface Water which the Environment Agency has produced and made available to Lead Local Flood Authorities. This dataset has been produced by modelling the flood risk arising from rainfall events with a 1 in 30 year and 1 in 200 year probability of occurring.

When assessing future flood risk, the following factors were considered;

- Topography,
- Location of ordinary watercourses and modifications to them
- Effectiveness of any works constructed for the purpose of flood risk management,
- Location of populated areas,
- Location on non-residential properties (i.e. areas of economic importance),
- Location of critical infrastructure,
- Areas of environmental importance,

- Areas of cultural importance,
- The current and predicted impact of climate change

## Identifying Flood Risk Areas

The review of information on past and future flooding will be used to identify Flood Risk Areas. This will be based on assessment of impacts on human health, economic activity, cultural heritage and the environment. Defra and the Environment Agency have identified a range of indicators to quantify and help understand the impact and consequences of flooding.

The indicators are summarised in table 1 below

Table 1 flood risk indicators

Aspect impacted by flooding	Indicators used	National threshold of significance per km grid square
Human Health	Residential properties  Critical Services eg schools, hospitals	200 people which equates to approximately 85 properties 1
Economic Activity	Number of non-residential properties Road and Rail links affected Area of agricultural land	20 N/A N/A
Environmental Heritage	Designated sites (SSSI's, SACs, SPAs RAMSAR)	N/A
Cultural Heritage	World Heritage Sites, Listed Buildings	N/A

## Reviewing Flood Risk Areas

The Environment Agency has used a national methodology, which has been set out by Defra, to identify Indicative Flood Risk Areas across England. Of the ten indicative Flood Risk Areas that have been identified nationally, one (London) includes parts of Hertfordshire.

### 3.1 Data Sources

Data sources are listed in table 2

### 3.2 Data Limitations

There has not been a consistent system for recording flooding events in use across Hertfordshire the majority of information has been recorded to meet a range of operational needs rather than for the specific purpose of being able

to assess and understand flood risk; as a result there is variability in the available information. This may be for a variety of reasons some examples of which are set out below

- An incomplete record eg an incident may not be reported
- Data is held on ad hoc systems
- Only basic information may be recorded eg flood, property and date
- Type may not be recorded eg could include a burst water main
- Cause of flooding may not be recorded eg could be a temporary blockage
- Detail such as duration depth or extent not recorded
- Scale may not be apparent eg a puddle reported as road flooding

To help with future reporting and review a consistent methodology will be adopted for the investigation and recording of flooding events in the future and will be put in place to be available from December 2012.

### **3.3 Quality Assurance, Security and Data Restrictions**

The data published in the SFRAs has been assessed and validated as part of that process.

The original sources range from databases that are geographically referenced to anecdotes about flooding issues in particular areas. Collectively the data represents a record of locations where flooding has been known to occur in the past. Individually the records may be referenced to a specific location eg an address or a more general area such as a street or neighbourhood. The limitations of the data were understood for the purposes of the review carried out for this PFRA.

#### **Security**

Copies of the information and data used for the PFRA are held electronically on a password protected network with access restrictions appropriate to the data. GIS datasets are stored together with a copy of licences relating to use.

#### **Licences and restrictions on use**

Licences which allow use by Hertfordshire County Council or its consultants are held for the Environment Agency datasets. Some of it is unrestricted other data use is restricted to the work of the Lead Local Flood Authority or in some cases more specifically the production of the PFRA.

The information provided by British Waterways is licensed for use by Hertfordshire County Council in the production of the preliminary flood risk assessment.

The extracts from the water company DG5 registers have been published and are available in the public domain so no confidentiality or licence agreements were required.

## Data Sources used in preparation of the PFRA

**Table 2**

Information Source	Summary	Date	Availability
Areas Susceptible to Surface Water Flooding	1 <sup>st</sup> generation national mapping of surface water flood risk. Shows indicative areas using 3 bands of increasing potential flood depth (low, intermediate or more). Modelling based on with no allowance for infiltration / drainage and based on natural topography with no allowance for buildings.	2010	Environment Agency
Flood Map for Surface Water	2 <sup>nd</sup> generation national mapping. Shows indicative areas using 2 bands of flood depth > 0.1m and. 0.3m modelled for two probabilities of rainfall events 0.5% and 3.3%. Modelling based on an allowance for drainage and infiltration in rural and urban areas and includes buildings.	2010	Environment Agency
Flood Map (Rivers and the Sea)	Mapped outlines of river flooding	2010	Environment Agency
Detailed River Network	Representation of the river network based on Mastermap data.	2010	Environment Agency
National Receptors Database	Categorises flood risk receptors can be used to help identify domestic properties, commercial properties, strategic infrastructure, roads and railways	December 2010	Environment Agency
Indicative Flood Risk Areas	Map and associated data sets derived from modelling of potential future flood risk and national receptors database. Identifies areas above the nationally defined level of significance for indicative Flood Risk Areas - 30,000 people affected (developed from aggregation of adjacent 1km grid squares with flood risk above thresholds set nationally)	December 2010	Environment Agency
Thames CFMP	Overview of flood risk in the Thames catchment. – characterises areas of flood risk as CFMP policy units.	July 2008	Public
Great Ouse CFMP (Draft)	Overview of flood risk in the Great Ouse catchment - characterises areas of flood risk as CFMP policy units.	March 2010	Public
Hertfordshire Level 1 SFRA	Overview of potential flood risk in the county and more specifically relating to the Hertfordshire Waste Development Framework	November 2010	Public
Broxbourne SFRA	23 locations for surface water flooding 6 involving properties, 5 locations for Groundwater Flooding (causes attributed and records mapped) 2 sewer records.	Dec 2007	Yes
East Herts SFRA	Records collected from 1993 - 292 flooding reports categorised and mapped - 42 records for surface water, 93 linked to ordinary watercourses 7 records for groundwater	November 2008	Public

**Table 2 continued**

Hertsmere SFRA	Records collected from 1986 referenced to location description of source of information description of flooding and attributed cause. 531 records linked to drainage infrastructure, 714 records linked to land drainage 61 to land drainage and infrastructure (includes multiple events linked to one address).	June 2008	Public (overview level)
North Herts SFRA	26 Records 5 of overland flow 4 of ground water 11 cases of historic sewer flooding	July 2008	Public
Stevenage SFRA	Detailed overview of flood risk. Historical flood risk 7 areas of localised drainage and flooding problems listed No groundwater flooding events. Thames Water and Anglian Water had no records of sewer flooding.	February 2009	Public
Welwyn Hatfield SFRA	4 records of groundwater flooding, 1 record of sewer flooding 64 records of flooding from Hertfordshire Fire and Rescue – cause not identified.	May 2009	Public
Dacorum, St. Albans, Three Rivers and Watford SFRA	Combined SFRA covering 4 districts 85 records of surface water flooding 43 which are described as minor 18 records of groundwater flooding. 176 Sewer related flooding records	August 2007	Public
Hertfordshire Multi Agency Flood Plan	The plan also identifies a number of specific locations and infrastructure considered to be at risk from all types of flooding It sets out relevant issues, priorities and outlines procedures to provide a framework for the multi-agency response to a flood event within Hertfordshire. 3 points on the Highways Agency network identified with potential for surface water flooding.	March 2010	Public
Hertfordshire Highways	Records of highway related flooding events.	October 2010	Hertfordshire Highways
British Waterways Canal network	Information on canals and associated infrastructure together with records of breaches and overtopping events.	October 2010 and March 2011	British Waterways
Press cuttings and web archives	Press articles covering Watford and St Albans and web articles referencing flooding events in Hertfordshire 2006 - 2011	May 2011	Public realm (may be copyright)

#### **4. Historic Flood risk**

Flooding of properties throughout Hertfordshire has occurred in the past from a range of sources including surface water, groundwater, ordinary watercourses and sewers. The earliest records are sparse and found in various historical archives examples are, an account from 1795 of flooding following a thaw in an exceptionally severe winter and postcards from 1903 showing flooding in Watford. There are accounts of flooding in Hertfordshire in 1947 due to a thaw after a prolonged period of bad weather and there were similar events across the country. Information becomes increasingly available from this point onwards and has been largely collated by the Environment Agency. More sources appear around the 1980's with some local authorities keeping relatively detailed records. The largest flooding events in Hertfordshire, attributed to surface water, groundwater and ordinary watercourses, have affected in the order of 30 – 80 properties which is several orders of magnitude less than the threshold set for identification of Flood Risk Areas.

Significant harmful consequences will be considered as those that affect 3000 people.

##### **Surface Water Flooding**

Intense rainfall can create conditions where the local infiltration and drainage capacity is insufficient to cope with the volume of water and so water flows across the surface. It can result from an extreme rainfall event or in some cases may be due to a reduction in the capacity of a drainage system due to some form of blockage.

Records reflect this and examples range from, natural overland flow draining towards low points and causing localised flooding to blockage of a highway gully which results in reports of flooding affecting a footway or carriageway.

##### **Groundwater Flooding**

Groundwater flooding occurs when the water held underground rises to a level where it breaks the surface in areas away from usual channels and drainage pathways. The presence of the chalk aquifer in Hertfordshire and other underground water bearing areas such as the river gravel deposits mean that there is potential for groundwater flooding and that it needs to be considered as a potential source of flood risk.

Groundwater flooding can occur for a number of reasons generally it will result from an exceptional and extended period of heavy rainfall but it may have a more localised causes related to reduced abstraction, underground leaks or displacement of underground flows. It may occur as generalised flooding, for example in low lying areas where the typical level of the water table is close to the surface, or where springs develop and water flows along unexpected pathways. These are two illustrative examples of the broad principle of groundwater flooding and the outcomes can be simply described, but the



mechanisms that generate groundwater emergence can be complex and a range of more detailed scenarios could apply depending on local conditions.

Groundwater flooding is described in a number of records at various times and various places across the county, typically localised events affecting an individual or small group of properties. The view in many of SFRAs was that not all of these reports were due to true groundwater flooding and the majority of them did not identify potential groundwater flooding as being of strategic significance.

There are confirmed cases of more widespread groundwater flooding from the winter of 2000 – 2001 when groundwater levels were exceptional and peaked at record measured levels. Much of the emergence was in dry river valleys and mostly affected areas of agricultural land however Hertfordshire County Council reported on a number of roads being affected. Measures also had to be put in place to manage the impact on 2 settlements in particular, Kimpton in North Hertfordshire and an area to the north east of St Albans between Sandridge and Jersey Farm.

In Kimpton the River Kym, the line of which had been historically dry, re-emerged and followed its historical route which is thought to be along a line which now includes two of the roads in the village. The water had to be routed by various means through the village to join the River Mimram further down the valley. The operation was co-ordinated by the local authorities lasted for a number of weeks and was estimated to have cost £500,000. In an account of the event there is a note that the river also reappeared for a short while in 1947 – although if it was associated with the sudden thaw that caused extensive flooding across the country during the winter of 1947 it would be a case of overland flow rather than groundwater emergence.

The Sandridge example resulted in a large lake forming incorporating an existing balancing lagoon the adjacent road was blocked for a number of weeks. There was also a general rise in groundwater levels under the floors of properties and 34 properties were directly affected in the area, 6 of which were flooded internally.

### **Sewer flooding**

Sewer flooding is relevant to this assessment when it is caused by excess surface water entering the drainage network. The Water Companies keep a record of property flooding which is called the DG5 register. A composite of the DG5 extracts in the SFRAs was prepared for the 10 year period to 2007 there were 291 records of sewer flooding of which 77 were attributed to surface water and 25 to combined sewers. As the records were only referenced to broad areas by postcode district it is difficult to draw any detailed conclusions. No sewer flooding is deemed to have had significant consequences in the context of this PFRA.

## **Canals and Ordinary Watercourses**

British Waterways supplied data about the canal network in Hertfordshire which includes extent of canals, aqueducts, culverts, locks, sluices and events such as overtopping and breaches for the: Grand Union Canal including the Wendover and Aylesbury Arms, the Lee Navigation and the River Stort. Two minor breach events have been recorded for Hertfordshire on the Grand Union Canal. British Waterways is currently investigating the potential for flooding from the canal network. There is a raised section of the Grand Union Canal in Berkhamsted and Dacorum Borough Council commissioned a level 2 SFRA assessment in order to understand the potential flood risk. There are no significant flood risks associated expressly with the canals.

## **Interaction with main rivers and the sea**

As Hertfordshire is landlocked and located some distance from the coast flooding interactions with the sea can be discounted. Under certain conditions there are interactions between local drainage networks and rivers especially in low lying areas when river levels rise and surface water drains become ineffective as sewer outfalls become submerged and effective discharge is reduced or stopped. There are examples of this occurring in Watford and Harpenden (Batford) and it could potentially apply to other areas. The events are relatively localised so would not be categorised as having significant harmful consequences.

### **4.1 Analysis of Historic Flooding in Hertfordshire**

The varied nature of the records does not allow any reliable conclusions to be drawn. If some assumptions are made a provisional estimate can be made about the magnitude of past floods.

The total number of records reviewed is in the order of 2000, many of these can only be attributed to single or relatively low numbers of properties and they are spread at intervals over 20 to 30 years. A range of causes has been given for flooding events which may or may not be related. A few larger events were reported as effecting 30 or more properties. So the likelihood is that at for any single flood event the maximum number of properties that could be confirmed as being affected is in the order of 100 - 150 which would be almost two orders of magnitude less than the threshold set for determining Flood Risk Areas on the risk of future flood risk.

### **4.2 Consequences of Historic Flooding**

Even if there was a high degree of confidence in the assumptions made above there are few records that enable the consequences of flooding to be quantified with any certainty. None of the SFRAs identify flooding from surface water, groundwater or ordinary watercourses as being of strategic significance from historic records. On this basis no past floods have been recorded in the spreadsheet (annex 1) as having significant harmful consequences.

## 5. Future flood Risk

### 5.1 Overview of Future Flood Risk

#### Surface Water Flooding

There is no comprehensive information available locally on surface water flood risk in Hertfordshire. Local flood risk assessments have been developed in various locations when required as through development planning processes however these will be localised in nature and in total only cover a very small extent of the county. Surface Water Management Plans are currently being developed for two of the districts in Hertfordshire and this will be a source of information for future reviews.

The best available sources of information are the national assessments of surface water flood risk which have been made available to Lead Local Flood Authorities by the Environment Agency.

Table 3 Summary of Future Flood Risk Datasets

Table 3 Summary of Future Flood Risk Datasets		
Dataset	Probability of Rainfall Event	Banding
Areas Susceptible to Surface Water Flooding	1 in 200 annual	More
		Intermediate
		Less
Flood Map for Surface Water	1 in 30 annual	Shallow ( 0.1m)
		Deep (0.3m)
	1 in 200 annual	Shallow ( 0.1m)
		Deep (0.3m)
Areas Susceptible to Groundwater Flooding	N/A	Percentage of 1km square where there is potential for groundwater flooding < 25%, ≥25%, ≥50%, ≥75%

Experience from the SWMP investigations in Watford and St Albans (unpublished) shows a reasonable correlation between the Flood Map for Surface Water and more detailed local modelling that was carried out over the areas. The FMfSW does not give an absolute picture as surface water catchments will have differing sensitivities to storm duration and intensity as well as differing attributes relating to drainage and infiltration. However it is a good starting point as consistent guide to potential surface water flood risk across the majority of Hertfordshire.

The information on the Area Vulnerable to Surface Water Flooding map should not be discounted as in certain locations and under certain conditions eg where drainage and infiltration is impaired it may give a better overview of potential flood risk.

The Flood Map for Surface Water (FMfSW) is illustrated at figure 4

Using this data set the number of properties at risk from surface water flooding to a depth of 0.3m with a 1 in 200 chance of occurring estimated for Hertfordshire and adjacent counties is:

Hertfordshire	53,400
Essex	54,400
Buckinghamshire	29,200
Cambridgeshire	14,900

Table 4 below shows the breakdown of the Hertfordshire figure by district

Table 4 Estimated numbers of properties at risk of surface water flooding in Hertfordshire by district

Broxbourne	3800	St Albans	6800
Dacorum	8700	Stevenage	2800
East Herts	7000	Three Rivers	4400
Hertsmere	4400	Watford	4300
North Herts	7400	Welwyn Hatfield	3800
		Hertfordshire total	53400

## Groundwater and Ordinary Watercourse Flooding

Locations identified at risk of surface water flooding, which lie within an area susceptible to groundwater flooding, may be flooded by surface water, by groundwater, or both. Similarly, locations identified at risk of surface water flooding, that lie within an area susceptible to flooding from ordinary watercourses, may be affected by surface water flooding, by flooding from ordinary watercourses, or both.

Unless an area identified as 'susceptible to groundwater flooding' is also identified as 'at risk from surface water flooding', it is unlikely that this location would actually experience groundwater flooding to any appreciable depth, and therefore it is also unlikely that the consequences of such flooding would be significant.

The consequences of future flooding from groundwater (in the areas susceptible to groundwater flooding) and Ordinary Watercourses (in the areas susceptible to flooding from Ordinary Watercourses) are therefore not likely to

be additional to those counted and recorded for the future surface water flooding maps.

## **5.2 Locally Agreed Surface Water Information**

For the purposes of this report the locally agreed surface water information is considered to be the Environment Agency's Flood Map for Surface Water.

More detailed information will become available for some localised areas through site Flood Risk Assessments, level 2 SFRA investigations and the outputs from activity such as the SWMPs in Watford and St Albans. As a result the information available for identifying future flood risk will be added to and continue to evolve.

## **5.3 Potential Consequences of Future Flooding**

The Environment Agency has used the Flood Map for Surface water and the National Receptors Database to identify areas, based on kilometre grid squares, across the country that exceed a given threshold of flood risk. The thresholds are listed in table 1 and the methodology outlined in section 6.2.

The areas in Hertfordshire which exceed these thresholds are illustrated as blue squares in figure 5.

The aggregate figures for indicators in the blue squares in Hertfordshire are summarised below.

- 72,300 people
- 244 points of critical infrastructure (schools etc)
- 7477 non domestic properties

## **5.4 Cultural and Environmental Impacts**

It is more difficult to draw general conclusions about flood risk relating to the natural and built heritage than that relating to domestic and commercial properties.

The impact of flooding on environmental sites is variable depending on timing and duration. Some sites will benefit from flooding at certain times of the year but at other times flooding will have negative impact.

There are 45 Sites of Special Scientific Interest (SSSIs) wholly or partly in Hertfordshire. Information supplied by the Environment Agency was validated locally using the Flood Map for Surface Water dataset 1 in 200 years (deep). It was confirmed that the sites would potentially flood to the following extents.

- 8 between 92 and 22% flooded by area
- 7 between 9.2 to 3.2% flooded by area
- 30 less than 2.5% flooded by area

The sites with the larger areas of flooding were also potentially associated with river flooding. For the majority of sites only a relatively small area was flooded. The impact of pollution conveyed from sources such as waste water treatment works will be variable depending on the volume of flood water and degree of dilution. Taking all this together with the uncertainties about impact of flooding due to timing no significant adverse impacts have been recorded. The higher level designations of SAC and SPA are based on the SSSI networks. Extrapolation of the SSSI assessment shows that there is only a relatively small area of the SACs that are affected by the potential future surface water flooding. The SPA and RAMSAR designation of the Lee Valley is based on the importance of the area for over wintering wildfowl – it is difficult to calculate the potential impact of surface water flooding and river flooding is also likely to have to be taken into account. No significant harmful consequences have been recorded in the spreadsheet at annexe 2.

An assessment was made of the impact on cultural heritage – there are no World Heritage Sites in Hertfordshire. Using the FMfSW 1 in 200 shallow as the assessment criteria 47 out of the 660 grade 1 and grade 2\* listed buildings could potentially be affected by surface water flooding to some extent. However flooding may not have a significant impact depending on the reason for the building being listed. Clusters of buildings at risk of surface water flooding were identified in Hertford, Stevenage and Baldock – this was at a level of 5 buildings in a kilometre grid square. No significant harmful consequences have been recorded in the spreadsheet at annexe 2.

Information about future floods and their possible consequences is recorded in the spreadsheet (annex 2).

## **5.5 Impact of Climate Change**

There is clear scientific evidence that global climate change is happening now. It cannot be ignored. Over the past century around the UK we have seen sea level rise and more of our winter rain falling in intense wet spells.

Seasonal rainfall is highly variable. It seems to have decreased in summer and increased in winter, although winter amounts changed little in the last 50 years. Some of the changes might reflect natural variation, however the broad trends are in line with projections from climate models.

Greenhouse gas (GHG) levels in the atmosphere are likely to cause higher winter rainfall in future. Past GHG emissions mean some climate change is inevitable in the next 20-30 years. Lower emissions could reduce the amount of climate change further into the future, but changes are still projected at least as far ahead as the 2080s.

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

there could be around three times as many days in winter with heavy rainfall (defined as more than 25mm in a day). It is plausible that the amount of rain in extreme storms (with a 1 in 5 annual chance or rarer) could increase locally by 40%.

### Key Projections for Thames and Anglian River Basin Districts

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

Table 5 Summary of UKCP09 predictions

	Thames	Anglian	Hertfordshire <sup>1</sup>
Winter precipitation increases of around	15% (very likely to be between 2 and 32%)	14% (very likely to be between 3 and 31%)	15% (very likely to be between 1% and 36%)
Precipitation on the wettest day in winter up by around	15% (very unlikely to be more than 31%)	14% (very unlikely to be more than 29%)	12% (very unlikely to be more than 35%)
Relative sea level rise from 1990 levels (not including extra potential rises from polar ice sheet loss)	Sheerness very likely to be up between 10 and 40cm	Felixstowe very likely to be up between 10 and 41cm	Not Available
Peak river flows in a typical catchment likely to increase between	8 and 18%	8 and 16%	Not Available

### Implications for Flood Risk (Thames)

Implications for Flood Risk Climate changes can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability.

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

<sup>1</sup> Comparable data based on Hertfordshire Grid Square 1589 as reported in Hertfordshire County Council Corporate Climate Risk Assessment Issue 1 March 2009 - Technical summary Hertfordshire in the 2050's pp 84 - 5

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

### **Implications for Flood Risk (Anglian)**

Climate changes can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability. Wetter winters and more of this rain falling in wet spells may increase river flooding.

More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers, so we need to be prepared for the unexpected.

Drainage systems in the district have been modified to manage water levels and could help in adapting locally to some impacts of future climate on flooding, but may also need to be managed differently.

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

### **Adapting to Change**

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

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

### **Long Term Developments**

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

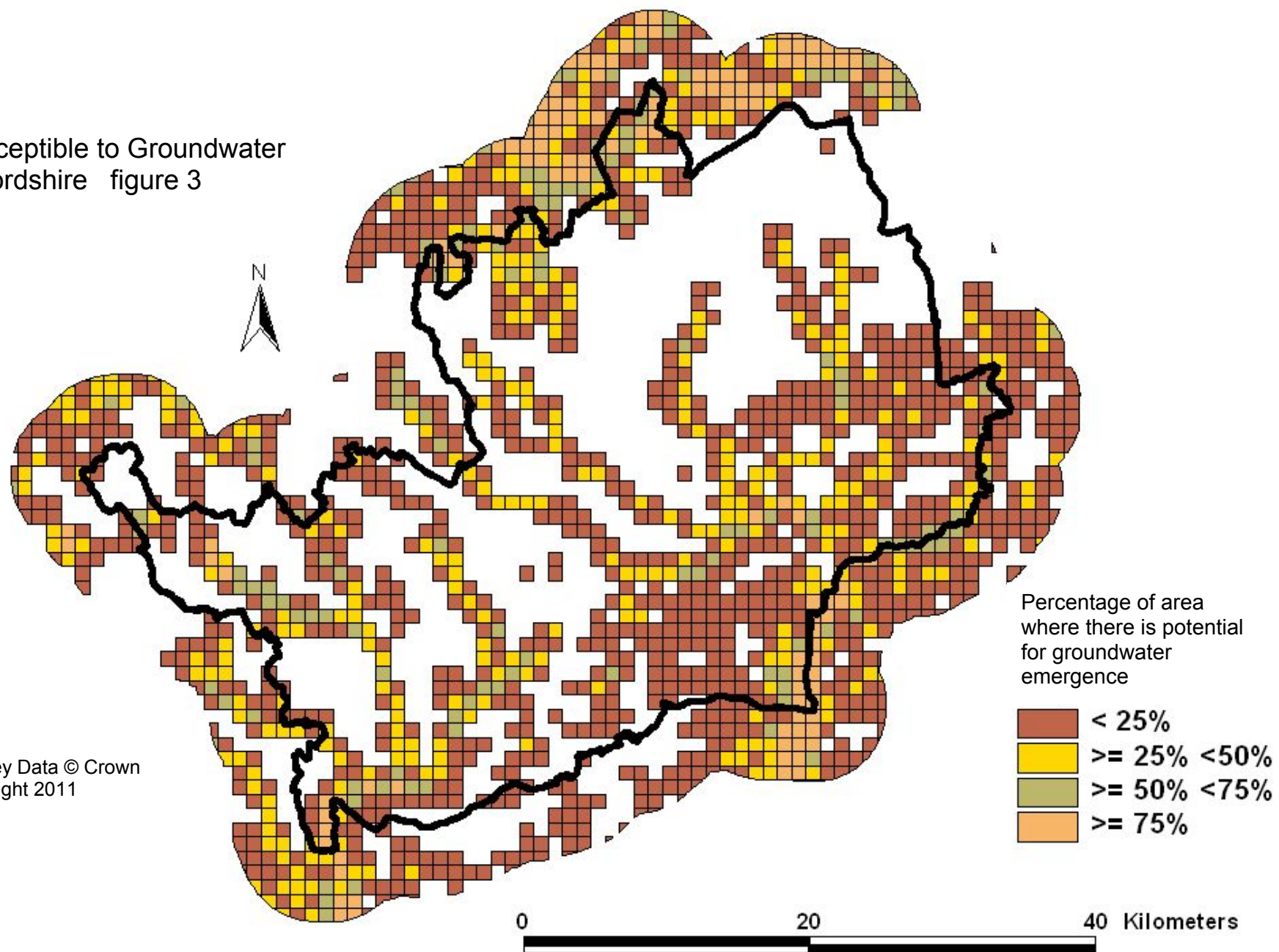
In England, Planning Policy Statement 25 (PPS25) on development and flood risk aims to "ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to



make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall."

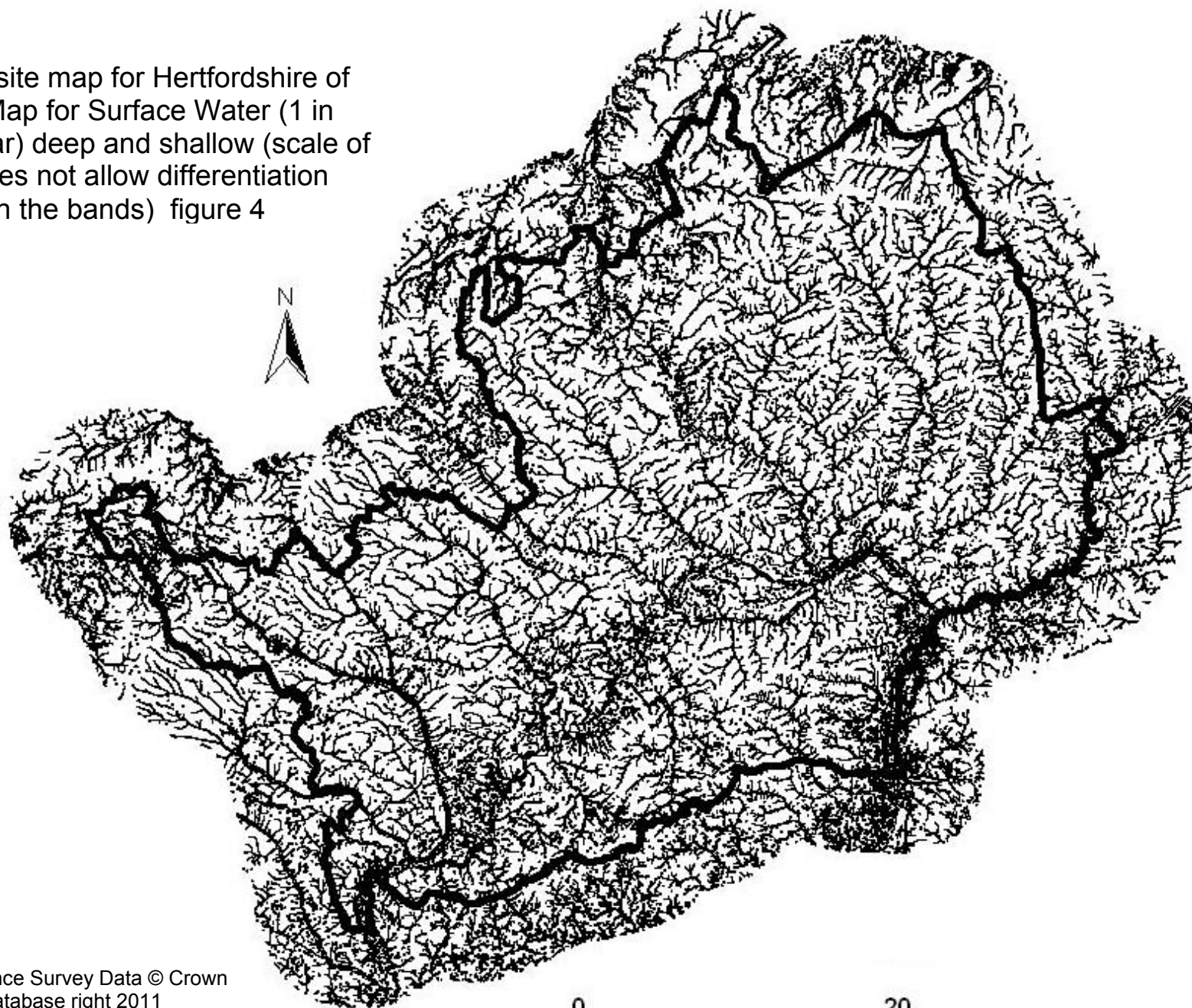
Adherence to Government policy ensures that new development does not increase local flood risk. However, in exceptional circumstances the Local Planning Authority may accept that flood risk can be increased contrary to Government policy, usually because of the wider benefits of a new or proposed major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

Map of Areas Susceptible to Groundwater  
Flooding for Hertfordshire figure 3



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Composite map for Hertfordshire of  
Flood Map for Surface Water (1 in  
200 year) deep and shallow (scale of  
map does not allow differentiation  
between the bands) figure 4



Contains Ordnance Survey Data © Crown  
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0 20 40 Kilometers



## **6. Flood Risk Areas**

### **6.1 Identification of Flood Risk Areas**

An analysis of future flood risk from surface water in Hertfordshire was carried out using the data set provided by the Environment Agency 'Places above Flood Risk Thresholds' which was derived from the 1 in 200 annual probability (deep) Flood Map for Surface Water with the following risk thresholds

- 200 or more people affected *and/or*
- 1 or more critical services, including electricity and water *and/or*
- 20 or more non residential properties

All the kilometre grid squares above these thresholds intersecting or contained within the county boundary were identified and flood risk was aggregated using the methodology for producing the national cluster maps (identifying areas where five or more squares out of nine in a three kilometre by three kilometre matrix exceed the flood risk thresholds above and grouping them into clusters where they touch or overlap).

Based on this analysis no areas were identified in Hertfordshire that meet the national criteria to be designated as Flood Risk Areas (clusters with a total of more than 30,000 people). The three largest clusters are around Watford (11946), Hemel Hempstead (5655) and Stevenage (5110).

No historical evidence was found of extensive surface water flooding (at an equivalent scale to the national thresholds for Flood Risk Areas based on modelled flood risk) that would support the identification of a Flood Risk Area in Hertfordshire.

### **6.2 Review of Indicative Flood Risk Areas**

However the London indicative Flood Risk Area extends into some areas in the south of Hertfordshire - these areas have been identified due to the coincidence of the clustering methodology and their proximity to urbanisation of the Greater London area.

There would be a better fit to local circumstances if the indicative London Flood Risk Area were amended to be drawn to follow the administrative boundary between Hertfordshire and Greater London. The primary areas that this would apply to are annotated as B and D in figure 5. This would reflect the way that local flood risk is being managed in London by "Drain London" - a partnership of the thirty-two London Boroughs together with the City of London, the Environment Agency, Thames Water, Transport for London and London Councils. A Surface Water Management Plan has been produced for each of the London Boroughs to a standardised framework and integrated timetable.

Hertfordshire is not part of the "Drain London" partnership and will be working within the context of its own Local Flood Risk Strategy to a different timetable

and with a different range of partners so there is unlikely to be a significant synergy between the strategic flood risk management programme in Hertfordshire and that of Greater London.

Amending the boundary in this way will result in the numbers of people at risk of flooding which define the London Flood Risk Area changing from 666,072 to 660,121, consequently the area will remain above the 30,000 people threshold.

The amendments are summarised in table 6 and figure 5 below. As can be seen from the table the amendments represent a relatively small change in the aggregated flood risk for the London FRA in the order of 1 to 1.5% depending on which aspect of flood risk is being considered.

Table 6

	People in Hertfordshire / Indicative London Flood Risk Area	People in Hertfordshire / Amended London Flood Risk Area	Amendments expressed as % of elements above flood risk thresholds in respective areas				Number of 1km squares above flood risk thresholds
			People	Infrastructure	Non residential properties		
Hertfordshire	66330	72280	8.2%	5.3%	7.7%		6.9%
London indicative FRA	666072	660121	0.9%	0.75%	1.45%		1.5%

On the map below (fig 5) outlines of Hertfordshire settlements with over 10,000 inhabitants have been mapped over the plot of the 1km squares above the flood risk thresholds. All the settlements have a similar proportion (by area) of flood risk identified by the national thresholds and future management strategies are likely to be very similar in all of the settlements. The areas at B and D on the map are consistent with this pattern which supports managing them within the context of Hertfordshire rather than the London FRA.

The amended area at point C relates to a portion of grid square which is below the threshold levels but within a 3km x 3 km cluster. (There are some similar smaller areas which have not been annotated). Management of these areas will be consistent with other similar areas in Hertfordshire and the approach will be defined in the Local Flood Risk Management Strategy which will be developed during 2011 and published in the second quarter of 2012.

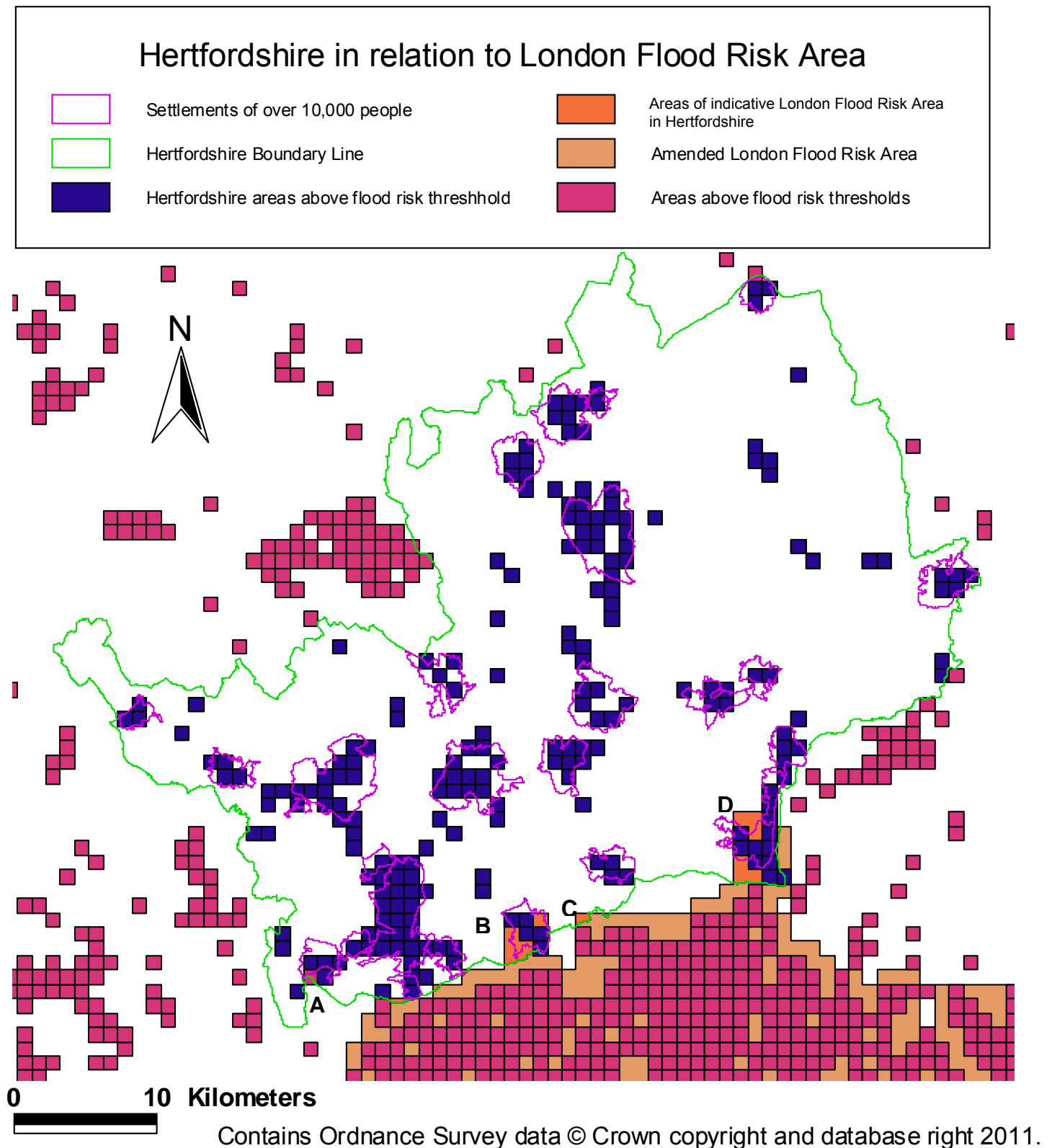
The square coloured purple at point A on the map has not been included in the calculations as the mapped flood risk lies outside the Hertfordshire boundary. However the square contains key infrastructure related to Hertfordshire and is an example of an area of flood risk that will need to be managed in cooperation with an adjacent LLFA.

It is acknowledged that future flood risk has been calculated using the data relating to grid squares above the national threshold levels rather than using total flood risk in Hertfordshire and the indicative London FRA. This is consistent with the methodology used to identify Flood Risk Areas in this

round of the PFRA process but will not give the absolute figure for number of people and non domestic properties potentially at risk.

Details of the amendment to the Indicative London Flood Risk Area have been entered in the accompanying spreadsheet at annex 3.

Figure 5



## 7. Next steps

Hertfordshire County Council's Environment and Planning Cabinet Panel endorsed the outline time table and approach for the production of the Local Flood Risk Management Strategy at their meeting on 12<sup>th</sup> May 2011. The strategy will be developed during 2011 and will be published during the second quarter of 2012.

Risk Management Authorities and other relevant organisations in Hertfordshire will be involved in the production of the strategy – which in turn will set out strategic and operational partnerships. It is proposed that the strategy is reviewed annually with the opportunity for a more extensive review to coincide with future PFRA planning rounds.

From 22nd December 2011 there will need to be a system in place for the recording of future flood events in a format that is consistent with the INSPIRE Directive (2007/2/EC)

## References

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## Annexes

- Annex 1 - Records of past floods and their significant consequences (preliminary assessment report spreadsheet)
- Annex 2 - Records of future floods and their consequences (preliminary assessment report spreadsheet)
- Annex 3 - Records of Flood Risk Areas and their rationale (preliminary assessment report spreadsheet)
- Annex 4 - Review checklist
- Annex 5 - GIS layer of amended London flood risk area