Harborough District Council

Level 1 Strategic Flood Risk Assessment

Final Report
April 2009




Prepared for:

DISTRICT OF HARBOROUGH
RURAL SOUTH LEICESTERSHIRE

Revision Schedule

Harborough District Council
Level 1 Strategic Flood Risk Assessment

Final Report

April 2009

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B	April 09	Final Report	Nicola Bell **Planner** Helen Burton **Assistant Flood Risk Specialist** Jo Chesters **Senior Flood Risk Specialist**	Michael Timmins **Principal Flood Risk Specialist**	Kerry Whalley **Associate**

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Abbreviations

AA	Appropriate Assessment
AAP	Area Action Plan
ABI	Association of British Insurers
AEP	Annual Estimated Probability
AMR	Annual Monitoring Report
ASCCUE	Adaptation Strategies for Climate Change in the Urban Environment
AW	Anglian Water
BHS	British Hydrological Society
BW	British Waterways
CAMS	Catchment Abstraction Management Strategy
CBHE	Chronology of British Hydrological Events
CFMP	Catchment Flood Management Plan
DCLG	Department of Communities and Local Government
DEFRA	Department for Environment, Food and Rural Affairs
DPD	Development Plan Document
EA	Environment Agency
EMRA	East Midlands Regional Assembly
EU	European Union
FRA	Flood Risk Assessment
FZ	Flood Zone
GIS	Geographical Information System
HA	Highways Agency
HDC	Harborough District Council
HMA	Housing Market Area
HMSO	Her Majesty's Stationery Office
LCC	Leicestershire County Council
LDD	Local Development Document
LDF	Local Development Framework
LDS	Local Development Scheme
LFRS	Leicestershire Fire & Rescue service
LPA	Local Planning Authority
MDSF	Modelling and Decision Support Framework
MOD	Ministry of Defence
NFCDD	National Flood and Coastal Defence Database

ODPM	Office of the Deputy Prime Minister
OFWAT	Office of Water Services
PCPA	Planning and Compulsory Purchase Act 2004
PDL	Previously Developed Land
PPG	Planning Policy Guidance
PPS	Planning Policy Statement
PUA	Principal Urban Area
RBD	River Basin District
RBMP	River Basin Management Plan
RDDLP	Revised Deposit Draft Local Plan
RFRA	Regional Flood Risk Appraisal
RM/2	Flood Protection – Land Liable to Flood
RPG	Regional Planning Guidance
RSS	Regional Spatial Strategy
SA	Sustainability Appraisal
SCP	Sustainable Communities Plan
SEA	Strategic Environmental Assessment
SFRA	Strategic Flood Risk Assessment
SFRM	Strategic Flood Risk Mapping
SoP	Standard of Protection
SPG	Supplementary Planning Guidance
SRC	Sub Regional Centre
SRS	Sub Regional Strategy
SSSI	Site of Special Scientific Interest
STW	Severn Trent Water
SuDS	Sustainable Drainage Systems
SW	Scott Wilson
SWMP	Surface Water Management Plan
TCSA	Three Cities Sub Area
UDP	Unitary Development Plan
UKCIP	United Kingdom Climate Impacts Programme
WAG	Welsh Assembly Government
WRc	Water Research Centre
WCS	Water Cycle Study
WLP	Waste Local Plan
WFD	Water Framework Directive

Executive Summary

Local Planning Authorities (LPAs) are required to produce Local Development Frameworks (LDFs), which are a portfolio of Local Development Documents (LDDs) that collectively deliver the spatial planning strategy for the authority area. The LDDs undergo a Sustainability Appraisal (SA) which assists LPAs in ensuring their policies fulfil the principles of sustainability. Strategic Flood Risk Assessments (SFRAs) are one of the documents to be used as the evidence base for planning decisions and are a component of the SA process. Therefore, SFRAs should be used in the review or production of LDDs.

Planning Policy Statement 25: Development and Flood Risk (PPS25) and its Practice Guide Companion recommend that SFRAs are completed in two consecutive stages. The Level 1 SFRA enables application of the Sequential Test, and the Level 2 SFRA increases the scope of an SFRA for development sites where the Exception Test is required. The Sequential Test is a simple decision making tool designed to ensure that all sites at little or no risk of flooding are developed in preference to areas at higher risk. Where it is not possible, due to wider sustainable development issues, to locate the development in a low flood risk area, a sequential approach within the Flood Zone is required and the Exception Test should be applied where necessary. This Executive Summary and the accompanying SFRA report constitute Level 1 of the Harborough SFRA, which has been commissioned by Harborough District Council (HDC).

Flood related planning policy at national, regional and district levels has been collated and tabulated. This serves to highlight the fact that flood risk is taken into account at every hierarchical level within the planning process and also helps to demonstrate how the SFRA will feed into HDCs LDF process. HDC have not yet identified specific strategic development locations and the SFRA is designed to inform this decision making process.

The main source of flood risk policy and strategy within the region are Catchment Flood Management Plans (CFMPs). As well as highlighting the flood risks within a catchment, CFMPs also outline policies for dealing with flood risk management at various locations within the catchment. HDC falls within the Welland, Trent and Severn CFMPs.

The EA will take further action to reduce flood risk through policies set out in the CFMPs. There are opportunities for the Council to assist in the reduction of risk by vigorously applying PPS25, promoting the use of Sustainable Drainage Systems (SuDS) and seeking opportunities for flood storage. Increased channel maintenance will reduce debris build up and help reduce incidents of blockage and resultant flooding.

PPS25 requires that, as part of any SFRA, all sources of flooding are identified. In order to assess the risk of flooding, the Environment Agency (EA) has provided data and has been closely involved in the HDC SFRA. In addition, other key stakeholders have been consulted and those that have provided data include Severn Trent Water (STW), Anglian Water (AW), HDC, Leicestershire County Council (LCC), and local parish councils. From historical flood records, and using other sources of information, five main sources of flooding were identified: fluvial flooding, sewer flooding, surface water flooding, groundwater flooding and flooding from artificial sources.

The catchments of the River Welland, River Chater, River Soar, River Sence, River Avon and River Swift are the main hydrological influences of the study area.

In order to present the best available flood information, SFRA Flood Risk Zones are derived using a variety of existing sources of data. Where detailed numerical modelling of rivers has been undertaken and the flood outlines mapped, these have been used in preference to broad scale modelled flood outlines. All SFRA Flood Risk Zones are based on information provided by the EA and prescribed methodologies in PPS25.

The EA are constantly updating flood zone information. It is our understanding the updates for the area will be available soon and therefore, prior to undertaking any sequential testing or allocation of developments, the EA should be consulted to see if more detailed information is available. Any updated flood zone information can be incorporated into the SFRA at the next update.

Less than 10% of the administrative area of HDC falls within Flood Zone 3. The majority of the flood zones are rural areas, and therefore in general the flood risk within the Harborough District is not considered to be significant. However, urban locations within the study area that are potentially affected by flooding include, amongst others, Market Harborough, Broughton Astley and the Leicester Urban Fringe. In addition, there are numerous other settlements in the study area that have smaller areas at risk of fluvial flooding.

Sewer flooding was identified using historical records from the STW and AW sewer flooding DG5 databases detailing the total number of flood events that affected both internal and external property. The number of recorded sewer flooding events varies across the district and is represented on the Flood Risk Maps at street level, not at an individual property address.

Surface water flooding has been identified from Parish Council records. The records show numerous localised flood events with the main sources of flooding recorded as fluvial, surface water run-off and overland flow. The main areas affected by surface water flooding are Kibworth Beauchamp, North Kilworth, and Dunton Bassett.

No records of groundwater flooding were found during the course of the study. However, this does not mean that groundwater flooding does not occur, more that it has not been reported. Following periods of sustained rainfall, there may be potential for groundwater flooding to occur, which should be considered in the planning process of any new developments within the district.

Consultation with the EA and HDC, along with analysis of flood risk policy documents (Catchment Flood Management Plans) has revealed that there are structures and embankments (either purpose built or natural) that contribute to flood risk management, although these may not be depicted graphically on the mapping carried out for this SFRA, as the National Flood and Coastal Defence Database (NFCDD) (and hence the EA Defences Geographical Information System or GIS layer) is continually being updated. The EA maintain and keep records of many of the defences in the district, though it should be noted that there may be a great deal more “private” or “non-maintained” structures and embankments that may provide a level of protection to some areas. The standard of protection for defences within the study area varies between specific schemes having a Standard of Protection (SoP) of between 1 in 50 and 1 in 75 years.

In line with PPS25 the CFMPs have identified an increased level of flood risk to the district over the next 25 to 100 years as a result of climate change. Firstly as a result of wetter and warmer winters, an increase in large fluvial flood events is likely to affect the larger rivers and watercourses in the study area. Secondly, extreme rainfall events are likely to become more frequent leading to a greater storm intensity and duration. This is likely to lead to more run-off causing surface water

flooding and overwhelming of the urban sewer networks in particular. Revised guidance from the United Kingdom Climate Impacts Programme (UKCIP) is due to be released shortly and is likely to update current figures of increases in flood risk.

This SFRA was completed using the PPS25 climate change recommendations; however during the lifetime of this document it is quite likely that climate change levels may alter. As a result, future site specific flood risk assessments (FRAs) may have to adapt to these changes in line with current guidance in response to continuing research into climate change.

To attempt to counteract this increase in run-off in local areas, the use of Sustainable Drainage Systems (SuDS) is becoming more important. In addition to the more usual attenuation and infiltration systems, providing more green spaces within the urban environment can also help to reduce run-off and also increase wildlife habitat. These areas can sometimes be most effective when placed alongside development in water corridors. Groundwater Vulnerability (GWV) data was collected for this study. GWV refers to the potential for contamination of groundwater, rather than groundwater flooding, and can be used to identify areas suitable for particular SuDS techniques.

Using information and analysis gathered during the planning policy and flood risk reviews, a strategic overview of flood risk was carried out to identify potential conflicts between development pressures and flood risk now and in the future. The main elements of emerging Regional Spatial Strategy policy for the Leicester and Leicestershire Housing Market Area (of which Harborough District is a part) are strengthening the role of Leicester as a Principle Urban Area (PUA), strengthening the role of sub-regional centres such as Market Harborough and meeting affordable housing need. Harborough District's housing requirement is set at 8,800 dwellings to 2026, of which 820 should be located in or adjoining the Leicester PUA with the rest being located mainly in Market Harborough.

The East Midlands Regional Spatial Strategy (RSS) predominately directs new housing development to the Leicester Principal Urban Area (PUA) and Market Harborough. Although it is acknowledged that there is land within Flood Zones 2 and 3 in these areas, it is very minimal. It is therefore considered that the scale of development required can be directed to areas of the lowest risk of flooding (alongside implementing appropriate flood mitigation measures); to ensure the spatial strategy set out in the RSS can be achieved. It is however recognised that a proportion of new housing allocations in these areas are likely to be on greenfield land, due to the rural nature of the District and a large amount of previously developed land being used up in recent years.

SFRA Flood Risk Maps were produced to undertake local level assessments by "zooming" in on areas or settlements as requested by HDC. These assessments present all of the available flood risk information for a local area. The SFRA Flood Risk Maps and main issues in each area are presented as summaries to the side of the maps. The purpose of the local assessments is to identify where future strategic level development sites could potentially be located. In addition, the maps can be used to identify the requirements for, and also inform, site specific FRAs for future development. Guidance on undertaking site specific FRAs is provided in the report.

The Harborough SFRA has been completed in accordance with PPS25 and the current guidance outlined in the PPS25 Practice Guide Companion. The SFRA has been developed by building upon existing knowledge with respect to flood risk within the study area. These documents have an intended lifespan of 6 – 10 years. Therefore it should be noted that although up to date at the time of production, the SFRA has a finite lifespan and should potentially be upgraded or revised as

required by the LPA. As a result, it is recommended that the SFRA be adopted as a "living" document and should be reviewed regularly and, if necessary, updated with new flood risk or planning policy data.

1 Introduction

1.1 Background

The Planning and Compulsory Purchase Act 2004 (PCPA) (HMSO, 2004) requires Local Planning Authorities (LPAs) to produce Local Development Frameworks (LDFs) to replace the system of Local, Structure and Unitary Development Plans. LDFs are a portfolio of documents (Local Development Documents or LDDs) that collectively deliver the spatial planning strategy for the authority area. The PCPA 2004 requires LDDs to undergo a Sustainability Appraisal (SA) which assists LPAs in ensuring their policies fulfil the principles of sustainability. Strategic Flood Risk Assessments (SFRAs) are one of the documents to be used as the evidence base for planning decisions; they are also a component of the SA process and should be used in the production or review of LDDs.

The release of Planning Policy Guidance Note 25 (PPG25): Development and Flood Risk in July 2001 introduced the responsibility placed on LPAs to ensure that flood risk is understood and managed effectively using a risk-based approach as an integral part of the planning process.

PPG25 was superseded by Planning Policy Statement 25: Development and Flood Risk (PPS25) in December 2006. PPS25 re-emphasises the active role LPAs should have in ensuring flood risk is considered in strategic land use planning. PPS25 encourages LPAs to undertake SFRAs and to use their findings to inform land use planning. In June 2008, the Planning Policy Statement 25: Development and Flood Risk Practice Guide was released, which supersedes the Planning Policy Statement 25: Development and Flood Risk "Living Draft". The new PPS 25 Practice Guide sets out the requirements of an SFRA and their recommended approach has been adhered to by this SFRA.

To assist LPAs in their strategic land use planning, SFRAs should present sufficient information to enable LPAs to apply the Sequential Test to their proposed development sites:

> "The Strategic Flood Risk Assessment is at the core of the PPS25 approach. It provides essential information on flood risk, taking climate change into account, which allows the local planning authority (LPA) to understand the risk across its area so that the Sequential Test can be properly applied."
> *(PPS25, 2008:43*)

In addition, where development sites cannot be located in accordance with the Sequential Test as set out in PPS25 (i.e. to steer development to low risk sites): there is a need to apply the Exception Test. In which case,

> *"…the scope of the SFRA should be widened. This increased scope SFRA is referred to as a Level 2 SFRA. ..."*
> (*PPS25, 2008:45*)

In addition to forming a tool for use in strategic land use planning, an SFRA should also be accessible and provide guidance to aid the general planning process of a LPA.

1.2 The Harborough District SFRA

Harborough is a predominantly rural District located to the east and south east of Leicester, north east of Rugby and south of Melton Mowbray. The main urban area within Harborough is Market Harborough, with other key settlements including Lutterworth, Broughton Astley, Great Glen, Kibworth, Ullesthorpe, Fleckney, Houghton on the Hill and Thurnby with numerous additional parish villages. In total, the administrative area of Harborough covers approximately 602 km^2.

The emerging East Midlands' Regional Plan will form part of the Development Plan for Harborough District, setting housing requirements for the region down to District level. Following consultation on a draft plan, the Secretary of State's Proposed Changes were published in July 2008. This revised version of the Regional Spatial Strategy for the East Midlands (RSS8) is expected to be released early in 2009.

Also forming part of the Development Plan for the District are saved policies from the Harborough District Local Plan which was adopted in 2001. Full details of saved policies can be found on the Council's website at www.harborough.gov.uk/hdlp. These saved policies will gradually be replaced as Local Development Documents (LDD), forming part of the Local Development Framework (LDF), are adopted.

The spatial planning of any proposed development must be considered with regard to the current and future risk of flooding from a number of sources, including fluvial, surface water, artificial sources and groundwater. It is therefore vitally important that flood risk is considered at a strategic scale to inform land allocations and future developments proposed by the emerging LDFs.

1.3 The SFRA Structure

The Practice Guide Companion to PPS25 recommends that SFRAs are completed in two consecutive stages; this follows the iterative approach encouraged by PPS25 and provides LPAs with tools throughout the LDF and SFRA process sufficient to inform and update decisions regarding development sites. The two stages are:

- Level 1 SFRA – Enables application of the Sequential Test,
- Level 2 SFRA – Increases scope of SFRA for sites where the Exception Test is required.

The results of the SFRA will enable HDC to review the potential development sites and to inform the scope of the Sustainability Appraisal (SA).

1.3.1 Level 1 SFRA

The Level 1 SFRA (this report), should present sufficient information to enable the LPA to apply the Sequential Test to potential development sites and assist in identifying whether the application of the Exception Test will be necessary.

The objective of the Level 1 SFRA is to collate and review available information on flood risk from all sources for the study area. Information has been sought from a variety of stakeholders including the Environment Agency (EA), Harborough District Council (HDC), Leicestershire County Council (LCC), Highways Agency (HA), British Waterways (BW), Severn Trent Water (STW), Anglian Water, and Local Parish Councils. In addition to the review of data and consultation with local stakeholders, the Level 1 SRFA also considers any available data needed to meet the requirements of a Level 2 SFRA. Where necessary the report identifies works beyond the critical scope that may benefit the assessment.

The information presented in a Level 1 SFRA should not be considered as an exhaustive list of all available flood-related data for the study area. The Level 1 SFRA report is a presentation of flood sources and risk, which is based on data collected following consultation with and input from the LPA and relevant stakeholders, within the timeframe available. The Level 2 SFRA will enable the contacts and relationships with key stakeholders developed in the undertaking of the Level 1 SFRA to continue to assist in providing data and information for the Level 2 SFRA.

The Level 1 SFRA should be used by the LPA, together with other evidential documents to undertake Sequential Testing. This will help to identify where sites can be located in areas with lesser flood risk and this may require further investigation through a Level 2 SFRA.

1.3.2 Level 2 SFRA

A Level 2 SFRA would provide sufficient information to facilitate the application of the Exception Test, where required. The Level 2 SFRA would be based on information collected for the Level 1 SFRA and additional works where necessary.

In general, the Level 2 SFRA should aim to provide clear guidance on appropriate risk management measures for adoption on sites within Flood Zones 2 and 3. This should minimise the extent to which individual developers need to undertake separate studies on the same problem. The scope of a Level 2 SFRA cannot be fully determined until the Sequential Test has been undertaken by the Council on all possible site allocations.

1.4 The SFRA Aims & Purpose

The purpose of the SFRA is to identify areas within the Harborough District that are at risk of flooding by providing sufficient level of detail on all sources of flood risk to enable the Council to identify locations for future growth and apply the Sequential Test and Exception Test, where necessary.

The main objectives of the Level 1 Harborough SFRA, as identified in the tender brief dated August 2008, are:

1. to ensure the Council meets its obligations under PPS25 and other relevant guidance;
2. to inform the Level 2 SFRA and provide a reference document to inform decisions in the LDF about the directions for growth within the Harborough District and allocation of land for development;

3. to provide a reference document to advise and inform private and commercial developers of their obligations under the latest planning guidance; and
4. to provide recommendations which will help in drawing up criteria for the assessment of planning applications and to guide future development control decisions.

This Level 1 SFRA and other planning policy requirements will be used to identify future development sites. Any additional sites that require further investigation, following this SFRA, may need to be considered with site specific FRAs.

2 Study Area

The study area comprises the administrative area of HDC and covers a total area of approximately 602 km^2 of rural south Leicestershire. It is one of seven Leicestershire Districts and lies within the East Midlands Region. The main land use within the District is rural agriculture and grassland. The District is characterised by extensive tracts of countryside interspersed with ninety one rural village parishes.

The main urban population centres of the District include the market towns of Market Harborough, lying on the southern boundary of the District, and Lutterworth, close to the south western boundary. Broughton Astley, Great Glen, Kibworth and Fleckney serve as rural centres for the numerous smaller settlements spread throughout the remainder of the District. Thurnby, Bushby and Scraptoft form part of the built up area of the Leicester urban fringe.

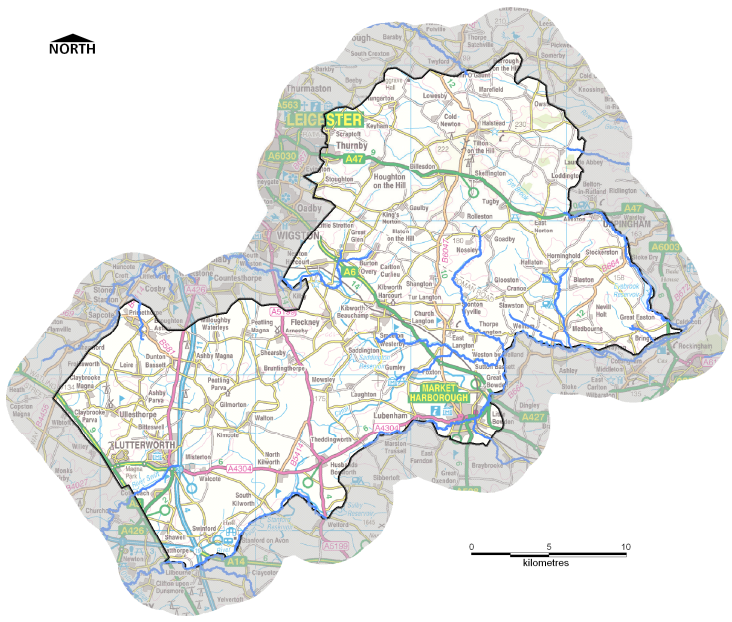

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Figure 2-1: Study Area

2.1 Administrative Bodies

2.1.1 Harborough District Council

The study area lies wholly within the administrative area of HDC. HDC is required to deliver planning strategies that manage and reduce the risk of flooding, and to consult the EA when preparing planning documents and determining applications.

HDC, in conjunction with LCC, are responsible for emergency planning within the district. Both Councils are Category One Responders under the Civil Contingencies Act. The two councils work together via the Local Resilience Forum, a partnership formed from all the Category One Responders in the surrounding area.

Since there are no Internal Drainage Boards (IDBs) in this area of Leicestershire, HDC assume responsibility for land drainage within the study area. These responsibilities include regulating activities along smaller watercourses and undertaking works to alleviate flooding or recurrent flooding in areas not within the responsibility of the EA. In some cases, HDC will also have responsibilities as a 'riparian' owner, through its management of parks and open spaces and as a significant landowner.

2.1.2 Environment Agency

The EA is the principal holder of flood risk data in the UK. Harborough falls within both the Midlands and East Anglian Regions of the EA and is administered by the Eastern and Central Area offices. The EA has discretionary powers under the Water Resource Act (1991) to manage flood risk for all Main Rivers and their associated flood defences within the study area, and as a result, are the holders of the majority of flood risk data available in the study area.

2.1.3 Leicestershire County Council

The County Council is responsible for producing appropriate plans for responding to flooding. The primary role of the authority in the event of an emergency is to provide care for people affected by the emergency. LCC is currently working on a county-wide flood plan, which is primarily founded on individual community based Local Flood Plans involving community wardens allocated for each flood risk area.

LCC, together with HDC, work together via the Local Resilience Forum, a partnership formed from all the Category One Responders in the surrounding area.

The LCC Highways Department has a duty to maintain the structure of public roads, bridleways and footpaths so that the public's right to pass along public highways is protected. The authority has powers to install and maintain drainage systems to prevent flooding to a highway and where this is necessary, the authority may be obliged to provide such measures. The authority may also take action to address problems related to the drainage of adjoining land, where this would otherwise threaten a public highway.

2.1.4 Severn Trent Water

STW provides potable water distribution for the Harborough administrative area and wastewater collection for the urban centres of Broughton Astley and Lutterworth. In addition, private individuals may be responsible for drainage systems in this area that operate prior to discharge either into a watercourse or into a public (adopted) sewer network. Table 2-1 shows the water suppliers and waste water collection handlers in the Harborough District.

2.1.5 Anglian Water

AW provides wastewater collection and management for the south and western region of the Harborough administrative area including the main population centre, Market Harborough. Again, private individuals may be responsible for drainage systems in this area that operate prior to discharge either into a watercourse or into a public (adopted) sewer network. Table 2-1 shows the water suppliers and waste water collection handlers in the Harborough District.

Table 2-1: Water supply and wastewater collection in the Harborough District

Town/Village Name	Water Supply	Sewer Controller
Market Harborough	Severn Trent	Anglian Water
Scraptoft and Thurnby	Severn Trent	Severn Trent
Stoughton	Severn Trent	Severn Trent
Houghton On The Hill	Severn Trent	Severn Trent
Tilton On the Hill	Severn Trent	Anglian Water
Billesdon	Severn Trent	Anglian Water
Tugby	Severn Trent	Anglian Water
Great Glen	Severn Trent	Severn Trent
Burton Overy	Severn Trent	Severn Trent
Newton Harcourt	Severn Trent	Severn Trent
Hallaton	Severn Trent	Anglian Water
Medbourne	Anglian Water	Anglian Water
Great Easton	Severn Trent	Anglian Water
Broughton Astley	Severn Trent	Severn Trent
Lutterworth	Severn Trent	Severn Trent
Claybrooke Magna	Severn Trent	Severn Trent
Ullesthorpe	Severn Trent	Severn Trent
Leire	Severn Trent	Severn Trent
Dunton Bassett	Severn Trent	Severn Trent
Ashby Magna	Severn Trent	Severn Trent
Bitteswell	Severn Trent	Severn Trent
Gilmorton	Severn Trent	Severn Trent
Walton	Severn Trent	Severn Trent
Peatling Magna	Severn Trent	Severn Trent
Arnesby	Severn Trent	Severn Trent
Walcote	Severn Trent	Severn Trent
Swinford	Severn Trent	Severn Trent
South Kilworth	Severn Trent	Severn Trent
North Kilworth	Severn Trent	Severn Trent
Fleckney	Severn Trent	Severn Trent

Town/Village Name	Water Supply	Sewer Controller
Saddington	Severn Trent	Anglian Water
Smeeton Westerby	Severn Trent	Anglian Water
Kibworth	Severn Trent	Anglian Water
Tur Langton	Severn Trent	Anglian Water
Church Langton	Severn Trent	Anglian Water
East Langton	Severn Trent	Anglian Water
Thorpe Langton	Severn Trent	Anglian Water
Foxton	Severn Trent	Anglian Water
Great Bowden	Severn Trent	Anglian Water
Lubenham	Severn Trent	Anglian Water

2.1.6 British Waterways

British Waterway's South East Waterways department is responsible for the Grand Union Canal which flows through the centre of the Harborough District. BW is accountable for undertaking a programme of inspection and maintenance of canal structures including any raised embankments, weirs and sluices, enabling the control of water levels within the waterways through interactions with fluvial watercourses.

2.1.7 Highways Agency

The study area falls within Network Operations Area 11 of the HA network. The Managing Agent Contractor (MAC) responsible for this Area is OPTIMA Infrastructure Management. Such highways include the M1 Motorway stretching roughly between junction 19 and north up to mid way between junctions 20 and 21 west of Ashby Magna; and the A5 Trunk road along the south western boundary of the study area.

2.1.8 Leicestershire Fire & Rescue Service

LFRS are involved in the emergency response to flood events within the study area. Their Civil Contingencies department currently implement a number of plans and protocols including a Draft Category 5 – Severe Flooding Procedure (currently undergoing staff consultation) and a Regional Water Rescue Standard Operating Procedure.

2.2 Historical Flooding

There have been numerous historical flood events in the Harborough study area. There are many contributing factors to these flood events, such as flooding from rivers, sewers and drainage network, land (overland flow) and groundwater.

Flooding resulting from a range of sources was therefore considered through consultation with key stakeholder administrative bodies widely responsible for a range of fluvial, pluvial (urban drainage), groundwater, and potential artificial sources of flooding.

Historical flood event data from the River Welland Catchment Flood Management Plan[1], the River Severn Catchment Flood Management Plan[2], the River Trent Catchment Flood

[1] River Welland Catchment Flood Management Plan, Draft Plan, Environment Agency, June 2008.

Management Plan[3], the British Hydrological Society Chronology of British Hydrological Events (BHS CBHE) database[4] and, internet searches were assessed to identify historical flood events within the study area.

Historical flooding records within the BHS CBHE database show frequent flood events at Market Harborough for the period 1852 to 2006. The sources of this flooding are listed as fluvial (River Welland and River Soar tributaries) and surface water run-off.

Flooding at Lutterworth from the River Swift is recorded during July 1875 and September 1931 but there are no more recent flood records for this area. The EA records report flooding from the River Swift to the north of Cotesbach near the sewage treatment works, but there is no date recorded.

The administrative bodies identified within Section 2.1 were also contacted as part of the SFRA for details regarding key locations for which they hold records of any historic flood events. Details were kindly supplied by the EA, HDC's drainage team, LCC Highways team, STW, AW and LF&RS.

Historical flood records from the EA show that areas of Great Glen, Wistow and Newton Harcourt were affected by flooding from the River Sence in 1999 and 2000 (February, April and November). Flooding from Burton Brook also affected Great Glen and areas of Burton Overy during the same months.

Flooding also occurred to Great Eastern, areas of Blaston and South Market Harborough from smaller, local watercourses, but the dates the flooding occurred is not known.

HDC historical records show frequent flooding of Market Harborough town centre, especially in the locality of the High Street, The Square, Church Street and Coventry Road. This frequent flooding is caused by insufficient capacity of the local public sewers. These records correlate with a BBC news article reporting frequent sewer flooding (1998 – 2004) affecting multiple local shops and businesses.

There are numerous records of flooding from overland flow and surface water run-off to the following areas; Scraptoft, Fleckney, Lubenham and Great Glen.

Ninety one Parish Councils within the study area were also contacted regarding any historical instances of flooding for which they have local knowledge or records. Specific emphasis was placed in the questionnaire on the broad dates and locations in which flooding has occurred, and if known, the sources of flood water, any hydraulic structures that may have influenced the level of flooding by being prone to blockage, and the resultant impacts caused by the floodwater such as identifying the features affected.

The records provided by the Parish Councils show numerous localised flood events with the main sources of flooding recorded as fluvial, surface water run-off and overland flow. The main areas affected by surface water flooding are Kibworth Beauchamp, North Kilworth, and Dunton Bassett. Areas of Peatling Magna are also affected by fluvial flooding from an un-

[2] River Severn Catchment Flood Management Plan, Draft Report, Environment Agency, May 2008
[3] River Trent Catchment Flood Management Plan, Final Draft Report, Environment Agency, October 2007.
[4]British Hydrological Society, Chronology of British Hydrological Events, Online Database, University of Dundee. http://www.dundee.ac.uk/geography/cbhe/

named watercourse which has a lack of capacity in the channel and culverts during periods of heavy rainfall.

The records also show that areas of Thurnby (Barley Lane, Station Road, Fiona Drive, Uppingham Rad, Grange Lane, Lakeside Court and Stoughton Road) are flooded following periods of heavy rainfall.

All the historical events from all sources are summarised within the Historical Flooding Records in Appendix A with the dates, causes and effects presented (where available). Detailed mapping of the Harborough District, provided in Appendix D, illustrates the locations of recorded historical flood events by information source.

Changes to land use practices and implementation of flood management schemes may affect the likelihood and frequency of flood events. Historical flood records are not indicative of the current or future flood frequency or magnitude and neither can they provide an indication that such a repetition of flooding will occur.

Data for historical sewer flooding was provided by STW on a post code basis. Where historical flooding to individual properties has been identified the information is presented by street name rather than the property name and / or address. The DG5 data provided by AW identified a particular clustering of events in Market Harborough and has been presented as a series of broad areas in GIS format.

The broad location of these flooding hotspots have however been collated within GIS layers and spreadsheet format which have been provided to HDC. Further consideration of these events with regard to any future development in the vicinity will therefore require detailed investigation as part of a site specific FRA to determine any such probabilities of recurrence from either source.

2.3 Flood Sources

2.3.1 Fluvial

The majority of the south eastern area of the District is drained by the River Welland, and the River Chater drains the north eastern area. The south western area is drained by the River Avon and River Swift, and the north western region of the District is drained by the River Sence and tributaries of Gaddesby Brook and Barkby Brook conveying water North West of the study area towards the River Soar. Many local watercourse tributaries assist in conveying water into these watercourses. Those smaller watercourses in the District that have been named are shown in Table 2-2 below.

Table 2-2: Local Named Watercourses

Laughton Brook	Barkby Brook	Medbourne Brook
Burton Brook	Queniborough Brook	Great Glen Brook
Langton Brook	Melton Brook	Gaddesby Brook
Saddington Brook	Broughton Astley Brook	Eye Brook
Scraptoft Brook	Stonton Brook	Foxton Brook
Thurnby Brook	Whetstone Brook	Bushby Brook
Mowsely Brook		

Following the nationwide major flood events of 2007, specific incidents of fluvial flooding were reported to HDC and responded to by engineers within Great Bowden, Keyham and Thurnby.

2.3.1.1 River Welland

The catchment of the River Welland drains the majority of the study area and represents the main flood risk to the community. The River Welland begins its course to the south west of the market town of Market Harborough, meandering in a north easterly direction through the town towards Welham Parish. The river then continues to flow eastwards through Bringhurst on the eastern edge of the study area.

The River Welland accepts inflows from the River Jordan which approaches Market Harborough from the south. The River Welland also accepts water from tributaries draining the study area including Langton Brook which approaches the River Welland from the west upstream of Welham. Langton Brook also conveys flows from its tributary Foxton Brook.

Stonton Brook, another Welland tributary, drains the area to the north of Thorpe Langton along with Medbourne Brook, which joins the River Welland south of Medbourne. Great Easton Brook joins from the north upstream of the River Welland's confluence with Eye Brook, carrying water released from the Eye Brook Reservoir. The River Chater, contributing to the larger Welland catchment, flows eastwards out of the study area conveying water from the Withcote and Launde Parishes.

The Upper Welland catchment is underlain by low permeability Lias clays, marlstone and clay soils known to experience some seasonal water logging. Diamicton till is commonly present overlying the higher ground with predominantly sand gravel and silt in the lower valleys.

The topography of the River Welland catchment within the study area is characterized by steep sloping river valleys, particularly on the River Jordan upstream of Market Harborough. Runoff in this area of the River Welland catchment discharges directly into the watercourses. The main cause of flooding in the catchment is heavy rain falling over a short time period, because in these higher elevations the impervious geology and steeper topography create higher rates of runoff. This causes flood flows to generally respond more rapidly resulting in relatively high flood velocities. The impact of heavy rain is exacerbated further by already saturated ground or blocked channels.

2.3.1.2 River Avon

The upper reaches of the River Avon flow south west along the HDC boundary conveying flows released from Sulby and Welford Reservoirs, where it is joined by further flows released from Stanford Reservoir. The River Avon continues to flow generally south westwards, north of Stanford Upon-Avon and south of Catthorpe.

To the north, the River Swift is a major tributary of the River Avon, their confluence being located approximately 4km south west of the study area at Rugby. The River Swift is sourced high in the Knaptoft Parish area and flows in a south westerly direction past Walton, Kimcote, Walcote and Misterton, continuing north of Cotesbach, south west of Lutterworth.

Impermeable Lias clays and mudstones dominate the Warwickshire Avon catchment. Diamicton till is commonly present overlying the higher ground with predominantly sand, gravel and silt in the lower valleys. These and the steep sloping ground result in flood flows generally responding more rapidly.

2.3.1.3 River Soar, River Sence and Other Tributaries

The River Soar is a major tributary of the River Trent and drains a catchment area of 1,380 km^2. The River Soar rises near Hinckley, just outside the Harborough District boundary, and flows across a flat valley northeast towards Leicester. Just south of Leicester, a minor reach of the Soar encroaches on to the western edge of the Harborough study area, before continuing to join the River Trent north east of Leicester at Trentlock, Nottingham.

The headwaters of the River Sence begin near Billesdon, Gaulby, Illston on the Hill and Houghton on the Hill. Burton Brook, a tributary, flows westwards through Burton Overy where it joins the River Sence at Great Glen. From here the Sence continues to flow westwards past Wistow and Newton Harcourt out of the study area towards the south of Leicester City where it joins the River Soar on its right bank.

Other tributaries of the River Soar include Broughton Astley Brook which flows northwards through Broughton Astley out of the study area. Barkby Brook originating north of Hungarton; Melton Brook sourced near Old Ingarsby; and Thurnby Brook and Bushby Brook originating near Houghton on the Hill, all flow north westwards out of the Harborough study area towards their confluences with the River Soar in Leicester.

The area of Great Glen is known to have suffered from periodic flooding for a number of years. Parts of Great Glen are situated on low-lying areas, predominantly the southern areas of Great Glen, which is partly responsible for the periodic flooding. The risk of flooding in this area has been witnessed to have reduced by the new water balancing arrangements installed when the new A6 by-pass was constructed**.**

The CFMP states that across the River Soar, upper River Sence and their tributary catchments within the study area the main soil type is ‘loamy’, underlain by carboniferous limestone and triassic mudstone. Whilst the limestone in the upland areas is more permeable, the steep slopes can dominate and promote rapid surface run-off. By comparison, the more dominant mudstone rocks have high clay content and are less permeable.

The catchment is therefore moderately well drained, but in the lower lying parts it can be seasonally waterlogged. The catchment run-off can, therefore, be quite variable, and when waterlogged will result in a rapid response with high run-off rates.

2.3.2 Pluvial and Overland Flooding

During periods of prolonged rainfall events and sudden intense downpours, surface water runoff may exceed the capacity of existing drainage systems or combine as overland flow from adjacent higher ground subsequently 'ponding' in low-lying areas of land (without draining into watercourses). One of the main issues with pluvial flooding is that in areas with no history of flooding, relatively small changes to hard surfacing and surface gradients can cause flooding (i.e. garden loss and reuse of brownfield sites). As a result, continuing development could mean that pluvial/surface water flooding can become more frequent and although not on the same scale as fluvial flooding, it can still cause significant disruption.

The Harborough District and its town centres such as Market Harborough, Lutterworth, Great Glen and Kibworth regularly suffer from flooding (See Records of Historical Flooding in Appendix A). Great Glen has flooded eight times in the last ten years with the main causes reported as fluvial flooding from the River Glen and River Sence and surface water run-off. Flooding from the River Swift and surface water run-off was reported in Lutterworth during 2008 with regular more localised flooding, caused by inadequate drains, affecting Station Road near the Town Hall. Kibworth has flooded three times since 2004 with many areas affected by surface water run-off following heavy rainfall.

Much of the flooding experienced in 1999, 2002 and 2006 in Market Harborough during the summer months can be attributed to pluvial/surface water flooding following prolonged intense rainstorms. The main factor behind this flooding is believed to be the insufficient capacity of the drainage system following heavy rainfall events causing flooding.

The last major flood occurred in Market Harborough on Tuesday 30th July 2002 during the wettest day on record since June 1982. Approximately 60mm of rain fell across Leicestershire. The town suffered 30 mm of rainfall within an hour flooding over 70 business properties within the town centre. The main factor contributing to these floods was determined to be the insufficient capacity of the local public sewers prior to discharge to the River Welland. The drainage problems were also considered to be associated with the lack of drainage provision for new housing developments, causing backing up within the existing drainage system.

In January 2008, a period of intense rainfall on already saturated land caused flooding in a number of Harborough's rural areas, including Great Glen, Foxton, Billesdon, Burton Overy, Newton Harcourt, Kibworth, Thurnby, Lutterworth, Lubenham and Scraptoft. The historical localised flooding is widely known throughout the area, reflected by the local Grammar School within the town centre of Market Harborough having been built on stilts.

OPTIMA Infrastructure Management on behalf of HA, confirmed that there had been previous recorded incidents of surface water flooding on the M1 and A5 trunk road within the study area since their contract had began, however these were subsequently cleared upon arrival of their Incident Support Unit. The Area Engineer also confirmed there are currently no known flood risks associated with either of these roads.

2.3.3 Sewers and Drainage

The majority of sewers built in the last 30 years are built to the guidelines within "Sewers for Adoption" (WRC, 2006). These sewers have a design standard to contain up to and including the 1 in 30 year rainfall event. Therefore the majority of sewer systems will surcharge during rainstorm events with a return period greater than 1 in 30 years (e.g. 100 years). Many sewers are however much older and date back to the Victorian era and are of an unknown capacity and condition.

AW and STW provided DG5 data for the region which indicated that flooding hotspots across the study area have been affected by flooding from sewers. Sewer flooding is thought to be the most common cause of flooding in the UK and yet there is limited information available on the issue.

A town centre pub and other local businesses located on the High Street in Market Harborough have suffered severe sewer flooding in four of the last six years, illustrating the severity and frequency of flooding in this area (BBC). The area of Church Street in Billesdon is also a known flooding hotspot.

The DG5 data provided by STW has been presented as a series of points in GIS format to HDC. This data shows sewer and drainage flooding to have occurred throughout the study area, with a particular clustering of events in Billesdon, Great Glen and Lutterworth. Currently, investigation is being undertaken by Pick Everard who was appointed by STW to assess foul sewers within Billesdon with a view to ascertain the necessity for remediation work.

The DG5 data provided by AW identified a particular clustering of events in Market Harborough and has been presented as a series of broad areas in GIS format.

Leicestershire County Council has in the past responded to a number of incidences involving highway drainage issues and problems caused to property owners. These were in Newton Harcourt, Upper Bruntingthorpe, Mowsley, Tugby, Kings Norton and Thurnby. LCC have since reported that all these issues have been dealt with satisfactorily, except within Tugby which is currently dependant on work being undertaken by Anglian Water.

Approximately £500,000 is being spent on a series of measures to reduce the risk of flooding caused by heavy rain in key areas of Leicestershire County[5]. Within the study area, the money is being spent on extensive research which will enable LCC to determine the most effective way of tackling flooding in Leicestershire. The aim is to minimize the risk of widespread flooding previously experienced in parts of the county.

Within Harborough, £50,000 of this money is to fund work to reduce flooding in Coventry Road, Market Harborough and £30,000 each is being spent to tackle flooding along South Churchill Road in Cranoe, and Mill Lane in Smeeton Westerby. A further £35,000 is to fund tackling flooding at Burton Overy village centre. Road drainage improvement schemes have either begun, or have been planned for, in Market Harborough, Cranoe, Burton Overy and Smeeton Westerby.

[5] http://www.leicestershire.gov.uk/pressrelease.htm?id=136322, Leicestershire County Council, 20/08/2008, Accessed 13/11/2008.

The interim findings of the Pitt Report (June 2008) highlighted sewer and drainage flooding as a key issue requiring further investigation. This should be addressed in any future site specific flood risk assessments, or informed by any emerging Surface Water Management Plan (SWMP). SWMPs are used to plan and deliver improved surface water drainage in existing urban areas and for new development through a partnership of stakeholders. Any relevant additional data should be incorporated into the SFRA when it is updated.

SWMPs and SFRAs also have close links to Water Cycle Strategies. Whereas a SWMP concentrates on surface water issues a Water Cycle Strategy is undertaken to examine water infrastructure options to satisfy the requirement for housing, population and economic growth (additional development growth) in order to provide Water Services Infrastructure in a timely manner through sensitive environmental and social planning, which minimizes the additional use of natural resources. The strategy would include an assessment of any potential issues with the sewer and drainage network such as flooding hotspots and network capacity, and would provide a more holistic view of water issues within the study area.

Draft guidance currently being produced by the Environment Agency suggests that a Water Cycle Study (WCS) should be undertaken if:

- The scale of growth proposed by regional or local planning is significant when compared to the existing urban development. At present, significant refers to a 5% increase in new housing stock during the LDF period;
- The Environment Agency raise concerns about the environmental capacity of the water cycle to cope with proposed development;
- The Water Company identifies there are problems with funding, or putting new systems in place to meet the development framework;
- The development area is a proposed eco-town;
- It is a Growth Point status condition; or
- It is a condition of the RSS or LDF.

In areas of high housing growth, water cycle studies and water cycle strategies will play an important role in developing programmes for enabling the required improvements to water infrastructure to be provided. Figure 2.2 sets out the links between SFRAs, SWMPs and Water Cycle Studies. Any relevant additional data should be incorporated into the SFRA when it is updated.

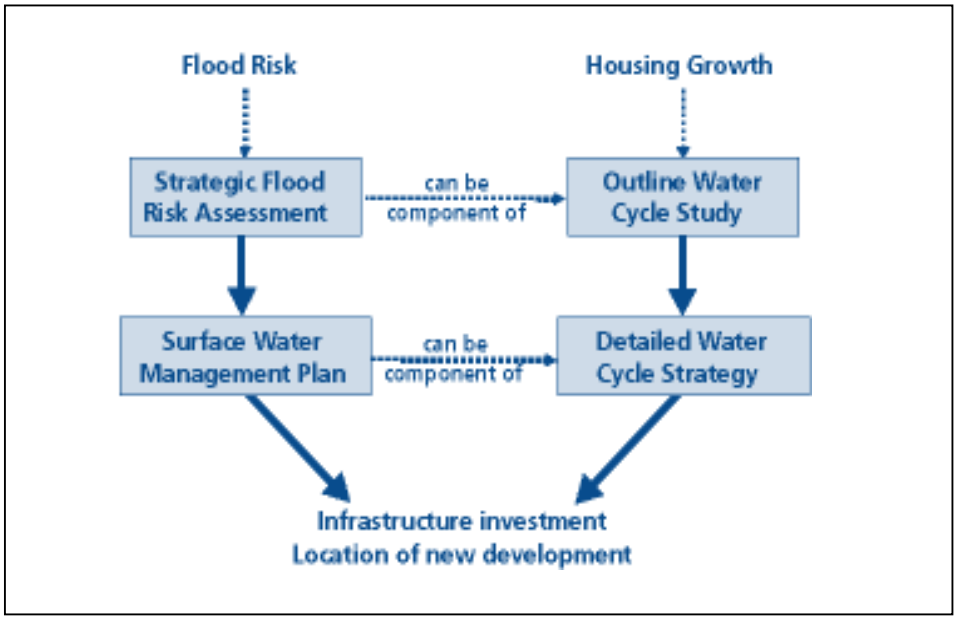


Figure 2.2: - Links between Water Cycle Studies, SWMPs and SFRAs

2.3.4 Groundwater

Groundwater flooding usually occurs following a prolonged period of low intensity rainfall. The future risk from this source is more uncertain than surface water as the climate change predictions indicate that although sea levels will rise, thus possibly raising groundwater levels, overall summer rainfall will decrease, therefore having a long-term effect of lowering the groundwater levels.

The DEFRA Strategy for Flood and Coastal Erosion Risk Management study (2004)[6] did not show any recorded instances of groundwater flooding in the study area. This does not mean that is has not occurred, or that it will not occur, just that none has been recorded in the EA records. There are no further additional historical records of groundwater flooding in the region; however it is still a possibility.

Further consideration of the risk of groundwater flooding should be considered as part of a Level 2 assessment or through site specific FRAs.

2.3.5 Reservoirs, Canals and other Artificial Sources

The Grand Union Canal runs generally south east from the west of Newton Harcourt parallel to the River Sence through the centre of the study area towards Market Harborough with a second branch redirecting south west passing Husbands Bosworth towards Rugby.

[6] DEFRA Strategy for Flood and Coastal Erosion Risk Management Groundwater Flooding Scoping Study (LDS 23) (May 2004)

As the flows into and out of canals are heavily regulated, flooding is rare, however flooding can occur as a result of overtopping of canal banks, adjacent to emergency relief sluices (paddles) or, in very rare cases, as a result of an elevated embankment failure.

The BHS CBHE database documents one instance of flooding along the Grand Union Canal in August 1865, just south west of Smeeton at the confluence of the Grand Union Canal aqueduct and a feeder channel from Saddington Reservoir (refer to the Historical Flooding Records table within Appendix A). However, as stated in Section 2.2 historical incidents are not necessarily indicative of the current or future likely frequency or magnitude that such a repetition may occur.

BW subsequently confirmed through consultation that there have been no incidents of flooding on record originating from canals in which they are responsible for within Harborough and as such, there are no known flood prone areas. There are no flood defence measures along the Grand Union Canal, however BW undertake routine maintenance of their structures and have a regular inspection routine. This is usually undertaken in response to badger activity and is not specifically aimed at reducing flood risk. The flood risk from BW's canals is consequently considered to present a low flood risk to the study area.

There are several reservoirs within the study area and within the river catchments upstream of the study area that fall under the Reservoirs Act (i.e., greater than 25,000 m^3 capacity) including Eye Brook Reservoir, the location of which are shown on the detailed mapping in Appendix D.

Reservoirs carry with them an inherent flood risk as they have the potential to breach or overtop. Eye Brook Reservoir is located to the north east of Great Easton to the south of the HDC boundary. The reservoir is located upstream of Caldecott on the Eye Brook. If the reservoir were to breach or overtop water would flow down the Eye Brook through Caldecott to the River Welland. Great Easton is unlikely to be affected as the urban settlement is located at a higher level than the reservoir.

In addition, there are numerous smaller reservoirs which are associated with the rural nature of the study area including several balancing reservoirs and flood storage ponds (FSP) such as Saddington Reservoir, Medbourne Brook FSP and Great Easton FSP.

HDC may wish to undertake more detailed analysis of particular water bodies to determine flood risk in areas allocated for development downstream of reservoirs. This can be considered as part of a Level 2 assessment or a site specific FRA (under review of a Panel Engineer).

2.4 Flood Risk Management

2.4.1 Defence Infrastructure

There are several flood risk management schemes in operation throughout the study area. These offer varying standards of protection (SoP). There are currently flood risk management schemes in operation at Market Harborough on the River Welland to the south of the study area in the form of raised embankments and concrete flood walls; the SoP offered by these structures is 1 in 75 years as the river flows through the centre of Market Harborough.

There are also flood defences present in the Great Glen area but the SoP offered by these structures and their exact location is unknown as they are not included on the EA National Flood and Coastal Defence Database.

Bowden and Braybrooke Offline Flood Storage Reservoirs are located along the River Jordan to the south of the study area. The River Welland CFMP states that the Flood Storage Reservoirs provide a SoP of 1 in 50 years (2% Annual Estimated Probability (AEP)) to Market Harborough, and particularly during low magnitude but high frequency events (notionally 10% AEP events).

AW implemented a £2m investment programme in June 2005 constructing a storage tank beneath the Commons Car Park near Jubilee Gardens in Market Harborough to attenuate sewer flood flows by upgrading the capacity and controlling the sewer outfalls into the River Welland. Since the completion of this work, it has proved a benefit to Market Harborough town centre which subsequently escaped flooding during periods of flash heavy rainfall in June 2007 which would have otherwise deluged the town centre[7].

Online FSRs along Medbourne Brook and Great Eastern Brook to the east of the study area provide a SoP up to the 2% AEP event. Eye Brook along the eastern boundary of the study area provides protection to Caldecott along with the Caldecott sluices.

It should be noted that flood risk management schemes are built to a certain design standard and have a certain design life. As climate change increases peak flows the SoP is likely to decrease over the course of the scheme's lifetime. In order to maximise the SoP, it is necessary to carry out regular maintenance and inspection of any flood risk management structures in the study area.

2.4.2 Flooding Mechanisms

2.4.2.1 Overtopping

Overtopping occurs when water passes over the crest of a flood defence. When flow exceeds the capacity of the conveying channel, the water level will rise in that channel until its banks are overtopped. Water will then spill over the channel banks and onto adjoining land. With an upland river the adjoining land is its natural floodplain and will generally be of limited extent and fairly well defined. In a downstream river where the gradient flattens the floodplain can be much wider. Flood risk management and urban development can significantly alter natural flow paths within the floodplain area and affect the dispersion of floodwater.

Flood defences are usually designed with a degree of 'freeboard', the height by which the crest level of the defence exceeds the design flood level. Main river defences and tidal embankments are designed to have a constant freeboard above their design level so, in theory, when they are overtopped the overflow should be small in volume and of uniform depth along the full length of the defence embankment, occurring during the highest water levels at the peak of the flood. In reality the freeboard varies from point to point due to the natural subsidence of defences over time, and water heights can vary locally. Even so, the embankment acts like a weir limiting the rate of flow and volume over the embankment and limiting flooding velocities and volume to the immediate area.

[7] http://www.harboroughmail.co.uk/news/39Flood-defences-save-town39.2986826.jp, Harborough Mail, 28 June 2007, Accessed November 2008.

2.4.2.2 Breaching

Breaching of flood embankments is one of the main causes of major flooding in lowland areas. Breaches can occur in any situation where there is a defence which has a crest raised above adjacent land levels. An earth embankment may be breached as a result of overtopping, which weakens the structure through erosion, eventually creating a breach in the defences. Breaches in embankments are more likely during high water level events. A fluvial breach in an embankment will result in the dispersal of floodwater from the channel resulting in a lowering of the water levels and flow through the breach.

The time taken for a breach to be sealed can have a major effect on the extent and depth of flooding. In addition to the flood risk associated with a breach event, there is an implied flood hazard. The highest hazard exists in the period immediately following a breach, and usually, but not necessarily, in the areas closest to the breach, also known as the Rapid Inundation Zone. Floodwater flowing through a breach will be of high velocity and volume, dissipating rapidly across large low-lying areas, and possibly affecting evacuation routes. Flooding as a result of a breach in defences can be life threatening with far reaching consequences.

It is recommended that a precautionary approach be taken with regard to development behind defences. Until a time when the results of a detailed hazard mapping study are available (during any Level 2 SFRA) it is recommended that each development is judged on its vulnerability class and that the developer is responsible for providing evidence (through a site specific FRA) that the risk to the site and surrounding area can be managed and that the development remains safe.

2.4.2.3 Mechanical or Structural Failure

Flooding may result from the failure of engineering installations such as land drainage pumps, sluice gates and floodgates. Hard defences may fail through the slow deterioration of structural components such as the rusting of sheet piling, erosion of concrete reinforcement and toe protection or the failure of ground anchors. Such deterioration is often difficult to detect, so that failure when it occurs is often sudden and unexpected. Failure is more likely when the structure is under maximum stress, such as extreme fluvial events when pressures on the structure are at its most extreme.

2.4.3 Flood Warnings

The Civil Contingencies Bill requires that the EA 'maintain arrangements to warn the public of emergencies'. The EA are responsible for issuing flood warnings to the public based on 24 hour monitoring of rainfall, river levels and sea state (where applicable). This data is combined with weather data and tidal reports from the Met Office, including the use of radar to track storms and rainfall intensity, and data from the national tide gauge network. The warnings are issued by local radio, supplemented by direct dial telephone systems, (Floodline Warnings Direct[8]), which are updated every 15 minutes, and other local systems as appropriate. The EA also endeavours to raise awareness of flooding in areas prone to flooding and suggest that people living in vulnerable areas make preparations in advance.

[8] www.environment-agency.gov.uk/floodwarnings, Environment Agency, 2008

The EA has general supervisory and other statutory duties for flood defence and flood warnings in Harborough. The work carried out to meet these duties includes:

- Maintaining main river channels and flood risk management structures,
- Providing and operating a flood warning service.

The existing warning service provided by the EA applies only to flooding from rivers and the sea. There is no obligation on water companies to provide warnings of flooding from sewers or drains.

The degree of advance warning that can be provided is critical to the amount of action that can be taken to prevent damage. A minimum of 2 hours advance warning is the standard currently used in England and Wales for river flooding. The ability to provide this depends on the geography of an area, the intensity of the rainfall and the type of weather systems causing the rain as these variables can act together to produce an unlikely and therefore unpredictable event.

When conditions require, the EA provide local forecasts on the possibility of flooding and determine which defences to operate and when, closing moveable defence features if necessary.

The role of flood warnings in flood risk and residual risk reduction can be either a standalone measure or in combination with built defences and should be used to benefit existing development but not facilitate new development. Flood warning as a stand-alone measure can reduce the consequences of flooding to properties by enabling reactive action to protect life and reduce the effect of flooding on property. Flood warning in combination with built defences can protect life and reduce damage in the event of the defence level being exceeded by the severity of the flood.

The need for flood warnings in medium and highly populated areas, such as Market Harborough and Lutterworth is particularly important, as the consequence of flooding in areas where people's perception of flood risk is low can be significant. In such cases flood warning needs to work closely with emergency planning to allocate potential evacuation routes and contingency plans following a flood event. The difficulties of issuing effective warnings of possible defence failure poses a significant challenge and in some cases it will not be practical to provide a reliable or timely flood warning service to an area because of the rapidity or unpredictable nature of flooding.

There are a number of flood warning areas in Harborough, including along the river corridor of the River Welland and its main tributaries including between Market Harborough and Stamford (EA Ref. 055FWFPUWE01), and in the Lubenham and Market Square area of Market Harborough (EA Ref. 055FWFPUWE02). Flood warnings are also provided along the River Jordan in Little Bowden (EA Ref. 055FWFPUWE03) and along the River Avon downstream of Stanford Reservoir.

2.5 Potential Development Pressures

The District of Harborough covers an area of approximately 602 km^2 and is situated in the south of Leicestershire and borders Warwickshire to the west, Northamptonshire to the south and Rutland to the east. There are 5 rivers (Swift, Avon, Welland, Sence and Eye Brook) and the Grand Union Canal that flow through the District.

The District is largely a rural area with the towns of Market Harborough and Lutterworth providing the main built-up areas, with the remainder made up of rural centres and a large number of smaller villages and hamlets. The rural nature of the District is emphasised by the majority of settlements (71 out of 93) having a population of less than 500 people. The total population of the District is 76,559 (census 2001), with 65% of the population living in Market Harborough and Lutterworth.

Harborough has a strong relationship with neighbouring authorities, given the proximity of key employment centres and the resultant inward and outward commuting across District boundaries. To this end Harborough District forms part of the Three Cities sub-area which includes Derby, Nottingham and Leicester. Leicester City has the strongest relationship with Harborough District, which is reflected in Harborough forming part of the Leicester and Leicestershire Housing Market Area (HMA). Scraptoft, Thurnby and Bushby form part of the Leicester Principle Urban Area as defined in the emerging East Midlands' Regional Plan.

2.5.1 Housing Land

The amount of housing provision required in Harborough District in the future is set out in the Adopted RSS8 and revised in the Draft Regional Plan Proposed Changes which will replace the RSS8 when adopted. The table below illustrates the difference in the number of dwellings required in these documents.

Table 2-3: Housing Requirements

Policy	Timeframe	Total Housing Requirement
Adopted RSS8	2001 - 2021	7550 (377 per annum)
Regional Plan Proposed Changes	2001 - 2026	8800 (355 per annum)

A housing Monitoring Paper was prepared for 2007 / 2008 to assess completions, commitments and the housing trajectories, both through to 2021 to meet the adopted RRS8 targets and through to 2026 to meet the targets set out in the emerging Regional Plan.

The Paper demonstrates that from the start of the Regional Plan period (2001) the total net housing completions (up to 31st March 2008) are 2749. Taking this figure into consideration the remaining dwellings required to 2021 (to meet the RSS8 target) is 4801 (369 per annum) and to 2026 (to meet the emerging Regional Plan target) is 6051 (336 per annum).

Harborough has projected completion figures for the next 5 years to be 1519 dwellings, across allocated sites within the Local Plan and existing permissions. This expected number of completions illustrate that Harborough District will not meet the RRS8 5 year target of 1781 between 2008/9-2012/2013 (262 dwelling shortfall), but it will surpass the emerging Regional Plan targets.

Shortfalls in housing provision are identified beyond the 5 year period. Although this is subject to change as a result of windfall site and future planning permissions, it indicates that HDC will need to allocate further land for housing through the LDF process.

A Strategic Housing Land Availability Assessment (SHLAA) is currently being prepared by HDC to understand the level of housing potential within the District and to identify sites which are considered to be suitable for housing and could potentially be developed. The assessment is due to be completed by the beginning of April 2009.

The proportion of housing developed on previously developed land has risen dramatically from 33% in 2001/02 to a record high of 90% in 2007/08, with the target of 60% being surpassed for the past 4 years. The trajectory shows that Harborough DC will be able to meet the target for the next 2 years but beyond this the 60% is not expected to be met due to the large greenfield allocations coming forward.

The District's housing requirement as set out in the Proposed Changes to the RSS is for the provision of 8,800 dwellings between 2001- 2026. The RSS specifies that, of the 8,800 District requirement, 820 dwellings should be located within or adjoining Leicester Principal Urban Area (PUA). It goes on to state that development in the remainder of the District will be located mainly at Market Harborough.

This RSS requirement that growth outside the PUA should be directed to Market Harborough is not reflected in completion, commencement and commitment figures since 2001. Between 2001/2002 and 2007/2008 58% of completions and commencements and 50% of unbuilt commitments have been outside the PUA and Market Harborough. It is therefore likely that in order to ensure conformity with the emerging RSS, a relatively large amount of housing will need to be directed to Market Harborough. The broad locations for development will be set out in the forthcoming Core Strategy, with specific sites identified in the Allocations DPD.

2.5.2 Employment Land

From the beginning of the Regional Plan period (2001) to 31st March 2008 a total of 83.77 ha of employment land has been developed across the District. General employment and warehousing floor space is focused at the Magna Park site to the West of Lutterworth, with office space concentrated in Market Harborough.

During 2007/08, only 4.78 ha of employment land development was completed. Of this total 4.67 ha was on Greenfield land. This accounts for 58.3% of all the employment completions on Greenfield land during the current plan period. It is noted that there has been a trend in recent years of residential development occurring on old employment sites.

As with future housing allocations, employment land is likely to be allocated in the main urban centres of the District – Market Harborough and Lutterworth. However, it will remain important that rural economies are continued to be supported whilst ensuring the protection of the countryside which surrounds the settlements. One key consideration for employment land

allocations will be whether to extend the Magna Park site in Lutterworth. This is something that will be considered as part of the Core Strategy and Allocations DPDs in the emerging LDF.

2.6 Climate Change and Future Flood Risk

PPS25 and the accompanying Practice Guide allows for an increase in the peak rainfall intensity of up to 30%. This will significantly affect smaller urban catchments, leading to rapid runoff to watercourses and surface water flooding, surcharging of gullies and drains and sewer flooding.

The CFMP documents have also considered flood risk for the next 50-100 years and taken into account the flood risk drivers of climate change, urban development and changes in land use. Catchment models and the Modelling and Decision Support Framework (MDSF) software were used in the CFMP to test sensitivity to the flood risk drivers across the catchments in the study area.

Changing land use may have positive (mitigating) or negative impacts on flood risk. It is widely believed that large scale increases to the amount of 'green spaces' such as tree planting and habitat creation within the National Forest, or the incorporation of parks and open spaces within development, may have an attenuating effect on peak river flows. This is possible through increased interception of rainfall and evapotranspiration by vegetation, and also in the increase of permeable land. These effects may be maximised by strategically linking such green spaces into corridors or areas.

To account for climate change in Harborough, modelled flood outlines for Flood Zone 3a and 3b with an allowance for climate change were provided by the EA for several watercourses, although these outlines also included the effects (benefits) of flood defences. In accordance with PPS25, a precautionary approach to the portrayal of flood zones would be those which do not take into account the presence of defences. The EA are constantly updating flood zone information. It is our understanding the updates for the area will be available soon and any updated flood zone information can be incorporated into the SFRA at the next update.

Where there are no modelled climate change flood levels without the presence of defences, an estimate of the impacts of climate change on flood outlines will be required. To this end, the Flood Zone 2 (1 in 1000 year) outlines could be used as a proxy. This is not to say that the 100 year flood outline will necessarily increase to the 1 in 1000 year outline, but rather that one would expect the depth and extents of flooding to increase to somewhere between the 1 in 100 year and 1 in 1000 year outlines. This is a conservative approach designed to help strategic planners identify where increased detail and resolution in the flood outlines is required. Further consideration of the risk of flooding as a result of climate change should be considered as part of a Level 2 assessment or through site specific FRAs.

Sewer and surface water flooding are likely to become more frequent and widespread under urbanisation and climate change scenarios as the amount of impermeable surfaces and runoff increase. PPS25 (Annex F) requires that FRAs take account of all types of flooding, including surface water flooding. For new developments, the best way of avoiding and managing surface water flooding is to control the water at source through SuDS. SuDS help adaption to climate change and deliver RSS8 and HDC Local Plan objectives in relation to

management of surface water run-off, climate change and flooding. Further mitigation measures for new development are suggested in Section 6.2.3.

The location of future urban developments and flood defences within a catchment can heavily influence flood risk in the area and has the potential to further increase flood risk at sites downstream of such developments. Impacts include the lowering of the SoP offered by flood defences and the carrying capacity of culverts, drains, sewers and watercourse channels. This potentially leads to areas being at risk of flooding that were previously not at risk and highlights the increasing conflicts and pressures that are emerging between climate change scenarios and future development aspirations.

The PPS 1 Climate Change Supplement sets out important objectives in order to tackle climate change, sea level rise and avoid flood risk. The purpose of design policies should be to ensure that developments are sustainable, durable and adaptable to natural hazards such as flooding. Following this guidance, it should be possible to mitigate against increased flood risk through incorporating 'flood proofing' measures such as raised finished floor levels into the development design, and/or development of compensatory storage and flood storage basins.

The Adaptation Strategies for Climate Change in the Urban Environment (ASCCUE) project is a study undertaken collaboratively by the University of Manchester, The University of Cardiff, University of Southampton and Oxford Brooks University.

The project aimed to further the understanding of the impacts and risks of climate change on towns and cities through three 'exposure units' of human comfort, urban green space and the built environment. One of the aspects examined was surface water runoff during extreme rainfall events. With an increase in development, there comes an increase in the amount of impermeable areas thus leading to increased runoff during storm events. In one of the worst-case modelled scenarios (large urban centre) an increase in rainfall of 56% by 2080, led to an increase in runoff of 82%. This highlights the increasing conflict and pressures that are emerging between climate change scenarios and future development aspirations.

2.6.1 Fluvial Flood Risk

Scott Wilson has been provided with several detailed hydraulic model results for watercourses within the study area. There is a potential for increased peak river flow as a result of climate change; an increase in peak flow results in a greater floodplain envelope. The methodology is explained further in Section 4.5.

Annex A of PPS25 advises that the effects of climate change at a regional level are likely to mean an increase in peak river flows and rainfall intensities and these impacts should be considered in the preparation of site-specific Flood Risk Assessments. See Table 2-4 below.

The River Welland CFMP states that in Market Harborough the future flood extents and depths are greater than the current situation.

Table 2-4: Recommended precautionary sensitivity for rainfall intensities and river flows (PPS25 Table B.2)

Parameter	1900 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	+5%	+10%	+20%	+30%
Peak river flow	+10%	+20%		

A lifespan of 60 years is used for a commercial development, and 100 years for residential development, e.g. a commercial building built in 2009 could be assumed to reach the end of its design life in 2069. Most models are not able to accommodate a tiered increase in river flow, and so the standard procedure is for the increase in flow to be taken as 20% as an appropriate allowance. It should be noted, however, that where possible, a managed adaptive approach to the effects of climate change should be adopted, which will allow for further adaptation in the future as understanding of the effects of climate change improves.

When applying the Sequential Test, it is recommended that the climate change scenarios should be used in order to take flood risk into account over the expected lifetime of the development.

2.6.2 Surface Water and Sewer Flooding

In general climate change is predicting more frequent short duration high intensity storm events and as a result the potential increase in peak rainfall intensity (see Table 2.4) is likely to lead to an increase in surface water flooding, surcharging of gullies and drains and sewer flooding. Flood risk from surface water run-off could potentially increase by the same order (20% increases) as fluvial and tidal flood risk.

The study of flood risk in the Harborough District indicates that some areas (Market Harborough, Peatling Magna, Dunton Bassett, North Kilworth and Kibworth Beauchamp) are particularly susceptible to surface water flooding (Appendix A). It is therefore important that development of any site does not increase the rate or volume of run-off leaving the site as this would further increase the risk of flooding in neighbouring areas.

Historically, traditional approaches to urban drainage have comprised of underground tank and pipe networks. More recently the benefits and opportunities to use SuDS have been realised and encouragement to use such systems is found throughout flood risk management policy at all levels. PPS1: Delivering Sustainable Development and PPS25 require that LPSs should promote SuDS. LPAs should ensure policies encourage sustainable drainage practices in their Local Development Documents.

A development's drainage system should reproduce the run-off characteristics prior to development, in most cases sites should seek to reproduce greenfield run-off characteristics. The SuDS hierarchy should be followed when determining the type and location of SuDS. Opportunities to use techniques which attenuate excess run-off at source should be identified and utilised in preference to regional controls and should be considered early in the site design to ensure sufficient space and appropriate location.

There should be less reliance on the upgrading of the sewer system to higher design standards to accommodate new developments; rather, water should be managed on the surface through the appropriate application of SuDS.

To ensure optimum surface water management it is recommended that a Surface Water Management Plan (SWMP) or Integrated Urban Drainage Plan (IUDP) should be carried out, (as recommended in the Pitt Report), to gain a more complete understanding of surface water and drainage across the Harborough District so that future drainage work can be planned in an integrated manner throughout the District.

3 Policy Review

This section provides an overview of the planning policy framework relevant to HDC. This report conforms to National and Regional Planning Policy. Information contained in the SFRA will provide evidence to facilitate the preparation of robust policies for flood risk management. The SFRA should be used to inform the LDDs and will enable informed decisions to be made relating to land use and development allocation within the respective DPDs.

The Government is currently 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 and Unitary Development Plans (UDPs).

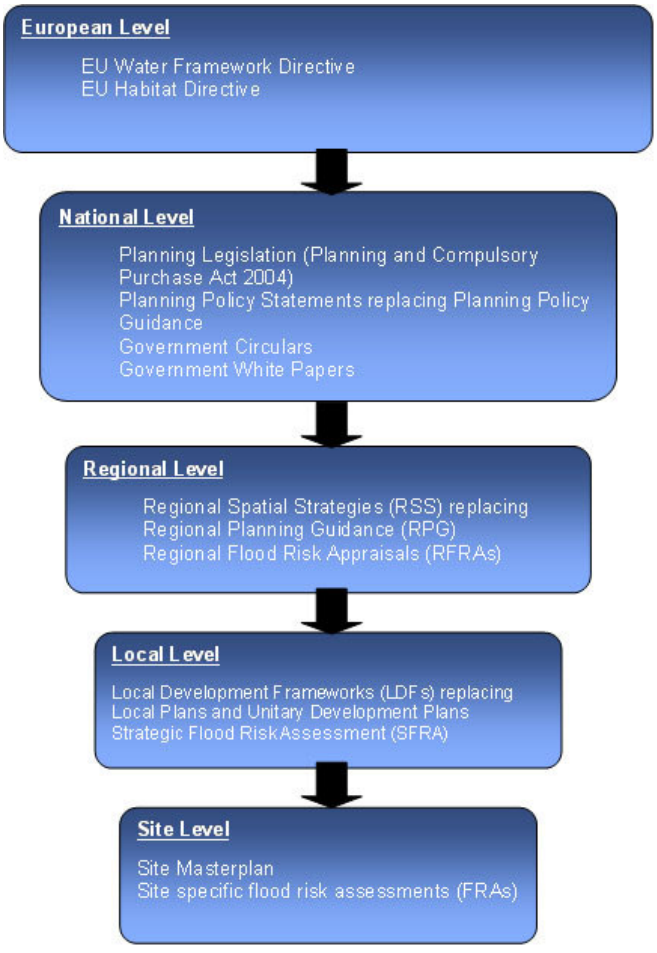


Figure 3.1: Hierarchical levels of the planning system.

3.1 Planning Policy

The planning policy review collates and summarises all planning policy and guidance, relevant to flood risk in the Harborough administrative area from European to local level.

3.2 European Policy

Water Framework Directive (December 2000)

The Water Framework Directive (WFD) is a substantial piece of EC legislation and the largest directive related to water to date. The directive came into force on 22nd December 2000, and establishes a new, integrated approach to the protection, improvement and sustainable use of Europe's rivers, lakes, estuaries, coastal waters and groundwater. The directive requires that all member states manage their inland and coastal water bodies so that a "good status" is achieved by 2015. This aims to provide substantial long-term benefits for sustainable management of water.

The Directive introduces two key changes to the way the water environment must be managed across the European Community:

1. Environmental & Ecological Objectives. The WFD provides for Protected Areas and Priority Substances to safeguard uses of the water environment from the effects of pollution and dangerous chemicals. In addition, important ecological goals to protect, enhance and restore aquatic ecosystems are set out,
2. River Basin Management Plans (RBMPs). RBMPs are the key mechanism to ensure that the integrated management of rivers, canals, lakes, reservoirs and groundwater is successful and sustainable. RBMPs aim to provide a framework in which costs and benefits can be properly taken into account when setting environmental and water management objectives.

Each RBMP must apply to a "River Basin District" (RBD) a geographical area which is defined based on hydrology – see Annex 1, DEFRA & WAG River Basin Planning Guidance (RBPG), August 2006). There are three RBDs that are relevant to the Harborough District, the Humber RDB, the Severn RBD and the Anglian RBD.

The river basin planning process involves setting environmental objectives for all groundwater and surface water (including estuaries and coastal waters) within the RBD, and designing steps and timetables to meet the objectives. The EA is responsible for implementing the WFD in England and Wales and aims to have completed draft RBMPs by 2009.

According to the DEFRA and WAG River Basin Planning Guidance (August 2006), a RBMP should be a strategic plan that gives all stakeholders within a RBD some confidence about future water management in their District. It should also set the policy framework within which future regulatory decisions affecting the water environment will be made.

Although RBMPs specifically address sustainable water management issues, the WFD also requires that other environmental considerations and socio-economic issues are taken into account. This ensures that the policy priorities between different stakeholders are balanced to ensure that sustainable development within RBDs is achieved.

As a result of the strategic nature of RBMPs, they are inherently linked to and can both influence and be influenced by planning policy within their areas. The following sections are extracted from the DEFRA and WAG River Basin Planning Guidance (August 2006).

Spatial Plans Influencing RBMPs

Emerging development plans will be an important source of information on future water management pressures that can inform the EA and refine its understanding of the current status of water bodies, and how this might change if no action was taken. The RBPG stresses the importance of taking into account the continuation of sustainable human development (including ports, recreational uses, water storage and flood risk management schemes) within RBDs and the setting of water management frameworks.

The EA's Catchment Flood Management Plans (CFMPs) and Catchment Abstraction Management Strategies (CAMS) are examples of such high-level planning tools that can inform development of RBMPs. Using CFMPs, the Regional Flood Risk Assessments (RFRA) and Strategic Flood Risk Assessments (SFRAs) will build upon existing flood risk and planning information to present current and potential future development within RBDs in relation to flood risk. In addition, policies that emerge from these studies (for example SuDS, Flood Risk Management procedures and mitigation options) will inform the development of the water management frameworks in RBMPs. The Harborough District Council SFRA should play an important role in informing the water management framework in the emerging Humber, Severn and Anglian RBMPs.

RBMPs Influencing Spatial Plans

As well as being informed by various spatial and catchment wide plans and strategies, RBMPs should produce strategic, regional policy information that is necessary to feed into the spatial planning process such as Local Development Frameworks. For example, where RBMPs have a direct affect on the use and development of land they will have to be material considerations in the preparation of statutory development plans for the areas they cover. It will also be necessary for planning authorities to consider WFD objectives at the detailed development control stage (not least to consider the requirements of Article 4(7) of the WFD in relation to new physical modifications).

To allow local authorities to incorporate WFD objectives into their various statutory development plans, the EA will provide local authorities with information such as CFMPs, CAMS and other catchment-wide guidance and strategies, to enable effective integration of the water management framework within statutory development plans. In order to address the fact that these plans have different planning cycles and are at different stages in their development, RBMP policies that affect the development and use of land must be considered in the monitoring and review of statutory spatial plans.

In addition, some of the measures necessary to achieve WFD objectives will be delivered through land use planning mechanisms. For example spatial planners can make major contributions to WFD objectives by including appropriate planning conditions and planning obligations in relevant planning permissions for new developments, or by restricting some forms of development. Delivery of these measures is more likely to take place if they are included in LDFs by land use planners.

3.3 National Planning Policy

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

PPS25 is the obvious key national policy in relation to flood risk and is therefore necessarily the starting point for any policy review on flood risk. PPS25 is supported by a Practice Guide Companion (June 2008) and builds on the principles set out in PPG25 (July 2001). PPS25 seeks to guide the preparation of SFRAs and the location of development in order to avoid and manage flood and residual risk. PPS 25 also aims to reduce flood risk to and from new development through policies on layout and design. PPS25 reaffirms that all forms of flooding and their impact on the natural and built environment are imperative planning considerations.

PPS25 sets the following **minimum requirements for the appraisal, management and reduction of flood risk**:

- identify land at risk from flooding and the degree of risk;
- preparing RFRAs / SFRAs as appropriate, either as part of the Sustainability Appraisal of their plans or as a freestanding assessment;
- policies for the location of development which avoid flood risk to people and property where possible and manage any residual risk, taking into account climate change;
- reduce flood risk to and from new development through location, layout and design, including sustainable drainage approaches;
- use opportunities offered by new development to reduce flood risk;
- only permit development in areas of flood risk when there are no suitable alternative sites elsewhere and the benefits outweigh the risks from flooding;
- work with the EA and other stakeholders to ensure that best use is made of their expertise and information in informing planning decisions; and
- ensuring spatial planning supports flood risk management and emergency planning.

A Risk-based Approach

PPS25 presents a three-tier approach to flood risk assessment at the regional, strategic and site-specific levels. At the regional level this will be in the form of a RFRA and at the local level a SFRA. Policies and proposals should be established on the basis of flood risk assessments.

PPS25 indicates that the Regional Planning Body should take flood risk into consideration when determining strategic planning considerations in the RSS. The RSS, guided by the RFRA, should identify broad locations and establish location criteria for development in the region. This in turn will inform Strategic Flood Risk Assessments and consequently LDDs at the local level.

Key requirements for SFRAs:

- SFRAs will refine information on the probability of flooding, taking into account all sources of flooding and the impacts of climate change. SFRAs should have regard to catchment-wide flooding issues that affect an area;
- the SFRA should provide the foundation from which to apply the Sequential and Exceptions tests in the development allocation and development control process (see Flood Zones 1-3b). Where decision-makers have been unable to allocate all proposed development and infrastructure in accordance with the Sequential Test, taking account of the flood vulnerability category of the intended use, it will be necessary to increase the scope of the SFRA to provide the information necessary for application of the Exception Test;
- SFRAs should be prepared in consultation with the EA, emergency response and drainage authority functions of the LPA; and

SFRAs should identify the four key Flood Zones listed in Table 3-1:

Table 3-1: Site specific FRAs

Flood Zone	Category	Assigned Annual Flood Risk Probabilities
1	Low Probability of Flooding	Land having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%)
2	Medium probability of Flooding	Land having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) nor between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any report.
3a	High Probability of Flooding	Land having a 1 in 100 annual probability of river flooding (>1%) or a 1 in 200 annual probability of flooding from the sea (>0.5%) in any year.
3b	Functional Floodplain	Land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the EA.

Minimum requirements (set out in PPS25, Annex E) for flood risk assessments are that they should:

1. Be proportionate to risk and appropriate to the scale, nature and location of the development,
2. Consider risk of flooding to the development and risk arising from the development,
3. Consider the impacts of climate change,
4. Be undertaken early in the planning process, by competent people,
5. Consider adverse and beneficial effects of flood management infrastructure and consequences of failure,

6. Consider vulnerability of those occupying the development, taking account of the Sequential and Exception Tests, the vulnerability classification and safe access arrangements,
7. Ensure that assessments are fit for purpose by ensuring that different types of flooding are considered and quantified. Flooding should be considered from natural and human sources and joint cumulative effects should also be considered. Flood risk reduction measures should be identified,
8. The effects of flooding events (including extreme events) on people, property, the natural and historic environment and river and coastal processes should be considered,
9. The remaining residual risk reduction measures should be included. It should be demonstrated that this is acceptable for the particular development/land use,
10. The ability of water to soak into the ground may change with development and this should be considered, as should how the proposed layout of the development may affect drainage systems,
11. Assessments should be supported by appropriate data and information including historical data on previous events.

Annex E also identifies that there may be considerable benefits in LPAs within a catchment area of high development pressure or a designated development area, joining together to undertake a **sub-regional SFRA**. This will assist LPAs to consider the issues raised by flooding on the wider scale, and enable them to contribute to, and take account of, the RBMPs, which must be published by the EA by 2009. Para 2.27 of the Companion Guide to PPS25, states that where sub-regional SFRAs are undertaken, these will provide more detailed information on the broad spatial distribution of flood risk within extensive areas of Flood Zone 3, where development is to be considered, but here it will be necessary to apply the Exception Test. The Thames Gateway sub-regional SFRA is cited as an example.

3.3.2 PPS25 in Context

It is important to see PPS25 as part of a wider integrated approach to spatial planning. Flood risk should be considered alongside other spatial planning concerns such as the delivery of housing, economic growth, management of natural resources, regeneration and the management of other natural hazards. There are clear links to other Planning Policy Statements that may not be explicit in PPS 25, but which are necessary to achieve its objectives. The most obvious link is with the supplement to PPS1 “Climate Change and Sustainable Development”.

3.3.3 PPS1 Supplement “Climate Change and Sustainable Development”

PPS1 is the Government's overarching statement on the purpose of the planning system. Paragraph 3 of the PPS makes clear that ‘sustainable development is the core principle underpinning planning’. The PPS1 Supplement sets out important objectives in order to tackle climate change, sea level rise and avoid flood risk. The purpose of design policies should be to ensure that developments are sustainable, durable and adaptable to natural hazards such as flooding.

PPS25 is clearly a key part of the Government's programme of responses to the challenge of climate change. If climate change is not stabilised (mitigated) then this will have two impacts on flood risk. Firstly, projected sea level rises would suggest that the risk of flood defence levels being overtopped would increase. Second, climate change is likely to create higher rainfall in winter, and consequently will increase the risk of flooding along river catchments. An increased frequency of intense rainfall events is also likely to increase the numbers of urban and flash floods, and will also mean increases in the extent of flooding from rising groundwater. Therefore, the implementation of this PPS1 supplement is crucial in mitigating for flood risk now and in the future.

3.3.4 PPS3 Housing

PPS3 Housing sets out the Government's broad policy objectives for planning for housing and those policies it considers will help to realise those objectives, including the efficient use of land, variety of household types and supply, affordability and designing for quality with the consideration of climate change and flood risk, PPS3 aims to deliver housing policies that seek to minimise environmental impact.

PPS25 strongly supports the strategy for housing set out in PPS3. In meeting the objective of increasing housing supply the assessment of flood risk is crucial. Incorporation of local flood mitigation measures such as Sustainable Urban Drainage Systems (SuDS), and good quality design and site layout, ensures it is possible to build safely and to manage flood risk.

3.3.5 PPS7 Sustainable Development in Rural Areas

PPS7 sets out the Government's planning policies for rural areas, with the protection and enhancement of the natural and historic environment, the quality and character of the countryside and existing communities all of crucial importance. The PPS states that any development in rural areas should consider flood risk at all stages of the planning process in order to reduce future damage.

3.3.6 PPS9 Biodiversity and Geological Conservation

The Government's planning policies on the protection of biodiversity and geological conservation via the planning system are outlined in PPS9. Crucially, many protected sites fall within flood zones and there is also an imperative to consider the impact of removing woodland on carbon sinks and on flooding.

In the case of increased flood risk, any adverse affects arising from the development of land should be avoided rather than minimised.

3.3.7 PPS12 Local Spatial Planning

PPS12 sets out the Government's policy on the preparation of local development documents, which together comprise the LDF. Key issues include the consideration of climate change and the need to identify local areas at risk from flooding and to highlight the geographical location of such areas on the adopted proposals map. The preparation of all local development documents must be informed by a Sustainability Appraisal. Gathering

information on flood risk is an important element of assembling the baseline information for these assessments.

3.4 Regional Planning Policy

At a regional level, the East Midlands RSS8 adopted in March 2005, provides the broad development strategy for the region through to 2021. The East Midlands Regional Assembly (EMRA) is also in the process of preparing a Regional Plan to replace RSS8, which will cover the period up to 2026. The Proposed Changes to the Regional Plan were published on the 22nd July 2008 and the consultation period ended 17th October 2008. The Government Office for East Midlands are now in the process of considering the comments from the consultation exercise and hope to produce the final plan in early 2009.

3.4.1 The East Midlands Regional Spatial Strategy (RSS8), March 2005

The issue of flood risk is raised at a highly strategic level in the adopted RSS8. Regional Core Objective 9 (within Policy 1) of the adopted RSS8 is:

> *To take action to reduce the scale and impact of future climate change, in particular the risk of damage to life and property from flooding, especially through the location and design of new development*. (p.14)

Furthermore, Policy 3 includes flood risk as a physical constraint within its sustainability criteria. Policy 34 also refers to the important role that the management of strategic river corridors plays in managing flood risk.

Policy 36 addresses "A Regional Approach to Managing Flood Risk" and reinforces the general messages that have since emerged in PPS25 and stresses the need for Strategic Flood Risk Assessments "*where appropriate*", though SFRAs are now mandatory following PPS25.

Beyond direct references to flood risk, the adopted RSS8 identifies the spatial strategy for development in the region. Harborough District predominately falls within the Three Cities Sub Area defined in RSS8, where development should support the economic regeneration of Derby, Leicester and Nottingham. Outside of these three cities employment and housing development should be located within and adjoining settlements. Such development should be in scale with the size of those settlements, in locations that respect environmental constraints and the surrounding countryside, and where there are good public transport linkages.

Market Harborough falls within the Southern Sub-Area of the region and is identified as a Sub-Regional Centre (SRC). SRCs are to accommodate development, but of a lesser scale than the Principal Urban Areas (PUA) (Leicester, Derby, Nottingham, Lincoln and Northampton) and the Growth Towns (Corby, Kettering and Wellingborough).

3.4.2 The Draft East Midlands Regional Plan

Policy 1 in the draft Regional Plan reflects the same policy in the adopted RSS8 and therefore Objective j refers to the need to manage flood water to reduce the impacts on climate change. The sub-regional boundaries have evolved and the whole of Harborough District (including

Market Harborough) now falls within the Three Cites Sub-Area. The strategic aims of the Three Cities Sub Area remain broadly the same and Market Harborough is still promoted as a SRC, which encourages appropriate development of a lesser scale to be located within it.

Harborough District falls within the Leicester and Leicestershire Housing Market Area (HMA). Two of the key objectives in the HMA are to:

- Strengthen the role of Leicester through urban intensification and planned and sustainable urban extensions; and
- Strengthen the sub-regional role of SRCs such as Market Harborough.

The total housing provision target for the Leicester and Leicestershire HMA is 97, 000 new homes over the total plan period 2001-2026. Harborough District accounts for 8,800 of this total, which equates to 300-440 dwellings per annum dependant upon the period.

3.4.3 A Flourishing Region: Regional Economic Strategy for the East Midlands 2006-2020 (2005)

The Strategy identifies climate change as a major global economic driver and states that the effects of climate change itself may have far-reaching implications including, heightened flood risks and the associated impacts on agricultural land, housing developments and related planning and insurance constraints.

A priority environmental action of the Strategy is adaptation to climate change, the region needs to "*identify where and how we mitigate against change, adapt to new circumstances and exploit new opportunities.*" (p.99)

3.4.4 East Midlands Regional Flood Risk Appraisal (2006)

The RFRA for the East Midlands was produced in July 2006 and seeks to inform the Regional Sustainability Appraisal as part of the ongoing development of the RSS. It assessed flood risk data from a variety of sources and assigned a flood risk score to areas on a District wide basis based upon a number of criteria including percentage of land in Flood Zone 3, probability and consequence of flooding, secondary sources of flooding and residual risk.

The assessment for the region is that:

> *'although flood risk is a significant factor in the East Midlands, adoption of a range of appropriate flood risk management policies and mitigation measures will enable Regional Plan policies to be implemented in a sustainable manner'* (p43)

Flood Risk Profiles were determined for each LPA. The Flood Risk Profile for Harborough District reveals that less than 10% of Flood Zone 3 land exists within the District. However, at the time of writing, no SFRAs had been carried out in the District.

The flood risk profile states that Harborough DC consider flood risk to be a highly significant factor in decision making on planning issues in their area. This is highlighted with the score

Harborough attribute to the factor being higher than any other local authority in the Leicester and Leicestershire HMA.

3.4.5 Three Cities Sub-Regional Strategy

Derby, Nottingham and Leicester form the Three Cities Sub Area (TCSA) as identified by the Regional Spatial Strategy for the East Midlands (RSS8) and amended in the draft RSS (the Draft East Midlands Regional Plan) respectively. Harborough District falls within the TCSA.

The draft RSS contains a Three Cities Sub-Regional Strategy, which has the following vision:

> '*The Three Cities Sub-Area will be an area where the principles of sustainability are implemented through new development and regeneration. This will involve the significant strengthening of the complementary roles of the three Principal Urban Areas (PUA) by providing new jobs, homes, services, community facilities and green and environmental infrastructure in and around them. The role of Sub-Regional Centres will be maintained through appropriate development, and the needs of other settlements requiring regeneration will be met in a sustainable way. Natural and cultural assets will be protected and enhanced.'*

This broad spatial strategy focuses development in the three cities, both housing and employment to drive sustainable economic development. However, in terms of housing it is acknowledged that provision in cities alone will be insufficient to meet all the necessary provision to 2026. The additional need will therefore be met by planned sustainable urban extensions and supportive development in SRCs. Specifically, within Harborough District's dwelling target of 8,800 by 2026, 820 of the dwellings should be within or adjoining Leicestershire PUA, with the remainder of the dwellings mainly located within Market Harborough.

In terms of natural resources the Three Cities strategy requires the siting of major development to have regard to the environmental capacity of its location, and include measures to minimise and mitigate any negative impacts. Flooding specifically is identified as a potentially serious issue for the Sub-Area, given that the three PUAs all have rivers flowing through them and have a history of flooding in the past. The flooding risk relationship of the Harborough District to Leicester and the wider sub-region is therefore of strategic importance.

3.4.6 New Growth Point – Three Cities & Three Counties – Derby, Leicester & Nottingham

The three cities of Derby, Leicester and Nottingham are a New Growth Point, part of the Government's plans to increase the rate of house building in England from 160,000 to 200,000 per year by 2016. Their bid put forward proposals for sustainable growth to help achieve this ambition. The proposals include:

- An additional 81,500 homes by 2016;
- Regeneration and provision of community facilities to encourage more people into the city centre,

- A new public park linking Derby city centre with the Derwent Valley Mills World Heritage Site; and
- Improving connectivity and public transport within and between the three cities, including links to East Midlands Airport.

The Three Cities & Three Counties is the largest and most complex of the 29 New Growth Points in England, currently offering some 19% of the expected national total of new homes over the lifetime of the programme. In support of the Three Cities' and Three Counties' growth ambitions the Government allocated around £5.48m in 2007-08 from the first year's funding budget.

3.5 Local Planning Policy

The Development Plan for Harborough currently comprises:

- The Regional Spatial Strategy for the East Midlands (March 2005),
- Leicestershire Minerals and Local Plan Review (1995),
- The Harborough District Local Plan (April 2001) – Saved Policies,
- Alterations to the Harborough Local Plan (February 2004) – Saved Policies.

Work has commenced on the LDF for Harborough. This LDF will comprise a number of LDDs which will set out the spatial planning policies for the District and gradually replace saved Local Plan policies. These documents will need to be in general conformity with the Regional Spatial Strategy.

A number of issues outside of the Council's control have delayed the preparation of the LDF. At this time none of the key DPDs have been adopted and therefore they do not form part of the Development Plan. However their current status and direction are still material planning considerations and are therefore discussed in section 3.7.

3.5.1 Leicestershire, Leicester, and Rutland Structure Plan (2005)

The Leicestershire, Leicester and Rutland Structure Plan 1996 - 2016 was adopted on 7th March 2005. Under the Planning and Compulsory Purchase Act 2004 policies in the Plan were "saved" for a 3 year period ending on the 7th March 2008. The Structure Plan will be replaced where necessary by elements of the Regional Spatial Strategy (due to be adopted early 2009) and District LDF documents.

A list of proposed saved Structure Plan policies was submitted to the East Midlands Regional Assembly and the 'Endorsement of Advice on Saving Structure Plan Policies Post March 2008' report was considered by the EMRA's Housing, Planning and Transport Board on 18th December 2007. Only two policies were extended as part of this process (Housing Policy 1 and Housing Policy 3), with all remaining policies expiring on the 7th March 2008. The two saved policies will be superseded by policies in the emerging RSS.

3.5.2 Harborough District Local Plan (2001)

The Harborough District Local Plan (HDLP) was adopted in April 2001 and sets out policies and land-use proposals to guide development in the District over the period 1991-2006. Under the new Act the Local Plan was saved for 3 years (until September 2007) and 75% of the policies have now been saved indefinitely, or until they are replaced by policies within the Local Development Framework to prevent a policy vacuum.

The overall aim of the Local Plan is to meet the housing and employment land provision required by the Structure Plan objectives, in the most sustainable way. The strategy for the location of development is therefore governed by three key elements:

- Concentration of development in and around the main towns and settlements;
- Allocation of housing development in and around settlements where there is potential for it to be served by public transport; and
- Restriction of development in the majority of villages to a scale compatible with the size and character of the village.

Implicit to these location objectives is the need to balance the scale and location of new development with the need to maintain and enhance the quality of the environment. In terms of specific environment policies, only one general flood risk policy has been saved (Policy RM/2) and thus Harborough District is predominately reliant on the guidance set out in the adopted and emerging RSS and PPS25.

The Local Plan will continue to be the starting point for determining planning applications (together with other adopted documents that make up the development plan for the District) until replaced by documents forming part of the LDF.

3.5.3 Alterations to the Harborough Local Plan (2004)

Due to changes in national housing guidance (the publication of Planning Policy Guidance Note 3 (PPG 3) Housing) Harborough District Council were required to produce an alterations document to accompany the Local Plan. This document was published in February 2004 and identifies the rank order and subsequent release of the three remaining housing sites within Harborough District to ensure compliance with the PPS3 'plan, monitor and manage' approach to the delivery of housing. Policies ALT1 (Phasing of Housing Sites) and ALT3 (Density of Housing Development) are saved.

At the time of writing the Alterations document, Harborough District had three remaining sites allocated for housing development:

- Land off Warwick Road, Kibworth (KB/1) – Flood Zone 1;
- Land to the west of Farndon Road, Market Harborough (MH/3) – Flood Zone 1 with a small area in Flood Zone 3;
- Land off Stretton Road, Great Glen (GG/2) – Mostly Flood Zone 1 with small areas in Flood Zones 2 and 3.

Site KB/1 is under construction, MH/3 has planning permission but work has not yet commenced on site and no planning applications have yet been submitted for GG/2. GG/2 is therefore the only uncommitted allocated housing site within the District.

3.6 Waste & Minerals Planning Policies

3.6.1 Leicestershire Minerals Local Plan Review (1995)

The Leicestershire Minerals Local Plan highlights in Policies 1, 2 and 3 the importance of protecting the quality and quantity of water resources, water supply, land drainage and flood protection interests from the impact of mineral extraction and reclamation.

3.6.2 Leicestershire, Leicester, and Rutland Waste Plan 1995-2006 (2002)

The adopted Waste Local Plan (WLP) refers to flood risk and in Policy WLP 8 states that waste development will not be permitted where it would adversely affect the effectiveness of local land drainage systems and floodplains, waterways and watercourses, derogate groundwater sources and resources and provide inadequate protection for water quality.

3.6.3 Minerals and Waste Development Framework (MWDF)

The Minerals and Waste Development Framework will set out the County Council's spatial strategy for future minerals and waste development. As the new documents emerge the existing Mineral Local Plan and Waste Local Plan will be replaced.

The MWDF will contain several development plan documents including a Core Strategy; a suite of Development Control Policies; Site Specific Allocations and Policies; and an illustrative Proposals Map. Separate Core Strategy and Development Control Polices documents have been prepared for Minerals and Waste and both have been submitted to the Secretary of State for examination in June 2008.

Both the Waste and Minerals core strategy have a policy (DC12 Waste and DC11 Minerals) that states that planning permission will not be granted for development which would:

> *(i). Have a detrimental impact on the quality or flow of groundwater or surface water drainage; or*
> *(ii). Exacerbate flood risk in areas prone to flooding and elsewhere.*

3.7 Emerging Local Development Framework

A number of issues outside of the Council's control have delayed preparation of Harborough District Council's Local Development Framework (LDF). As such, preparation of the LDF is not currently running in accordance with the timetable set out in the Local Development Scheme (LDS) (dated March 2007). In order to the ensure the District's future LDF is effective, sound and meets the needs of our communities, additional time is being built into the work programme. A revised LDS 2009-2012 has been approved by the Secretary of State and will come into effect in April 2009.

3.7.1 Core Strategy

A Core Strategy Development Plan Document (DPD) is being prepared as part of the Harborough LDF which will set out the vision and strategic spatial objectives for development in the District, including the amount of and broad locations for future housing and employment use.

The Core Strategy was originally scheduled for adoption in 2009 and a Preferred Options report was published for consultation in 2006 to work towards this. However due to unforeseen delays and changes in the wider policy environment the revised LDS (2009-2012) has now set out a new timetable for the production of the Core strategy – with adoption programmed for 2011.

3.7.2 Allocations DPD

Harborough District Council is proposing to produce an Allocations DPD which will set out detailed residential, employment, commercial and leisure site allocations within the District. The draft revised LDS (2009-2012) sets out a new timetable for the production of the document - with adoption programmed for March 2012.

3.8 Non-Statutory National Planning Documents

3.8.1 Making Space for Water

During 2004, the Department for Food and Rural Affairs (DEFRA) undertook a consultation exercise, the object of which was to engage a wide range of stakeholders in the debate regarding the future direction of flooding strategy. The consultation document 'Making Space for Water' is part of the Governments overall approach to managing future flood risks and sets out the following aim:

> *To manage the risks from flooding and coastal erosion by employing an integrated portfolio of approaches which reflect both national and local priorities, so as to:*
>
> - *Reduce the threat to people and their property;*
> - *Deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principles'* (p.1)

Thus, the aim of the strategy is to balance the main pillars of sustainable development, namely social, economic and environmental factors.

Making Space for Water examines the impact of climate change on flood levels. Experts consider that the primary impacts on flood risk will be from changes in precipitation, extreme sea levels and coastal storms. DEFRA and the EA will produce revised guidance for use by those implementing flood and coastal erosion risk management measures. The revised guidance, yet to be published, will ensure that adaptability to climate change through robust and resilient solutions becomes an integral part of all flood and coastal erosion management decisions.

Making Space for Water emphasises the Government's commitment to ensure that a pragmatic approach to reduce flood risk is adopted. However, the paper notes that 10 per cent of England is already within mapped areas of flood risk. Contained within these areas are brownfield sites, which policy has identified as a priority for future development. The document asserts that over the past five years 11 per cent of new houses were built in flood risk areas.

The plan advocates the use of European Union (EU) funding streams, such as INTERREG IIIB, to enable local authorities to undertake trans-national projects aimed at advancing knowledge and good practice in flood risk management. The document also encourages integration with water management initiatives, in particular CFMPs. The document proposes that RSSs and LDFs should take full account of strategic flood risk assessment and incorporates the sequential approach as set out in PPS25.

At the development control level, the document encourages local planning authorities to follow the existing guidance to require site-specific FRAs. In addition, the use of FRAs as supporting documents to planning applications in areas of flood risk is encouraged. The document proposes that if mitigating measures are shown to be required, they should be fully funded as part of the development.

3.8.2 Sustainable Communities Plan

The Sustainable Communities Plan (SCP) was launched by the Office of the Deputy Prime Minister (ODPM) in February 2003. The plan's main aims include improving the overall quality of housing in England, a step change in housing supply to meet demand, encouraging new growth areas while maintaining and protecting the Green Belt. These objectives are to be achieved with sustainability at the centre to ensure a legacy of improved, liveable communities.

The challenge is to reconcile the SCP's requirement to identify sufficient land for large volumes of new homes whilst ensuring that the sites allocated satisfy sustainability criteria specifically with regard to the avoidance of flood risk.

3.9 Catchment Flood Management Plans

A CFMP is a high-level strategic plan which is used to identify and agree long-term policies for sustainable flood risk management within individual river catchments. CFMPs undertake an assessment of flood risk to identify the causes, size and location of flood risk throughout the catchment and the various influences that can affect the probability and consequences of flooding. This enables the effect of potential changes in the catchment on flood risk to be identified. Each potential source of change can be influenced by land use planning policy, such as a changing policy approach towards greenbelt protection or the allocation of large greenfield sites for housing development. Potential changes may include, for example:

- Development and land use change, such as new development or significant changes in the developed environment;
- Changes in the rural landscape, including large scale changes in land management;
- Loss of, or potential threat to, wildlife habitats or biodiversity;

- Climate change.

Flood risk management looks at the probability of a flood occurring and the potential resultant impacts. A spatial planning element also exists in flood risk management since it involves decisions on when, where and how to store or convey flood waters to minimise the risks to people, property and the environment.

CFMPs identify broad, long term (50-100 years) policies for sustainable flood risk management in the context of a particular catchment. The planning period is therefore considerably longer than the period typically considered to be "long-term" in land-use planning policy terms, which is usually 10 to 15 years. This potential conflict in planning timeframes should be taken into consideration, as a change to land-use policy can occur in a much shorter period of time than the CFMP may account for. There is also a potential conflict in that catchment boundaries do not necessarily relate to LPA boundaries and land use policy approaches may vary between LPAs, increasing the complexity for flood risk management decisions across the catchment.

CFMPs aim, amongst other objectives, to inform and support planning policies, statutory land use plans and implementation of the WFD, so that future development in the catchment is sustainable in terms of flood risk. Awareness of the role of CFMPs among land-use planners is in its infancy as these plans, along with SFRAs, are a relatively new requirement.

Preparing CFMP's involves carrying out a strategic assessment of current and future flood risk from all sources, understanding both the likelihood and impact of the risk and the effect of current measures to reduce that risk. The scale of risk is broadly measured in economic, social and environmental terms. CFMPs identify opportunities and constraints within the catchment to reduce flood risk through strategic changes or responses, such as changes in climate, urban development, land use, land management practices and/or the flood defence infrastructure and waterways.

CFMP policies which are identified for each individual "policy unit" (which relates to a specific geographical area), establish whether action should be taken to increase, decrease or maintain the current scale of flood risk. The CFMP does not identify specific ways of managing flood risk, which are the subject of subsequent, more detailed studies. A single policy is applied to each policy unit. Six policy options exist and may be applied:

Table 3-2: CFMP Policy Options

Policy Option	Policy
1	No active intervention (including flood warning and maintenance), continue to monitor and advise
2	Reduce existing flood risk management actions (accepting that flood risk will increase with time)
3	Continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from this baseline)
4	Take further action to sustain the current scale of flood risk into the future (responding to the potential increases in flood risk from urban development, land use change, and climate change)
5	Take further action to reduce flood risk (now and/or in the future)
6	Take action with others to store water or manage run-off in locations that provide overall flood reduction or environmental benefits, locally or elsewhere in the catchment.

In order to achieve the specified policy approach, a number of actions may be identified for each policy unit. It is expected that CFMPs will be used by regional and local government authorities to inform their spatial planning activities, SAs/SEAs and emergency planning.

There are three CFMPs covering the study area. These include the River Welland CFMP, the River Trent CFMP and the River Severn CFMP which are all at the stage of draft preparation. Consequently, it is unlikely that its implications have been fully taken into account in current DPDs.

3.9.1 River Welland CFMP

Harborough is covered by Policy Units 1 (Upper Tributaries), 2 (Welland and Glens) and 4 (Market Harborough) in the draft River Welland CFMP. Broadly speaking these units correspond to the River Welland, the River Jordan, and numerous smaller tributaries within the Harborough study area.

The CFMP considered flood risk under climate change scenarios which involved scaling up the EA hydrodynamic model inflows by 20%. The CFMP considered a 56% increase in urban growth scenario in the model's hydrology. Land use change was also considered to assess the amount of rainfall runoff in the catchment and resulting response time.

Policy Unit 1 – Upper Tributaries

This policy area includes the majority of the rural part of south eastern Harborough including the headwaters of the River Welland and its tributaries including Langton Brook, Stonton Brook, Eye Brook and the River Chater where agricultural land use is prominent. There are no formal flood defences present within this policy unit however flood warning dissemination and channel maintenance are the current methods of flood risk management.

The CFMP explains that the main flood mechanism in Policy Unit 1 is fluvial flooding. There is considered to be no risk to life and only minimal risk to infrastructure or environmental sites from the current 1% AEP flood event within the study area. A small increase in the risk resulting from the effects of climate change was determined in the CFMP for agricultural land.

Policy Option 2, 'to reduce existing flood risk management actions (accepting that flood risk will increase with time)', was selected for this area of the catchment within the study boundary. Particular emphasis is given to reducing the level of channel maintenance to create more natural channels, and to encourage geomorphological features.

Policy Unit 2 – Welland & Glens

Within south eastern Harborough this policy area includes the River Welland from Market Harborough north eastwards out of the study area towards Uffington, including the lower valleys of the Great Glen Brook, Medbourne Brook and Eye Brook where a mixture of urban and agricultural land uses are present.

There are flood defences present in the Great Glen area but the SoP offered by these structures and their exact location is unknown as they are not included in the EA NFCDD information. Flood warning dissemination and flood storage reservoirs are the current methods of flood risk management in the area. The River Welland and its main tributary corridors are located within EA Flood Warning Areas.

The CFMP explains that the main flood mechanism in Policy Unit 2 is fluvial flooding. Localised surface water flooding and groundwater flooding in the glens are also considered to pose a risk. The flood water velocities are considered to be low however varying depths pose a major risk to life and property in this policy unit area.

A small increase in the risk to life and property resulting from the effects of climate change was determined in the CFMP as a result of increasing flood depths. There is considered to be no risk to infrastructure from the future 1% AEP flood event within the study area; however short sections of railway were identified as being at risk during the 0.1% AEP event as a result of climate change. Future flooding may have a positive impact on Sites of Special Scientific Interest (SSSI) sites, however agricultural land is considered to be at an increased risk.

Policy Option 2, 'to reduce existing flood risk management actions (accepting that flood risk will increase with time)', was selected for this area of the catchment within the study area. Particular emphasis is given to reducing the level of channel maintenance to create more natural channels, to encourage geomorphological features and increase floodplain connectivity.

Policy Unit 4 – Market Harborough

Within south eastern Harborough this policy area includes Market Harborough located at the confluence of the River Welland and the River Jordan where urban land use is prominent. Flood warning dissemination, earth embankments, concrete walls, flood storage reservoirs in

Bray Brooke and Bowden south of Market Harborough and the study area, and AW flood storage tanks to attenuate sewer flood flows are the current methods of flood risk management.

The CFMP explains that there are three main flood mechanisms in Policy Unit 4 including fluvial, sewer and surface water flooding overwhelming the urban drainage system following heavy rainfall. The flood water depths and velocities are considered to be low with isolated properties at risk.

Sewer and surface water flooding is considered to pose the greatest flood risk to the policy unit area. There is considered to be no risk to critical infrastructure during even the future 1% AEP flood event, however an electricity substation and a sewage and water management plant are at risk during a 0.1% AEP (1 in 1000 year) event.

The CFMP concludes that flood depths in Market Harborough were shown to increase by a notable measure increasing the risk to life and property. No risk to critical infrastructure or environmental sites from the future 1% AEP flood event is identified within the study area, however short sections of a road, a medical centre, a Waste Water Treatment Works and four electricity substations were identified as being at risk during the 0.1% AEP event as a result of climate change.

Policy Option 3, 'continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from this baseline)', was selected for this area of the catchment within the study area. Particular emphasis is given to reviewing flood warning lead times and awareness of flood hazards and a review of surface water drainage systems and sewers to prevent inappropriate development in the floodplain. River naturalisation and enhancement schemes were also suggested.

3.9.2 River Trent CFMP

Harborough is covered by Hydrological Unit E, and Policy Units 8 (Rural Leicestershire) and 9 (Upper Soar) in the draft River Trent CFMP. Broadly speaking these units correspond to the River Soar and the River Sence catchments within the Harborough study area.

The CFMP considered flood risk under climate change scenarios with increased rainfall and land use changes altering the resultant rainfall runoff rates in the catchment by reducing the response time.

Policy Unit 8 – Rural Leicestershire

Within north western Harborough this policy area includes the River Sence and its tributaries from Burton Overy towards Leicester city, including Burton Brook, where grassland and agricultural land uses are prominent. There are no formal flood defences in this policy unit area of the Harborough study area.

The CFMP explains that the main flood mechanism in Policy Unit 8 is fluvial flooding, resulting from catchment runoff causing out of bank flows in the lower catchment, however this

mechanism generally poses a very low risk of flooding. Damage through inundation to isolated properties and roads is identified in the CFMP as relatively minor. Following climate change the flood risk in this area is considered to remain low.

Policy Option 6, 'Take action with others to store water or manage run-off in locations that provide overall flood reduction or environmental benefits, locally or elsewhere in the catchment', was selected for this area of the catchment within the study area. Particular emphasis is given to land use changes and flood storage in the form of habitat creation as possible responses to manage the future flood risk.

Policy Unit 9 – Upper Soar

Within the very north west of Harborough this policy area includes Broughton Astley Brook which begins east of Ashby Parva, continuing northwards west of Dunton Bassett northwards out of the study area towards its confluence with the River Soar north of Croft. A second un-named tributary of the River Soar flows northwards from Bittesby through Claybrooke Magna proceeding outside the study area towards Sharnford. A third tributary of the River Soar, Whetstone Brook originates south of Ashby Magna continuing though Willoughby Waterleys outside the study area towards Whetstone. Flood warning dissemination and flood storage reservoirs are the current methods of flood risk management in this area.

The CFMP explains that the main flood mechanism of Policy Unit 9 within the Harborough study area is fluvial flooding resulting from out of bank flows when channel capacities are exceeded. Ponding surface water due to inadequate drainage and resultant surcharging also poses a risk in the general Leicester area. The current flood risk is considered in the CFMP to be medium. The future flood risk in this policy unit area is therefore considered to increase substantially as a result of land use and climate changes.

Policy Option 4, 'take further action to sustain the current scale of flood risk into the future (responding to the potential increases in flood risk from urban development, land use change, and climate change)', was selected for this area of the catchment within the study area. Particular emphasis is given to opportunities to increase the distance of development away from the floodplain by creating green corridors.

3.9.3 River Severn CFMP

Harborough is covered by the Warwickshire Avon Hydrological Unit, and Policy Unit 14 (Upper Avon) in the draft River Severn CFMP. Broadly speaking this unit corresponds to the River Avon, and the River Swift within the Harborough study area.

The CFMP considered flood risk under climate change scenarios within the river models which involved greater winter rainfall with less snowfall in upland areas and an increased number of convective storms, all leading to flash fluvial and surface water flooding. Land use changes altering the resultant rainfall runoff rates in the catchment are also considered.

Policy Unit 14 – Upper Avon

Within south western Harborough this policy area includes the River Avon flowing south west from the Sulby and Welford Reservoirs south of South Kilworth, and its main tributary, the River Swift originating from the Knaptoft Parish area flowing in a south westerly direction past Lutterworth. Within this area grassland and agricultural land uses are prominent. There are no formal flood defences in the Harborough region of this policy unit area.

The CFMP explains that the main flood mechanism in this policy is fluvial flooding, with the Sewage and Water Treatment Works near Cotesbach being at risk during a 1% AEP event. An EA Flood Warning Area stretches south westwards along the River Avon from Stanford Reservoir. Damage through inundation to isolated properties and roads was identified and following climate change, the flood risk to property in this area is considered to increase.

Policy Option 6, 'Take action with others to store water or manage run-off in locations that provide overall flood reduction or environmental benefits, locally or elsewhere in the catchment', was selected for this area of the catchment within the study area. Particular emphasis is given to flood proofing, land use changes and flood volume attenuation in the Harborough upland area of this catchment as possible responses to manage the future flood risk; for example encouraging the use of sustainable farming practices (environmental stewardships) which could help provide a benefit to downstream urban areas by reducing peak discharges.

3.10 Flood Risk

3.10.1 Regional / National

1. In accordance with PPS25, all sites should be allocated in accordance with the Sequential Test to reduce the flood risk and ensure that the vulnerability classification of the proposed development is appropriate to the Flood Zone classification;
2. FRAs should be undertaken for all developments within Flood Zones 2 and 3 and sites with identified flooding sources (according to PPS25 Annex E) to assess the risk of all sources of flooding to the development and identify options to mitigate the flood risk, taking climate change into account, to the development, site users and surrounding area;
3. FRAs are required for all major developments in Flood Zone 1 (according to PPS25 Annex E). These are residential developments consisting of sites greater than 0.5 ha or greater than 10 dwellings and commercial developments that are greater than 1 ha or have a floor area greater than 1000 m^2.
4. A FRA will be required where the proposed development or change of use to a more vulnerable class may be subject to other sources of flooding or where the EA, IDB and / or other bodies have indicated that there may be drainage problems.
5. A FRA may be required if the proposed development is located within 20 m of main river or any river or sea defences.
6. Flood Risk to development should be assessed for all forms of flooding (in accordance with PPS25 Annex E);

7. According to PPS25, it is recommended that where floodplain storage is removed, the development should provide compensatory storage on a level for level and volume for volume basis to ensure that there is no loss in flood storage capacity.

3.10.2 Sub-Regional / Local

1. As stated in PPS25, surface water flooding should be investigated in detail as part of site specific FRAs for developments and early liaison with the EA and the relevant LPA for appropriate management techniques should be undertaken.
2. As stated in PPS25, groundwater flooding should be investigated in more detail as part of site specific FRAs.

3.11 Sustainable Drainage Systems

A guide to SuDS is provided in Appendix A. Sustainable drainage policies should address the following issues:

3.11.1 Regional / National

1. SuDS should be included in new developments unless it is demonstrably not possible to manage surface water using these techniques,
2. PPS25 requires the use of SuDS as an opportunity of managing flood risk, improving water quality and increasing amenity and biodiversity,
3. Building Regulations Approved Document H – Drainage and Waste Disposal (2002) promotes the use of SuDS in the first instance wherever practical.
4. FRAs are required for all major developments in Flood Zone 1 (according to PPS25 Annex E). These are residential developments consisting of sites greater than 0.5 ha or greater than 10 dwellings and commercial developments that are greater than 1 ha or have a floor area greater than 1000 m^2 ,
5. As stated in PPS25, runoff rates from new developments should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates prior to the proposed development, unless specific off-site arrangements are made and result in the same net effect,
6. It is recommended that runoff and/or discharge rates should be restricted to Greenfield runoff rates in all areas including those known to have a history of sewer and/or surface water flooding.
7. Development on brownfield sites should look to provide betterment (usually a 20% reduction) in surface water run-off over the existing situation. Developers should contact the relevant EA office to establish the exact requirements for achieving betterment on brownfield sites.

3.11.2 Sub-Regional / Local

At the site-specific FRA level, the suitability of SuDS should be investigated for each development.

An assessment off the underlying geology and soil, together with site-specific recommendations for SuDS and FRAs is presented in the Broad Scale Assessment of SuDS at the end of Appendix A.

Through integration of these suggestions, the emerging LDF will comply with PPS25 and the aspirations and policies represented in following:

- The Water Framework Directive (summarised in section 3.2),
- Regional policy for the East Midlands Policy 35 is relevant to the management of flood risk,
- The River Welland, River Trent and River Severn CFMPs,
- The Leicestershire and Rutland Biodiversity Action Plan
- The National Forest Biodiversity Action Plan,
- Welland, Trent Corridor, Warwickshire Avon, Soar and Tame, Anker and Mease Catchment Abstraction Management Strategies (CAMS).

3.12 Water Environment

3.12.1 Regional / National

1. Development should not have a detrimental impact on the water environment through changes to water chemistry or resource,
2. Developments should look to incorporate water reuse and minimisation technology,
3. Developments should not be located within the 8 metre Byelaw distance (9 m if development is located within the area of Harborough District administered by the Anglian region of the EA) of the river bank to ensure access for maintenance but amongst other things should ensure a riparian corridor for improvement of the riverine environment.

Through integration of these suggestions, the emerging LDF will comply with PPS25 and the aspirations and policies represented in following:

- The Water Framework Directive (summarised in Section 3.2),
- Regional policy for the East Midlands Policy 35 is relevant to the management of flood risk,
- The River Welland, River Trent and River Severn CFMPs,
- The Leicestershire and Rutland Biodiversity Action Plan
- The National Forest Biodiversity Action Plan,
- Welland, Trent Corridor, Warwickshire Avon, Soar and Tame, Anker and Mease Catchment Abstraction Management Strategies (CAMS).

Flood Risk Management Policies contained within the CFMPs have been set out by the EA and assigned to different zones within the SFRA area. The strategies suggested above interlink with these aspirations and if integrated will help to strengthen the position of the LPA.

3.12.2 The Pitt Report

Following the summer 2007 floods an independent review of the flood related emergencies which occurred was undertaken by Sir Michael Pitt on behalf of the Government. The final report has been published and should be reviewed by HDC with appropriate action taken where the report recommends it

In the main, the Pitt Report has been guided by four key principles and conclusions reached, including;

- The needs of those individuals and communities who have suffered flood or are at risk.
- That change will only happen with strong and more effective leadership across the board.
- That we must be much clearer who does what.
- That we must be willing to work together and share information.

These principles were translated into recommendations, which have been included below, which specifically address the role of the Local Authority with regards to flood risk management and recommends that the Local Authority takes a lead role in the management of flood risk with the support of the relevant organisations.

- Recommendation 14 – Local Authorities should take the lead on the management of local flood risk, with the support of the relevant organisations.
- Recommendation 15 – Local Authorities should positively tackle local problems of flooding by working with all relevant parties, establishing ownership and legal responsibility.
- Recommendation 16 – Local Authorities should collate and map the main flood risk management and drainage assets (over and underground), including a record of their ownership and condition.
- Recommendation 17 – All relevant organisations should have a duty to share information and cooperate with Local Authorities and the EA to facilitate the management of flood risk.
- Recommendation 18 – Local Surface Water Management Plans, as set out under PPS25 and coordinated by local authorities, should provide the basis for managing all flood risk.
- Recommendation 19 – Local authorities should assess and, if appropriate, enhance their technical capabilities to deliver a wide range of responsibilities in relation to local flood risk management.

4 SFRA – Methodology

4.1 Objective

As outlined in Sections 1.3 and 1.4, the objective of the Level 1 SFRA is to collate and review the information available relating to flooding in the study area. Once reviewed and any data gaps have been resolved, the information is presented in a format to enable HDC to apply the Sequential Test to growth areas and to identify potential development sites in Flood Zone 2 and Flood Zone 3, which would require the application of the Exception Test through a Level 2 SFRA. Gaps in the data / information have been identified in order to ascertain additional requirements needed to meet the objectives of a Level 2 SFRA, where required.

4.2 Tasks

The sequence of tasks undertaken in the preparation of the SFRA was, in chronological order:

- Inception meeting with Harborough District Council and the EA on 11th September 2008,
- Determination of local stakeholders,
- Contact with key stakeholders to request data/information,
- Collation and review of data and populate data register,
- Presentation of available and relevant information on flood sources and flood risk,
- Review of received data against SFRA objectives,
- Identification of gaps in data.

4.3 Stakeholders

The stakeholders that were contacted to provide the data / information for the SFRA were:

- Harborough District Council,
- Environment Agency,
- Leicestershire County Council,
- Severn Trent Water,
- Anglian Water,
- British Waterways,
- Highways Agency,
- Leicestershire Fire & Rescue Service,

- Parish Council/Meetings,
- British Geological Survey.

The principal contacts and their associated details for the above stakeholders are presented in Appendix C.

4.3.1 Local Authorities

HDC provided information, advice and data on flood risk and planning issues across their administrative area and how their LDF programme is emerging. In addition to their planning and development aspirations, HDC was able to provide some detail of flooding from various sources within their boundary.

4.3.2 Environment Agency

At the inception meeting discussions were held with the EA to determine what information could be made available for the purposes of the SFRA and to discuss how to best use the data. The EA subsequently provided a large amount of data, including data relating to flood risk management, flood risk policy and historical flooding.

A full list of the data provided by the EA can be found in the Data Register in Appendix B, but can be summarised as:

- Catchment Flood Management Plans (CFMP) for the River Trent (Draft), River Severn (Draft) and River Welland (Draft),
- Rivers Welland and River Trent Catchment Abstraction Management Strategy (CAMS),
- Strategic Flood Risk Mapping (SFRM) outlines and supporting data,
- Details and locations of historical flood events,
- Groundwater Vulnerability Mapping,
- Locations of flood defence assets and flood warning areas.

The EA has also assisted in the production of the SFRA by providing expert advice and comment.

4.3.3 Leicestershire County Council

LCC were able to provide some details of flooding hotspots within Harborough relating to known highway drainage issues.

LCC's Local Resilience Forum Emergency Planning Department, are also currently working on a county-wide Flood Plan, which will be based primarily on local Community Flood Plans involving Community Wardens assigned to each identified flood risk area. These plans are intended to determine and investigate the problems associated with flooding at specific areas of concern, such as where there have been persistent localised incidents, in order to inform

the relevant agencies of work required to be undertaken. The most recent of these was completed for Billesdon in 2005[9].

Emergency Management Teams have been assigned in each District to ensure that a comprehensive plan for the county is produced. Emergency management for Harborough DC is provided by the Welland with Oadby & Wigston Emergency Planning Partnership (WOW), pooling the available resources of four Councils including Harborough DC, Oadby & Wigston BC, Melton BC and Rutland CC, to provide effective emergency management capability.

4.3.4 Severn Trent Water

STW have provided a register of flood events that have affected properties (internal) and outside areas such as roads (external) to a particular postcode. This information is provided to the regulatory body Office of Water Services (OFWAT) and is used to help define their works programme. The register is also known as the DG5 register, and contains commercially sensitive information as well as information covered by the Data Protection Act (1998). As a result, a detailed analysis of the scale, consequences and risks of sewer flooding has not been possible at this stage of the SFRA.

Data protection issues have prevented the identification of flooding at individual properties. Where historical flooding to individual properties has been identified the information is presented on the maps as a flood hotspot by street rather than the property name and / or address.

4.3.5 Anglian Water

AW has provided details of their DG5 register of flood events that have affected properties (internal) and outside areas such as roads (external) as polygon areas. As for the data provided by STW, detailed analysis of the scale, consequences and risks of sewer flooding has not been possible at this stage of the SFRA. Historical flooding is presented on the maps as a flood hotspot by broad area rather than the property name and / or address.

4.3.6 British Waterways

BW South East Waterways department were contacted as part of this SFRA for information regarding details of specific known locations and sources of historical flooding and were able to confirm that there have been no incidents of flooding originating from the Grand Union Canal which flows through the centre of the Harborough District for which they are responsible.

4.3.7 Highways Agency

OPTIMA Infrastructure Management on behalf of HA, provided details of recorded locations of historical flooding incidents since their contract began on or within the immediate vicinity of roads for which they are responsible.

[9] Billesdon Flooding Report, Adrian Vaughan, Harborough District Council, September 2005

4.3.8 Leicestershire Fire & Rescue Service

The Data Management Team within LFRS provided details of recorded locations of historical flooding incidents where the fire service has been involved in resolving the risk and provided details of a number of their emergency planning documents and protocols currently implemented by their Civil Contingencies department, including a Draft Category 5 – Severe Flooding Procedure (currently undergoing staff consultation) and a Regional Water Rescue Standard Operating procedure.

4.3.9 Parish Council Consultation

Ninety one Parish Councils and Parish Meetings within the study area were also contacted regarding any historical instances of flooding for which they have local knowledge or records. Specific emphasis was placed in the questionnaire on the broad dates and locations in which flooding has occurred, and if known, the sources of flood water, any hydraulic structures that may have influenced the level of flooding by being prone to blockage, and the resultant impacts caused by the floodwater such as the features affected.

At the time of this report's submission SW obtained a significant volume of detailed historical flooding information from approximately 50% of the Parishes contacted. These parish records, including date, location and cause of flooding have been added to the historical flooding database in Appendix A

4.4 Data / Information Collected

Data was requested from the above stakeholders. Received data was integrated with Scott Wilson's GIS system, where possible, to facilitate a review of the information. The data requested from the identified stakeholders was based on the following categories:

- Terrain Information,
- Mapping data (ordnance survey),
- Hydrology,
- Hydrogeology,
- Flood Defence,
- Environment Agency Modelled Flood Levels,
- Environment Agency Flood Zone Maps,
- Historical flooding,
- Sewer flooding problems,
- Planning related data and policies

All data was registered on receipt and its accuracy and relevance reviewed to assess confidence levels for contribution to the SFRA. Details of all the data collected at the time of production are presented in Appendix B.

Table 4-1: Method for qualitative confidence ranking of data received

		RELEVANCE		
		1 - VERY RELEVANT	2 - PARTLY RELEVANT	3 - NOT RELEVANT
ACCURACY	1 - EXCELLENT	VERY GOOD	GOOD	GOOD
	2 - GOOD	GOOD	GOOD	FAIR
	3 - FAIR	GOOD	FAIR	FAIR
	4 - POOR	FAIR	FAIR	POOR
	5 - VERY POOR	FAIR	POOR	VERY POOR

4.5 GIS, Flood Mapping and Application

Using the data collected a series of GIS layers were collated to visually assist HDC in their site allocation decisions and Development Control activities.

Broadly, the layers can be classified into planning policy, informative and flood risk categories. Appendix B outlines the GIS layers received and includes an assessment of the level of confidence associated with them.

4.5.1 GIS Data Gaps & Assumptions

Some data that is necessary to satisfactorily complete an SFRA is often not available at all, or is not available in GIS format. In order to present complete Flood Zones with the best available information for the Harborough study area, it has been necessary to make certain assumptions, so that gaps in data could be filled; these assumptions have been outlined in Section 4.5.2 below.

4.5.2 Flood Risk GIS Layers

The following sub-section is intended for use in conjunction with the SFRA Flood Risk Zone mapping presented in Appendix D. Planning guidance indicating what type of development is likely to be appropriate in certain Flood Risk Zones is presented in Tables D.2 and D.3 of PPS25. These tables can then be viewed in conjunction with the SFRA Flood Risk Zone mapping to inform planning decisions.

SFRA Flood Risk Zone Mapping

SFRA flood risk maps in general reproduce the EA high, medium and low probability flood zones where no other more detailed up to date information is available. SFRA flood risk maps

also include assessment of the functional floodplain and the effect of climate change on flood zones.

However, SFRA flood risk maps do not only show fluvial/tidal flood zones, they also show localised flooding areas. The localised flooding areas relate to historical flooding at individual locations, and may arise from any source of flooding, including groundwater, surface water run-off or insufficient drainage capacity as well as historical incidents of fluvial or tidal flooding.

These SFRA Flood Risk Maps present Flood Zone 1, Flood Zone 2, Flood Zone 3a and Flood Zone 3b in relation to current levels of flood risk. In addition some of these areas have also been mapped to take into account climate change as recommended by PPS25. These maps are included in Appendix D and should enable the LPA to undertake the Sequential Test as part of the SFRA.

In order to present the most up-to-date and relevant flooding information available, the SFRA Flood Risk Zone maps have been created using a variety of existing sources of data. Where detailed hydraulic modelling has been undertaken and flood outlines mapped, these have been used in preference to broad-scale modelled flood outlines. For each reach, information on the data has been provided detailing the source of the data used to create the Flood Zone and the relative confidence in the data.

Flood Zone 1 refers to all areas that are considered to be at low risk of fluvial (or tidal) flooding. Flood Zone 1 consists of all areas that fall outside of Zones 2 and Flood Zones 3a and 3b. Whilst fluvial and tidal flooding is not a major concern in these areas, the risk of flooding from other sources, such as surface water, groundwater, sewers or artificial sources may still be an issue.

Flood Zone 2 is the extreme flood event outline. This is the flood outline for the 1 in 1000 year flood event and is based upon a combination of broad scale modelling provided by the EA and detailed modelling.

Flood Zone 3a is the outline for the 1 in 100 year fluvial flood event and is part of Flood Zone 3 that is outside Flood Zone 3b (the functional floodplain). It is based on both broad scale and detailed modelling information provided by the EA.

Flood Zone 3a has been determined with an allowance for climate change. For fluvial reaches, this Flood Zone is calculated by adding a net increase of 20% over and above peak flows to the 100 year event. Where modelled information is not available, the Flood Zone 2 outline has been used as a proxy until such a time when more detailed information is available (i.e. an EA modelling study or hydraulic modelling is undertaken for a site specific FRA). This is not to say that the entire area used as a proxy is Flood Zone 3 plus an allowance for climate change, moreover that the boundary of Flood Zone 3 plus an allowance of climate change falls somewhere within that area.

Functional Floodplain

One of the requirements of PPS25 is that the Functional Floodplain (**Flood Zone 3b**) should be mapped to highlight those areas where only water compatible development and essential infrastructure is recommended.

Functional floodplain is defined by Table D.1 in PPS25 as an area of land where water has to flow or be stored at times of flood. The functional floodplain has an annual probability of flooding of 5% (i.e. from a 1 in 20 year return period event). PPS25 states that functional floodplain should be determined considering the effects of defences and other flood risk management infrastructure.

Any planning applications for proposed appropriate development must be accompanied by a site-specific FRA that proves that the proposed development will not impede flood flows, will not increase flood risk elsewhere and will remain operational in times of flood. In light of the above, it is important that functional floodplain is illustrated by the SFRA in order for HDC to consider its location when preparing LDF documents and other strategic documents.

For some main rivers within the HDC boundary the 5% (1 in 20 year return period event) flood outline has not yet been delineated. The 1 in 25 year return period event was available in some cases, from provided modelling data, and this has been used to map the functional floodplain. Where the 1 in 25 year flood outline is not available Flood Zone 3, excluding those areas within a development limit or defended area is used as a proxy to represent the functional floodplain. This is not to say that the whole of Flood Zone 3 is functional but rather to highlight where there is a gap in information and where it will be necessary at the Level 2 SFRA stage or at site specific FRAs, to delineate the functional floodplain in more detail.

Some watercourses in the study area do not have Flood Zones associated with them or do not have all Flood Zones defined. This is not to suggest these watercourses do not flood, moreover that modelled data is not currently available, or the upstream catchment is too small to be picked up through the broad scale modelling.

Paragraph E9 in PPS25 highlights that for proposals of 1ha or above in Flood Zone 1 and for all development in Flood Zones 2 and 3, a site specific FRA is required to accompany a planning application. A site specific FRA should identify and delineate the flood zones associated with any watercourses and also highlights the flood risks to the site from other sources of flooding. The EA provides standing flood risk advice and useful information that can be found on their website (www.environment-agency.gov.uk).

Where a development is proposed within 20 metres of a watercourse (The Town and Country Planning General Development Procedure (Amendment No 2) (England) (Order 2006)) with no flood risk information shown in the SFRA, it is recommended that the EA is consulted to determine whether or not a flood risk assessment is required and what data or local knowledge may exist.

The EA are constantly updating flood zone information. It is our understanding the updates for the area will be available soon and therefore, prior to undertaking any sequential testing or allocation of developments, the EA should be consulted to see if more detailed information is available. Any updated flood zone information can be incorporated into the SFRA at the next update.

Climate Change

Flood Zone 3a has been determined with an allowance for climate change. Where modelling data was available this Flood Zone is calculated by adding a net increase of 20% over and above the peak flows to the 1 in 100 year flood event.

Where modelled information is not available, the Flood Zone 2 outline has been used as a proxy until such time when more detailed information is available (i.e. an EA modelling study or hydraulic modelling undertaken for a site specific FRA). This is not to say that the entire area used as a proxy is Flood Zone 3 plus an allowance for climate change, moreover that the boundary of Flood Zone 3 plus an allowance for climate change falls somewhere within that area.

Historical Flood Mapping

Historic flood events have been plotted as a series of points in approximate areas that have flooded in the past. It should be noted that the majority of these flood events have not been linked to return periods. Much of the information used to create the points is based on historic flood events primarily from the Environment Agency, and local data provided by HDC and Parish Councils, so it is reasonable to assume some inaccuracies may exist. In addition, historical flooding records do not always differentiate between flooding caused by fluvial sources and flooding as a result of other sources such as overwhelmed drainage or waterlogged rural land. However, the layer serves a useful purpose to highlight to HDC that there are areas, some of which may be shown to be outside the Flood Zones, which have experienced flooding in the past.

Sewer and Storm Water Flooding

Limited information regarding incidents of sewer flooding has been provided by STW and AW in the form of DG5 data. The locations of sewer flooding incidents have been presented as polygons within the GIS layer (see the detailed Flood Maps in Appendix D for details).

The identification of sewer and storm water flooding does not identify individual properties. The DG5 data supplied indicated streets within a settlement that are known to have a flooding history. Where historical flooding has been identified the information is presented by street name rather than the property name and / or address.

This layer will help to highlight to HDC certain areas where the drainage network can be overwhelmed during periods of high intensity rainfall and therefore new development in these areas should take account of this.

Surface Water Flooding

There is currently no dataset depicting predicted surface water flood risk areas, and time restraints have prevented surface water flood risk mapping for the Harborough District as part of the SFRA. The Pitt Report notes that the EA is assessing the feasibility of developing a rapid, national topographic screening technique to show areas which are susceptible to surface water flooding from heavy rainfall, which could be used to inform future updates of the SFRA. In the interim, data on surface water flooding hotspots included in the SFRA will be of use to local emergency responders and for planning purposes. Many of the hotspots have been identified from Parish Council records.

Flood Defences

A GIS layer indicating the presence of EA-maintained flood defences was provided which indicates that there are a number of EA or HDC maintained defences located in the south east region of the District along the River Welland and its tributaries.

Limited information regarding the standard of protection of the defences was available; however these data confirmed that defences along the River Welland as it flows through Market Harborough protect the community to a 1 in 75 year standard.

Through discussion with the EA we have established that there are defences in the Great Glen area, although this information is not shown on the NFCDD or the GIS layer provided by the EA. There may be other flood defences in the Harborough District that are not represented on the GIS layer as the information was not available at the time of writing this report.

The EA are constantly updating their flood defence database and any updated flood defence information can be incorporated into the SFRA at the next update.

Groundwater Vulnerability Mapping

The EA's groundwater vulnerability maps have been presented in a thematic map to highlight areas that overlie aquifers with a high vulnerability. Major Aquifers with a high vulnerability tend to have a more permeable surface geology. Groundwater vulnerability relates to the potential for contamination to groundwater and thus is a useful tool to determine the suitability of sustainable drainage (SuDS) techniques. See Appendix E for the District-wide Geology and Groundwater Vulnerability map.

British Geological Survey Geology Mapping

British Geological Survey (BGS) maps were assessed as part of the Level 1 SFRA. The data has been used to undertake the geology and SuDS review in Appendix A. The geology map for the District is shown in Appendix E.

Reservoir Act (1975) Water Bodies

A layer displaying major water bodies falling under the regulation of the Reservoir Act has been provided by the Environment Agency. This can assist HDC in assessing sites immediately downstream of major water bodies. HDC may wish to undertake more detailed analysis of particular water bodies to determine flood risk.

4.6 SFRA – Flood Risk Review Summary

4.6.1 Summary

In line with PPS25, the Sequential Test should be applied at all stages of the planning process. The aim of this is to direct new development towards areas that have a low probability of flooding. The mapping provided in Appendix D indicates the geographical extent of Flood Zone 2, Flood Zone 3a and Flood Zone 3b for the Harborough study area.

The broad-scale and localised SFRA Flood Maps clearly show that, whilst flood risk exists in areas of the District, particularly from pluvial sources and sewerage infrastructure, it does not pose a widespread and significant issue for the potential allocation of development sites.

The East Midlands Regional Spatial Strategy (RSS) sets the total housing requirement for the Harborough District at 8, 800 dwellings between 2001 - 2026. The latest Housing Monitoring Paper prepared by HDC in 2007/2008 shows that 2749 of this 8, 800 have already been completed, leaving a total of 336 dwellings per annum to be delivered between 2007/8 to 2026. The RSS specifies that 10% (880 dwellings) of the total housing provision should be located within the Leicester Principal Urban Area (PUA), with the remainder directed towards Market Harborough.

Although it is acknowledged that there is land within Flood Zone 2 and 3 in both Leicester PUA and Market Harborough, it is very minimal. It is therefore considered that the scale of development required can be directed to areas of the lowest risk of flooding (alongside implementing appropriate flood mitigation measures), to ensure the spatial strategy set out in the RSS can be achieved. It is however recognised that a proportion of new housing allocations in these areas are likely to be on greenfield land, due to the rural nature of the District and a large amount of previously developed land being used up in recent years.

Where potential development sites are at risk from flooding, HDC must determine their suitability based on the Sequential Test and vulnerability classifications presented in Tables D1 and D2 of PPS25. Wherever possible the HDC should seek to direct development to lower probability SFRA Flood Risk Zones. Where this is not possible, development should preferably be located in Flood Zone 2 and where this is not possible, sites in Flood Zone 3 may be considered.

After successful completion of the Sequential Test and depending upon the vulnerability of the proposed development (as classified in PPS25 – Table D2), some development sites that are either wholly or partly situated in Flood Zone 2 or Flood Zone 3 may require the application of the Exception Test. Those development areas requiring application of the Exception Test will require further assessment in a Level 2 SFRA. Information on the application of the Sequential Test, guidance on strategies for managing flood risk, guidance on the potential use of SuDS and guidance on site-specific FRAs are provided in Section 5.2, Chapter 6, and Appendix A.

5 The Sequential Test

5.1 The Sequential Approach

The sequential approach is a simple decision-making tool designed to ensure that sites at little or no risk of flooding are developed in preference to areas at higher risk. It can be applied at all levels and scales of the planning process, both between and within Flood Zones. All opportunities to locate new developments (except water-compatible) in reasonably available areas of little or no flood risk should be explored, prior to any decision to locate them in areas of higher risk.

The Sequential Test refers to the application of the sequential approach by LPAs. This allows the determination of site allocations based on flood risk and vulnerability (Table 5-1 and Table 5-2). Development should be directed towards Flood Zone 1 wherever possible, and then sequentially to Flood Zone 2 and Flood Zone 3. A flow diagram for application of the Sequential Test from the Practice Guide Companion to PPS25 is provided (Figure 5.1).

The application of the sequential approach aims to manage the risk from flooding by avoidance. This will help prevent the promotion of sites that are inappropriate on flood risk grounds. The application of the Exception Test through a Level 2 SFRA will ensure that new developments in flood risk areas will only occur where flood risk is clearly outweighed by other sustainability drivers and mitigation measures are provided.

The LPA must demonstrate that it has considered a range of possible sites in conjunction with the Flood Zone information from the SFRA and applied the Sequential Test and where necessary the Exception Test (see Appendix D of PPS25) in the site allocation process.

PPS25 acknowledges that some areas will be at risk of flooding from flood sources other than fluvial. All sources of flooding must be considered when looking to locate new development. Other sources of flooding that require consideration when situating new development allocations include:

- Surface Water,
- Groundwater,
- Sewers,
- Artificial Sources.

As highlighted in Section 2.3 these flood sources are typically less understood than fluvial sources. Data primarily exists as point source data or through interpretation of local conditions. In addition, there is no guidance on suitable return periods to associate with floods arising from these sources. For example modern storm water drainage systems are constructed to a 1 in 30 year standard. Any storm event in excess of the 1 in 30-year return period storm would be expected to cause flooding.

Contact with STW and AW needs to be maintained as part of the SFRA updating process to ensure that any sewer models or data on sewer flooding incidents is incorporated into the SFRA. PPS 25 recommends that site specific FRAs should undertake detailed drainage and

surface water investigation. It is recommended that such findings are collated on an ongoing basis to ensure the full extent of such issues is highlighted to the District.

If a location is recorded as having experienced repeated flooding from the same source this should be acknowledged within the Sequential Test.

5.2 Using the SFRA to Apply the Sequential Test

The Sequential Test should be undertaken by the LPA and accurately documented to ensure decision processes are consistent and transparent. The Sequential Test should be carried out on potential development sites, with a view to balancing the flood probability and development vulnerability of sites throughout the LPA area.

The recommended steps required in undertaking the Sequential Test are detailed below. These recommendations are based on the Flood Zone and Flood Risk Vulnerability and is summarised in the tables below. The use of the SFRA maps, data and GIS Layers in the application of the Sequential Test is also detailed in this section.

Table 5-1 Flood Zones definitions (see Table D1, Annex D of PPS25)

Flood Zone	Definition		Probability of Flooding
	Fluvial	Tidal	
1	< 1 in 1000 year (< 0.1%)	< 1 in 1000 year (< 0.1%)	Low Probability
2	Between 1 in 1000 year (< 0.1%) and 1 in 100 year (1%)	Between 1 in 1000 year (< 0.1%) and 1 in 200 year (0.5%)	Medium Probability
3a	> 1 in 100 year (> 1%)	> 1 in 200 year (> 0.5%)	High Probability
3b	Either > 1 in 20 (5%) or as agreed by between the EA and LPA	Either > 1 in 20 (5%) or as agreed by between the EA and LPA	Functional Floodplain

Percentages refer to the annual probability of a flood event occurring in any year

Table 5-2 Flood Risk Vulnerability Classification (from PPS25, Appendix D, Table D2)

Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes), which has to cross the area at risk, and strategic utility infrastructure, including electricity generating power stations and grid and primary substations.
Highly Vulnerable	• Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent.
More Vulnerable	• Hospitals. • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable	• Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non–residential institutions not included in 'more vulnerable' and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment plants. • Sewage treatment plants (if adequate pollution control measures are in place).
Water-compatible Development	• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel workings. • Docks, marinas and wharves. • Navigation facilities. • MOD defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

Table 5-3 Flood Risk Vulnerability and Flood Zone 'Compatibility'
(from PPS25, Appendix D, Table D.3)

Flood Zone	Flood Risk Vulnerability Classification				
	Essential Infrastructure	**Water Compatible**	**Highly Vulnerable**	**More Vulnerable**	**Less Vulnerable**
1	✓	✓	✓	✓	✓
2	✓	✓	Exception Test Required	✓	✓
3a	Exception Test Required	✓	×	Exception Test Required	✓
3b	Exception Test Required	✓	×	×	×

(✓ - Development is appropriate, × - Development should not be permitted)

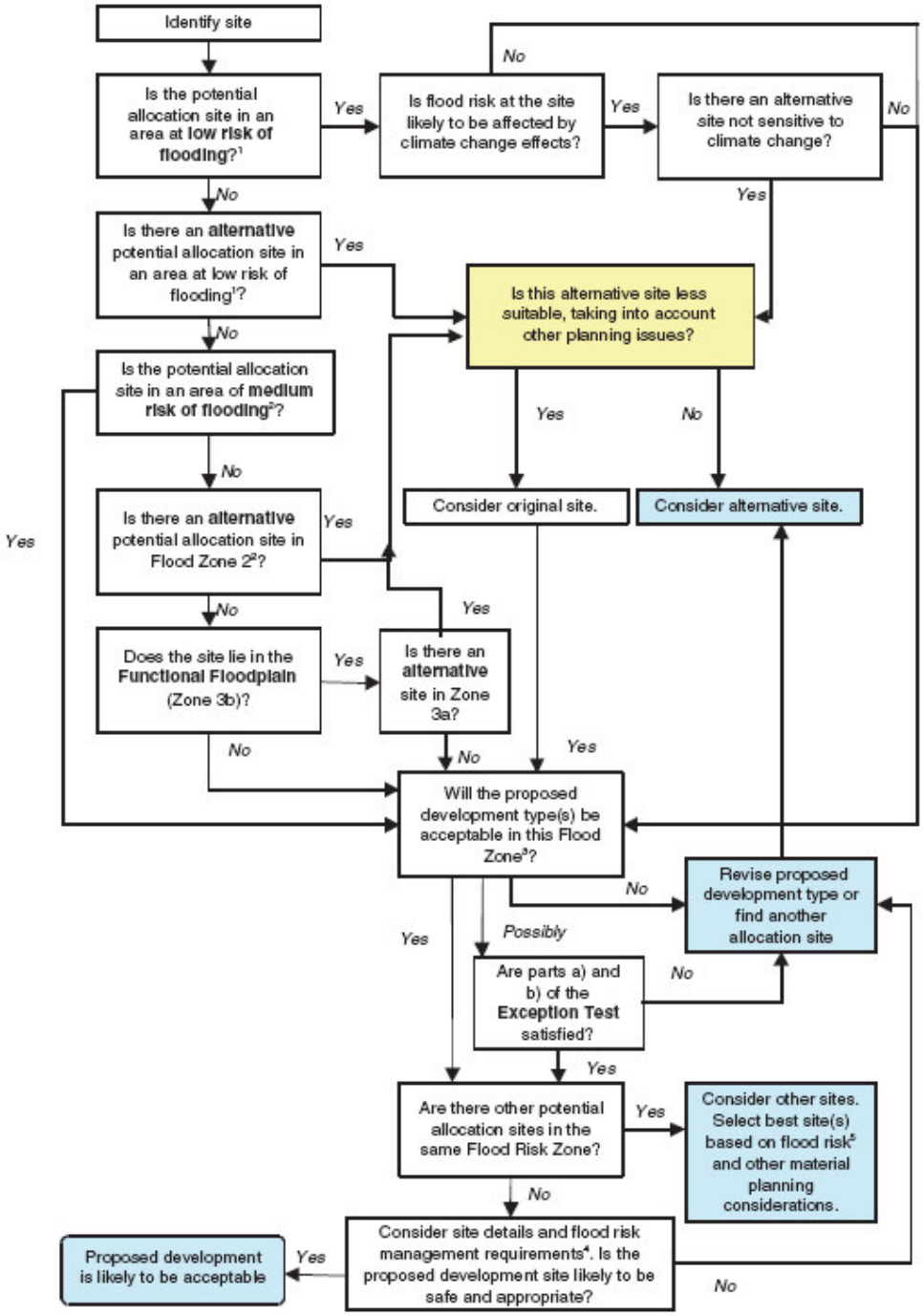


Figure 5-1: Flow diagram illustrating the application of the Sequential Test

Table 5-4 Sequential Test Key - A Guide to using the SFRA Flood Risk Zone GIS Layers

Category	GIS Layer	Example Questions
Flood Zone Classification	SFRA combined fluvial & tidal FZ2, FZ3a & FZ3b layers. Also examine historical floodplain and take into consideration climate change outlines.	**Question 1** – Through consultation of the SFRA Flood Risk Zone Maps, is the development site located in Flood Zone 1?
		Question 2 - Through consultation of the SFRA Flood Risk Zone Maps, is the development site located in Flood Zone 2?
		Question 3 - Can the development be located in SFRA Flood Risk Zone 1?
		Question 4 - Through consultation of the SFRA Flood Risk Zone Maps, is the development site located in SFRA Flood Risk Zone 3a?
		Question 5 - Can the development be located in SFRA Flood Risk Zone 1 or 2?
		Question 6 - Through consultation of SFRA Flood Risk Zone Maps, is the development site located in SFRA Flood Risk Zone 3b?
		Question 7 - Can the development be located in SFRA Flood Risk Zone 1, 2 or 3a?
	Watercourse networks.	**Question 8 -** Is the site located within 8m of a watercourse (9m if development located in EA Anglian region)?
Development Vulnerability if located in SFRA Flood Risk Zone 2, 3a or 3b	Not applicable refer to Table D2 in PPS25	**Question 9** – Is the proposed development defined as 'highly vulnerable' according to Table D2 in Planning Policy Statement 25?
		Question 10 - Is the proposed development defined as 'more vulnerable' according to Table D2 in Planning Policy Statement 25?
		Question 11 - Is the proposed development defined as 'less vulnerable' according to Table D2 in Planning Policy Statement 25?
		Question 12 - Is the proposed development defined as 'essential infrastructure according to Table D2 in Planning Policy Statement 25?
		Question 13 - Is the proposed development defined as 'water compatible development' according to Table D2 in Planning Policy Statement 25?

Table 5-4 Sequential Test Key - A Guide to using the SFRA Flood Risk Zone GIS Layers (continued)

Category	GIS Layer	Example Questions
Other Flood Sources	SFRA combined fluvial and tidal FZ3 & FZ2 outlines plus climate change	**Question 14 –** Is the site impacted by the effects of climate change?
	Sewer Flood Layer & Historical Flood Outlines	**Question 15** - Is the site in an area potentially at risk from surface water sewer flooding?
	Historical Flood Outlines, Parish Council data, GEZ, CEH stream network (BFI) and groundwater vulnerability maps	**Question 16** - Is the site in an area potentially at risk from overland flow flooding?
		Question 17 - Is the site located in an area of rising groundwater levels?
		Question 18 - Does the site have a history of flooding from any other source?
Flood Risk Management	Flood Defence Layer (NFCDD), Flood Warning Layer, Areas Benefiting from Flood Defences Layer, Parish Council data	**Question 19** - Does the site benefit from flood risk management measures?
		Question 20 - Can the development be relocated to an area benefiting from flood risk management measures or of lower flood risk?

Table 5-5 Flood Risk Vulnerability and Flood Zone Compatibility

Use Category	Development	SFRA FLOOD ZONE			
		1	2	3a	3b
		FRA[1]	FRA	FRA	FRA
Essential Infrastructure	Essential Transport Infrastructure, Strategic Utility Infrastructure, Electricity Generating Power Stations	A	S ⇩ A	S ⇩ E ⇩ A	S ⇩ E ⇩ A
Highly Vulnerable	Police Stations, Ambulance Stations, Fire Stations, Command Centres and telecoms installations required to be operational during flooding, Emergency dispersal points, Basement dwellings, Caravans, mobile homes and park homes intended for permanent residential use, Installations requiring hazardous substances consent	A	S ⇩ E ⇩ A	N	N
More Vulnerable	Hospitals, Residential institutions (care homes, children's homes, social services homes, prisons and hostels), Dwelling houses, Student halls of residence, Drinking establishments, Nightclubs, Hotels, Non-residential health services, Nurseries, Educational establishments, Landfill sites, Sites used for waste management facilities for hazardous waste, Sites used for holiday or short-let caravans and camping (subject to a specific warning and evacuation plan)	A	S ⇩ A	S ⇩ E ⇩ A	N
Less Vulnerable	Shops, Buildings used for financial, professional and other services, Restaurants and cafes, Hot food takeaways, Offices, General Industry, Storage and distribution, Non-residential institutions (unless identified as more vulnerable), Assembly and Leisure, Land and buildings used for agriculture and forestry, Waste treatment (except landfill and hazardous waste), Minerals working and processing (except for sand and gravel workings), Water treatment plants, Sewage treatment plants (if adequate pollution control measures are in place)	A	S ⇩ A	S ⇩ A	N
Water Compatible Development	Flood control infrastructure, Water transmission infrastructure and pumping stations, Sewage transmission infrastructure and pumping stations, Sand and gravel workings, Docks, marinas and wharves, Navigation facilities, MOD defence installations, Ship building, repairing and dismantling, Dockside fish processing and refrigeration, Activities requiring a waterside location, Water based recreation (excluding sleeping accommodation), Lifeguard and coastguard stations, Amenity open space, Nature conservation and biodiversity, Outdoor sports and recreation, Essential facilities such as changing rooms, Essential ancillary sleeping or residential accommodation for staff required for water compatible development (subject to a specific warning and evacuation plan)	A	A	A	A

To be read in conjunction with Table D.1 and Table D.2 in PPS25. Table 5-5 seeks to highlight what development is appropriate in flood zones and where FRAs are required.

TABLE 5-5 - KEY

A: *Appropriate use*
N: *Use should not be permitted*

S: *Use only appropriate if it passes the Sequential Test*
E: *Use only appropriate if it passes the Exception Test*
⇩: *If passed proceed*

FRA[1]*: Flood risk assessment should be carried out for sites of 1 hectare or more in FZ 1, to consider the vulnerability of flooding from sources other than river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off.*

FRA*: Flood risk assessment required for all developments.*

Note; Even where development is found to be acceptable through the application of the Sequential and Exception Tests further flood resistance/resilience may be required in the design and construction of specific developments. Such a test should be based on the SFRA.

Sequential Test: Development should be steered first towards the lowest risk areas. Only where there are no reasonably available sites should development on suitable available sites in higher risk areas be considered taking into account flood risk vulnerability and applying the Exception Test where required.

Exception Test: Exceptionally, development whose benefits outweigh the risk from flooding may be acceptable. For this test to be passed, the development should demonstrably provide wider sustainable benefits to the community, should be on developable previously-developed land (unless there are no reasonably available sites on developable previously-developed land), and should be demonstrably safe without increasing flood risk elsewhere and where possible reducing flood risk overall.

5.3 Recommended Stages for Application of the Sequential Test

The information required to address many of these steps is provided in the accompanying GIS layers and maps presented in Appendix D. The recommended stages for the application of the Sequential Test by the Council are as follows:

1. Assign potential developments with a vulnerability classification (Table D-2 PPS 25). Where development is mixed, this should be moved to the higher classification,
2. The location and identification of potential development should be recorded,
3. The SFRA Flood Risk Zone classification of potential development sites should be determined based on a review of the Flood Zones presented in this SFRA for fluvial and tidal sources. Where these span more than one Flood Zone, all zones should be noted,
4. The design life of the development should be considered with respect to climate change:
    - 60 years – 2072 for commercial / industrial developments,
    - 100 years – 2112 for residential developments,

5. It should be noted that for the purposes of the Sequential Test, SFRA Flood Risk Zones with no consideration of defences should be used i.e. the SFRA flood zones, which are based on up to date information from the EA at the time of writing this report.
6. Highly vulnerable developments should be located in those sites identified as being within Flood Zone 1. It should be noted at this stage that Flood Zone 1 represents any area that is not determined as Zone 2 or Zone 3. If these cannot be located in Flood Zone 1 because the identified sites are unsuitable or there are insufficient sites in Flood Zone 1, sites in Flood Zone 2 can then be considered. If sites in Flood Zone 2 are inadequate then the LPA may have to identify additional sites in Flood Zones 1 or 2 to accommodate development or seek opportunities to locate the development outside their administrative area,
7. Once all highly vulnerable developments have been allocated to a development site, the LPA can consider those development types defined as more vulnerable. In the first instance more vulnerable development should be located in any unallocated sites in Flood Zone 1. Where these sites are unsuitable or there are insufficient sites remaining, sites in Flood Zone 2 can be considered. If there are insufficient sites in Flood Zone 1 or 2 to accommodate more vulnerable development, sites in Flood Zone 3a can be considered. More vulnerable developments in Flood Zone 3a will require application of the Exception Test. More vulnerable development types are not appropriate in Flood Zone 3b – Functional Floodplain,
8. Once all more vulnerable developments have been allocated to a development site, the LPA can consider those development types defined as less vulnerable. In the first instance less vulnerable development should be located in any remaining unallocated sites in Flood Zone 1, continuing sequentially with Flood Zone 2, then 3a. Less vulnerable development types are not appropriate in Flood Zone 3b – Functional Floodplain,
9. Essential infrastructure should be preferentially located in the lowest flood risk zones, however this type of development may be located in Flood Zones 3a and 3b, provided the Exception Test is fulfilled,
10. Water compatible development has the least constraints with respect to flood risk and it is considered appropriate to allocate these sites last. They do not require the application of the Exception Test,
11. On completion of the sequential test, the LPA may have to consider the risks posed to a site within a Flood Zone in more detail in a Level 2 Assessment. By undertaking the Exception Test, this more detailed study should consider the detailed nature of flood hazard to allow a sequential approach to site allocation within a Flood Zone. Consideration of flood hazard within a Flood Zone would include:
    - Flood risk management measures,
    - The rate of flooding,
    - Flood water depth,
    - Flood water velocity.

Where the development type is highly vulnerable, more vulnerable, less vulnerable or essential infrastructure and a site is found to be impacted by a recurrent flood source (other than fluvial), the site and flood sources should be investigated further regardless of any requirement for the Exception Test. This should be discussed with the EA to establish the

appropriate time for the assessment to be undertaken, (i.e. Exception Test through a Level 2 SFRA or assess through a site specific FRA).

The SFRA Flood Risk Zone maps presented in Appendix D are designed to assist HDC in determining the flood risk classification for each site and in completing the Sequential Test. This will aid the determination of the most suitable type of development for each site based on development vulnerability and flood risk. Certain sites have been identified as lying within Flood Zones 2 and 3 and, if the sites cannot be relocated, it will be necessary to undertake an Exception Test.

5.4 Using the SFRA Maps, Data and GIS Layers

Table 5-4 highlights which GIS layers and SFRA data should be used in carrying out the Sequential Test. The table poses some example questions that are not exhaustive, but should provide some guidance for a user of the SFRA.

Appendix F summarises the steps required to maintain and update the SFRA together with a revision schedule. This should be checked prior to the SFRA being used at a strategic land allocation scale or on a Development Control level to ensure the most current and up-to-date version of the SFRA is being used. In addition, close consultation with some of the key stakeholders, in particular the EA may highlight updated flood risk information that may reduce uncertainty and ensure the Sequential Test is as robust as it can be.

As identified in Section 2, some watercourses in the study area do not have Flood Zones associated with them or do not have all Flood Zones defined. This is not to suggest these watercourses do not flood, moreover that modelled data is not currently available. Therefore, allocations adjacent to un-modelled watercourses or watercourses where all Flood Zones have not been defined cannot be assessed against all aspects of the Sequential Test using the existing data.

To overcome this gap in the data and to enable HDC to proceed with the application of the Sequential Test the following criteria should be considered:

- **For watercourses where no Flood Zones have been defined –** If a site is within the 8 m byelaw distance of a watercourse (9m if the site is within the EA Anglian region of the Harborough District) and promoted for development further investigation should be undertaken to determine the suitability of the site for the proposed development. For application of the Sequential Test the site should be considered as lying within Flood Zone 3a until proven otherwise. If following further investigation the site is found to lie within Flood Zone 3b the development may not be appropriate against the policies presented in PPS25.
- **For watercourses where Flood Zone 3b (functional floodplain) has not been defined** – If a proposed development site is located in Flood Zone 3, there is a possibility it may also fall within Flood Zone 3b. Further investigation should be undertaken to define Flood Zone 3b for the local water course(s). According to the PPS25 Practice Guide Companion when applying the Sequential Test the site should be considered as lying within Flood Zone 3b until proven otherwise. If following further investigation the site is found to lie within Flood Zone 3b the development may not be appropriate against the polices presented in PPS25.

- **For watercourses where the effect of climate change on Flood Zones has not been defined** - For any development located in or adjacent to a Flood Zone boundary, there is a possibility that when considering the effects of climate change the site may be at greater flood risk. For example if a site is clearly identified to be in Flood Zone 3a (and not within 3b), when the effects of climate change are considered the site may be found to lie within Flood Zone 3b. For application of the Sequential Test, for sites located in Flood Zone 3 or at the boundary of Flood Zone 2 and 3, where the effects of climate change are not defined, the sites can be considered to lie within the current Flood Zone; however the effects of climate change should be investigated further. If following further investigation the site is found to lie within a different Flood Zone the Sequential Test should be reapplied to determine if the proposed development is appropriate.

It should be noted that adopting this approach requires HDC to accept an element of risk when reviewing and allocating their development sites. For example, should HDC identify a site in Flood Zone 2 as acceptable for more vulnerable development, when considering the effects of climate change on Flood Zone definition the site may be found to be located in Flood Zone 3 and therefore require application of the Exception Test. Similarly location of more vulnerable development in Flood Zone 3a may be inappropriate if further work identifies those parts of Flood Zone 3a to be redefined as Flood Zone 3b with consideration of climate change.

As part of the SFRA update process, new modelled watercourse outlines should be incorporated into the SFRA mapping. New modelled outlines may become available as part of a site specific FRA or as part of ongoing EA updated modelling.

6 Site Specific Flood Risk Assessment Guidance

6.1 Introduction

The assessment of flood risk is a fundamental consideration for new development or redevelopment regardless of its scale or end-use. Understanding the flood risk posed to and by a development is key to managing the risk to people and property thereby reducing the risk of injury, property damage or even death. The effects of climate change may exacerbate future flood risk. Current predictions indicate that milder, wetter winters and hotter, drier summers will be experienced in the future and there will be a continued rise in sea levels. These changes will potentially lead to changes to the magnitude, frequency and intensity of flood events. Some areas currently defended from flooding may be at greater risk in the future due to the effects of climate change or as the defence condition deteriorates with age.

Opportunities to manage flood risk posed to and by development exist through understanding and mitigating against the risk. The location, layout and design of developments should be considered to enable the management of flood risk through positive planning. This positive planning approach must consider the risks to a development from local flood sources and the consequences a development may have on increasing flood risk to the surrounding areas. Early identification of flood risk constraints can ensure developments are sustainable whilst maximising development potential.

Level 1 SFRAs should present sufficient information to assist LPAs to apply the Sequential Test and identify where the Exception Test may be required. These documents are predominately based on existing data. The scale of assessment undertaken for an SFRA is typically inadequate to accurately assess the risks at individual sites within the study area as, for example, the EA and SFRA Flood Zone Mapping do not account for all watercourses within the study area and may show a specific site to be within Flood Zone 1 when it may be adjacent to a watercourse. Therefore individual applications will be required to submit individual FRAs.

Site-specific FRAs are required to assess the flood risk posed to and by proposed developments and to ensure that, where necessary, appropriate mitigation measures are included in the development.

The guidance presented in the following sections has been based on:

- The recommendations presented in PPS25 and the Practice Guide Companion,
- The information contained within this SFRA report.

At the time of writing this document site-specific allocation had not been finalised, therefore pending the finalisation of the LPA allocations, the development areas were used to identify the flood risks to potential growth and development areas. If on completion of the preferred options there are any allocations that fall outside these growth areas, then the Sequential Test and potential Exception Test for these sites will need to be explored at that time. The

following recommendations are made by way of an indication of how to proceed with the SFRA process once the preferred options allocations are finalised:

- The LPAs should apply the Sequential Test to the potential development sites and identify those sites they consider will be necessary to apply the Exception Test,
- If sites require the Exception Test the LPAs should provide responses to parts 'a' and 'b' of the Exception Test for each of the allocation sites,
- Following completion of the Sequential Test and parts 'a' and 'b' of the Exception Test the EA should be consulted to confirm their acceptance of the LPAs arguments and justification for progressing with sites that require the Exception Test. The LPA should then refer future developers to complete an FRA to meet the requirements of part 'c' of the Exception Test in line with recommendations set out in PPS25.

6.1.1 When is a Flood Risk Assessment required?

When informing developers of the requirements of an FRA for a development site, consideration should be given to the position of the development relative to flood sources, the vulnerability of the proposed development and its scale.

In the following situations a FRA should always be provided with a planning application:

- Development sites located in Flood Zone 2 or Flood Zone 3,
- FRAs are required for all major developments in Flood Zone 1 (according to PPS25 Annex E). These are residential developments consisting of sites greater than 0.5 ha or greater than 10 dwellings and commercial developments that are greater than 1 ha or have a floor area greater than 1000 m^2,
- Development sites located in an area known to have experienced flooding problems from any flood source,
- Development sites located within the 8 m Byelaw distance (9 m if development is located within the area of Harborough District administered by the Anglian region of the EA) of any watercourse regardless of Flood Zone classification.

6.1.2 What does a Flood Risk Assessment require?

Annex E of PPS25 presents the minimum requirements for FRAs. These include:

- The consideration of the risk of flooding arising from the development in addition to the risk of flooding to the development,
- Identify and quantify the vulnerability of the development to flooding from different sources and identify potential flood risk reduction measures,
- Assessment of the remaining 'residual' risk after risk reduction measures have been taken into account and demonstrate that this is acceptable for the particular development,
- The vulnerability of people that could occupy and use the development, taking account of the Sequential and Exception Tests and the vulnerability classification, including arrangements for safe access and egress,

- Consideration of the ability of water to soak into the ground, which could change with development, along with how the proposed layout of the development may affect drainage systems,
- Fully account for current climate change scenarios and their effect on flood zoning and risk.

The Practice Guide Companion to PPS25 advocates a staged approach to site-specific FRAs with the findings from each stage informing the next and site master plans, iteratively throughout the development process.

The staged approach comprises of three stages outlined below.

6.1.3 Level 1 - Screening Study

A Level 1 Screening Study is intended to identify if a development site has any flood risk issues that warrant further investigation. This should be based on existing information such as that presented in the Level 1 SFRA. Therefore this type of study can be undertaken by a Development Control Officer in response to the developer query or by a developer where the Level 1 SFRA is available. Using the information presented in the Level 1 SFRA and associated GIS layers a Development Control Officer could advise a developer of any flooding issues affecting the site. A developer can use this information to further their understanding of how flood risk could affect a development.

6.1.4 Level 2 - Scoping Study

A Level 2 Scoping Study is predominately a qualitative assessment designed to further understanding of how the flood sources affect the site and the options available for mitigation. The Level 2 FRA should be based on existing available information, where this is available, and use this information to further a developers understanding of the flood risk and how they affect the development. This type of assessment should also be used to inform master plans of the site raising a developer's awareness of the additional elements the proposed development may need to consider.

6.1.5 Level 3 – Detailed Study

Where the quality and/or quantity of information for any of the flood sources affecting a site is insufficient to enable a robust assessment of the flood risks, further investigation will be required. For example it is generally considered inappropriate to base a flood risk assessment for a residential care home at risk of flooding from fluvial sources on Flood Zone maps alone. In such cases the results of hydraulic modelling are preferable to ensure details of flood flow velocity, onset of flooding and depth of floodwater is fully understood and that the proposed development incorporates appropriate mitigation measures.

At all stages the LPA, and where necessary the EA and/or STW and AW, should be consulted to ensure the FRA provides the necessary information to fulfil the requirements for Planning Applications.

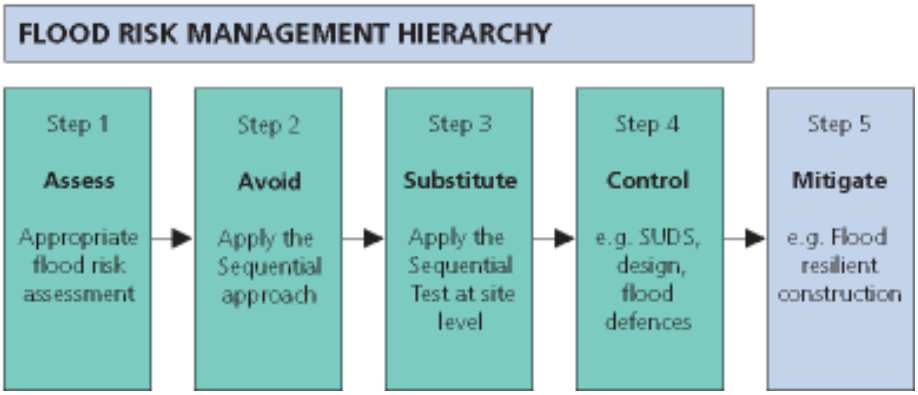
6.1.6 Site-Specific Guidance

HDC should consider the consequences of including SuDS on development sites and the impact these can have on the developable area. In all cases the LPA should assess allocation sites in relation to geology and local issues to enable completion of the SuDS summary in Appendix A; National and local policies should be reviewed against local flood risk issues and objectives identified by the EA. Through completion of these recommendations the LPA will be able to transparently manage flood risk and ensure risk to their development sites and communities, now and in the future are mitigated.

National Flood Risk Guidance

PPS25 Methodology must be followed including information and guidance provided in the Practise Guide to PPS25 with particular reference to the Flood Risk Management Hierarchy illustrated in Figure 6.1 below. EA guidance on sequential testing must also be followed as detailed above.

Figure 6 .1 – Flood Risk Management Hierarchy



Local Flood Risk Policy

Where development is to be situated within a Flood Zone the following policies should be observed:

- The development should seek to reduce flood risk to the development site, to sites adjacent or downstream of the development and to the area overall,
- Flood proofing/resilience measures should be incorporated into the design e.g. bungalows should have velux windows, sockets located high up on walls,
- Emergency access and egress routes should remain operational before, during and after the 1 in 100 year plus climate change flood event.
- Emergency Planning,
- EA Flood Warning Procedure should be adhered to,

- Flood action plans should be developed- these would consider Escape routes, a refuge room, adequate supplies of bottled water and food,
- Using Section 3.9 and Appendix A, site specific FRAs should ensure appropriate SuDS techniques are investigated according to local geology, groundwater source and protection zones.

6.2 Residual Risk Management

Residual risk in a generic sense can be defined as being the remaining risk following the implementation of all reasonable risk avoidance, reduction and mitigation measures. In a flood risk context, this residual risk pertains to the flood risk that remains after flood avoidance and alleviation measures have been put in place. Examples of such residual risks include overtopping or breaching of flood walls or embankments.

Residual risk management therefore aims to prevent or mitigate the consequences of flooding that can occur despite the presence of flood alleviation measures.

Application of the Sequential Test as part of PPS25 aims to preferentially develop or relocate potential development sites into areas with low flood risk. Where this is not realistically possible, some development sites may be located in higher flood risk areas, such as PPS25 defined Flood Zones 2 and Flood Zone 3. As a result, such developments will require residual risk management to minimise the consequences of potential flooding, e.g. following a breach or overtopping of local defences.

Ensuring properties are defended to an appropriate design standard reduces flood risk. However, further options are also available should the residual risk to a development prove unacceptable. This chapter presents some of the information and options available to understand and manage residual risk.

6.2.1 Potential Evacuation and Rescue Routes

New developments are required to provide safe access and exit during a flood and the measures by which this will be achieved should be clear in the Flood Risk Assessment (FRA).

Safe access and exit is required to enable the evacuation of people from the development, provide the emergency services with access to the development during a flood and enable flood defence authorities to carry out any necessary duties during the period of flood.

Safe routes should be identified within the development and for the area surrounding the new development. Even where a new development is above the floodplain and considered acceptable it should be demonstrated that the routes to and from the development are also safe to use.

If potential evacuation routes are likely to become inundated so that safe access/egress would not be possible, then the proposed development should be relocated. This may also be the case should the possible evacuation routes be particularly long or across difficult terrain.

For a given development, it must be decided whether safe exit and access constitutes dry access routes or depth and velocity combinations that are below appropriate precautionary thresholds. This decision needs to be made by the LPA in consultation with the Emergency

Services and will need to take into consideration the proposed use of the development, the vulnerability of the occupants and the availability of emergency services and flood forecasting.

Table 6.1 below, (reproduced from the FD2320/TR2 document), gives an indication of the depths and velocities of flood waters that are likely to be "danger for some", "danger for most" or "danger for all". The white cells within the Table indicate a "low or very low hazard". The Table indicates that flood depths below 0.25 m and velocities below 0.5 m/s are generally considered low hazard. When designing safe access and exit routes, the combinations of depth and velocity on the routes should correspond to the white boxes.

Table 6.1: - Danger to people for different combinations of depth and velocity

Velocity (m/s)	Depth of flooding (m)											
	0.05	0.10	0.20	0.30	0.40	0.50	0.60	0.80	1.00	1.50	2.00	2.50
0.00												
0.10												
0.25												
0.50												
1.00												
1.50												
2.00												
2.50												
3.00												
3.50												
4.00												
4.50												
5.00												

Key:
- Danger for some
- Danger for most
- Danger for all

Development for vulnerable users e.g. disabled or the elderly should be located away from high-risk areas. The Sequential Test does not however differentiate between the vulnerability of the end users of the site, only the vulnerability of the intended use of the site. A proposed residential development for highly vulnerable end users will still fall under the 'More Vulnerable' classification in Table D.2 of PPS25 and the Sequential and Exception Tests will apply accordingly.

Where development for highly vulnerable end users cannot be avoided, safe and easy evacuation routes are essential and the rescue services should not be overstretched leaving some other sites at risk if development is permitted in the flood zones.

The EA can advise on acceptable proposals but it is the responsibility of the developer, through an FRA, to demonstrate the risk posed to the site, and that proposals will not increase the risk to the development and the surrounding area.

6.2.2 Time to Peak of Flood Hazard

The time to the peak of the flood hazard relates to the amount of time it takes for a flood event to reach its maximum level, flow or height, the greater the time to peak the greater the time available for evacuation. The time to peak can, for residual flooding, be very short. Should a defence structure breach then inundation can be rapid, resulting in a short time to peak for the

areas local to the breach. Typically, areas immediately adjacent to a breach location will have a shorter time to peak than areas set back from the flood defence.

6.2.3 Methods of Managing Residual Flood Risk

The following sub-sections outline various methods available for the management of residual flood risk. The methods outlined will not be appropriate for all development types or all geographical areas. Therefore, they should be considered on a site-by-site basis. In addition, it is important that the use of such techniques do not exacerbate flooding elsewhere within the flood cell.

Recreation, Amenity and Ecology

There are many different ways in which recreation; amenity and ecological improvements can be used to mitigate the residual risk of flooding either by substituting less vulnerable land uses or by attenuating flows or both. They range from the development of parks and open spaces through to river restoration schemes. In addition, they have wider ecological biodiversity and sustainability benefits.

The basic function of these techniques is increased flood storage and the storage or conveyance of rainwater. Typical measures include various guises of pools, ponds, and ditches. These all can have the added benefit of improving the ecological and amenity value of an area. These features can provide a haven for local wildlife. In addition, they can contribute to a sites amenity value both aesthetically and for recreation by providing attractive areas available for activities such as walking, cycling, water sports or wildlife watching.

Secondary Defences

Secondary defences are those that exist on the dry side of primary defences. Typically, their main function is to reduce the risk of residual flooding following a failure or overtopping of the primary defences.

Secondary defences can relocate floodwaters away from certain areas or reduce the rate of flood inundation following a residual event. Examples of secondary defences include embankments or raised areas behind flood defence walls, raised infrastructure e.g. railways or roads and on a strategic level, canals, river and drainage networks. The latter are a form of secondary defence as they are able to convey or re-direct water away from flood prone areas even if this is not their primary function.

Land Raising

Land raising can have mixed results when used as a secondary flood alleviation measure. It can be an effective method of reducing flood inundation on certain areas or developments by raising the finished levels above the predicted flood level. However, it can result in the reduction in flood storage volume within the flood cell. As a result, floodwater levels within the remainder of the cell can be increased and flooding can be exacerbated elsewhere within the flood cell. Level for Level compensation storage would be required where any loss of floodplain storage had occurred as a result of land raising or development within the floodplain.

Partial land raising can be considered in larger, particularly low-lying areas such as marshlands. It may be possible to build up the land in areas adjacent to flood defences in order to provide secondary defences. However, again the developer should pay due regard to the cumulative effects of flooding such as increasing flood risk elsewhere.

Finished Floor Levels

Where developing in flood risk areas is unavoidable, the most common method of mitigating flood risk is to ensure habitable floor levels are raised above the maximum flood water level.

The Environment Agency requires 600 mm freeboard for computed flood levels in addition to the modelled flood levels when setting finished floor levels. It is also necessary to ensure that roads levels are such that emergency access and evacuation routes are maintained. This can significantly reduce the risk of the proposed development becoming inundated by flooding. As with the land raising option, it is imperative that any assessment takes into consideration the volume of floodwater potentially displaced by such raising.

In areas where significant depths of floodwater are predicted to inundate the site, development design can incorporate the use of non-habitable uses on the ground floor. These can include garage areas, utility or storage spaces. This method can be somewhat contentious as it can be difficult to ensure that the ground floor remains uninhabited for the lifetime of the development and emergency access can be difficult.

Flood Resilience

The Association of British Insurers in cooperation with the National Flood Forum has published guidance on how homeowners can improve the flood resilience of their properties (ABI, 2004). These measures can not only improve properties against flood risk, by reducing the residual risk, but can also improve the insurability of homes in flood risk areas. The guidance identifies the key flood resistant measures as being:

- Replace timber floors with concrete and cover with tiles,
- Replace chipboard/MDF kitchen and bathroom units with plastic equivalents,
- Replace gypsum plaster with more water-resistant material, such as lime plaster or cement render,
- Move service meters, boiler, and electrical points well above likely flood level,
- Put one-way valves into drainage pipes to prevent sewage backing up into the house.

Advice on flood mitigation for homes and businesses is also given in the ODPM's 2003 report, 'Preparing for Floods' (ODPM, 2003b).

Flood Warning and Emergency Procedures

Flood warning and emergency procedures are typically higher-level management strategies. Such procedures typically include information such as flood warning, evacuation and repair procedures. Documents providing guidance on how to use flood resistance and resilience measures to limit damage caused by flooding, such as 'Improving the Flood Performance of

New Buildings, (DCLG, May 2007), can also offer important guidance and should be referred to.

When undertaking FRAs for developments within flood risk areas, the local flood warning and emergency response plans should be referred to as a flood damage mitigation method.

Where these procedures already exist they should be updated to include the information generated by this SFRA. Emergency planning maps are provided in each of the supporting appendices and should be consulted in order to identify places of refuge within the District. This will ensure that emergency plans are appropriate to the conditions expected during a flood event and that LPAs and emergency services are fully aware of the likely conditions and how this may affect their ability to safeguard the local population.

7 Summary and Recommendations

This section summarises the findings of the SFRA, recommendations and further work.

7.1 Summary: Flood Risk Issues

Within the River Welland catchment the main cause of flooding is heavy rainfall over a short period of time which, due to steep elevations in the upper catchment and impervious geology, creates high rates of run-off which are conveyed downstream to the urban areas.

Within the Harborough District the main sources of flooding are fluvial, surface water run-off and lack of capacity in the local public sewer system.

The Harborough District and its town centres such as Market Harborough, Lutterworth, Great Glen and Kibworth regularly suffer from flooding (See Sections 2.2, 2.3.2 and Appendix A – Historical Flood Records for details). Much of the flooding experienced in 1999, 2002 and 2006 in Market Harborough during the summer months can be attributed to pluvial/surface water flooding following prolonged intense rainstorms. The main factor behind this flooding is believed to be the insufficient capacity of the drainage system following heavy rainfall events causing flooding.

The area of Great Glen is known to have suffered from periodic flooding for a number of years. Parts of Great Glen are situated on low-lying areas, predominantly the southern areas of Great Glen, which is partly responsible for the periodic flooding.

In January 2008, a period of intense rainfall on already saturated land caused flooding in a number of Harborough's rural areas, including Great Glen, Foxton, Billesdon, Burton Overy, Newton Harcourt, Kibworth, Thurnby, Lutterworth, Lubenham and Scraptoft.

The DEFRA Strategy for Flood and Coastal Erosion Risk Management study (2004)[10] did not show any recorded instances of groundwater flooding in the study area. This does not mean that is has not occurred, or that it will not occur, just that none has been recorded in the EA records. There are no further additional historical records of groundwater flooding in the region; however it is still a possibility.

An assessment of flooding from impounded water bodies indicated that only one incident of flooding from a canal which was a breach of the Grand Union Canal at the confluence of the canal with a feeder channel from Saddington Reservoir in 1865. There are no records of breaching or overtopping from reservoirs in the Harborough District.

There are currently flood risk management schemes in operation at Market Harborough on the River Welland to the south of the study area in the form of raised embankments and concrete flood walls; the SoP offered by these structures is 1 in 75 years as the river flows through the centre of Market Harborough.

There are also flood defences present in the Great Glen area but the SoP offered by these structures and their exact location is unknown as they are not included on the EA National Flood and Coastal Defence Database.

Bowden and Braybrooke Offline Flood Storage Reservoirs are located along the River Jordan to the south of the study area. The River Welland CFMP states that the Flood Storage Reservoirs provide a SoP of 1 in 50 years (2% Annual Estimated Probability (AEP)) to Market Harborough, and particularly during low magnitude but high frequency events (notionally 10% AEP events).

[10] DEFRA Strategy for Flood and Coastal Erosion Risk Management Groundwater Flooding Scoping Study (LDS 23) (May 2004)

Online FSRs along Medbourne Brook and Great Eastern Brook to the east of the study area provide a SoP up to the 2% AEP event to Medbourne Brook and Great Eastern. Eye Brook along the eastern boundary of the study area provides protection to Caldecott along with the Caldecott sluices.

7.2 Summary: Flood Zone Data Issues

SFRA flood maps in general reproduce the EA high, medium and low probability flood zones where no other more detailed up to date information is available. SFRA flood maps also include assessment of the functional floodplain and the effect of climate change on flood zones.

Flood Zone 3a (1 in 100 year flood outline) is based on broad scale and detailed modelling provided by the EA.

Flood Zone 3b or 'functional floodplain' is based on detailed modelling of the 1 in 25 year return period event. Where this data is not available Flood Zone 3a (excluding areas within development limits or defended area) has been used as proxy.

Minor watercourses with a catchment area of less than 3km^2 may not have defined flood zones. This is not to suggest that these watercourses do not flood but that detailed modelling information is not available. Developments sited near these watercourses should include a detailed assessment of fluvial flooding through a FRA.

Climate change has been included on the SFRA maps where modelled information was available. Where data is not available the Flood Zone 2 (1 in 1000 year return period) flood outline has been used as proxy.

The EA are constantly updating flood zone information. Updates for the Harborough District area are understood to be available soon. These updates should be used to update the SFRA maps at the next review. The EA should be consulted on a site by site basis through the FRA process.

The identification of sewer and storm water flooding does not identify individual properties. The DG5 data supplied indicated streets within a settlement that are known to have a flooding history. Where historical flooding has been identified the information is presented by street name rather than the property name and / or address.

The location of flood defences is based on data provided by the EA. The database for the Harborough District however is not complete and there may be further defences present that are not represented on the SFRA maps – e.g. in the Great Glen area.

Historical flooding highlighted on the SFRA are based on flooding records from the EA, HDC and the Parish Councils. Some of this information is based on second hand information so it is reasonable to assume that some inaccuracies exist.

7.3 Summary: Climate Change Issues

The impact of climate change will result in an increase in peak river lows and rainfall intensities and should be considered in the preparation of FRAs.

Future fluvial flood extents and depths of flooding within the Harborough District area will be greater than the current situation. Flooding of town centres such as Market Harborough, Lutterworth, Great Glen and Kibworth that regularly suffer from flooding could potentially flood more frequently and to a greater depth and extent.

Surface water flooding may increase by the same order as fluvial and tidal flood risk which will lead to an increase in surface water flooding, surcharging of gullies and rains and sewer flooding. This will exacerbate flooding in areas such as Market Harborough town centre and smaller settlements

such as Peatling Magna, Kibworth Beauchamp and Kibworth Harcourt that already suffer frequent flooding from surface water run-off.

There should be less reliance on the upgrading of the sewer system to higher design standards to accommodate new developments; rather, water should be managed on the surface through the appropriate application of SuDS.

To ensure optimum surface water management it is recommended that a Surface Water Management Plan (SWMP) or Integrated Urban Drainage Plan (IUDP) should be carried out, (as recommended in the Pitt Report), to gain a more complete understanding of surface water and drainage across the Harborough District so that future drainage work can be planned in an integrated manner throughout the District

7.4 Recommendations: Site Allocation Process

It is recommended that the outputs of 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 Flood Zone 1, HDC should use the flood maps to apply the Sequential Test to their remaining land use allocations. The following should be considered:

- Flood Zone 3b has been mapped where it exists. Where it does not exist, Flood Zone 3a has been used as proxy to represent Flood Zone 3b.

- Following application of the Sequential Test, a detailed interrogation of emerging allocations should be carried out. This will ensure that all potential flood risk issues to the site are identified.

The Sequential Approach should also be applied within development sites to inform site layout locating the most vulnerable elements of a development in the lowest flood risk areas (in accordance with Table D3 of PPS25). The use of Flood Zones 2 and 3 for recreation, amenity and environmental purposes can provide an effective means of flood risk management as well as providing considerable green spaces with connected social and environmental benefits.

A Level 2 SFRA should be carried out in order to provide a detailed assessment of the risk of flooding from non-fluvial sources, in areas where new development is proposed.

With regard to fluvial sources of flood risk, a Level 2 SFRA will be required where the need to apply the Exception Test is identified (as outlined in Table D3 of PPS25). This cannot be determined until the Sequential Test has been carried out on all proposed development sites. It is recommended that as soon as the need for the Exception Test is established, the Level 2 SFRA is undertaken by a suitably qualified expert so as to provide timely input to the overall LDF process. The following should be noted:

- Breach and overtopping assessments will be required for development situated behind defences and immediately adjacent to raised canals.

- The effects of structures in the vicinity of the development sites (culverts, bridges etc) might need to be assessed to determine the capacity and residual risk areas that might result from blockage. This will inform the appropriate placement of development and ensure appropriate mitigation is in place.

7.5 Recommendations: Council Policy and Practice

The EA's direction on flood risk management in the Harborough District is outlined in the CFMP documents. It is recommended that HDC seeks to work with the EA to deliver the selected policies for flood risk management at a local level.

It is also recommended that HDC flood risk management policies and practice should take the following into account:

- Use the Sequential Test to locate new development to areas of low flood risk, giving the highest priority to Flood Zone 1.
- Use the Sequential Approach within development sites to inform site layout by locating the most vulnerable development to the areas of least flood risk.
- Protect the functional floodplain from development and seek to reinstate the functional floodplain wherever possible.
- Ensure that pedestrian access to and from all new developments is possible without passing through the 1% AEP (1 in 100 year) plus climate change floodplain, emergency vehicular access is possible, emergency services are not stretched due to the location of the development and flood resistance and resilience is incorporated.
- No new building should be allowed in a flood risk area that is not flood resilient.
- The treatment and control of surface water run-off should provide a level of betterment incorporating the use of a range of SuDS techniques. As a minimum there should be no increase in the peak discharges/volumes from any Greenfield site and a minimum of 20% reduction of peak discharges/volumes from any Brownfield site where an existing positive drainage system has been identified.
- Further culverting or building over culverts should be avoided.

HDC can assist the EA by vigorously applying PPS25, promoting the use of SuDS, and ensuring that Flood Zones 2 and 3 remain undeveloped where possible and reinstating areas of functional floodplain which have been developed. In addition, the level of flood preparedness (flood warning, flood proofing and flood resilience) should be increased and promoted in this area. An increase in targeted channel maintenance has also been identified as an opportunity in some areas to decrease debris build up in channel and help reduce incidents of blockage and resultant flooding.

7.6 Recommendations: Emergency Planning

It is recommended that the Council's Emergency Rescue Plan is reviewed and updated in the light of the findings of the SFRA to ensure that safe evacuation and access for emergency services is possible during times of flood both for existing developments and those being promoted as possible sites within the LDF process.

It is also recommended that HDC works with the EA to promote awareness of flood risk, especially to those living in flood risk areas, and encourage communities to sign up to the EA Flood Warning Direct service in line with the Pitt Report, this should be achieved through 'door knocking' by local authorities.

In line with the Pitt Report it is recommended that a review of designated rest centres and other major facilities should be carried out to ensure that they have the necessary levels of resilience to enable them to be used in response to flooding and other major emergencies, or that alternative arrangements are put in place.

7.7 Recommendations: General

A number of general issues and resultant recommendations have come forward through the SFRA process, and should be taken into account by the Council. These are;

- Not all minor watercourses have had Flood Zone maps produced for them, specifically those with a catchment area of less than 3km^2. Any development site located adjacent to an unmapped watercourse within Flood Zone 1 should apply an 8m easement (9m in the EA Anglian Region) from the top of bank, and a site specific FRA undertaken.

- In the future it is likely that the EA will take strategic direction over managing inland flood risks. HDC should adopt a leadership and scrutiny role, overseeing flood risk management within the local area.

- HDC should review the vulnerability of critical infrastructure in the local areas and take steps to work with service providers to initiate retrospective FRAs and subsequent flood proofing works if required.

- Incorporate requirements for flood resistant and resilient refurbishment of flooded properties in high risk areas.

- In line with recommendations in the Pitt Report, it is recommended that HDC produces a Surface Water Management Plan as a tool to improve co-ordination of activities between stakeholders involved in surface water drainage.

7.8 Recommendations: Future Updates to 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 the outputs from the following studies are used to update future versions of the SFRA report and associated maps:

- Future Flood Risk Mapping Studies.

- Future groundwater flood risk maps, surface water flood risk maps and reservoir inundation maps. These should also feed into emergency planning documents.

- Future Flood Risk Management Strategies

- Surface Water Management Plans

7.9 Recommendations: Level 2 SFRA

A Level 2 SFRA is more site specific than a Level 1 SFRA, addressing flood risk to potential development sites which have gone through the Sequential Test and have been located in Flood Zones 2 and 3, or behind existing defences. The data required for a Level 2 SFRA will therefore depend upon which, if any, of the Councils final list of preferred sites remain in Flood Zones 2 and 3 following application of the Sequential Test and where the Exception Test needs to be applied.

A Level 2 SFRA will be required in order to provide a detailed assessment of the risk of flooding from all non-fluvial sources in areas where new development is proposed.

The more detailed scope of a Level 2 SFRA involves an in depth review of flood hazard i.e. flood probability, flood depth, rate of onset of flooding etc. If a development is located behind existing defences it would be necessary to model overtopping, breach and constructional failure of the defence scenarios.

References

National Policy & Guidance Documents

ABI (2004) *'Flooding and Insurance'.*

CIRIA, 2007, 'The SuDS Manual' C697, London.

DEFRA (2005) *'Making Space for Water,' DEFRA Publications, London.* http://www.defra.gov.uk/environ/fcd/policy/strategy.htm.

DEFRA and WAG *(2006) 'River Basin Planning Guidance'.*

DEFRA and Environment Agency *(2005) Framework and Guidance for Assessing and Managing Flood Risk for new Development (FD2320).*

Department for Communities and Local Government (2001) *Planning Policy Guidance.*

Department for Communities and Local Government (2007) '*Improving the Flood Performance of New Buildings'.*

Department for Communities and Local Government (1996) '*Planning Policy Statement 1: Delivering Sustainable Development' (PPS1).*

Department for Communities and Local Government (2006) *'Planning Policy Statement 3: Housing' (PPS3).*

Department for Communities and Local Government (2004) *'Planning Policy Statement 7: Sustainable Development in Rural Areas' (PPS7).*

Department for Communities and Local Government (1994) *'Planning Policy Statement 9: Biodiversity and Geological Conservation' (PPS9).*

Department for Communities and Local Government (2004) '*Planning Policy Statement 12: Local Spatial Planning' (PPS12).*

European Commission (2000) *'The Water Framework Directive'*

HMSO, June 2004, 'Planning and Compulsory Purchase Act', The Queens Printer of Acts of Parliament http://www.opsi.gov.uk/acts/acts2004/20040005.htm.

HMSO Department for Communities and Local Government (2006*), 'Planning Policy Statement 25: Development and Flood Risk' 2006, The Stationery Office, Norwich.* http://www.communities.gov.uk/index.asp?id=1504639.

HMSO (1990) *Town and Country Planning Act*

ODPM (2003b) *Preparing For Floods*

ODPM (2003) Sustainable Communities Plan

Sir Michael Pitt (2008) The *Pitt Review: Learning Lessons from the 2007 floods.*

WRc, March 2006, 'Sewers for Adoption', 6th Edition

Regional & Local Policy & Guidance Documents

Environment Agency *(2003) The River Trent corridor Catchment Abstraction Management Strategy*

EMRA *(2006) Three Cities Sub Regional Spatial Strategy*

East Midlands Regional Assembly *(2006) East Midlands Regional Flood Risk Appraisal*

EMRA *(2005) England's East Midlands Integrated Regional Strategy: Our Sustainable Development Framework*

Harborough District Council (2001) *Harborough District Local Plan*. www.harborough.gov.uk/hdlp.

HDC *(2007) Harborough Local Development Scheme*

Government Offices for the East Midlands *(2005) Regional Economic Strategy for East Midlands 2006 – 2020*

Government Offices for the East Midlands (2005) *East Midlands Regional Spatial Strategy (RSS 8)*

Government Offices for the East Midlands (2006) *East Midlands' Regional Plan Secretary of State's Proposed Changes (2008)*

Leicester City Council *(2005) Leicestershire, Leicester, and Rutland Structure Plan 1996-2016*

Leicester City Council *(2002) Leicestershire Minerals Local Plan Review 1995-2006*

Leicester City Council *(2002) Leicestershire Leicester and Rutland Waste Plan*

Leicester City Council *(2008) Minerals and Waste Development Framework*

Leicestershire and Rutland Wildlife Trust, *Leicestershire Rutland biodiversity action plan*

National Forest, *National Forest Biodiversity Action Plan*