Warwick District Council

Level 1 Strategic Flood Risk Assessment

Volume 1

Level 1 Strategic Flood Risk Assessment

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Produced for

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Abbreviations and Glossary

Abbreviations	
AEP	Annual Exceedance Probability
CFMP	Catchment Flood Management Plan
CRT	Canal and River Trust
Defra	Department of Environment, Food and Rural Affairs
DPD	Development Plan Document
EA	Environment Agency
FEH	Flood Estimation Handbook
FRA/FRAs	Flood Risk Assessment / Flood Risk Assessments
HA	Highways Agency
ha	Hectare
IDB	Internal Drainage Board
LiDAR	Light Detection and Ranging
LDF/LDFs	Local Development Framework / Local Development Frameworks
mAOD	Metres above Ordnance Datum
NFCDD	National Flood and Coastal Defence Database
NPPF	National Planning Policy Framework
PFRA	Preliminary Flood Risk Assessment
PPG/PPGs	Planning Policy Guidance Note / Planning Policy Guidance Notes
PPS/PPSs	Planning Policy Statement / Planning Policy Statements
PPS25	Planning Policy Statement 25 – Development and Flood Risk
SA	Sustainability Appraisal
SFRA	Strategic Flood Risk Assessment
SPD	Supplementary Planning Document
SPZ	Source Protection Zone
STW	Severn Trent Water
SUDS	Sustainable Drainage Systems
WCC	Warwickshire County Council
WDC	Warwick District Council

Glossary	
Annual Exceedance Probability	For example, the 1% AEP is equivalent to 1% probability of occurring in any one year (or, on average, once in every 100 years).
Catchment Flood Management Plan	A high-level strategic plan through which the Environment Agency seeks to work with other key-decision makers within a river catchment to identify and agree long-term policies for sustainable flood risk management.
Core Strategy	The Development Plan Document which sets the long-term vision and objectives for the area. It contains a set of strategic policies that are required to deliver the vision including the broad approach to development.
Defra	The UK government department responsible for policy and regulations on the environment, food and rural affairs.
Development Plan Document	A spatial planning document within the Council's Local Development Framework which set out policies for development and the use of land. Together with the Regional Spatial Strategy they form the development plan for the area. They are subject to independent examination.
Dry pedestrian egress	Routes to and from buildings that will remain dry and allow pedestrian/wheelchair evacuation to dry land in times of flood.
Environment Agency	The leading public body for protecting and improving the environment in England and Wales.
Environment Agency Flood Map	Nationally consistent delineation of 'high' and 'medium' flood risk, published on a quarterly basis by the Environment Agency.
Environmental Stewardship	Environmental Stewardship is a new agri-environment scheme which provides funding to farmers and other land managers in England who deliver effective environmental management on their land. The scheme is intended to build on the recognised success of the Environmental Sensitive Areas scheme and the countryside Stewardship Scheme. Flood risk management is among its secondary objectives.
Exception Test	If, following application of the Sequential Test, it is not possible (consistent with wider sustainability objectives) to demonstrate that there are no reasonably available sites in areas with less risk of flooding that would be appropriate to the type of development or land use proposed, the Exception Test may apply. The NPPF sets out strict requirements for the application of the Test.
Flood Estimation Handbook	The latest hydrological approach for the estimate of flood flows in UK.
Flood Risk Management Hierarchy	PPS25 reaffirms the adoption of a risk-based approach to flooding by following stepped hierarchical measures at all stages in the planning process. Avoidance/prevention is the first measure, followed by substitution, control and then mitigation.

Glossary	
Flood Risk Vulnerability	PPS25 provides a vulnerability classification to assess which uses of land maybe appropriate in each flood risk zone.
Fluvial Flood Risk / Fluvial Flooding	Flood risk / flooding caused by rivers.
Formal Flood Defence	A structure built and maintained specifically for flood defence purposes.
Functional Floodplain Zone 3b	Defined as areas at risk of flooding in the 5% AEP (20 year) design event.
Habitable Room	A room used as living accommodation within a dwelling but excludes bathrooms, toilets, halls, landings or rooms that are only capable of being used for storage. All other rooms, such as kitchens, living rooms, bedrooms, utility rooms and studies are counted.
High probability Zone 3a	Defined as areas at risk of flooding in the 1% AEP (100 year) design event.
Internal Drainage Board	Organisation responsible for non-Main Rivers and drainage within their boundary area.
Informal Flood Defence	A structure that provides a flood defence function however has not been built and/or maintained for this purpose (e.g. boundary wall).
JFLOW	A computer river model based on routeing a flood calculated by Flood Estimation Handbook methodology along a river corridor the levels of which are derived from a Side Aperture Radar (SAR) remote sensed Digital Terrain Model.
Land Swapping	Potential for long term opportunities to remove development from areas that flood at present and relocate in lower risk locations which is essentially restoration of the floodplain.
Light Detection and Ranging (LiDAR)	An airborne terrain mapping technique which uses a laser to measure the distance between the aircraft and the ground.
Local Development Framework	The Local Development Framework (LDF) consists of a number of documents which together form the spatial strategy for development and the use of land.
Low Probability Zone 1	Defined as areas outside Zone 2.
Main River	A section of watercourse (including the structures and devices on it used to regulate flow) which is maintained by the Environment Agency.

Glossary	
'Making Space for Water' (Defra 2004)	The Government's strategy to manage the risks from flooding and coastal erosion by employing an integrated portfolio of approaches, so as: a) to reduce the threat to people and their property; b) to deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principles, c) to secure efficient and reliable funding mechanisms that deliver the levels of investment required.
Medium probability Zone 2	Defined as areas at risk of flooding in events that are greater than the 1% AEP (100 year), and less than the 0.1% AEP (1000 year) design event.
National Flood and Coastal Defence Database	Database owned by the Environment Agency containing details of the location, standard and condition of all Environment Agency maintained defences.
Ordinary Watercourse (non-Main River)	Any section of watercourse not designated as a Main River.
Planning Policy Statements	The Government updated its planning advice contained within Planning Policy Guidance Notes (PPGs) with the publication of new style Planning Policy Statements (PPSs). The majority of these have now been revoked within the National Planning Policy Framework (2012).
Planning Policy Statement 25: Development and Flood Risk	Planning Policy Statement that reflects the general direction set out in 'Making Space for Water'. Now revoked within the National Planning Policy Framework (2012).
Preliminary Flood Risk Assessment	An assessment of local flood risk (both historical and future) and the consequence of flooding across the study area to enable the identification of Flood Risk Areas.
Previously Developed (Brownfield) Land	Land which is or was occupied by a building (excluding those used for agriculture and forestry). It also includes land within the curtilage of the building, for example a house and its garden would be considered to be previously developed land.
Residual Risk	The risk which remains after all risk avoidance, reduction and mitigation measures have been implemented.
Return Period	The probability of a flood of a given magnitude occurring within any one year e.g. a 1 in 100 year event has a probability of occurring once over 100 years. However, a 1 in 100 year event could occur twice or more within 100 years, or not at all.
Sequential Test	Informed by a SFRA, a planning authority applies the Sequential Test to demonstrate that there are no reasonably available sites in areas with less risk of flooding that would be appropriate to the type of development or land use proposed.

Glossary	
Strategic Flood Risk Assessment	A Strategic Flood Risk Assessment is used as a tool by a planning authority to assess flood risk for spatial planning, producing development briefs, setting constraints, informing Sustainability Appraisals and identifying locations of emergency planning measures and requirements for flood risk assessments.
Supplementary Planning Document	Provides supplementary guidance to policies and proposals contained within Development Plan Documents. They do not form part of the development plan, nor are they subject to independent examination.
Sustainability Appraisal	Appraisal of plans, strategies and proposals to test them against broad sustainability objectives.
Sustainable Development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (The World Commission on Environment and Development, 1987).
West Midlands Regional Spatial Strategy	This is a new Regional Spatial Strategy which identifies the vision for the region. It will set a new housing requirement for each District or Borough.

Executive Summary

Mouchel was appointed by Warwick District Council (WDC) to update the 2008 Level 1 Strategic Flood Risk Assessment (SFRA) in accordance with National Planning Policy Framework (NPPF) (March 2012) in England, which superseded Planning Policy Statement 25 (PPS25): Development and Flood Risk. The purpose of this SFRA is to assess and map all forms of flood risk from groundwater, surface water, sewer and river sources, taking into account future climate change predictions, and use this as an evidence base to locate future development primarily in low flood risk areas. The outputs from the SFRA will help the Council to prepare sustainable policies for the long-term management of flood risk and improve existing emergency planning procedures.

In accordance with the "Technical Guidance to the National Planning Policy Framework" (March 2012) document and the "Development and Flood Risk, a Practice Guide Companion to PPS25" (updated December 2009 and still current under the NPPF), a Level 1 SFRA has been carried out and is presented in this report. The study takes full account of the effect of climate change predictions as set out in the NPPF Technical Guidance document. The SFRA should be regarded as a 'living' document and reviewed on a regular basis in light of new information as it becomes available.

In accordance with NPPF, areas of 'low', 'medium' and 'high' risk have been mapped using data collected from the Environment Agency, Warwick District Council, Severn Trent Water, the Highways Agency and the Canal and River Trust. This has included information on flooding from rivers, surface water (land drainage), groundwater, artificial water bodies and sewers. This provides the basis for the Sequential Test to be applied.

WDC will need to apply the Sequential Test to all sites within the 'high' and 'medium' risk Flood Zones to demonstrate that there are no reasonably available sites in areas with less risk of flooding that would be appropriate to the type of development or land use proposed. If there is an area of overlap between the site boundary and area at risk of flooding, this should be utilised as an opportunity to reduce flood risk within the site, by using waterside areas for recreation, amenity and environmental purposes.

Where the need to apply the Exception Test is identified, if WDC considers that there are an insufficient number of suitable sites for development, the scope of the SFRA could be widened to a Level 2 assessment. It is recommended that this is undertaken by a suitably qualified technical expert or engineer.

This SFRA has been reviewed and approved by the Environment Agency, and a letter confirming acceptance of the SFRA can be found in Appendix A.

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1 Introduction

1.1 Project History

In August 2007 a group comprising Coventry City Council, Solihull Metropolitan Borough Council and the County, Districts and Boroughs of Warwickshire commissioned Halcrow to produce a Level 1 Strategic Flood Risk Assessment (SFRA) (2008) in accordance with Planning Policy Statement 25 (PPS25): Development and Flood Risk. This document presents the findings of the SFRA for Warwick District Council (WDC), while Volume 2 contains the accompanying maps.

Mouchel was appointed in 2012 by WDC to update the 2008 Level 1 SFRA with new flood data / records since the 2008 and in accordance with National Planning Policy Framework (NPPF) (March 2012) in England, which superseded Planning Policy Statement 25 (PPS25): Development and Flood Risk.

1.2 Project Aims

The aims of the NPPF on development and flood risk are to ensure that flood risk is taken into account at all stages of the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is necessary in such areas, exceptionally, the policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall. 'Safe' in the context of this study means that dry pedestrian access to and from the development is possible without passing through the 1 in 100 year event plus climate change floodplain, and emergency vehicular access is possible during times of flood. It also means that the development includes flood resistance and resilience measures to ensure it is safe.

The aim of this SFRA therefore is to map all forms of flood risk and use this as an evidence base to locate new development primarily in low flood risk areas (Zone 1). Where development cannot be located in Flood Zone 1 the planning authority will need to apply the Sequential Test to land use allocations and, where necessary, the Exception Test (Level 2 SFRA). In addition, it allows a planning authority to:

- prepare appropriate policies for the management of flood risk
- inform the Sustainability Appraisal (SA) so that flood risk is taken account of, when considering options and in the preparation of strategic land use policies
- identify the level of detail required for site-specific Flood Risk Assessments (FRAs)
- determine the acceptability of flood risk in relation to emergency planning capability

The SFRA will inform the site selection process for future development sites and provide recommendations for policies to deal with non-allocated sites. The SFRA will feed into the Local Authorities SA of the Local Development Documents (LDDs) and will enable informed decisions to be made relating to land use and development allocation within the respective Development Plan Documents (DPDs).

1.3 Project Objectives

Mouchel has carried out this project in accordance with the methodology outlined in the WDC SFRA Update Project Proposal, dated July 2012, though the methodology and deliverables have been aligned to the NPPF and document "Development and Flood Risk: A Practice Guide Companion to PPS25" (updated December 2009 and still current under the NPPF). The SFRA has also followed advice from the Environment Agency.

For this study, a Level 1 SFRA approach has been agreed with WDC and the Environment Agency. A Level 1 SFRA is defined in the Practice Guide Companion to PPS25 as a desk-based study using existing information to allow application of the Sequential Test on the basis of Table 3 of the NPPF, and to identify whether application of the Exception Test is likely to be necessary.

The best available data within the study timescale has been collected for use in this study; however it is important to recognise that the SFRA is a 'living' document. As new information becomes available (such as improved river models) updates will be made to the Flood Maps and this should be reflected in the SFRA document, to ensure that the best information is used to guide the site selection process for future developments.

1.4 Project Deliverables

The project outputs for Level 1 SFRA have been adopted for this study. The deliverables of this assessment are as follows:

- A technical report.
- A summary document.
- A series of maps.

Following the advice from Section 3.55 of the Practice Guide Companion to PPS25, the key project outputs are as follows:

1) Plans showing the administrative boundaries of the study area, watercourse centreline, modelled watercourses, canals, defences, Areas Benefiting from Defences (ABDs) and culverted watercourse sections (Volume 2, Plans A1 and A2).

2) Strategic flood risk maps showing flooding from all sources, including fluvial Flood Zones (including the functional floodplain where possible), and areas at risk of flooding from sources other than rivers (Volume 2, Plans B1 – B3).

3) An assessment of the implications of climate change for flood risk in the study area over an appropriate time period (Volume 2, Plan C).

4) The location of any flood risk management measures, including both infrastructure (Volume 2, Plan A1) and the coverage of flood warning systems (Volume 2, Plan F).

5) Guidance on the application of the Sequential Test (see Chapter 8).

6) Guidance on the preparation of FRAs for development sites (see Chapter 9).

7) Guidance on the likely applicability of different SUDS techniques for managing surface water run-off at key development sites (see Chapter 10).

1.5 Outcomes of the SFRA Process

A Level 1 SFRA provides sufficient data and information to enable a planning authority to apply the Sequential Test to land use allocations and can therefore identify, where necessary, where the Exception Test needs to be applied (see **Sections 1.5.1** and **1.5.2** respectively).

SA should also be informed by the SFRA for their area. Under the Town and Country Planning (Local Development - England) Regulations 2004, a SA is required for the Local Development Framework (LDF). The Regulations were then encompassed into the Planning and Compulsory Purchase Act (2004). The purpose is to promote sustainable development through better integration of sustainability considerations in the preparation and adoption of plans. The Regulations stipulate that SA for LDF should meet the requirements of the SEA Directive. A SFRA is used as a tool by a planning authority for the production of development briefs, setting constraints, identifying locations of emergency planning measures and requirements for FRAs.

There is clear guidance in the NPPF that SA should remain central to all documents as a means of direction towards the overarching goal of sustainable development. Paragraph 165 of the NPPF states:

"Planning policies and decisions should be based on up-to-date information about the natural environment and other characteristics of the area including drawing, for example, from River Basin Management Plans. Working with Local Nature Partnerships where appropriate, this should include an assessment of existing and potential components of ecological networks. A sustainability appraisal which meets the requirements of the European Directive on strategic environmental assessment should be an integral part of the plan preparation process, and should consider all the likely significant effects on the environment, economic and social factors."

It is important to reiterate that flood risk policy is not applied in isolation as part of the planning process. The formulation of WDC policy and the allocation of land for future development must also meet the requirements of other planning policy. Clearly a careful balance must be sought in these instances, and the SFRA aims to assist in this process through the provision of a clear and robust evidence base upon which informed decisions can be made.

1.5.1 The Sequential Test

A planning authority applies the Sequential Test to demonstrate that there are no reasonably available sites in areas with less risk of flooding that would be appropriate to the type of development or land use proposed. Appendix B shows the Sequential Test process as advocated in the PPS25 Practice Guide.

Preference should be given to locating new development in Flood Zone 1, Low Probability (see **Section 3.3.1**). If there is no reasonably available site in Flood Zone 1, the flood vulnerability (refer to **Figure 1**) of the proposed development can be taken into account in locating development in Flood Zone 2 (Medium Probability) and then Flood Zone 3 (High Probability). Within each Flood Zone new development should be directed to sites with lower flood risk (towards the adjacent zone of lower probability of flooding) from all sources as indicated by the SFRA.

Flood risk vulnerability classification (see table 2)		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood zone (see table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	×	Exception Test required	✓
	Zone 3b functional floodplain	Exception Test required	✓	×	×	×

Key: ✓ Development is appropriate.
× Development should not be permitted.

Notes to table 3:
This table does not show:
a. the application of the Sequential Test which guides development to Flood Zone 1 first, then Zone 2, and then Zone 3;
b. flood risk assessment requirements; or
c. the policy aims for each flood zone.

Figure 1: Flood Risk Vulnerability and Flood Zone Compatibility (NPPF Technical Guide Table 3)

Table 2 of the NPPF Technical Guide (reproduced in **Figure 2**) classifies different types of development under different flood risk vulnerabilities, and should be used in conjunction with Table 1 of the NPPF Technical Guide in allocating new development as part of the Sequential Test.

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 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 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.

Figure 2: Flood Risk Vulnerability Classification (NPPF Technical Guide Table 2)

1.5.2 The Exception Test

If, following application of the Sequential Test, it is not possible, or consistent with wider sustainability objectives, for the development to be located in zones of lower probability of flooding, the Exception Test can be applied. This test provides a method of managing flood risk while still allowing necessary development to occur.

The Exception Test is only appropriate for use when there are large areas in Flood Zones 2 and 3, where the Sequential Test alone cannot deliver acceptable sites, but where some continuing development is necessary for wider sustainable development reasons (the need to avoid social or economic blight and the need for essential civil infrastructure to remain operational during floods). It may also be appropriate to use it where restrictive national designations such as landscape, heritage and nature conservation designations, e.g. Areas of Outstanding Natural Beauty (AONBs), Sites of Special Scientific Interest (SSSIs) and World Heritage Sites (WHS), prevent the availability of unconstrained sites in lower risk areas.

As set out in Paragraph 102 of the NPPF, for the Exception Test to be passed:

- it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared

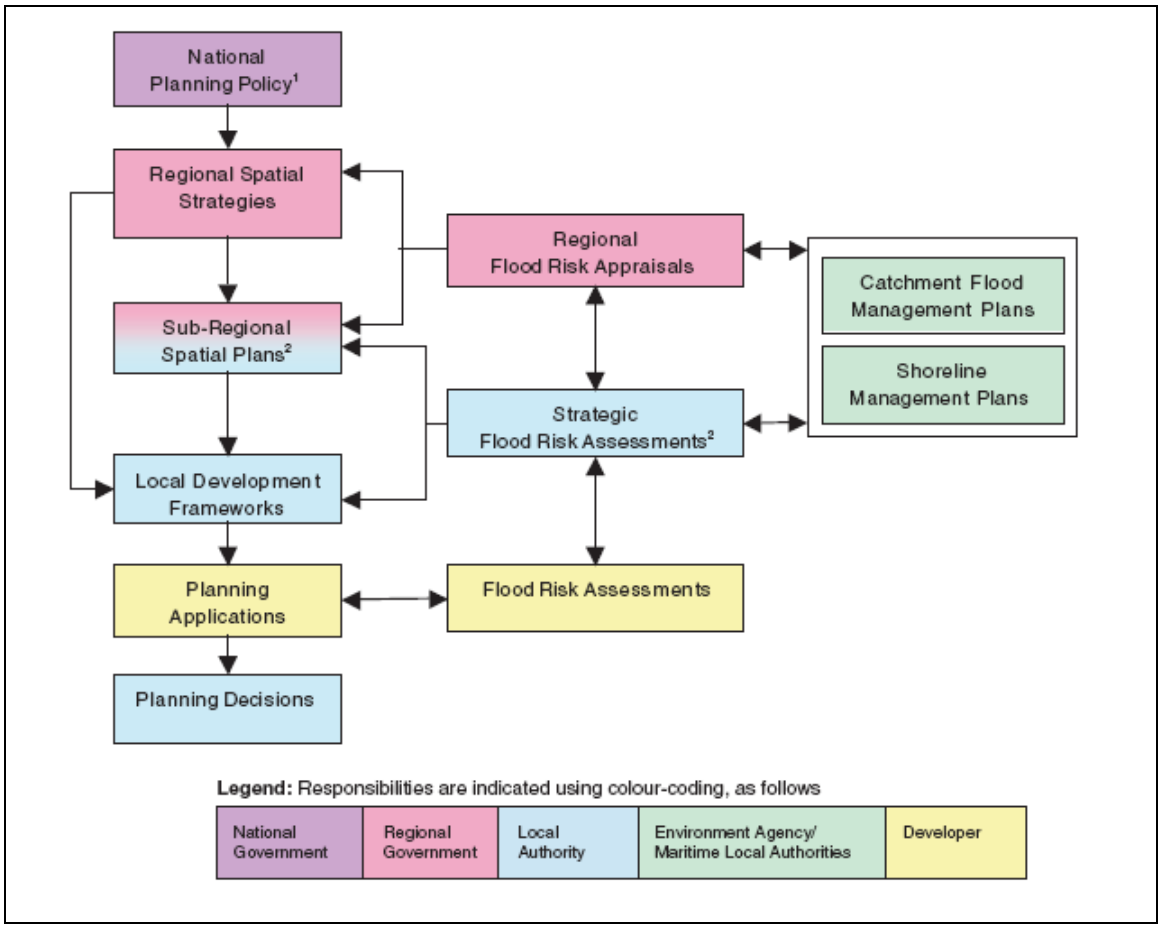
- a site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall

Both elements of the test will have to be passed for development to be allocated or permitted.

It is possible that WDC will need to apply the Exception Test as several indicative sites fall within Flood Zone 3, although it is not possible to fully determine this until the Sequential Test process has been undertaken.

1.6 SFRA Context

Figure 3 overleaf, taken from the PPS25 Practice Guide, illustrates the responsibilities for the production of key documents required to effectively manage flood risk through each stage of the spatial planning process, and, importantly, shows the link between other strategic documents.



1 Including the NPPF, NPPF Technical Guide, PPS25 Practice Guide and the other flooding-related national planning policies listed in Appendix A of the PPS25 Practice Guide.
2 Strategic Flood Risk Assessments may cover more than one local planning authority (LPA). The adoption of a catchment based approach by a number of LPAs working in partnership could be highly beneficial and is strongly recommended as a means of looking strategically at flood risk issues across local authority boundaries.
3 This diagram has been developed from the original within *Flood Risk Assessment Guidance for New Development Phase 2 R&D technical report FD2320/TR2* (Defra and Environment Agency, 2005).

Figure 3: Key Documents and Strategies for Managing Flood Risk

1.7 The Study Area

Warwick is a non-metropolitan District, covering an area of some 283km^2. The District lies within the heart of Warwickshire to the south of the city of Coventry. The District comprises four main towns including Royal Leamington Spa, Warwick, Kenilworth and Whitnash. The total estimated population in 2011 was 136,000.

The District contains a number of historic towns surrounded by rural areas. There are good road and rail links with surrounding major urban areas and a strong local economy, containing a number of employers and attractions including Warwick Castle, Kenilworth Castle, the Royal Pump Rooms and Stoneleigh Park (National Agricultural Centre). These attributes coupled with the Districts convenient location make the District a popular location to live, work and visit. This has led to considerable development pressures within the District.

1.7.1 Main Rivers and Hydrology

The District contains a number of designated Main Rivers most of which form tributaries of the River Avon:

- River Avon, a major tributary of the River Severn, enters the District in the north-east by Coventry Airport (436575, 275115) and initially forms the boundary between the District with the Borough of Rugby before flowing through the centre of the District in a south-westerly direction. At Barford (425965, 260745) the River Avon once again forms the District boundary with the adjoining District of Stratford-upon-Avon, before turning to flow in a southerly direction and exiting the District by Hampton Lucy (425975, 257345).

- Canley Brook enters the District in the northern extent by Canley (430075, 275385) and flows in a predominantly southern direction through the District until joining the left bank of the Finham Brook at 430685, 273035.

- The River Sowe enters the District in the north-eastern extent by Baginton (434505, 275605) and flows in a south-westerly direction through the District before joining the River Avon on the right bank by Stoneleigh (432505, 272405).

- Finham Brook rises in the northern extent of the District at 426295, 275195 where it is initially classified as non-Main River. The watercourse flows in a south-easterly direction, becoming designated Main-River as it flows along the north-western edge of Kenilworth at 427655, 273175. Here, the watercourse turns to flow in a north-easterly direction through the northern extent of Kenilworth before joining the right bank of the River Sowe at 433665, 273785 by Stoneleigh.

- River Leam enters the District in the east by Marton (440535, 269005) where it forms the boundary between the District with the Borough of Rugby. The watercourse then flows in a south-westerly direction through the District, turning to flow in a westerly direction through Royal Leamington Spa before joining the left bank of the River Avon by Warwick (430165, 265645).

- River Itchen forms a tributary of the River Leam. The watercourse forms part of the eastern boundary between the Districts of Warwick, Stratford-on-Avon and the Borough of Rugby from Snowford Bridge (439525, 265725) and flows in a northerly direction along the District boundary before joining the left bank of the River Leam by Marton (440535, 269005).

Watercourse maps, giving an overview of fluvial features in the study area, can be found in Volume 2, Plan A1. A number of minor watercourses and non-Main Rivers also flow through the District which have been analysed where data exists. These include: the Inchford Brook, Thelsford Brook, Cattle Brook, Sherbourne Brook, Pingle Brook, Gog Brook/Fisher Brook, Myton Brook, St John's Brook, Saltisford Brook, Hospital Brook, Fishponds Brook, Tanyard Stream, Littleton/Bins Brook, Whitnash Brook and, a series of unnamed watercourses.

There are no Internal Drainage Boards (IDBs) operating in the Council's area.

1.7.2 Geology and Topography

The topography, geology and soil are all important in influencing the way the catchment responds to a rainfall event. The degree to which a material allows water to percolate through it, the permeability, affects the extent of overland flow and therefore the amount of run-off reaching the watercourse. Steep slopes or clay rich (low permeability) soils will promote rapid surface runoff, whereas more permeable rock such as limestone and sandstone may result in a more subdued response.

The geology of the District consists predominantly of sedimentary rocks and is represented by four major geology periods, with the oldest rocks from the Carboniferous period followed by the Permian, Triassic and then the younger Jurassic rocks. The Carboniferous rock sequences make up approximately 4% of the geology consisting of argillaceous (clay rich) rocks and interbedded sandstones. The Permian period similarly comprises of argillaceous rocks and sandstones representing about 22% of the geology. The District is dominated by Triassic argillaceous rocks which make up 74% of the geology with some limestones and sandstones. Small outcrops of Jurassic argillaceous rocks can be found. The District is dominated by clay rich rocks where soils are not so well drained.

Drift deposits of various origins are found within the District. Till is sediment that is deposited by glaciers and made up of clay; detritus that is indicative of the underlying argillaceous rocks. There are also deposits of glacial sands and gravels, again due to the deposition of glaciers (Volume 2, Plan D1 (solid) and D2 (drift)). These superficial deposits are all indicative of the underlying geology.

The general trend in topography of the District appears to show a gradual increase in elevation in a south-east to north-west direction. The lower elevations of 50-70m Above Ordnance Datum (AOD) are found in and around Kenilworth, Leamington Spa and Warwick. The higher elevations of 120-140m AOD are to the west of the District in and around Hockley Heath and Lapworth.

2 Planning Context

2.1 Introduction

This section provides an overview of the planning policy framework relevant to WDC.

This report conforms with National and Regional Planning Policy[1]. Information contained in the SFRA will provide evidence to facilitate the preparation of robust policies for flood risk management in the development plan. The SFRA should be used to inform the Sustainability Appraisal of the emerging Local Plan enabling informed decisions to be made relating to land use and development allocation.

The success of the SFRA is heavily dependent upon WDC's ability to implement the recommendations put forward for future sustainable flood risk management. It is ultimately the responsibility of WDC to establish robust policies that will ensure future sustainability with respect to flood risk.

2.2 Planning Policy Framework

The UK planning system has a hierarchy of policies and plans, comprising national, regional and local guidance. Development Plans are prepared following public and stakeholder involvement and are intended to reconcile conflicts between the need for development and the need to protect the wider built and natural environment. They are also intended to provide clear guidance for developers.

Recent reforms to the planning system have seen the NPPF replace the majority of the National Planning Policy Statements (PPSs), the intention to abolish the Regional Spatial Strategies (RSSs) and LDFs and Local Plans replacing Core Strategies and old style local plans, such as that operating in this authority, and described in **Section 2.5** below.

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

2.3 National Planning Policy

2.3.1 National Planning Policy Framework (NPPF) (2012)

The National Planning Policy Framework (NPPF) for England was published in March 2012 and replaces the majority of the previous National Planning Policy Statements, including PPS25 Development and Flood Risk. It sets out the Government's planning policies for England and how these are expected to be applied. It sets out the Government's requirements for the planning system only to the extent that it is relevant, proportionate and necessary to do so.

[1] The Government has announced its intention to abolish the Regional Spatial Strategies (RSSs). However, to date they have not been formally abolished and therefore still constitute a material consideration in producing planning policy documents. It is therefore considered that the adopted regional strategy should remain a material consideration until abolition of RSSs is finally confirmed.

The NPPF provides a framework within which local people and their accountable councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

The NPPF sets out that for 12 months after publication (that is up to March 2013) full weight can be given to relevant policies in development plans adopted since 2004. After 12 months due weight should be given to relevant policies in existing plans according to their degree of consistency with the NPPF.

The NPPF states that planning authorities should adopt proactive strategies to mitigate and adapt to climate change, taking full account of flood risk.

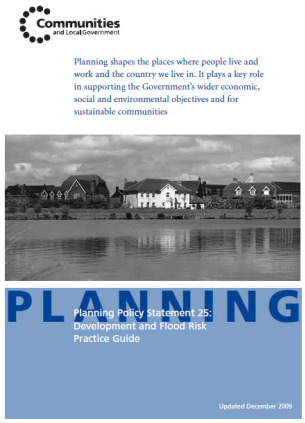
2.3.2 Technical Guidance to the National Planning Policy Framework (2012)

This document was published simultaneously with the NPPF. It only covers flood risk and minerals. It confirms that local authorities should direct "development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere." It describes land at risk "as Flood Zones 2 and 3; or land within Flood Zone 1 which has critical drainage problems and which has been notified to the local planning authority by the Environment Agency." It explains that planning authorities should apply a "sequential test" to steer development towards land with the lowest risk of flooding, which is normally land in Flood Zone 1.

The Technical Guidance makes clear "Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required."

The Technical Guidance explains what is expected of SFRAs, and this document has followed its contents.

2.3.3 PPS25: Development and Flood Risk Practice Guide (2009)



The PPS25 Practice Guide has not as yet been superseded by the NPPF and as such is used to complement the NPPF by offering guidance on how to implement its policies in practice. It draws on existing good practice, through case studies and examples, to show how regional planning bodies and local planning authorities can deliver the national policies in the NPPF in the light of their own varying circumstances.

2.3.4 Town and Country Planning Amendments

The Town and Country Planning (Development Management Procedure) (England) Order 2010 requires that Local Planning Authorities consult with the Environment Agency prior to determining applications for development in flood risk areas. In addition, the Town and Country Planning (Consultation) (England) Direction 2009 requires Local Planning Authorities (LPA) to consult the Secretary of State before granting planning permission in a flood risk area development where the Environment Agency has made an objection that is has not been able to withdraw even after discussions with the LPA.

2.4 Regional Planning Policy

Although the Government intend to revoke the regional strategies, they have not yet been formally abolished and therefore still constitute a material consideration in the planning process. As such, a review of Regional Spatial Strategy for the West Midlands is set out below.

Regional Planning Guidance for the West Midlands (RPG11) was published in June 2004 but under the Planning and Compulsory Purchase Act 2004, RPG11 was automatically replaced by a new Regional Spatial Strategy for the West Midlands.

The purpose of the West Midlands Regional Spatial Strategy (WMRSS) is to provide a long term land-use and transport planning framework for the West Midlands region. The WMRSS framework guides the preparation of local authority development plans and local transport plans. It determines (amongst other things) the scale and distribution of housing and economic development for each Local Authority within the region, investment priorities for transport and sets out policies for enhancing the environment. The WMRSS has been prepared by the West Midlands Regional Assembly was published in June 2004.

The WMRSS identifies the Major Urban Areas of Solihull and Coventry as places where more development opportunities will be created to retain and attract people and investment. Both these areas have also been identified as two of the local authorities to receive support under the Government's Growth Point Initiative, meaning that substantial levels of growth are expected between 2006 and 2016. RSS11 also identifies Rugby, less than 20 miles from Warwick, as an area where new development will be focused.

The WMRSS states that more rural areas of the West Midlands will be regenerated, through the improvement of choice in housing; diversification of the rural economy; better transport links; improving health, education, skills training, social, shopping and community facilities, the sustainable use of environmental assets, and the prudent use of natural resources.

The "Development and Flood Risk" section of the WMRSS sets out the following in relation to Flood Risk Management:

*"**8.42** The implications of climate change for the severity of floods is uncertain but the most realistic approach is to accept that flooding is an inevitable process. PPG25 [now PPS25] Development and Flood Risk sets out detailed guidance on how flood risk should be considered at all stages of the planning and development process, including a sequential approach to locating development. Local authorities should also consider local Environment Agency plans, Catchment Flood Management Plans and indicative floodplains (Quality of the Environment – Assets Diagram).*

***8.43** For the review of this RPG the RPB with the Environment Agency and other partners should identify where flooding issues are likely to be of Regional significance, assess their implications for the distribution of development and where appropriate, set out appropriate policies and measures to address them. This could include defining areas where sustainable drainage systems would best contribute to reducing flood risk, and improving water quality where the need to improve the performance of the floodplain, attenuate flows and provide local treatment of polluted run-off is greatest. However it should be borne in mind that sustainable drainage systems are unlikely to provide the complete answer to problems associated with large-scale river flooding episodes; in the longer term they can help attenuate flows and reduce the risk of flooding in urban areas downstream.*

***8.44** When considering the possible risks, implications and steps needed to prevent general flooding affecting new development, the potential for sewer flooding should also be considered by developers and planning authorities. Large new developments may require some new or updated infrastructure in the existing sewer network and treatment works in order to cope with the additional load. Sustainable drainage systems can, in the correct conditions, help alleviate sewer flooding problems by preventing surface water from entering the sewerage system."*

2.5 Local Planning Policy

WDC is currently preparing a new Local Plan to replace the Warwick District Local Plan 1996-2011. Policy DC10 in relation to flooding has been deleted from the Plan as it repeats national policy within PPS25. However, since PPS25 has been superseded by the NPPF, it is now the NPPF and its Technical Guidance which provides the policy framework in relation to flooding. This may put WDC at risk if there are any local circumstances that need to be taken into account as part of the decision making process.

3 Study Methodology

3.1 Level 1 SFRA Methodology

A Level 1 SFRA is defined in the PPS25 Practice Guide as a desk-based study using existing information to allow application of the Sequential Test and to identify where the Exception Test is likely to be necessary. The main tasks undertaken during the study were as follows:

a) Establishing relationships and understanding the planning context:

A start up liaison meeting was held to build relationships between the project team, WDC staff members and the Environment Agency. This allowed the partnering approach to form, and allow the free exchange of available information. Discussions were held on the status of the WDC LDF and planning pressures to gain a clear picture of the challenges faced by the planning teams, and the various opportunities and constraints guiding the site allocation process. The study area was also discussed in detail, giving an overview of local features and flooding experienced from all sources.

b) Gathering data and analysing it for suitability:

A quality review of flood risk information was carried out by an experienced core team, who reviewed the collated data, assessed its significance and quality and advised on which data would be needed to drive the SFRA. The main approach adopted for the SFRA was to build on previous studies and existing information, supplied during the data collection phase.

c) Producing strategic flood risk maps, GIS deliverables and a technical report

A series of GIS maps were produced using the data gathered in the early phases of the study. The main mapping output is the strategic flood risk maps for the entire study area, which shows Flood Zones 1, 2 and 3 and flooding from all other sources, and should be used to carry out the Sequential Test. Other maps include study area maps showing canals and fluvial features, climate change maps showing the impacts of climate change on flood probability, geological maps, historic flood outline maps, and maps showing flood watch and warning areas. Hardcopy maps are provided in Volume 2 of the SFRA report.

d) Providing suitable guidance

Sections have been written in the report providing guidance on policy considerations, the application of the Sequential Test, guidance for the preparation of FRAs and guidance for the application of Sustainable Drainage Systems (SUDS) in the study area.

3.2 Need for a Level 2 SFRA

Where the need to apply the Exception Test is identified, due to there being an insufficient number of suitably available sites for development within zones of lower flood risk or due to possible increases in flood risk arising from climate change, the scope of the SFRA may need to be widened to a Level 2 assessment.

This increased scope involves a more detailed review of flood hazard (flood probability, flood depth, flood velocity, rate of onset of flooding) taking into account the presence of flood risk management measures such as flood defences. This could include 2D modelling and breach/overtopping analysis for certain locations.

Level 2 SFRA outputs include:

- An appraisal of the condition of flood defence infrastructure and likely future policy.
- An appraisal of the probability and consequence of breach or overtopping of flood defence infrastructure.
- Maps showing distribution of flood risk across zones.
- Guidance on appropriate policies for making sites which satisfy both parts of the Exception Test.
- Guidance on the preparation of FRAs for sites with varying flood risk across the Flood Zone.

In general, the Level 2 SFRA should aim to provide clear guidance on appropriate risk management measures for adoption on sites within Flood Zone 3, which are protected by existing defences. 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 WDC on all possible site allocations.

3.3 Technical Background

It is useful to gain a good understanding of Flood Zones and the approach taken to satisfy the Level 1 SFRA requirements, using existing data.

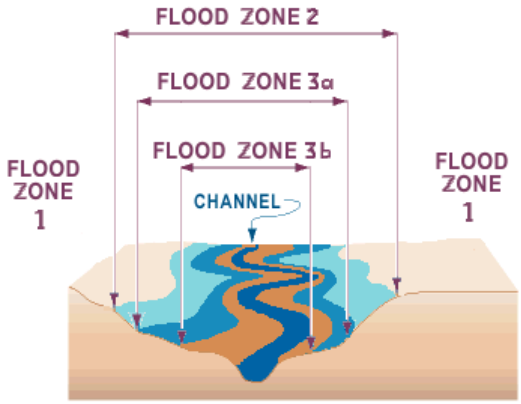
3.3.1 Flood Zones

Flood Zones show the areas potentially at risk of flooding from rivers or the sea, ignoring the presence of defences (although areas benefiting from formal defences are identified).

The NPPF defines the Flood Zones as follows:

Zone 1: Low Probability

This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).



Zone 2: Medium Probability

This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year.

Zone 3a: High Probability

This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

Zone 3b: The Functional Floodplain

This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone where possible (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, including water conveyance routes).

Flood Zone maps in this SFRA have been produced from the EA Flood Zone maps that are updated with approved hydraulic modelled outline data and published quarterly in their website.

3.4 Environment Agency Flood Zone maps

A national flood map dataset has been produced by the Environment Agency. Much of the fluvial Flood Zone 2 and 3 outlines are derived from the modelling package JFlow, which is a 'coarse' modelling approach (see Appendix C). In many places the results of more detailed flood mapping studies have superseded the JFlow outlines. Generally these studies have included detailed hydrological research, surveyed river cross sections, and more precise digital modelling such as ISIS, TuFlow and HecRas.

It should be noted that not all minor watercourses have had Flood Zone maps produced for them. Only watercourses with a catchment area greater than 3km² have been modelled using JFlow software and, therefore, smaller watercourses as identified on the 25K OS map within Flood Zone 1 may not be covered by the Environment Agency Flood Maps. As such, for any development site located adjacent to an unmapped watercourse within Flood Zone 1, it is recommended that a 9m development easement from the top of bank is applied, and a site specific FRA is undertaken.

The EA flood maps do not show the functional floodplain, Flood Zone 3b. The extent of Flood Zone 3b for any proposed development site should be determined by early consultation and direct liaison with the EA on a site by site basis.

4 Flood Risk in the Study Area

4.1 Approach to Data Gathering

Throughout the data collection and review process it has been critical to make best use of the significant amount of information which already exists with respect to flood risk (held by the Council, Environment Agency, Canal and River Trust, the Highways Agency, Severn Trent Water and other key consultees). The team has been able to review the collected data, assess its significance and quality, and advise on which part of the collected data needed to be used for the SFRA. The main approach to the SFRA has been to build on previous studies and gathered information.

Consultation has formed a key part of the data gathering stage of the SFRA. The above stakeholders were consulted during the SFRA and as part of the consultation process, an inception meeting was held with WDC and the Environment Agency to share their experience and knowledge of flooding issues across the study area. The benefits of adopting a partnering approach (as advocated by the NPPF) are significant and have helped to ensure that the findings and recommendations of the SFRA are relevant and workable for the Council.

4.2 Historical Flooding

Recent years have seen a number of large scale flood events throughout the UK including April 1998, autumn 2000, February 2002, New Year 2003, February 2004, summer 2007 and November 2012. The Environment Agency has produced a number of historic flood outlines for Warwick District (Volume 2, Plan E) which illustrate the extent of the following events:

- January 1939
- February 1979
- January 1985
- September 1992
- January 1992
- April 1998
- Summer (June / July) 2007

The biggest events took place in January 1985 and April 1998. The 1985 event in particular affected the lengths of the River Avon and River Leam which flow through the District, while the 1998 event affected similar areas but did not reach as far upstream of the River Leam. The Environment Agency has attributed both events to an exceedance of channel capacity during particularly extreme rainfall events. Records show that the 1998 flood affected several hundred properties including large areas within the District. The Environment Agency Flood Zone maps have incorporated the extent of the flooding from this event.

Widespread flooding was experienced through the District during the summer of 2007 (June and July). At that time England experienced the wettest three months to the end of July since records began, with at least twice the average rainfall falling across parts of the country. The extreme conditions led to large scale urban and rural flooding across south-west England, north-east England and the Midlands.

The extreme rainfall that occurred on the 14th and 15th June 2007 resulted in significant flooding in the area of Cubbington. Flooding occurred from a number of sources including fluvial flooding, surface water and artificial drainage. The drainage systems in the area (public, private, highway or land drainage) were not designed to cope with the exceptional conditions and as a result widespread flooding occurred, with the worst locations affected being in the bowl of New Street and Knightly Close and the valley bounded by Ladycroft, Price Road, Offchurch Road in the dip and the valley through the Thwaites factory. The bowl is at the foot of a steep 85% paved catchment contributing on three sides which amounts to some 28hectares. On the fourth side green field farmland and the school playing field contribute some 26 hectares to the overland flow into the bowls. Some of the green field land is protected by the Pingle Brook Flood Alleviation Scheme constructed by Warwick District Council in 2002.

The cause of the flooding was from a combination of sources including: surface water runoff from adjacent farmland and public highways, insufficient capacity of the drainage infrastructure (surface water and foul drainage systems, public foul and surface sewers owned by Severn Trent Water), the failure of the Severn Trent Terminal Pumping Station at Offchurch Road and, the overtopping of the Pingle Brook. It was also reported that the Pingle Brook flood alleviation scheme was overtopped. Water which fails to enter the artificial or surface water drainage system flows along the natural topography of the land and accumulates at the New Street bowl. Much of the existing drainage infrastructure is though to be of insufficient capacity to cope with such a large volume of water.

During the July event a number of locations were affected by flooding. These included Eathorpe, Hunningham, Offchurch, Leamington, Warwick, Cubbington and Rowington.

The 2012 event impacted the District with the Rivers Leam and Avon being most at risk. The Chair of Eathorpe Parish Council, near Leamington Spa, is reported to say that he believed it was not as bad as the 1998 and 2007 floods. Castle Road in Kenilworth was also reported to be flooded between Castle Hill and Brookside Avenue.

The EA web site information for the River Avon in Warwick also indicates that the 2012 event produced lower river levels than the 2007 event.

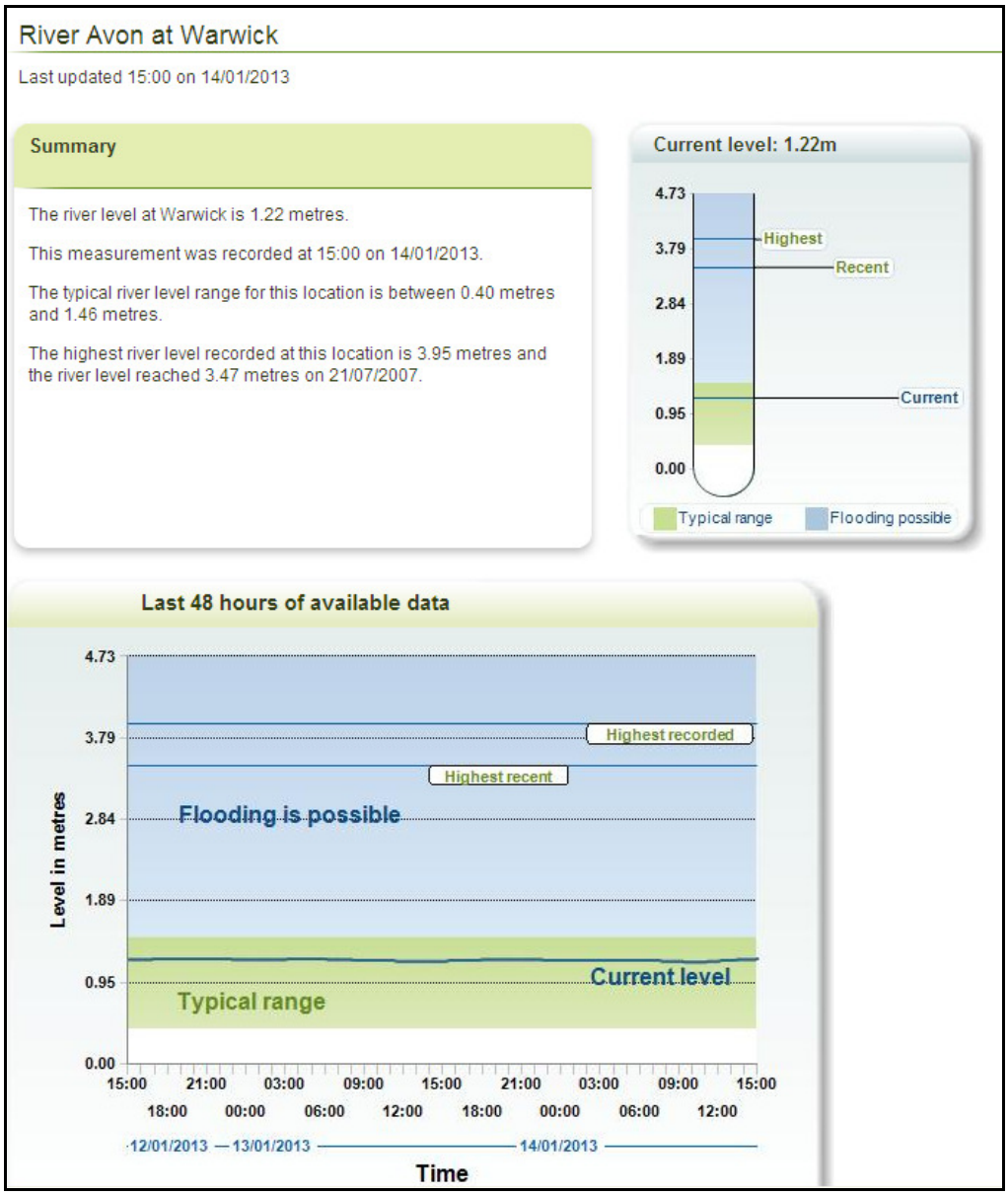


Figure 4: Historic River Levels for the River Avon, Warwick

4.3 Fluvial Flood Risk in Warwick District as defined by the Flood Zone maps

The Environment Agency Flood Zone maps provide an indication of the locations at risk from fluvial sources within the District. Within the District of Warwick there are a number of major towns including Royal Leamington Spa, Warwick and Kenilworth that are at least partially contained within Flood Zones 2 and 3.

Flood Zone maps for the River Avon extend predominantly into undeveloped agricultural land from the point at which the watercourse enters the District in the north-eastern extent (436575, 275115). As the watercourse flows in a south-westerly direction through the centre of the District, areas of the eastern and southern edge of Warwick are located within Flood Zones 2 and 3. Flood Zone outlines for St Johns Brook (a tributary of the River Avon) also show both residential and commercial properties adjacent to the watercourse at risk from flooding.

During the consultation period of the SFRA concern was raised by WDC as to the verification of the 2010 River Leam model with historical flood events, particularly the Easter 1998 event. Concern was expressed regarding how the Flood Zone maps were produced for the River Leam, specifically in relation to the downstream boundary and the extent of Flood Zone 3 through the centre of Leamington Spa.

Flood Zone maps for the Whitnash Brook joining the River Leam immediately downstream of Radford Road Bridge (433835, 265115) demonstrate that a small number of properties are located within Flood Zone 2 by Danesbury Crescent (433625, 264775), Marlborough Drive (433545, 264420) and Beaulieu Park (433585, 264515). It should be noted however that some misalignments are evident within the flood map and therefore there is the possibility that the current Flood Zones are incorrect in some places along this watercourse. This is due to the limitations of the method of generating Flood Zones in this area (see Appendix C for more details).

Flood Maps in the north-eastern extent of the District indicate that a small number of properties are located within Flood Zone 2 along the River Sowe downstream of Baginton Bridge (433955, 275285) along with a small area in the large works at the confluence of the Finham Brook (433765, 273922). A number of residential and commercial properties are also shown at risk of flooding from the Finham Brook as the watercourse flows around the western edge and centre of Kenilworth.

Other smaller watercourses within the District indicate a degree of flood risk to properties including the Gog Brook (427405, 263885), Fisher's Brook (427615, 263405) and Sherbourne Brook (426085, 261525) and Longbridge Brook (426735, 261795) in the south-western extent of the District. It should be noted that the flood outlines appear to be misaligned in places and therefore caution should be taken when interpreting the information.

4.4 Flooding from Other Sources

Methodologies for recording flooding from sources other than fluvial or tidal were not standardised until 2006. Therefore records held of such flooding can be incomplete, or not to a uniform standard. Information has been gathered on flooding experienced from sources other than rivers, and is described in this section.

4.4.1 Flooding from Sewers

All Water Companies have a statutory obligation to maintain a register of confirmed sewer flooding incidents caused by overloading of the sewer system by rainfall. This register does not contain incidents of sewer flooding caused by operational issues such as blockages or collapse. This register is referred to as the DG5 register and it provides a "snap shot" record of flood incidents from sewers which are deemed to be public and therefore maintained by the Water Company.

The DG5 register tends to show, to a greater or lesser extent, the date of all verified incidents, the post town, locality, street, postcode, a type and problem description, if internal flooding occurred, details of curtilage flooding, and the eastings and northings of the flood incident. There are clear investment criteria based on the frequency and severity of the confirmed sewer flooding incidents that lead to improvements to increase capacity and therefore reduce the risk of flooding. Severn Trent Water (STW) advised that currently schemes are designed to ensure no internal flooding for a 1 in 40 annual probability flood event. If a scheme to increase capacity has been completed then the affected properties will be removed from the register, however, if individual property protection measures have been fitted (i.e. flood gates) then the property remains on the register even though the consequence of flooding has been reduced. The DG5 register only contains records of flooding that emerges from an opening on a public sewer, further information on flooding caused by surface water runoff can be obtained from local government, the Highway Authorities/Agency and the EA.

Information on flooding from sewers has been provided by STW as recorded within the DG5 register and has been presented at postcode scale and due to data protection requirements it is not possible to specify the exact location of the incident. Therefore, if this information were to be displayed on the paper maps a significant extent of the District would appear to be affected by flooding, when in fact there may only be 1 property on the DG5 register in that particular postcode area. As such this data has not been displayed on the paper maps but is presented in **Table 1**.

The aim of the DG5 levels of service indicators is to measure the frequency of actual flooding of properties and external areas from the public sewerage system by foul water, surface water or combined sewage. It should be noted that flooding from land drainage, highway drainage, rivers/watercourses and private sewers is not recorded within the register.

Within the Warwick District there are currently 16 postcode areas that include properties on the DG5 register, although the DG5 register does not contain all properties at risk of sewer flooding. Due to the implications of the Data Protection Act on the data held on the DG5 register, and that this register provides a “snap shot” in time that is regularly updated, this report cannot pin-point the exact locations of properties that are recorded on the DG5 register; however, the numbers of properties affected within each postcode area has been identified and detailed in the tables below. The EA has asked that, should development take place in these areas, further work should be carried out to investigate the nature and scale of the risk posed, so that mitigation can be put in place and the areas can be targeted through appropriate policies for reducing flood risk.

Table 1: Flooding from Sewers as Recorded in the Severn Trent DG5 Register

2008 SFRA data:

Postcode Area	No. Properties Affected
B93 0	2
B93 8	3
B94 5	2
B94 6	4
CV23 9	3
CV3 4	3
CV3 6	2
CV31 1	24
CV31 2	32
CV31 3	8
CV32 4	28
CV32 5	14
CV32 6	17
CV32 7	48
CV33 9	3
CV34 4	9
CV34 5	4
CV34 6	9
CV35 0	3
CV35 7	4
CV35 8	15
CV35 9	2
CV37 0	9
CV4 7	8
CV4 8	1
CV47 2	3
CV47 9	1
CV7 7	15
CV8 1	32
CV8 2	88
CV8 3	3
Total	**399**

Data from 16 October 2012 and receptor type

Postcode Area	No. Locations Affected
B94 6	1
CV31 1	7
CV31 2	3
CV31 3	4
CV32 5	7

Postcode Area	No. Locations Affected
CV32 6	7
CV32 7	30
CV33 9	3
CV34 4	7
CV34 5	2
CV34 6	8
CV35 7	4
CV35 8	4
CV8 1	14
CV8 2	21
CV8 3	1
Total	**123**

Receptor Type	No. of Locations Affected of Type
Domestic	59
Commercial	4
Highway	19
Garden	36
Other	5
Total	**123**

It is evident from the table that flooding from sewers occurs throughout the District of Warwick with the most reported incidents in the east central and north of the District by Lillington / Cubbington and Kenilworth within postcode areas CV32 7 and CV8 1 and CV8 2. However, there has been a significant reduction in the number of properties on the DG5 register since the 2008 SFRA following significant investment in major schemes to increase the capacity of the sewerage system. Of particular significance is the Leamington scheme; approximately £8 million investment to renew the strategic sewerage system in Leamington Spa town centre including a new large diameter sewer in Victoria Park and the replacement of approximately 2km of existing sewers in the urban area of Leamington Spa. STW also endorse the use of SUDS.

Local Planning Authorities should adopt a planning policy requiring the use of SUDS as proposed in the NPPF and that the NPPF should be used to allocate land for development outside of the Flood Zones so that the risk of fluvial flooding is minimised. This reduces the risk of fluvial flood waters entering public foul and surface water sewers and resultant increase in risk of flooding. Individual developments should be designed so that natural flood pathways are left free of buildings. Further guidance on the application of SUDS can be found in **Section 10**, and in the CIRIA Report C697, Sustainable Drainage Systems (SUDS) Manual (2007) and CIRIA Report C635, Designing for Exceedance in Urban Drainage (2006).

4.4.2 Flooding from Surface Water Runoff

Anecdotal evidence received as part of the 2008 SFRA study indicated that surface water flooding has occurred with surface water transferred into the Tanyard Stream for approximately two miles of railway track drainage between the St Johns roundabout (429305, 270905) and Mill End (429605, 272705). In addition, surface water runoff from agricultural land is known to be a problem within the District on slopes over 10% during heavy, flashy rainfall events. This was particularly problematic during the summer 2007 flood events as the surrounding land was already saturated and the runoff from large areas of contributing agricultural land resulted in flooding for properties at the foot of the hills. Land management issues relating to farming methods can lead to drainage problems, increasing the speed at which surface water runs from the slopes and into the watercourses. Additional problems with surface water were also experienced from school playing fields and areas of open space during the summer 2007 flood events.

Anecdotal evidence received from Warwickshire County Council as part of the 2012 SFRA study indicates several areas in Kenilworth and one in Cubbington that has experiences flooding from surface water runoff. It was noted in correspondence that the flooding tends to be more ponding and standing water than major flooding, apart from the larger area of Cubbington, for which proposals for an alleviation scheme are being carried out.

4.4.3 Flooding from Impounded Water Bodies

Records of flooding from canals and reservoirs are erratic as there is no requirement for the Environment Agency to show historic flooding from canals and raised reservoirs on plans. In particular, the NPPF does not require flood risk from canals and raised reservoirs to be shown on the flood map. Risk mapping from inundation as a result of reservoir breach is provided by the EA on their web mapping, however, this mapping does not include risk from canals. It should be noted that overflows from canals are relatively common due to flows from land drainage and their frequent lack of overflows. Occasionally major bank breaches also occur, leading to rapid and deep flooding of adjacent land.

A number of canals are located within the Warwick District: the Stratford-upon-Avon Canal, the Grand Union Canal and the Saltisford Arm of the Grand Union Canal. It is important that canals are included in any SFRA as they form a vital land drainage function and major breach could pose a significant flood risk. Any FRA should therefore take account of canals. Not only do canals occasionally overtop in places due to high inflows from natural catchments (i.e. where inflows are higher than the capacity of the flood control structures), but they are also vulnerable where overtopping occurs from adjacent watercourses. Additional water from adjacent watercourses must be routed/conveyed by the canal which may cause issues elsewhere, not only within the catchment of interest but also in neighbouring catchments, as the canal crosses catchment boundaries. Additionally, the canal itself can reduce flood risk where Canal and River Trust (C&RT) control flood flows within the canal, or accept flood waters either for temporary storage or transfer.

At present canals do not have a level of service for flood recurrence (i.e. there is no requirement for canals to be used in flood mitigation), although C&RT, as part of its function, will endeavour to maintain water levels to control the risk of flooding from canals to adjacent properties. It is important, however, that any development proposed adjacent to a canal be investigated on an individual basis regarding flooding issues and should be considered as part of any FRA.

Consultation with the C&RT and the District Council has indicated that a number of canal breaches have occurred along the Grand Union Canal. These are presented in **Table 2** below.

Table 2: Canal Breach Records

Canal	Grid Reference	Breach Date	Comment
Grand Union Canal	429962, 265521	1868	Bridge Street, Emscote. Cause unknown.
Grand Union Canal	424855, 266621	1985	Hatton Locks, Hatton. Third parties driving pip under canal induced breach due to bed collapse.
Grand Union Canal	426662, 265521	2007	East of Old Budbrooke Road, Warwick. Minor over topping due to high water levels.
Grand Union Canal	428474, 266028	2007	Miller's Road, Packmores. Minor over topping due to high water levels.
Grand Union Canal	427695, 266055 427915, 266065 428085, 266175	2007	Breaches during summer 2007 flood events including locations at Lower Cape Road, Lower Lock Lane, Exham Close and Lyton Close causing flooding to property.
Grand Union Canal	425658, 266331	2009	Ugly Bridge, Hatton Locks, Hatton. Top leak through embankment into adjacent watercourse following minor waterwall wall failure.
Grand Union Canal	429808, 265544	2009	Bridge Street, Emscote. Minor over topping due to high water levels.
Grand Union Canal	428085, 266175	2012	Over topping during flood event at several locations including Exham Close

Reservoirs with an impounded volume in excess of 25,000 cubic metres (measured above natural ground level) are governed by the Reservoirs Act (1975) and are listed on a register held by the Environment Agency. Due to high standards of inspection and maintenance required by legislation, normally flood risk from registered reservoirs is moderately low. In the future the Reservoirs Act may also apply to reservoirs between 10,000 and 25,000 cubic metres.

The EA produce reservoir flood maps associated with large reservoirs that hold over 25,000 cubic meters of water. These maps are available on the EA web site and help identify areas potentially affected by reservoir flooding; they are only intended as a guide and are not a prediction of what will happen. Due to the sensitivity of the information the maps are at relatively small scale (limited detail) and do not provide information on potential depth or speed of the flood waters associated with reservoir flood risk. The maps display a realistic worst case scenario of the largest area that might be flooded if a reservoir were to fail and release the water it holds and are suitable for emergency planning purposes. The EA mapping for the WDC area is provided in **Figure 5**.

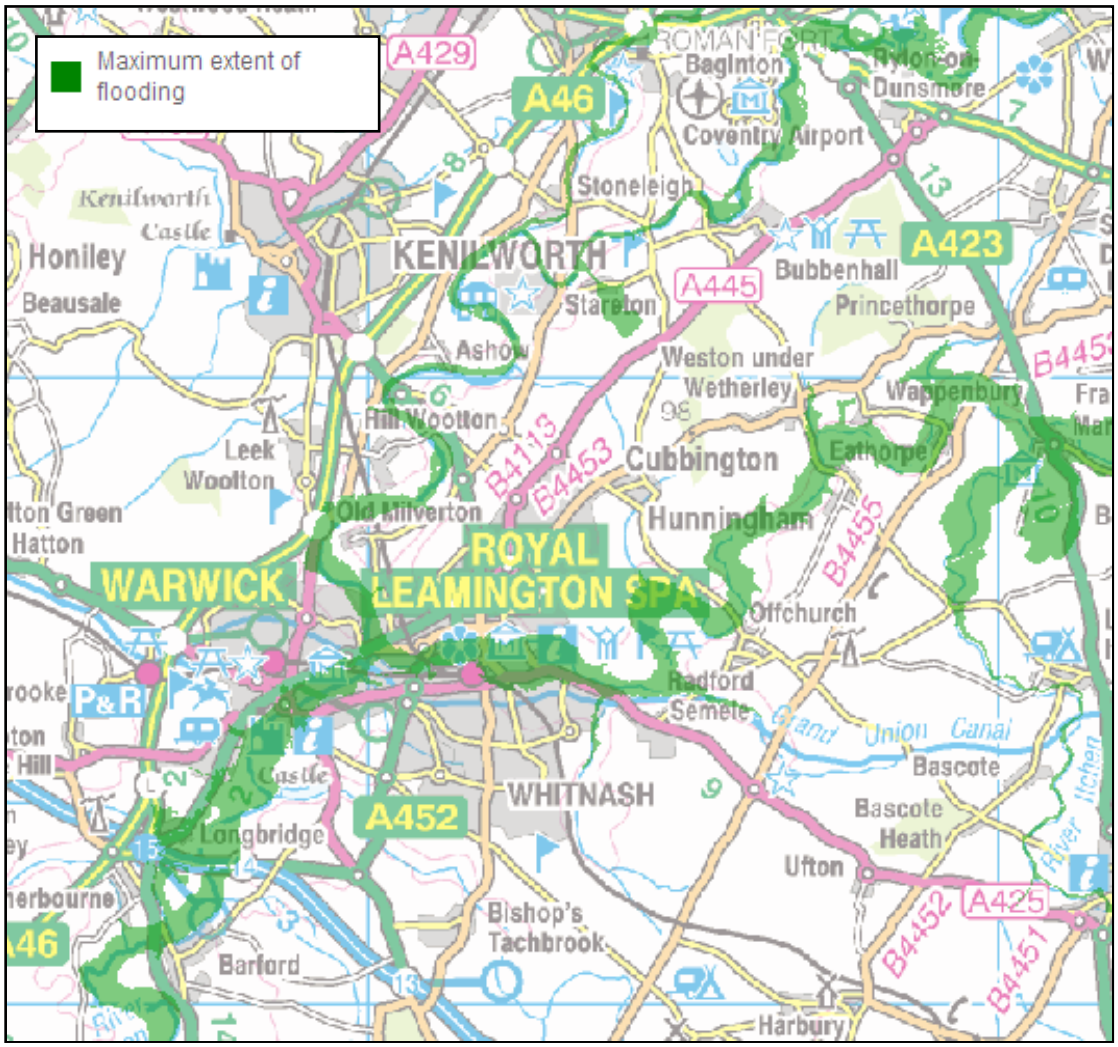


Figure 5: Environment Agency Risk of Flooding from Reservoirs Mapping

The reservoirs that are incorporated into the EA mapping are listed in **Table 3**.

Table 3: Reservoirs incorporated in the EA mapping of reservoir flood risk in WDC

Reservoir	Grid Reference	Owner
Coombe Pool	438310, 279216	Coventry City Council
Naseby	466673, 277975	Canal and River Trust
Stanford	459586, 280323	Severn Trent Water Authority
Sulby	465200, 281160	Canal and River Trust
Park Farm, Stoneleigh	434068, 271190	Sandfields Farms Limited
Draycote Water	445110, 270060	Severn Trent Water Authority
Willes Meadow	432970, 265770	Severn Trent Water Authority
Ventnor Farm Marina	446101, 263753	Ventnor Farm Marina Limited
New Waters, Warwick Castle	428538, 263427	Gladedale Homes (Scarborough) Limited
Upper Compton Verney	431036, 252617	Cariss

4.4.4 Flooding from Groundwater

The Environment Agency and other third parties organisations such as the British Geological Survey can monitor groundwater levels using boreholes and retain records of surveys undertaken. Both the Environment Agency and planning authorities can keep records of instances where a high water table has led to individual groundwater flooding events.

In 2005, the Environment Agency produced the Warwickshire Avon Catchment Abstraction Management Strategy technical document. The Avon catchment has significant groundwater resources stored in the major aquifers around the Coventry, Warwick, Kenilworth and Bromsgrove areas. This document noted that with regard to Abstraction Point AP2 (the River Sowe at Stoneleigh) the nature of this particular aquifer, has resulted in some areas of the catchment being dominated by rising groundwater levels, which in some cases have broken out resulting in, for example, cellar flooding.

Consultation with the Environment Agency and the British Geological Survey (BGS) has suggested that there are no major problems with flooding from groundwater within Warwick District.

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5 Strategic Flood Risk Mapping

5.1 Strategic Flood Risk Maps

A key output of the SFRA is a series of maps covering the LPA area, showing flood risk from sources including fluvial, surface water, foul and combined sewers, groundwater and impounded water bodies such as rivers and canals. The maps use the information detailed in **Section 4**. The strategic flood risk maps are presented in Volume 2.

Level 1 SFRAs should seek to use Flood Zone outlines which have been produced using detailed modelling techniques. As such modelling outcomes of watercourses in the WDC area have been incorporated into the Environment Agency's Flood Zone maps. When representing the Flood Zones a Level 1 SFRAs should also show the functional floodplain, Flood Zone 3b, where such outlines exist. If Flood Zone 3b has not been produced as part of a detailed modelling project, similar outlines, such as the 1 in 25 year outline can be used, upon agreement with the Environment Agency. In the absence of such detailed information, a precautionary assumption has been adopted where Flood Zone 3b has not been modelled. When carrying out the Sequential Test the LPA should assume that where Flood Zone 3b has not been modelled, its extent would be equal to Flood Zone 3a (High Probability).

This approach is suitable at the Level 1 SFRA stage when carrying out the Sequential Test, a process whereby development should be placed in the lowest risk zone, Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1, decision-makers should take into account the flood risk vulnerability of the development and consider reasonably available sites in Flood Zone 2. Only where there are no reasonably available sites in Flood Zones 1 or 2 should decision-makers consider the suitability of sites in Flood Zone 3.

In the absence of a Flood Zone 3b outline, the implications of assuming Flood Zone 3b is equal to Flood Zone 3a can be summarised in the following example. The NPPF says that 'more vulnerable' developments, such as a housing development, can be placed in Flood Zone 3a provided it passes the Exception Test, but cannot be placed in Flood Zone 3b. If such a development was placed in Flood Zone 3a following the Sequential Test, further modelling work would have to be carried out as part of a Level 2 SFRA to define the extent of Flood Zone 3b, thereby defining the area where the development could not be placed. In the event that detailed modelling work is not possible, the LPA should assume that Flood Zone 3b extends to the 3a extent, and should therefore remove the development from this area. Should a developer wish to prove otherwise, it is at this stage that developer contributions can be given in order to carry out further modelling work. Such a scenario would be expected in an area where the development pressures are significant and there is little other developable land in lower risk areas.

Should sites be placed in Flood Zones 2 or 3, they should always be assessed through a more detailed Level 2 SFRA, which will refine Flood Zone information and allow the development to be located on parts of the site at lowest probability of flooding, and ensure that other areas do not become subject to increased risk as a result of the development.

5.1.1 Hydraulic (River) Models

River models listed below have been incorporated into the EA flood zone maps used for the production of the SFRA. Within the District of Warwick the Environment Agency hydraulic models incorporated into the flood mapping since 2008 are the:

- River Leam (July 2010)
- River Avon from Welford to Bredon (November 2010)
- Warwick Tributaries (July 2012)

The River Leam model includes the River Itchen (incorporating the River Stowe), Pingle Brook and Whitnash Brook. The study limits are outlined in **Figure 6** and **Table 4**.

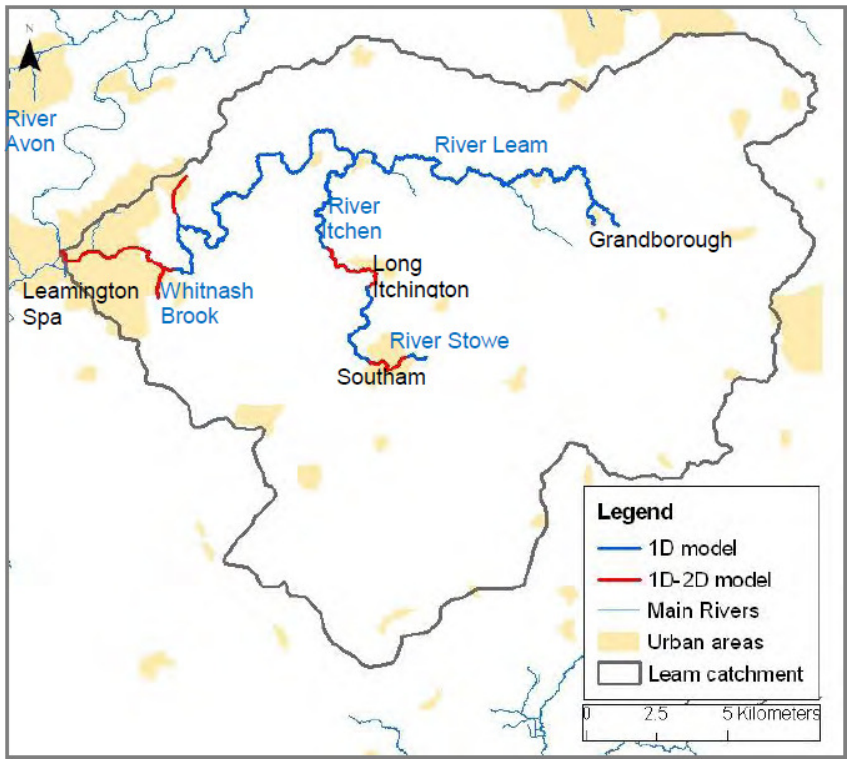

Figure 6: River Leam Location of Study Reach

Table 4: River Leam Study Limits

Watercourse	Upstream Limit	Downstream Limit
River Leam	Upstream of Grandborough	Confluence with the River Avon
River Stowe	Upstream of Southam	Confluence with the River Itchen
River Itchen	Confluence with the River Stowe	Confluence with the River Leam
Unnamed watercourse at Grandborough	Upstream of Grandborough	Confluence with the River Leam
Whitnash Brook	Adjacent to Church Lane, Leamington Spa	Confluence with the River Leam
Pingle Brook	Upstream of Cubbington	Confluence with the River Leam

The River Avon model study limits were from downstream of Welford Reservoir (464555, 280815) to the M5 motorway bridge located downstream of Bredon (391535, 236955). Ten tributaries of the River Avon were also included within the model, for the reach between the most downstream gauging stations to their confluence with the River Avon. These were:

- Clay Coton Brook (from 459405, 276925)
- River Swift (from 450685, 280705)
- Sowe Brook (from 433215, 273015)
- River Leam (from 430785, 265385)
- River Dene (from 427275, 255595)
- River Stour (from 420835, 250685)
- River Arrow (from 408745, 253605)
- Badsey Brook (from 406285, 244925)
- River Isbourne (from 402445, 240815)
- Bow Brook (from 392575,245345)

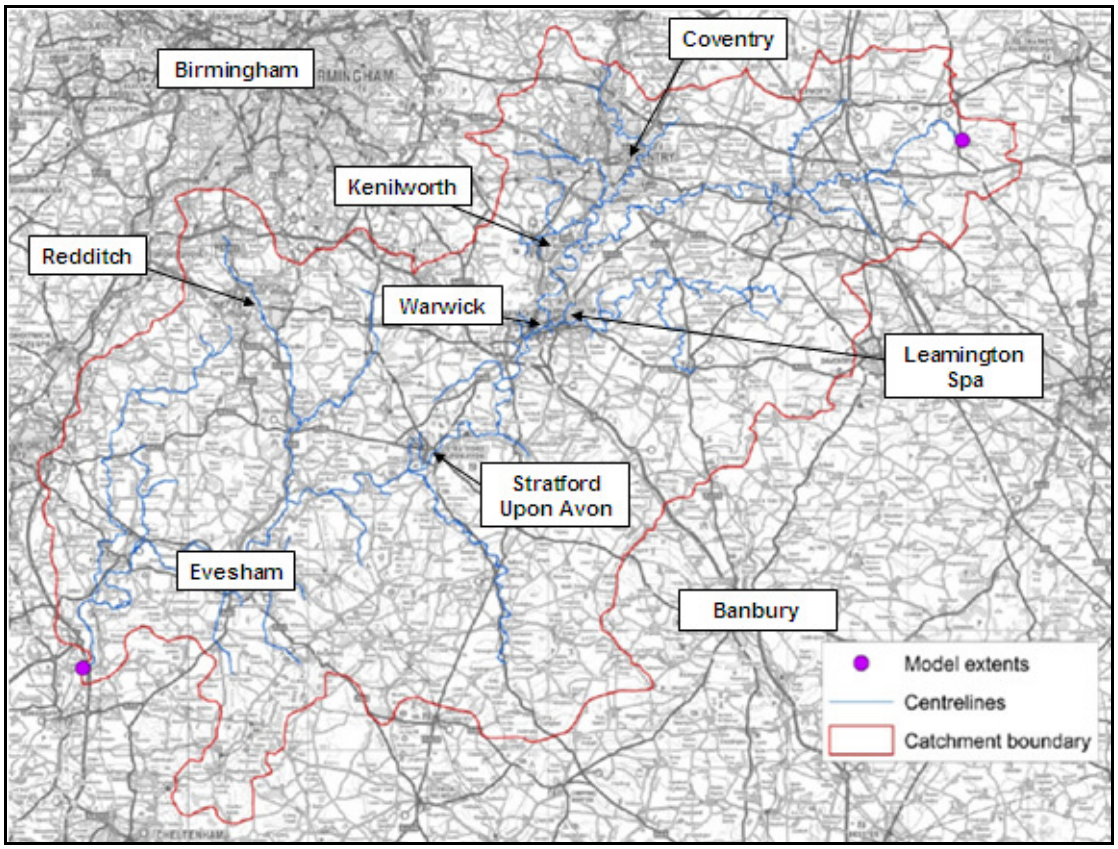

Figure 7: River Avon Model Study Area

The Warwick Tributaries model included the Gog / Fishers Brook, Saltisford Brook, St John's Book, Hospital Book and Myton Brook.

- Myton Brook extends for approximately 0.9km from Brook Farm (430350, 264650) to its confluence with the River Avon (429850, 265250)

- St. John's Brook extends for approximately 2.7km from upstream of the A46 (427650, 266750) to its confluence with the River Avon (428950, 264750)

- Hospital Brook from the upstream extent at Millers Road (428299, 265933) to its confluence with St John's Brook downstream of the railway line (428563, 265439)

- Saltisford Brook is approximately 2.3km in length with the upstream model limit at located upstream of the Grand Union Canal (427150, 265850) and the downstream limit at the confluence with the River Avon (428150, 264250)

- Gog Brook extends for 1.7km from Warwick Race Course (427050, 264350) to its confluence with the River Avon (427750, 262950)

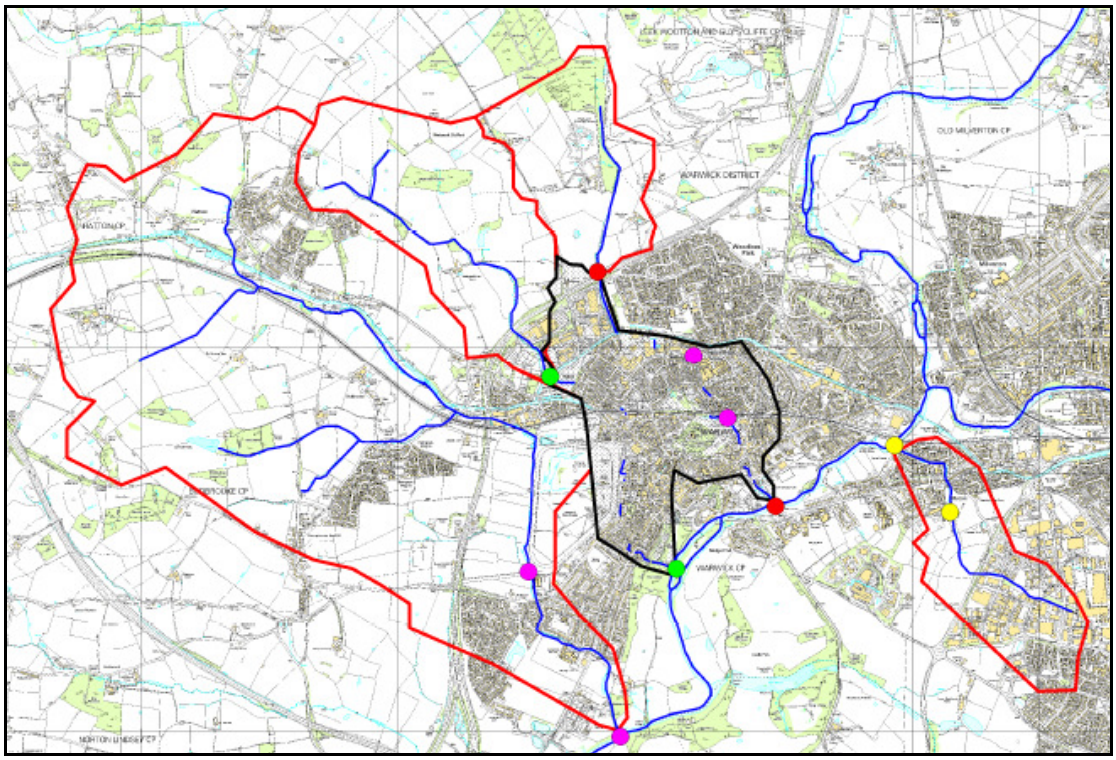

Figure 8: Warwick Tributaries Model Study Area

5.2 Local Flood Alleviation Schemes

5.2.1 Gog/Fisher's Brook

In 2012 Warwickshire County Council (WCC) undertook flood alleviation works associated with the Gog/Fisher's Book downstream of Hampton Road, Warwick. These works were undertaken to alleviate flood risk in the area of Tournament Fields and have been approved by the EA, however, the resultant alteration in floodplain extent in the area of Tournament Field has not yet been incorporated into the EA Flood Zone mapping.

5.3 Climate Change Maps

The NPPF sets out guidance for changes to flood risk as a result of climate change shown in **Figure 9**. These climate change scenarios are now included in most Environment Agency river models and flood outlines are produced; for older river studies this is less likely.

The main Climate Change table (adapted to demonstrate effects on rivers) from the NPPF is shown below:

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	*+5%*	*+10%*	*+20%*	*+30%*
Peak river flow	*+10%*	*+20%*		

Figure 9: NPPF Recommended National Precautionary Sensitivity Ranges for Peak Rainfall Intensities and River Flows

This table is derived from data presented in the Defra FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities – Climate Change Impacts (October 2006). This Defra document predicted effects of climate change on the United Kingdom and described how short duration rainfall could increase by 30% and flows by 20%, and suggests winters will become generally wetter. These effects will tend to increase both the size of Flood Zones associated with the sea and rivers, and the amount of flooding experienced from "other sources".

Where climate change outlines have been produced from existing models these outlines have been used on the SFRA climate change maps. If these do not exist, analysis of other modelled scenarios has been undertaken to assess their suitability for use as a climate change proxy. In general our past experience has shown that the 1 in 1000 or 1 in 200 year outlines often show similar extents to the climate change scenarios of the 100 year event.

For watercourses where models do not exist, the most up-to-date Environment Agency Flood Zone maps can be used to provide an indication flood risk including climate change. As such the 1 in 100 year climate change scenario assumes that the current day Flood Zone 2 (1 in 1000 year return period) will become Flood Zone 3 (1 in 100 year return period). It can also be assumed that the current functional floodplain (3b - 1 in 20 year return period) will become Flood Zone 3a (1 in 100 year return period). This is a precautionary approach but one which is consistent with past modelling experience, which has shown that the 1 in 1000 year flood outline is often similar to the climate change scenario for the 100 year event. The NPPF requires that present day Flood Zone maps are used to carry out the Sequential Test. However the LPA might wish to use the climate change maps to carry out the Sequential Test, in order to give a particularly long-term risk-based approach to planning.

This is the level of detail which is requires for a Level 1 SFRA, and gives an indication of how Flood Zones and flood probabilities are likely to change over time. The climate change scenarios are provided in a series of maps covering the study area (Volume 2, Plan C).

6 Flood Warning Systems and Flood Risk Management Measures

6.1 Flood Risk Management

Flood risk management can reduce the probability of occurrence through the management of land, river systems and flood defences, and reduce the impact through influencing development in flood risk areas, flood warning and emergency response.

6.1.1 Preliminary Flood Risk Assessment

Preliminary Flood Risk Assessments (PFRAs) have been produced by Lead Local Flood Authorities (LLFAs) in England and Wales to fulfil the requirements in the Flood Risk Regulations (2009), which implement the requirements of the European Floods Directive (2007). The Warwickshire Preliminary Flood Risk Assessment (PFRA) was completed in May 2011.

The Warwickshire PFRA summarises the findings from the first two stages of the flood risk management cycle for the County of Warwickshire and presents the results of a high level screening exercise, identifying areas of significant flood risk. It identifies six flood risk events with locally adverse consequences over the past twenty years (all of which meet a defined local 'significance criteria'). These events are:

- January 1992
- Easter 1998
- August 1999
- June 2005
- Summer 2007
- December 2008

None of the 10 EA national Indicative Flood Risk Areas (IFRA) have been identified as being within Warwickshire although Leamington Spa is identified as having a risk of flooding above the Flood Risk Threshold based upon the EAs Flood Map for Surface Water (FMfSW). The PFRA also includes structured actions for the County Council to implement to support and progress local flood risk management in the future.

Figure 10 provides a breakdown of the distribution of source of flooding within past flood records included in the PFRA.

Although flooding from Main Rivers is not the responsibility of the LLFA, most occurrences within Warwickshire result in interactions with the drainage network. As such, records of Main River flooding have been retained in the record of past flooding.

Artificial Infrastructure	Percentage
Highway Drain	17%
Combined Sewer	23%
Surface Water Sewer	45%
Canal Network	8%
Unspecified Sewer	6%
Pumping Station Failure	1%

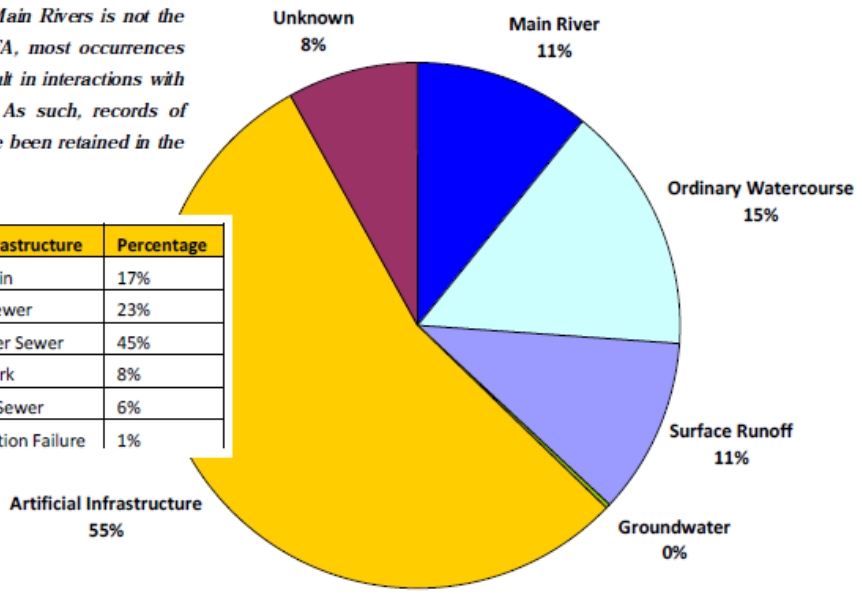

Figure 10: PFRA Distribution of Source of Flooding Within Past Flood Records

6.1.2 Catchment Flood Management Plans

A Catchment Flood Management Plan (CFMP) is a high-level strategic plan through which the Environment Agency seeks to work with other key-decision makers within a river catchment to identify and agree long-term policies for sustainable flood risk management. Two CFMPs cover the Warwick District: the River Trent and River Severn.

The CFMP documents give an overview of flood risk in the respective catchments and sets out a preferred plan for sustainable flood risk management over the next 50 - 100 years. The Environment Agency and their partners developed policies to manage flood risk in the future. These policies set our the direction flood risk management will take in the future, and will help achieve their vision for a more sustainable, cost effective and natural approach to managing flood risk. The policy options, agreed nationally by the EA and applied to CFMPs in a standard way across England and Wales, considered within all CFMPs are detailed in **Table 5**. The allocation of the policies to each unit involved the review of large amounts of information, alongside feedback and extensive consultation and consideration was given to how the policy units would interact with each other.

Table 5: 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 over time)

Policy Option	Policy
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 current scale of flood risk in 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 in the future)
6	Take action to increase the frequency of flooding to deliver benefits locally or elsewhere, (which may constitute an overall flood risk reduction, for example for habitat inundation)

River Trent CFMP

The River Trent CFMP was undertaken for the River Trent catchment and considers flooding over an area covering the River Trent catchment and all of its tributaries, which is a total area of over 10,000 square kilometres. Only a very small portion of the northern extent of the District of Warwick is covered by the Trent CFMP. There are no watercourses within the District that drain directly into the River Trent; however, a number of tributaries within the District drain into the River Blythe which is a tributary of the River Tame which ultimately drains into the River Trent. It is therefore unlikely that the District will be significantly affected by the policies within the Trent CFMP. The River Trent CFMP Summary Report (2010) is available on the Environment Agency's website.

The Trent catchment and that of its tributaries has been divided into 10 Policy Units. Each Policy Unit has been assessed to decide which policy will provide the most appropriate level and direction of flood risk management for both now and the future. Out of the six standard flood risk management policies listed in **Table 5**, one has been applied to each Policy Unit. The area of WDC included in this CFMP falls within Policy Unit 6 – Mid Staffordshire and Lower Tame. The policy option determined for this Sub Area is Policy 6.

River Severn CFMP

The River Severn CFMP was undertaken for the River Severn catchment and considers flooding over an area covering the River Severn catchment and all of its tributaries, which is a total area of approximately 11,000 square kilometres. The majority of the WDC area is covered by the Severn CFMP. The Canley Brook, Finham Brook, River Stowe, River Itchen and River Leam drain into the River Avon within the District before outfalling in to the River Severn to the south west of the District. As such the District will be affected by the policies within the Severn CFMP. The River Severn CFMP Summary Report (2009) is available on the Environment Agency's website. The Severn catchment and that of its tributaries has been divided into 20 Policy Units with WDC being included in four of these:

- Policy Unit 11: River Arrow and River Alne
- Policy Unit 13: Coventry Cluster
- Policy Unit 14: Upper Avon
- Policy Unit 16: Avon Tributaries

As with all CFMPs each Policy Unit has been assessed to decide which policy will provide the most appropriate level and direction of flood risk management for both now and the future. Out of the six standard flood risk management policies listed in **Table 5**, one has been applied to each Policy Unit. Details of the area of WDC included in this CFMP are provided in **Table 6**.

Table 6: River Severn CFMP Policy Options for WDC

Policy Unit	Area of WDC included in Policy Unit	Policy Option
11	Western extent of the WDC area including the settlements of Kingswood, Turners Green, Lowsonford and Lapworth	Policy 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)
13	The majority of the WDC area including the urban areas of Kenilworth, Leamington Spa and Warwick	Policy 5 - Take further action to reduce flood risk (now and in the future)
14	Eastern extent of WDC area including the settlements of Eathorpe and Wappenbury	Policy 6 - Take action to increase the frequency of flooding to deliver benefits locally or elsewhere, (which may constitute an overall flood risk reduction, for example for habitat inundation)
16	South western extent of WDC area including the settlements of Barford, Sherbourne and Norton Lindsey	Policy 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)

6.1.3 Flood Risk Management Strategies

The Environment Agency advocates a strategic approach to flood risk management on a 'whole catchment' basis. In line with this thinking, a number of flood risk management strategies have been undertaken by the Environment Agency within the Midlands region of which two cover the Warwick District: the River Trent and River Severn.

For the 2012 SFRA the Environment Agency has confirmed that the River Trent and River Severn Strategies below are still current, however, updates are likely to be undertaken in the next year with a change in format to be more specific to particular areas.

River Trent Strategy

In 2005, the Environment Agency produced a Flood Risk Management Strategy for the River Trent, which has been reviewed for inclusion in the 2008 SFRA. The study spanned from Stoke-on-Trent, where the River Trent's Head of Main River is located, to the tidal limit at Cromwell Weir downstream of Newark, a distance of some 200km. The principal aim of the Fluvial Trent Strategy is to identify the preferred high level approaches for sustainable management flood risk along the River Trent corridor over the next 50 years.

The strategy is limited to the Trent corridor only, and while local catchment wide solutions (i.e. of the tributaries) are appraised in some instances, flood risk along the Trent corridor is mainly considered. In the Warwick District there are no direct tributaries of the Trent, however, the River Blythe is a tributary of the River Tame which eventually feeds the River Trent. There is, therefore, little in the strategy which refers directly to the Trent's uplands tributaries which characterise the fluvial setting in District of Warwick. The strategy tends to focus on flood risk management measures for the headwaters of the River Trent Main River, located in neighbouring Stoke-on-Trent City Council. For this reason, flood risk management measures which would affect rivers in the District of Warwick do not feature on the strategy.

Nonetheless, the strategy identifies a number of options which are considered best practice and are recommended. These recommendations are supported by the NPPF requirements and indeed the main messages of this SFRA, which considers these options in more detail. These include:

- SUDS: either retrofitted or on new developments
- Development and Flood Risk: appropriate measures to restrict inappropriate developments
- Land Management: Appropriate land management techniques that could reduce surface runoff

Floodplain Obstructions: the removal of such obstructions, where appropriate, to improve local conveyance.

River Severn Strategy

The Fluvial Severn Strategy was issued in October 2006 and has been reviewed for inclusion in the 2008 SFRA. The study covered the area of influence around the Severn corridor to the downstream limit of the weirs at Gloucester. The principal aim of the Fluvial Severn Strategy is to provide a 50-year framework for the management of flood risk within the fluvial Severn study area and a 5-year plan for capital investment on project level flood defence/management.

Like the Trent Strategy, the Severn Strategy is focused on the Severn corridor only. Flood risk management options are therefore only appraised for implementation on the River Severn corridor, which for the purposes of the Strategy was taken as being just beyond the extent of the Environment Agency's current Flood Map. Therefore the wider catchment, which affects the District of Warwick, does not feature in the Strategy.

6.2 Flood Defences

Flood defences are structures which affect flow in times of flooding and therefore prevent water from entering property. They generally fall into one of two categories: 'formal' or 'informal'. A 'formal' defence is a structure which has been specifically built to control floodwater. It is maintained by its owner (this is not necessarily the Environment Agency) so that it remains in the necessary condition to function. An 'informal' defence is a structure that has not necessarily been built to control floodwater and is not maintained for this purpose. This includes road and rail embankments and other linear infrastructure (buildings and boundary walls) which may act as water retaining structures or create enclosures to form flood storage areas in addition to their primary function.

A study of informal defences has not been made as part of this assessment. Should any changes be planned in the vicinity of road or railway crossings over rivers in the study, it would be necessary to assess the potential impact on flood risk to ensure that flooding is not made worse either upstream or downstream. Smaller scale informal defences should be identified as part of site-specific detailed FRAs and the residual risk of their failure assessed.

In accordance with the scope of a Level 1 SFRA, a high level review of formal flood defences has been carried out using data from the NFCDD. This is a good starting point for identifying significant flood defences and potential areas benefiting from defence, but the quantity and quality of information provided differs considerably between structures. The NFCDD is intended to give a reasonable indication of the condition of an asset and should not be considered to contain consistently detailed and accurate data (this would be undertaken as part of a Level 2 SFRA where the need arises).

Only a few locations at risk of flooding are currently protected by permanent defences within the District of Warwick. These are located in the urban areas of Warwick, Leamington Spa, Kenilworth, Whitnash and Cubbington and can be viewed in Volume 2, Plan A1. At Mill End Kenilworth the Environment Agency NFCDD database identifies a stone block wall on the right bank of the Finham Brook which provides protection to a number of residential properties on the new housing development (429615, 272835) and, two privately owned defences taking the form of a flood wall adjacent to Mill End Sewage Treatment Works (STW) pumping station and an embankment at Woodmill Meadow (429555, 272815). The standard of protection offered by these defences is not known.

A number of council maintained defences have been identified within the Environment Agency's NFCDD database as part of this study. The defences include Common Lane bridge abutment and Bridge Street abutment in Kenilworth. In addition to the information in NFCDD, the Council have provided details of the Pingle Brook Flood Alleviation Scheme constructed by the District Council in 2002 in the grounds of Cubbington CE Primary School following the Easter 1998 floods. During the June 2007 flood event, the Pingle Brook flood alleviation scheme was overtopped. The scheme worked correctly to maximum design capacity however, the intensity of the storm exceeded the overall capacity of the works and overtopping of the system occurred with some water entering the school play ground.

The Environment Agency NFCDD layer also identifies a number of privately owned defences within the Warwick District. These include walled banks to private property on the left and right banks of the Finham Brook at Bridge Street, Kenilworth (428765, 272355), and, a timber piled bank to rear gardens on the left bank of the Finham Brook at Gloster Drive, Kenilworth (428935, 272565).

It has been noted that there is a defence located along the River Avon at Mercia Way, Warwick (429505, 265205). Consultation with the Environment Agency indicated that this defence is not a formal defence maintained by the Environment Agency, and, no further details were received as part of this study regarding the defence at this location. However concern has been raised about the defence during the consultation process and therefore this should be considered when taking into consideration any potential development adjacent to this location.

Sections of culverted watercourse as identified within NFCDD have been demonstrated in Volume 2, Plan A1. These are owned both privately, by the Environment Agency and by WDC.

In some areas, particularly for existing properties and proposed developments behind defences, it may be necessary to extend the scope of the SFRA to Level 2. The outputs from detailed overtopping and breach analysis of the key defences will provide refined hazard information on flood depths, velocities and flow paths, which could be used by the LPA emergency planning teams to define new or refine existing emergency plans for these areas.

6.3 Residual Risk

Residual flood risks can arise due to:

- the failure of flood management infrastructure such as a breach of a raised flood defence, blockage of a surface water conveyance system, overtopping of an upstream storage area, or failure of a pumped drainage system
- a severe flood event that exceeds a flood management design standard and results in, for example, overtopping

Within the District of Warwick there are no areas formally classified by the EA as Areas Benefiting from Defences[2] (ABDs) contained within the Environment Agency's ABD database. There are however several major formal flood defences within the District, details of which can be found in **Section 6.2**. With each defence there is a residual risk of overtopping, breach or blockage, which could result in significant damage to buildings and highway infrastructure as well as posing danger to life. During the June 2007 flood event, the Pingle Brook flood alleviation scheme was overtopped. The scheme worked correctly to maximum design capacity however, the intensity of the storm exceeded the overall capacity of the works and overtopping of the system occurred with some water entering the school play ground.

Information received from the C&RT and WDC has indicated that there are a number of locations where there is a risk of breaching or overtopping from the Grand Union Canal which could affect both residential and commercial property. Historical records of breach are set out in **Table 2**, **Section 4.4.3**. These locations include Bridge Street, Hatton, Lower Cape Road, Lock Lane by the Yuassa Commercial Unit, Exham Close and Lyton Close which have experienced a breach from the canal in 2007, 2009 and/or 2012.

Although there have been no ABDs identified within the District, it is possible that future modelling work undertaken by the Environment Agency may lead to the availability of such information and therefore the flood maps should be updated if this information becomes available. Areas of residual risk are treated uniformly and are represented in the GIS as a simple outline of the expected affected area. Actual levels of residual risk will vary spatially depending on flow routes, velocities, flood depths and proximity to the breach or overtopping location. In the event that the Exception Test needs to be applied to specific site allocations, the scope of the SFRA should be extended to a Level 2 assessment to refine information on the flood hazard in these locations.

All culverts and defences are mapped in Volume 2, Plan A1. These should be referenced by those proposing development to identify the possibility of localised residual risks as well as opportunities for de-culverting and restoring the natural channel.

6.4 Storage Areas

There are a number of flood attenuation areas within the District which are shown on the District Council's floodplain maps. A digital GIS layer of this information was not available for incorporation into this study. The District Council commented that a study has been undertaken on attenuation areas and defences within the District which provides details of standard of protection of defences and storage area volumes. This information should be considered as part of any FRA undertaken.

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[2] Areas that benefit from the flood defences in the event of a river flood with a 1 per cent (1 in 100) chance of happening each year, or a flood from the sea with a 0.5 per cent (1 in 200) chance of happening each year

It is imperative that any natural storage areas used as a means of attenuation of flood waters should be maintained to ensure their efficient operation during a flood event. If the storage areas are not maintained this may lead to an increased risk of flooding at locations downstream of the storage areas.

6.5 Existing Flood Warning System

The Environment Agency is the lead organisation on flood warning and its key responsibilities include direct remedial action to prevent and mitigate the effects of an incident, to provide specialist advice, to give warnings to those likely to be affected, to monitor the effects of an incident and to investigate its causes. This requires the Agency, local authorities and the emergency services to work together to protect people and properties. Warwick falls within the Central area of the Midlands Region of the Environment Agency. Prior to the Environment Agency's boundary re-organisation of the Midlands Region which occurred in April 2007, most of Warwick fell in Upper Trent Area, with a small proportion to the west of the District falling in Upper Severn Area.

When conditions suggest that floods are likely, it is the responsibility of the Environment Agency to issue flood warnings to the Police, Fire and Rescue Service, to the relevant local authorities, to the public and to the flood wardens. It is the responsibility of individuals in the community to receive flood warnings via the Floodline Warnings Direct (FWD) service which passes messages over the telephone network.

A flood warning system is in operation for the Main Rivers within the Warwick District and is outlined below in three stages.

- **Flood Alert**: Flooding is possible. Be prepared. The Flood Alert warning is activated two hours to two days in advance of flooding. The following actions are recommended:
    - Be prepared to act on your flood plan.
    - Prepare a flood kit of essential items.
    - Monitor local water levels and the flood forecast on our website.

There are five Flood Alert Areas with the Warwick District associated with the:

- River Arrow and River Alne
- River Blyth in Warwickshire
- River Sowe, River Sherbourne and Canley Brook
- Middle Avon Rugby to Bidford
- River Leam and River Itchen

Flood Alerts are issued for expected flooding, which could occur anywhere within the Flood Alert Area but with low or minor impact. The trigger for Flood Alert is a forecast that flooding of low impact land is expected.

- **Flood Warning**: Flooding is expected. Immediate action required. The Flood Warning warning is activated half an hour to one day in advance of flooding. The following actions, in addition to those associated with Flood Warning, are recommended:
    - Move family, pets and valuables to a safe place.
    - Turn off gas, electricity and water supplies if safe to do so.
    - Put flood protection equipment in place.

The Flood Warning service is currently set up to warn properties within the 1% Annual Exceedance Probability (1 in 100 year event) and the 0.1% Annual Exceedance Probability (1 in 1000 year event). The following locations are currently covered by the Environment Agency Flood Warning System:

- River Sowe at Baginton
- River Leam at Eathorpe, Huningham and Offchurch
- River Leam at Leamington (A – D)
- River Avon at Barford, Hampton Lucy, Alveston and Tiddington
- River Avon at Bubbenhall
- River Avon at Guys Cliffe and Emscote
- River Avon at Ashow and Blackdown
- River Avon at Warwick

- **Severe Flood Warning:** Severe flooding. Danger to life. This warning is used when flooding poses a significant threat to life. The following actions, in addition to those associated with Flood Warning, are recommended.
    - Stay in a safe place with a means of escape.
    - Be ready should you need to evacuate from your home.
    - Co-operate with the emergency services.
    - Call 999 if you are in immediate danger.

When the above warnings are no longer in force for specific areas no further flooding is currently expected in that area. It is used when river or sea conditions begin to return to normal. The following actions are recommended.

- Be careful. Flood water may still be around for several days.
- If you've been flooded, ring your insurance company as soon as possible.

6.6 Flood Response Plan

Emergency Planning is the term for the Council's response to major and intermediate incidents. In responding to major and intermediate incidents, Warwick District Council will work with the Emergency Services (Police, Fire and Rescue and Ambulance), the County Council Emergency Planning Unit and other organisations as appropriate. In the event of an emergency, Warwick District Council has an emergency plan, which details how the Council will respond to an emergency. Emergency Planning staff for the District are fully trained and are able to respond promptly and effectively to a major incident.

Warwick District has been affected by a number of major incidents, including significant flooding of the River Leam Corridor (1998), the fuel protests (2000) and Foot and Mouth crisis (2001). Each of these events has allowed the emergency plan to be tried and tested.

The response to major incidents is normally co-ordinated by the Police, although individual agencies are responsible for their own operations. In Warwick District, these operate at different levels from county-wide strategic co-ordination down to tactical and operational command. The District Council may also set up special contract arrangements such as telephone help lines. These will be widely publicised through local press, radio and TV at the time. Other incidents of a localised nature are normally dealt with by direct liaison between the appropriate services - road accidents, spillages, house fires causing temporary homelessness, etc.

The Council's role in a major incident is to support the emergency services and then to help return life to normal as soon as possible. To achieve this, the Council will:

- Respond to requests from the emergency services to assist in response to major incidents.
- Co-ordinate the response with Warwickshire County Council, other local authorities, town and parish councils and the voluntary sector.
- Mobilise its staff to carry out tasks requested by the emergency services. Depending on the scale and type of incident, this may include:
    - establishing an Emergency Control Centre to co-ordinate the Council's response
    - setting up Rest Centres to provide shelter, food and information to people evacuated from the vicinity of a major incident
    - providing advice on the temporary re-housing of people who are unable to return to their homes

    - specialist advice to the public on matters such as public health and structural stability of buildings
    - providing information to the public and the media
    - supplying sandbags in flooding incidents which are life threatening
    - assisting in cleaning up the area affected by a major incident
- As far as possible, keep the everyday council services running despite diversions of staff and other resources to handling of the incident.
- Take a leading role in helping the community to recover and to return life to normal.

The Council has a mutual aid protocol with other local authorities across Warwickshire to assist one another in responding to a major incident. This allows the Council to 'borrow' staff and equipment from other authorities, particularly if faced with a prolonged emergency.

It is generally agreed that the greatest risk to the area of Warwick District is the fluvial flooding of the Rivers Leam and Avon and their tributaries. Warwick District Council works in partnership with local Town and Parish Councils, Warwickshire County Council, the Environment Agency, Emergency Services, neighbouring Local Authorities and Local Volunteers to ensure that the Council is as collectively prepared as possible. The Environment Agency is the agency tasked with keeping communities informed of the risks of flooding, as described in **Section 6.5**.

It is recommended that the Council's Emergency Response Plan is reviewed and updated in 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 further recommended that the Local Authorities work with the Environment Agency to promote the awareness of flood risk to maximise the number of people signed up to the FWD service (previously this has involved targeted mail shots to those identified as living within Flood Zone 3a). Within the study area particular attention should be given to vulnerable people including those with impaired hearing or sight and those with restricted mobility.

With respect to new developments, those proposing the development should take advice from the LPAs emergency planning officer and for large-scale developments, the emergency services, when producing an evacuation plan as part of a FRA. As a minimum these plans should include information on:

How flood warning is to be provided:

- availability of existing warning systems
- rate of onset of flooding and available warning time

- method of dissemination of flood warning

What will be done to protect the infrastructure and contents:

- how more easily damaged items could be relocated
- the potential time taken to respond to a flood warning
- ensuring safe occupancy and access to and from the development
- occupant awareness of the potential frequency and duration of flood events
- provision of safe (i.e. dry) access to and from the development
- ability to maintain key services during an event
- vulnerability of occupants and whether rescue by emergency services may be necessary and feasible
- expected time taken to re-establish normal practices following a flood event

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7 Flood Risk Management Policy Considerations

7.1 Overview

This chapter provides recommendations for what should be included in the Council's policy for flood risk management as well as providing guidance to developers on the preparation of site-specific FRAs. Council policy is considered essential to ensure that the recommended development and flood risk conditions can be imposed consistently at the planning application stage.

The policy recommendations provided in this chapter are not exhaustive and it is therefore recommended that the Councils refer to the following key flood risk management documents in order to fully inform their own flood risk management policies:

- **Water Framework Directive (2000)** - European Community (EC) water legislation which requires all inland and coastal waters to reach good ecological status by 2015.
- **Making Space for Water (2005)** - outlines the Government's proposals for forward planning of flood management over the next 20 years advocating a holistic approach to achieve sustainable development. The protection of the functional floodplain is central to the strategy.
- **Flood Risk Regulations (2009)** – These regulations give local authorities a 'clear leadership role' in local flood risk management, ensuring that all sources of flooding is identified and managed as part of a locally agreed work programme. The regulations recognise the need to develop an integrated approach to urban drainage between various responsible bodies, including the planning authority, EA and sewerage undertakers.
- **Flood and Water Management Act (2010)** - This act shifts the emphasis from building defences to managing flood risk in line with Government statement "Making Space for Water".
- **Preliminary Flood Risk Assessment (2011)** – The PFRA presents the results of a high level screening exercise, identifying areas of significant flood risk.
- **River Trent and River Severn Catchment Flood Management Plans (2009 & 20120)** - Strategic planning documents through which the Environment Agency and other stakeholders identified and agreed policies for long-term flood risk management over the next 50 to 100 years. The Trent and Severn CFMPs have been completed policies are to be in line with those outlined in the CFMPs.

- **National Planning Policy Framework (2012)** – sets out national policy for development and flood risk and supports the Government's objectives for sustainable communities.

7.2 Policy Considerations

A key aim of an SFRA is to define flood risk management objectives and identify key policy considerations. It should be noted that it is ultimately the responsibility of the Council to formally formulate these policies and implement them.

It is recommended that the following flood risk objectives are taken into account during the policy making process and, where appropriate, used to strengthen or enhance the development and flood risk policies provided in **Section 7.3**.

Flood Risk Objective 1: To Seek Flood Risk Reduction through Spatial Planning and Site Design:

- Use the Sequential Test to locate new development in least risky areas, giving highest priority to Flood Zone 1.
- Use the Sequential Approach within development sites to inform site layout by locating the most vulnerable elements of a development in the lowest risk areas. For example, the use of low-lying ground in waterside areas for recreation, amenity and environmental purposes can provide an effective means of flood risk management as well as providing connected green spaces with consequent social and environmental benefits.
- Build resilience into a site's design (e.g. flood resistant or resilient design, raised floor levels).
- Identify long-term opportunities to remove development from the floodplain through land swapping.
- Ensure development is 'safe' for the lifetime of the development. For residential developments to be classed as 'safe', dry pedestrian egress out of the floodplain and emergency vehicular access should be possible. The Environment Agency states that dry pedestrian access/egress should be possible for the 1 in 100 year return period event plus climate change, and residual risk, i.e. the risks remaining after taking the sequential approach and taking mitigating actions, during the 1 in 1000 year event, should also be 'safe'.

Flood Risk Objective 2: To Reduce Surface Water Runoff from New Developments and Agricultural Land:

- SUDS required on all new development. As outlined in **Section 10.3** which outlines appropriate SUDS techniques for the District, infiltration systems should be the preferred means of surface water disposal, provided ground conditions are appropriate. Above ground attenuation, such as balancing ponds, should be considered in preference to below ground attenuation, due to the water quality and biodiversity benefits they offer.

- All sites require the following:

  - SUDS

  - Greenfield discharge rates with a minimum reduction of 20%, as required by the Environment Agency

  - 1 in 100 year on-site attenuation taking into account climate change

- Space should be specifically set aside for SUDS and used to inform the overall site layout.

- Promote environmental stewardship schemes to reduce water and soil runoff from agricultural land.

Flood Risk Objective 3: To Enhance and Restore the River Corridor:

- An assessment of the condition of existing assets (e.g. bridges, culverts, river walls) should be made. Refurbishment and/or renewal of the asset should ensure that the design life is commensurate with the design life of the development. Developer contributions should be sought for this purpose.

- Those proposing development should look for opportunities to undertake river restoration and enhancement as part of a development to make space for water. Enhancement opportunities should be sought when renewing assets (e.g. de-culverting, the use of bioengineered river walls, raising bridge soffits to take into account climate change).

- Avoid further culverting and building over of culverts. Where practical, all new developments with culverts running through their site should seek to de-culvert rivers for flood risk management and conservation benefit.

- Set development back from rivers, seeking a minimum 8m wide undeveloped buffer strip for development by all watercourses including those where the Flood Zone does not exist. This is an Environment Agency requirement.

Flood Risk Objective 4: To Protect and Promote Areas for Future Flood Alleviation Schemes:

- Protect Greenfield functional floodplain from future development (our greatest flood risk management asset) and reinstate areas of functional floodplain which have been developed (e.g. reduce building footprints or relocate to lower flood risk zones).
- Develop appropriate flood risk management policies for the Brownfield functional floodplain, focusing on risk reduction.
- Identify sites where developer contributions could be used to fund future flood risk management schemes or can reduce risk for surrounding areas.
- Seek opportunities to make space for water to accommodate climate change.

Flood Risk Objective 5: To Improve Flood Awareness and Emergency Planning:

- Seek to improve the emergency planning process using the outputs from the SFRA.
- Encourage all those within Flood Zone 3a and 3b (residential and commercial occupiers) to sign-up to Flood Warnings Direct service operated by the Environment Agency.
- Ensure robust emergency (evacuation) plans are implemented for new developments greater than 1 hectare (ha) in size.

7.3 Development and Flood Risk Policies

For the purposes of development management, detailed policies will need to be set out to ensure that flood risk is taken account of appropriately for both allocated and non-allocated 'windfall' sites. The following reflects the minimum requirements under the NPPF (reference should be made to Tables 1 - 3 in the NPPF Technical Guide).

Future Development within Flood Zone 1

In this zone, developers and local authorities should realise opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development. There is no significant flood risk constraint placed upon future developments within the Low Probability Flood Zone 1, although for sites larger than one hectare, the vulnerability from other sources of flooding should be considered as well as the effect of the new development on surface water runoff.

Typically, a Drainage Impact Assessment will be required to demonstrate that runoff from the site is reduced, thereby reducing surface water flood risk. This will involve the use of SUDS techniques which should take into account the local geological and groundwater conditions. For all sites, the post development runoff volumes and peak flow rates should be attenuated to the Greenfield discharge rates with a minimum reduction of 20%, as required by the Environment Agency.

Future Development within Flood Zone 2

Land use within Medium Probability Flood Zone 2 should be restricted to the 'water compatible', 'less vulnerable' and 'more vulnerable' category. Where other planning pressures dictate that 'highly vulnerable' land uses should proceed, it will be necessary to ensure that the requirements of the Exception Test are satisfied. The following should be considered:

- A detailed site-specific FRA should be prepared in accordance with the NPPF and Council planning policies.
- Floor levels should be situated above the 100 year plus climate change predicted maximum level plus a minimum freeboard of 600mm.
- The development should be safe, meaning that dry pedestrian access to and from the development should be possible above the 1 in 100 year plus climate change flood level and emergency vehicular access should be possible during times of flood.
- SUDS should be implemented to ensure that runoff from the site (post development) is reduced. For all sites, the post development runoff volumes and peak flow rates should be attenuated to the Greenfield discharge rates with a minimum reduction of 20%, as required by the Environment Agency, for both Greenfield and Brownfield sites. Space should be set-aside for SUDS.
- The proposed development should be set-back from the watercourse with a minimum 8m wide undeveloped buffer zone, to allow appropriate access for routine maintenance and emergency clearance. This is an Environment Agency requirement.

Future development within High Probability Flood Zone 3a

Land use within High Probability Flood Zone 3a should be restricted to the water compatible or 'less vulnerable' uses to satisfy the requirements of the Sequential Test. For 'more vulnerable' uses it is necessary to ensure that the requirements of the Exception Test are satisfied. The following should be considered:

A detailed site-specific FRA should be prepared in accordance with the NPPF and Council planning policies. Properties situated within close proximity to formal defences or water retaining structures (reservoirs/canals) will require a detailed breach and overtopping assessment to ensure that the potential risk to life can be safely managed throughout the lifetime of the development. The nature of any breach failure analysis should be agreed with the Environment Agency.

- The development should not increase flood risk elsewhere, and opportunities should be taken to decrease overall flood risk (such as use of SUDS and de-culverting). This can be achieved by developing land sequentially via the Sequential Approach, with areas at risk of flooding favoured for green space.

- Floor levels should be situated above the 1% (100 year) plus climate change predicted maximum level plus a minimum freeboard of 600mm. Within defended areas the maximum water level should be assessed from a breach analysis.

- The development should allow dry pedestrian access to and from the development above the 1 in 100 year plus climate change flood level and emergency vehicular access should be possible during times of flood. An evacuation plan should be prepared. With respect to new developments, those proposing the development should take advice from the LPAs emergency planning officer and for large-scale developments, the emergency services, when producing an evacuation plan as part of a FRA. All access requirements should be discussed and agreed with the Environment Agency.

- Basements should not be used for habitable purposes. Where basements are permitted for commercial use, it is necessary to ensure that the basement access points are situated 600mm above the 1 in 100 year flood level plus climate change.

- SUDS should be implemented to ensure that runoff from the site (post development) is reduced. For all sites, the post development runoff volumes and peak flow rates should be attenuated to the Greenfield discharge rates with a minimum reduction of 20%, as required by the Environment Agency, for both Greenfield and Brownfield sites. Space should be set aside for SUDS.

- The proposed development should be set-back from the watercourse with a minimum 8m wide undeveloped buffer zone, to allow appropriate access for routine maintenance and emergency clearance.

Future development within Functional Floodplain Zone 3b

Development should be restricted to 'water-compatible uses' and 'essential infrastructure' that has to be there. Table 2 from the NPPF (reproduced in **Figure 2**, **Section 1.5.1** of this report) outlines the types of development included within this classification. It should be noted that 'essential infrastructure' includes essential transport infrastructure (including mass evacuation routes) which may have to cross the area at risk as well as strategic utility infrastructure such as electricity generating power station and grid and primary substations. Reference should be made to Table 2 of the NPPF when considering development within Flood Zone 3b to ensure only appropriate development is considered. 'Essential infrastructure' in this zone must pass the Exception Test and be designed and constructed to remain operational in times of flood and not impede water flow.

7.4 Council Specific Policy Issues

It is recommended that the aforementioned policy considerations are included in the Council's policies. It is also recommended that the Severn and Trent CFMP flood risk management policies are reviewed and incorporated.

7.5 Sensitive Development Locations

Assuming that future site allocations and windfall sites are guided by the NPPF and the recommendations provided in this report, there are a number of locations in which development would significantly increase flood risk elsewhere.

Cubbington has experienced flooding from a number of sources including fluvial flooding, surface water and artificial drainage. The drainage systems in the area (public, private, highway or land drainage) were not designed to cope with the exceptional conditions and as a result widespread flooding occurred, with the worst locations affected being in the bowl of New Street and Knightly Close and the valley bounded by Ladycroft, Price Road, Offchurch Road. In addition overtopping of the Pingle Brook flood alleviation scheme has occurred in recent events and much of the existing drainage infrastructure is thought to be of insufficient capacity to cope with such a large volume of water. It is therefore recommended that future development is avoided.

In general, throughout the study area, any development (including developments in Low Probability Flood Zone 1) which does not incorporate SUDS may increase the risk of surface and/or fluvial flooding both on-site and off-site (downstream). As such effective planning policies should be implemented in accordance with the SUDS recommendations provided in this report.

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8 Guidance on the Application of the Sequential Test

This section provides guidance on how to apply the Sequential Test.

8.1 Step One: Strategic Overview of flood risk across all potential development areas

The recommended initial step is to determine the extents of potential land allocations on large scale maps showing the most up-to-date Flood Zones, in accordance with the NPPF. Summary tables of flood risk issues should then be prepared for each location, indicating if the potential areas overlap Zones 2, 3, localised flooding areas or if there are records of previous flood incidents shown in the maps. It is then recommended that the summary tables and proposed locations are sent to the Environment Agency for verification. Particular care should be taken by identifying allocations that could increase flood risk elsewhere (flood incident points, localised flooding areas, Flood Zones) and lack of dry access.

8.2 Step Two: Flood Risk Issues in Zone 1

The next step should be to analyse all potential sites within Zone 1 by identifying those that have any flood risk issues (for example those affected by other sources of flooding or those that do not have dry access routes during flood events).

For the sites with flood risk issues, an assessment of likely significance of flood risk should then be carried out in terms of likely probability of flooding and potential consequences/flood damages (advice from a drainage specialist may be required, such as the SFRA consultant, the Environment Agency, a highways drainage engineer and/or the planning authority drainage specialist). The purpose is to identify sites with significant flood risk - high probability of flooding and significant flood damages with deep flooding and high velocities which could result in loss of property and potentially loss of life.

If a site with significant flood risk from non fluvial sources is identified within Zone 1, this would be considered as if it was in the High Probability Zone 3a, for further application of the Sequential Test in Zone 3a (see **Section 8.3**), bearing in mind that if a more vulnerable land use is required for the site, it will have to pass the Exception Test.

For those sites within localised flooding areas or with flood incident records where flood risk issues are not significant (for example shallow flooding and non-frequent blockages etc) development should still be acceptable provided that adequate measures are put into place for mitigating the risk (for example contributions may be required from the developer for the upgrade of the surface water system in the area).

It is important to note that most potential sites that pass the Sequential Test in Zone 1 will still require site-specific FRAs. For development proposals on sites comprising 1ha or greater, the vulnerability to flooding from other sources (as well as from fluvial flooding) and the potential to increase flood risk elsewhere through the addition of hard/impermeable surfaces and the effect of the new development on surface water runoff, should be incorporated in an FRA. This need only be brief unless the factors above or other local considerations require particular attention. It is recommended that site-specific FRAs are still produced for Zone 1 sites of less than 1ha at locations where there are records of previous flood incidents.

8.3 Step Three: Sequential Test in Zones 2 and 3

The third step is to sequentially allocate sites as described in **Sections 1.5.1** and **3.3.1** and as part of a SA. It is recommended that prior to incorporating the Sequential Test within the SA, the following actions take place:

a) Apply the measure of avoidance/prevention by moving the boundaries of the potential sites away from Zones 2, 3a and 3b, for those cases where the loss of site area is acceptable.

b) Provisionally adopting land uses that are fully compatible with the vulnerability classification of the NPPF, to try to avoid the need to apply the Exception Test where possible.

8.4 Flood Risk to Current Potential Allocation Sites

The current potential allocation sites provided by WDC have been assessed in terms of flood risk with the findings set out in **Table 7**. The table only considers flood risk issues and does not consider wider spatial planning and environmental issues.

Advancement of these potential allocation sites or any future potential allocation sites should also consider future road and rail development such as the national HS2 rail proposals in relation to impact on natural drainage catchments, flood risk and surface water management.

Table 7: Flood Risk to Current Potential Allocation Sites

	ID Code	Location	Flood Zones	Flooding from Land	Flooding from Groundwater	Flooding from Artificial Sources
1	K100 (inc 2G)	Land at Thickthorn, between Kenilworth and A46	FZ1	Low – a few small areas indicated as being 'less' susceptible to surface water flooding. The site specific FRA will need to carefully consider surface water drainage management due to high flood risk areas downstream.	Low to Medium – The local risk of groundwater should be considered further during a FRA.	Low
2	10	Land at King's Hill, south of Green Lane, Finham	Mainly FZ1, some FZ2 and 3 between A46 and King's Hill Lane associated with Finham Brook (Main River)	Low to Medium – a few small areas indicated as being 'less' and 'more' susceptible to surface water flooding.	Low – The local risk of groundwater should be considered further during a FRA.	Low
3	1E/W100	Land west of Europa Way, Warwick	FZ1, site is cut by a watercourse that is main river to the north west corner of the site	Low to Medium – a few small areas indicated as being 'less' and 'more' susceptible to surface water flooding.	Low – The local risk of groundwater should be considered further during a FRA.	Low
4	1A	Land at former Ford Foundary, Leamington Spa	FZ1, western boundary adjacent to FZ2	Low – a few small areas indicated as being 'less' susceptible to surface water flooding.	Low to Medium – The local risk of groundwater should be considered further during a FRA.	Low – Residual Risk. Partially potential reservoir risk from Draycote Water.

	ID Code	Location	Flood Zones	Flooding from Land	Flooding from Groundwater	Flooding from Artificial Sources
5	1B/L35	Land at Station Approach, Leamington Spa	FZ1	Low – a few small areas indicated as being 'less' susceptible to surface water flooding.	Low to Medium – The local risk of groundwater should be considered further during a FRA.	Low – Residual Risk. Partially potential reservoir risk from Draycote Water.
6	3H/L36	Warwickshire College, Warwick New Road, Leamington Spa	Mainly FZ1 with southern boundary in FZ2 and FZ3	Low – a few small areas indicated as being 'less' susceptible to surface water flooding.	Low – The local risk of groundwater should be considered further during a FRA.	Low – Residual Risk. Partially potential reservoir risk from Draycote Water, Naseby, Willes Meadow, Stanford reservoirs.
7	1C/L39	Land at South Sydenham and East of Whitnash	Mainly FZ1 with eastern boundary in FZ2 and FZ3	Low – a few small areas indicated as being 'less' susceptible to surface water flooding.	Low to Medium – The local risk of groundwater should be considered further during a FRA.	Low – Residual Risk. Partially potential reservoir risk from Draycote Water.
8	1D/L14	Land at Lower Heathcote Farm, South of Harbury Lane.	FZ1	Low to Medium – a few small areas indicated as being 'less' and 'more' susceptible to surface water flooding.	Low to Medium – The local risk of groundwater should be considered further during a FRA.	Low

	ID Code	Location	Flood Zones	Flooding from Land	Flooding from Groundwater	Flooding from Artificial Sources
9	1F	Land at Lower Heathcote Farm, South of Harbury Lane	Mainly FZ1 with southern boundary in FZ2 and FZ3	Low to Medium – a few small areas indicated as being 'less' and 'more' susceptible to surface water flooding.	Low to Medium – The local risk of groundwater should be considered further during a FRA.	Low
10	2F	Land at Lower Heathcote Farm, South of Harbury Lane	Mainly FZ1 with southern boundary in FZ2 and FZ3	Low to Medium – a few small areas indicated as being 'less' and 'more' susceptible to surface water flooding.	Low to Medium – The local risk of groundwater should be considered further during a FRA.	Low
11	3F	Land at Lower Heathcote Farm, South of Harbury Lane	Mainly FZ1 with southern boundary in FZ2 and FZ3	Low to Medium – a few small areas indicated as being 'less' and 'more' susceptible to surface water flooding.	Low to Medium – The local risk of groundwater should be considered further during a FRA.	Low
12	L99 (inc 1F, 2F and 3F)	South of Harbury Lane without phasing	Mainly FZ1 with southern boundary in FZ2 and FZ3	Low to Medium – a few small areas indicated as being 'less' and 'more' susceptible to surface water flooding.	Low to Medium – The local risk of groundwater should be considered further during a FRA.	Low
13	L48	Land at Blackdown	FZ1	Low – a few small areas indicated as being 'less' susceptible to surface water flooding.	Medium – The local risk of groundwater should be considered further during a FRA. A detailed study may be required.	Low

	ID Code	Location	Flood Zones	Flooding from Land	Flooding from Groundwater	Flooding from Artificial Sources
14	L11	Fieldgate Lane	FZ1	Medium – some areas indicated as being 'more' susceptible to surface water flooding.	Medium – The local risk of groundwater should be considered further during a FRA. A detailed study may be required.	Low
15	W20	Warwick Gates employment land	FZ1	Low to Medium – a few small areas indicated as being 'less' and 'more' susceptible to surface water flooding.	Low to Medium – The local risk of groundwater should be considered further during a FRA.	Low
16	W18	Land at Montague Road	FZ1	High – Surface water management from development and opportunities to improve the situation should be considered during the FRA.	Medium – The local risk of groundwater should be considered further during a FRA. A detailed study may be required.	Low
17	L45	Leamington Spa Fire and Rescue HQ	FZ1	Low to Medium – a few small areas indicated as being 'less' and 'more' susceptible to surface water flooding.	Low to Medium – The local risk of groundwater should be considered further during a FRA.	Low
18	L23	Land at Red House Farm, Campion Hills	FZ1	Low to Medium – a few small areas indicated as being 'less' and 'more' susceptible to surface water flooding.	Medium – The local risk of groundwater should be considered further during a FRA. A detailed study may be required.	Low

	ID Code	Location	Flood Zones	Flooding from Land	Flooding from Groundwater	Flooding from Artificial Sources
19	W104	Loes Farm, Guy's Cliffe, Warwick	FZ1	Low to Medium – a few small areas indicated as being 'less' and 'more' susceptible to surface water flooding.	Low to Medium – The local risk of groundwater should be considered further during a FRA.	Low
20	L37	Riverside House, Milverton Hill	FZ1, FZ2 and FZ3	High – Surface water management from development and opportunities to improve the situation should be considered during the FRA.	Low to Medium – The local risk of groundwater should be considered further during a FRA.	Low – Residual Risk. Partially potential reservoir risk from Draycote Water
21	W102	South of Gallows Hill and North of Asps Farm	Mainly FZ1 with southern boundary in FZ2 and FZ3	Low to Medium – a few small areas indicated as being 'less' and 'more' susceptible to surface water flooding.	Low – The local risk of groundwater should be considered further during a FRA	Low
22	L54	North of Milverton	Mainly FZ1 with very minor extend of FZ2 in northern site area	Low to Medium – a few small areas indicated as being 'less' and 'more' susceptible to surface water flooding.	Medium – The local risk of groundwater should be considered further during a FRA.	Low
23	K09	Jersey Farm, Glasshouse Lane	FZ1	Low – a few small areas indicated as being 'less' susceptible to surface water flooding.	Low to Medium – The local risk of groundwater should be considered further during a FRA.	Low

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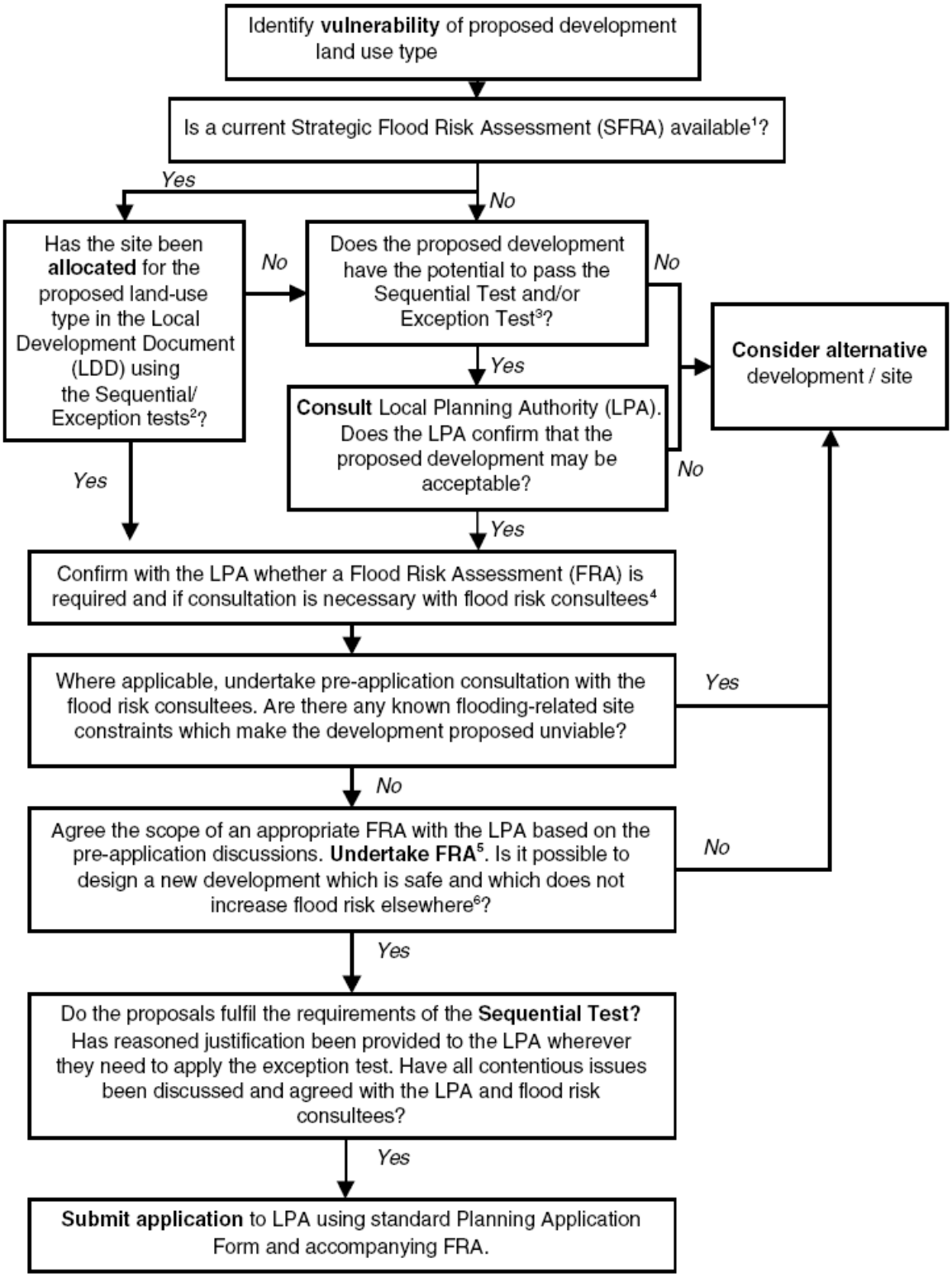
9 Guidance for Developers

9.1 Guidance Overview

A SFRA is a strategic document that provides an overview of flood risk throughout the study area. Site-specific FRAs will be required for most proposed developments and the level of detail will depend on the level of flood risk at the site (see general details about FRA requirements in the NPPF Technical Guide and Appendix B of the PPS25 Practice Guide). The onus is on the developer to provide this information in support of a planning application.

Since the release of PPS25 in December 2006, should a local planning authority wish to disregard the advice of the Environment Agency and approve an application for major development where the Environment Agency have objected on flood risk grounds then the planning application may be referred to the Secretary of State who will determine whether to call in the application. It is therefore imperative that developers hold discussions over the need for FRAs early on within the planning process. Consultation should be undertaken with the Environment Agency and the relevant Council to ensure that the Council's policies and guidance on flood risk management are respected and taken account of, and that the scope of the FRA is commensurate with the level of flood risk. The following reflects best practice on what should be addressed within a detailed FRA. Those proposing development should also be directed towards the NPPF requirement for the application of SUDS and Section 5 of the PPS25 Practice Guide on surface water management. **Figure 11** overleaf shows the PPS25 Practice Guide recommended process of undertaking an FRA as part of an individual planning application.



Notes

1 A SFRA can be defined as current if it has been prepared in accordance with PPS25.
2 If the site has been allocated in this way then subsequent steps in the process are likely to be significantly more straightforward.
3 If a site has not been allocated in the LDD because it was considered that the flood risk is unacceptable, it is unlikely that a proposed development at the site will be accepted by the LPA.
4 See paragraphs 2.49-2.60 of this Practice Guide for key consultees to the planning process with regard to flood risk.
5 Guidance on undertaking a FRA can be found in chapter 3.
6 Including surface water management.

Figure 11: Guidance for Developers for Individual Planning Applications

9.1.1 Proposed Developments within Functional Floodplain Flood Zone 3b

In line with the NPPF, development will not normally be allowed in the Functional Floodplain unless it is classified as a 'water compatible' or 'essential infrastructure' use.

9.1.2 Proposed Developments within High Probability Flood Zone 3a

All FRAs supporting proposed development within High Probability Zone 3a should assess the proposed development against all elements of the Council's flood policy, and include an assessment of the following:

- The vulnerability of the development to flooding from other sources (e.g. surface water drainage, groundwater) as well as from fluvial flooding. This will involve discussion with the Council and the Environment Agency to confirm whether a localised risk of flooding exists at the proposed site.
- The vulnerability of the development to flooding over the lifetime of the development (including the potential impacts of climate change), i.e. maximum water levels, flow paths and flood extents within the property and surrounding area. The Environment Agency may have carried out detailed flood risk mapping within localised areas that could be used to underpin this assessment. Where available, this will be provided at a cost to the developer. Where detailed modelling is not available, hydraulic modelling by suitably qualified engineers will be required to determine the risk of flooding to the site.
- The potential of the development to increase flood risk elsewhere through the addition of hard/impermeable surfaces, the effect of the new development on surface water runoff, and the effect of the new development on depth and speed of flooding to adjacent and surrounding property. This will require a detailed assessment to be carried out by a suitably qualified engineer.
- The localised risk of flooding that may occur. This is typically associated with local catchment runoff following intense rainfall passing directly over the council's area.
- A demonstration that residual risks of flooding (after existing and proposed flood management and mitigation measures are taken into account) are acceptable. Measures may include flood defences, flood resistant and resilient design, escape/evacuation, effective flood warning and emergency planning.
- Details of existing site levels, proposed site levels and proposed ground floor levels. All levels should be stated relevant to Ordnance Datum.

It is essential that developers thoroughly review the existing and future structural integrity of informal defences, if present, upon which the development will rely (i.e. over the lifetime of the development), and ensure that emergency planning measures are in place to minimise risk to life in the unlikely event of a defence failure. This would be particularly important for development that could potentially be affected as a result of a breach of any canals in the study area.

9.1.3 Proposed Development within Medium Probability Zone 2

For all sites within Medium Probability Zone 2, a scoping level FRA should be prepared based upon readily available existing flooding information, sourced from the Environment Agency. If a significant flood risk from other sources (e.g. groundwater or sewer flooding) is identified then a more detailed FRA should be prepared. It will be necessary to demonstrate that the residual risk of flooding to the property is effectively managed throughout, for example, the provision of raised floor levels and the provision of planned evacuation routes or safe havens.

9.1.4 Proposed Development within Flood Zones 1 and 2

The risk of alternative sources of flooding (e.g. surface water, sewage, and/or groundwater) must be considered, and surface water management including the use of SUDS must be employed to ensure no new or increase in existing flooding problems occur either on site or off site elsewhere within the area.

The SFRA provides specific recommendations with respect to the provision of sustainable flood risk mitigation opportunities that will address both the risk to life and the residual risk of flooding to development within particular 'zones' of the area. These recommendations should form the basis for the site-based FRA.

Additionally, the site based FRA should also consider future road and rail development such as the national HS2 rail proposals in relation to impact on natural drainage catchments, flood risk and surface water management.

9.2 Raised Floor Levels and Basements (Freeboard)

The raising of floor levels above the 1 in 100 year peak flood level will ensure that the damage to property is minimised. Given the anticipated increase in flood levels due to climate change, the adopted floor level should be raised above the 1% probability flood level assuming a 20% increase in peak river flows over the next 100 years.

It is highlighted that many of those areas currently situated within Medium Probability Zone 2 could become part of the High Probability Zone 3 due to climate change. This is important as it means that properties that are today at relatively medium risk will, in 20 to 100 years, be within High Probability Zone 3a. It is imperative therefore that planning decisions take due consideration of the potential risk of flooding in future years.

Floor levels should be situated a minimum of 600mm above the 1% probability peak flood level plus climate change flood level (+20% flows), determined as an outcome of the site based FRA. Additional freeboard may be required because of the risk of blockages to the channel, culvert or bridge. The height that the floor level is raised above the flood level is referred to as the 'freeboard', and is determined as a measure of residual risks.

The use of basements within flood affected areas should be discouraged. Where basements are permitted however, it is necessary to ensure that the basement access points are situated a minimum of 600mm above the 1% probability flood level plus climate change. The basement must have unimpeded access and waterproof construction to avoid seepage during flooding conditions. Habitable uses of basements within Flood Zone 3 should not be permitted, while basement dwellings can be allowed in Flood Zone 2 provided they pass the Exception Test. Additionally, climate change should be considered when ascertaining safety as there is potential that over the lifetime of the development climate change could increase risk and move the current flood zone from Flood Zone 2 to Flood Zone 3.

9.2.1 Development Behind Formal Flood Defences

Areas behind formal defences are at particular risk due to breach or overtopping, resulting in the rapid on-set of fast-flowing, deep water flooding with little or no warning. Risks will therefore be highest closest to these defences and as such it is recommended that the LPAs should set back developments and ensure that those proposing developments develop robust evacuation plans as part of their FRA in consultation with the Environment Agency.

Consideration of flood risk behind defences should be made as part of detailed FRAs. Developers should review Volume 2, Plan A1 to determine the location of structures and defences in proximity to the site and therefore identify the possibility of localised residual flood risk. The FRA should take into account the:

- potential mechanisms of failure of flood defence infrastructure
- standard of protection and design freeboard
- asset condition of the flood defence
- height of the flood defence infrastructure and retained water levels compared to ground levels
- potential location, width and invert level of breach(es) in the flood defences
- duration of water levels during a flood event
- period it would take the operating authority to close the breach
- period it would take for water to drain from the flooded area following a breach or overtopping event

In addition, where new development is proposed in a defended flood area, the potential cumulative impact of loss of storage on flood risk elsewhere in the event of breach of the defence should be considered.

9.2.2 Car Parks

Car parking may be appropriate in areas subject to shallow, low velocity flooding (in High Probability Zone 3a) provided sufficient flood warning is available, and appropriately located and worded signs are in place. However, this would need to be discussed and agreed with the LPA and Environment Agency. As part of a FRA, the developer should consider the likelihood of people being able to move their cars within the flood warning time.

9.3 Developer Contributions

If new developments are placed within Flood Zones 2 or 3, it might be necessary for local infrastructure to be increased. With regards to flood risk, it might also be necessary to extend flood warning system coverage, or increase the maintenance of flood defences. Where this is the case, the LPA should consider whether to secure this local infrastructure by planning condition or a financial contribution under a planning obligation to cover any direct added costs.

10 Guidance for the Application of Sustainable Drainage Systems

10.1 Introduction

The NPPF requires that LPAs should promote SUDS. LPAs should therefore include policies within their LDF to encourage sustainable drainage practices. SUDS is the term used to describe the various approaches that can be used to manage surface water drainage in a way that mimics the natural environment. The management of rainfall (surface water) is considered an essential element of reducing future flood risk to both the site and the off site surroundings. Indeed, reducing the rate of discharge from urban sites to Greenfield runoff rates is one of the most effective ways of reducing and managing flood risk within the Warwick District.

10.2 Types of SUDS

SUDS may improve the sustainable management of water for a site by:

- reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream
- reducing volumes of water flowing directly to watercourses or sewers from developed sites
- improving water quality compared with conventional surface water sewers by removing pollutants from diffuse pollutant sources
- reducing potable water demand through rainwater harvesting
- improving amenity through the provision of green space and wildlife habitat
- replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained

Any reduction in the amount of water that originates from any given site may be relatively minor however if applied across the catchment, the cumulative affect from a number sites could be significant.

There are numerous different ways that SUDS can be incorporated into a development. The appropriate application of a SUDS scheme to a specific development is heavily dependent upon the topography and geology of the site and the surrounding areas. Careful consideration of the site characteristics is necessary to ensure the future sustainability of the adopted drainage system. When designing surface water drainage systems, the Environment Agency states that climate change should be taken into account appropriate to the predicted lifetime of the development, and designed to account for the predicted increases in rainfall intensity, as outlined in **Figure 9**, **Section 5.2**.

The most commonly utilised components of SUDS are described below:

- Pervious surfaces: Surfaces that allow inflow of rainwater into the underlying construction or soil.
- Filter drains: Linear drains consisting of trenches filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage, to store and conduct water; they may also permit infiltration.
- Filter strips: Vegetated areas of gently sloping ground designed to drain water evenly off impermeable areas and to filter out silt and other particulates.
- Swales: Shallow vegetated channels that conduct and retain water, and may also permit infiltration; the vegetation filters particulate matter.
- Basins: Ponds at surface level that may be utilised for surface runoff storage.
- Infiltration devices: Sub-surface structures to promote the infiltration of surface water to ground. They can be trenches, basins or soakaways.
- Bioretention wetland areas: Vegetated areas designed to collect and treat water before discharge via a piped system or infiltration to the ground.
- Pipes and accessories: A series of conduits and their accessories normally laid underground, that convey surface water to a suitable location for treatment and/or disposal (although sustainable, these techniques should be considered where other SUDS techniques are not practicable).
- Green roofs: Vegetated roofs that reduce the volume and rate of runoff and remove pollution. They comprise a multi-layered system that covers the roof of a building or podium structure with vegetation cover/ landscaping/ permeable car parking, over a drainage layer. They are designed to intercept and retain precipitation, reduce the volume of runoff and attenuate peak flow.

The Environment Agency requires both Greenfield and Brownfield sites to achieve Greenfield discharge rates with a minimum reduction of 20%, to account for the future effects that climate change will have on runoff volumes.

For more guidance on SUDS, the following documents and websites are recommended as a starting point:

- NPPF (2012)
- Planning for SUDS – making it happen CIRIA C687 (2010). This document provides reference for those not over familiar with SUDS and the planning and development process.
- Practice Guide Companion to PPS25 (2009)

- SUDS – A guide for developers – Environment Agency (2008) provides an overview of SUDS, the drivers and benefits.
- The SUDS Manual – CIRIA C697 (2007) provides the best practice guidance on the planning, design, construction, operation and maintenance of Sustainable Drainage Systems and facilitates their effective implementation within developments.
- Site handbook for the construction of SUDS – CIRIA C698 (2007) provides guidance on the construction of SUDS to facilitate their effective delivery.
- CIRIA C644 – Green Roofs (2007) provides guidance on the design, construction and operation of Green Roofs. The guidance also describes how 'quick wins' for biodiversity can be achieved in the built environment by incorporating nesting and roosting boxes for birds, bats and other animals.
- Sustainable Drainage Systems – Hydraulic, structural and water quality advice – CIRIA (2004) is a technical report that summarises current knowledge on the best approaches to deign and construction of SUDS.
- Interim Code of Practice for Sustainable Drainage Systems, National SUDS Working Group (2004).
- www.ciria.org/
- www.susdrain.org/

10.3 Application of SUDS for Warwick District Council

This area has a mixture of slowly permeable and freely draining, slightly acidic, loamy and clayey soil areas. The more permeable sites should have priority given to infiltration drainage techniques, as opposed to attenuation prior to discharging surface water to watercourses. Where less permeability is found and infiltration techniques that rely on discharge into the existing soils are less viable (also the case in areas of high water table, source protection zones, contamination etc), discharging attenuated site runoff to watercourses is preferable to the use of sewers. Integrated urban drainage should also be used throughout the design process.

The entire Warwick District has been highlighted by DEFRA as being in a surface water Nitrate Vulnerable Zone (NVZ) and the area to the north of Warwick and Leamington Spa as being in a groundwater NVZ. Additionally there are areas in the west and north classified as a Groundwater Source Protection Zone (SPZ) by the EA. Any boreholes, water wells or other extraction points should also be identified and taken into account in the SUDS design process.

NVZs are generally indicative of the agricultural nature of the surrounding land and the use of fertilisers. Nitrate levels in many English waters are increasing principally due to surface water runoff from agricultural land entering receiving water bodies. The level of nitrate contamination will have an impact on the choice of SUDS and will have to be assessed for specific sites.

The Groundwater SPZ is situated over the local aquifers and is designated as inner, outer and total catchment areas. The Inner Zones of the SPZ are the most sensitive areas and vary in diameter from 0.1 to 0.4 Kilometres. The Outer Zones are also sensitive to contamination and vary in diameter from 0.4 to 1.8 Kilometres. The SPZ requires attenuated storage of runoff to prevent infiltration and contamination.

Eight Groundwater SPZ Inner Zones have been identified by the EA in the Warwick District and they are situated in the following areas:

- North-west area: Shrewley, Little Shrewley and Haseley
- Northern area: Two in Kenilworth
- Western area: Hampton on the Hill
- Central area: Cubbington and Campion Hills

Runoff which is likely to be heavily contaminated must be treated by a treatment device, which should be carefully considered to ensure the correct system is selected to remove pollutants and source control SUDS must be considered and incorporated where suitable. For example; the drainage system for a car park should incorporate a filter bed wherever possible before considering an interceptor device to remove contaminants.

If the local soil is contaminated then a lined system is generally required. This may include a drainage design which allows infiltration in the upper layer, but should incorporate an impermeable layer at its base to prevent contamination to the underlying soils and geology. In such cases lined underground attenuation storage may be suitable to store a 1 in 100 year +20% (for climate change) storm event and discharges into a nearby watercourse.

11 Recommendations

A number of recommendations have been made throughout this report on the basis of the findings of the SFRA. These are summarised below.

11.1 Site Allocation Process

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

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

11.2 Council Policy

It is recommended that for the purpose of clarity, a Supplementary Planning Document should be developed in light of the suggested policies and guidance notes, outlining the minimum requirement of the Environment Agency in response to the NPPF.

It is recommended that the following core considerations should be included within the Councils' flood risk management policy documents:

- Protecting the functional floodplain from development.
- Directing vulnerable development away from flood affected areas.
- Ensuring all new development is 'Safe', meaning that dry pedestrian access to and from the development is possible without passing through the 1 in 100 year plus climate change floodplain, and emergency vehicular access is possible.
- Promoting the use of SUDS in all Flood Zones for both Brownfield and Greenfield sites, to achieve Greenfield discharge rates with a minimum reduction of 20%. Space should be set-aside for SUDS.
- Supporting flood alleviation measures under consideration by the Environment Agency by safeguarding possible sites for flood storage and other channel works.
- Funding considerations based on the 'New flood and coastal resilience partnership funding arrangements' that include developer contributions (to be determined in consultation with the Environment Agency) via S106 planning obligations to fund (or part fund) strategic flood risk management facilities and bring benefit to the wider community.

11.3 Emergency Planning

It is recommended that the Council's Emergency Response Plans are reviewed and updated in 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 further recommended that the Council works with the Environment Agency to promote the awareness of flood risk and encourage communities at risk to sign-up to the Environment Agency Flood Warning Direct service.

11.4 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 outputs from the following studies are used to update future versions of the SFRA report and associated maps:

- updates to the Severn and Trent CFMPs, PFRA and other documents
- future flood risk mapping studies
- future flood risk management strategies
- future changes in planning policy and requirements

11.4.1 Missing or Incomplete Data

Data gaps have been assessed throughout the Level 1 SFRA data collection and review exercise. This has flagged the missing or incomplete data, which should be incorporated into the SFRA as it becomes available. The following data has not yet been received or incorporated into the Level 1 SFRA. Receipt of this data will further refine the SFRA.

Table 8: Missing or Incomplete Data

Data	Description	Source
Flood outlines	20year return period (or similar) flood outlines for all rivers except the River Leam and River Itchen. These would allow production of Flood Zone 3b.	Environment Agency
Flood Alert Areas and Severe Flood Warning	Flood Alert and Severe Flood Warning Areas Polygons	Environment Agency
LiDAR	Data not available for the western area of the District	Environment Agency

LiDAR data is detailed ground elevation data, which is extremely useful for Level 2 SFRAs. Among other uses, it primarily facilitates the creation of hazard maps, a Level 2 requirement for development in Flood Zones 2 and 3. Warwick District Council has good coverage of LiDAR data, as shown by the green shaded area on the map below. This LiDAR data has been gathered from the Environment Agency as part of the data collection process, to assist in the production of the Level 2 SFRA if and when the need arises.

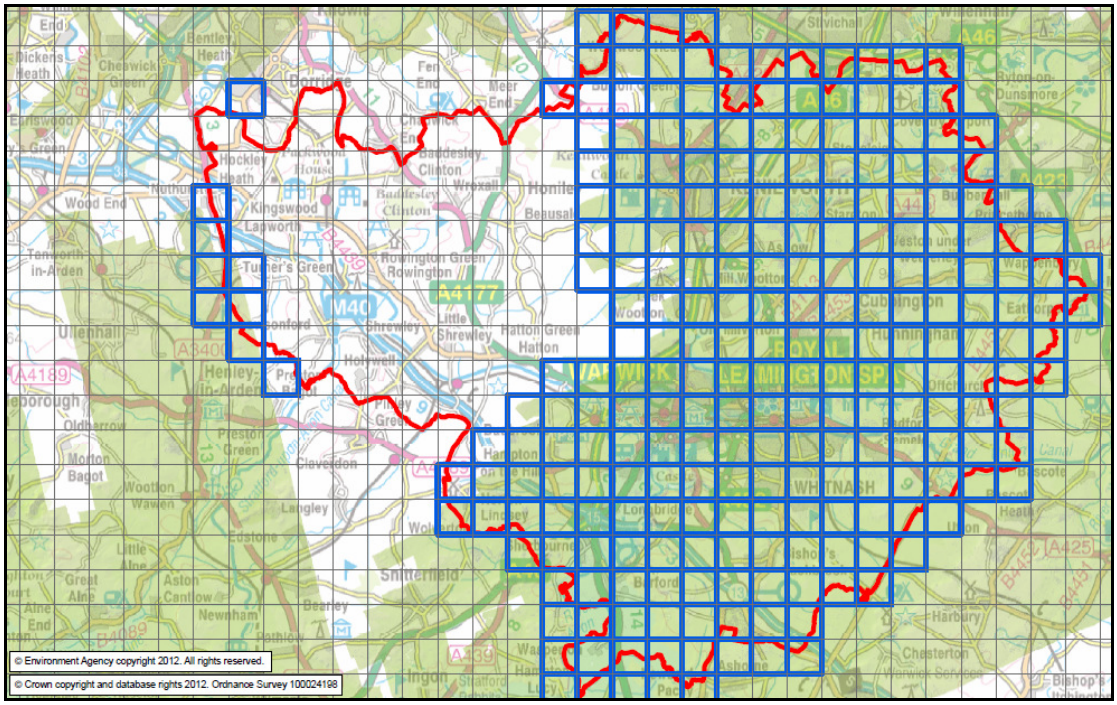


Figure 12: LiDAR Availability Extent

11.5 Level 2 SFRA

This Level 1 SFRA will allow Warwick District Council to assess their current proposed site allocations using the Sequential Test. This will act as a 'sieving' process, allocating as many sites as possible to Flood Zone 1. Where it is found that some sites can only be placed in Flood Zones 2 and 3, the Exception Test will need to be applied. In order for developments to go ahead in such areas a number of criteria should be satisfied:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. If the DPD has reached the 'submission' stage the benefits of the development should contribute to the SA.
- The development should be on developable, previously-developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously-developed land.
- A FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

A Level 2 SFRA should be viewed as rather 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 or 3.

The data required for a Level 2 SFRA within Warwick will therefore depend upon which, if any, of the council's final list of preferred sites remain in Flood Zones 2 & 3 following application of the Sequential Test and hence where the Exception Test needs to be applied.

In instances where Flood Zone 3b does not exist (and therefore for the purposes of the Sequential Test Flood Zone 3b is deemed to be equal to 3a), and a 'more vulnerable' development has been allocated in Flood Zone 3a, it may be necessary to define Flood Zone 3b using flood mapping techniques.

It is important that a Level 2 SFRA considers the variation of flood risk in a Flood Zone due to flood risk management measures i.e. flood defences. This increased scope involves a more detailed review of flood hazard (flood probability, flood depth, flood velocity, rate of onset of flooding). If development is to be located behind defences, it would be necessary to model constructional failure of the defence (breach) and water levels rising to exceed the level of the defence (overtopping). It is not necessary to carry out such scenarios behind all existing defences, if no new development is to be located behind these structures. In some instances improvements to existing flood defences may be required to manage residual flood risks. Here, the Level 2 SFRA should include an appraisal of the extent of works to provide or raise the flood defence to appropriate standard.

Level 2 SFRA outputs would include:

- an appraisal of the condition of flood defence infrastructure and likely future policy
- an appraisal of the probability and consequence of breach or overtopping of flood defence infrastructure
- maps showing distribution of flood risk across zones
- guidance on appropriate policies for making sites which satisfy parts a) and b) of the Exception Test safe, and the requirements for satisfying part c) of the Exception Test
- guidance on the preparation of FRAs for sites with varying flood risk across the Flood Zone

Appendix A – Environment Agency Correspondence

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Appendix B – The Sequential Test Process

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Appendix C – Details of the Environment Agency Flood Zones

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Ms Lorna Coldicott
Warwick District Council
PO Box 2178
Leamington Spa
Warwickshire
CV32 5QH

Our ref: UT/2007/101229/SF-01/IS1-L01
Your ref:

Date: 28 February 2013

Dear Ms Coldicott

LEVEL 1 STRATEGIC FLOOD RISK ASSESSMENT (FEBRUARY 2013)

WARWICK DISTRICT COUNCIL

I write in response to the submission of an updated Level 1 SFRA, which was received directly from Hilary Hampton of Mouchell on 01 February 2013.

The Environment Agency have reviewed the revised report, and find it acceptable, subject to the following minor amendments.

Page 52 of the report details Flood Risk Management Policy Considerations, specifically reducing flood risk reduction through spatial planning and site design. The final bullet point relating to this covers the definition of when a development is 'safe'. This paragraph should ensure climate change is taken into account, and ensure that the development is safe 'for the lifetime of the development'.

The last paragraph under the section 9.2 (Raised flood levels and basements) states that basement dwellings can be allowed in Flood Zone 2 if the Exception Test is passed, which is correct and in line with national policy. It should be added that climate change should be considered when ascertaining safety, as potentially over the lifetime of the development climate change could increase the risk and move the flood zone from Flood Zone 2 to Flood Zone 3.

The 6th point under section 11.2 (page 77) should be updated to bring it in line with current flood risk funding arrangements. The term we now use for funding is *'New flood and coastal resilience partnership funding arrangements'*, and it does not relate only to S106.

For any queries regarding the above, please contact my colleague John Beckett on 01543 404900.

Yours sincerely

Mr Paul Gethins
Planning Liaison Team Leader

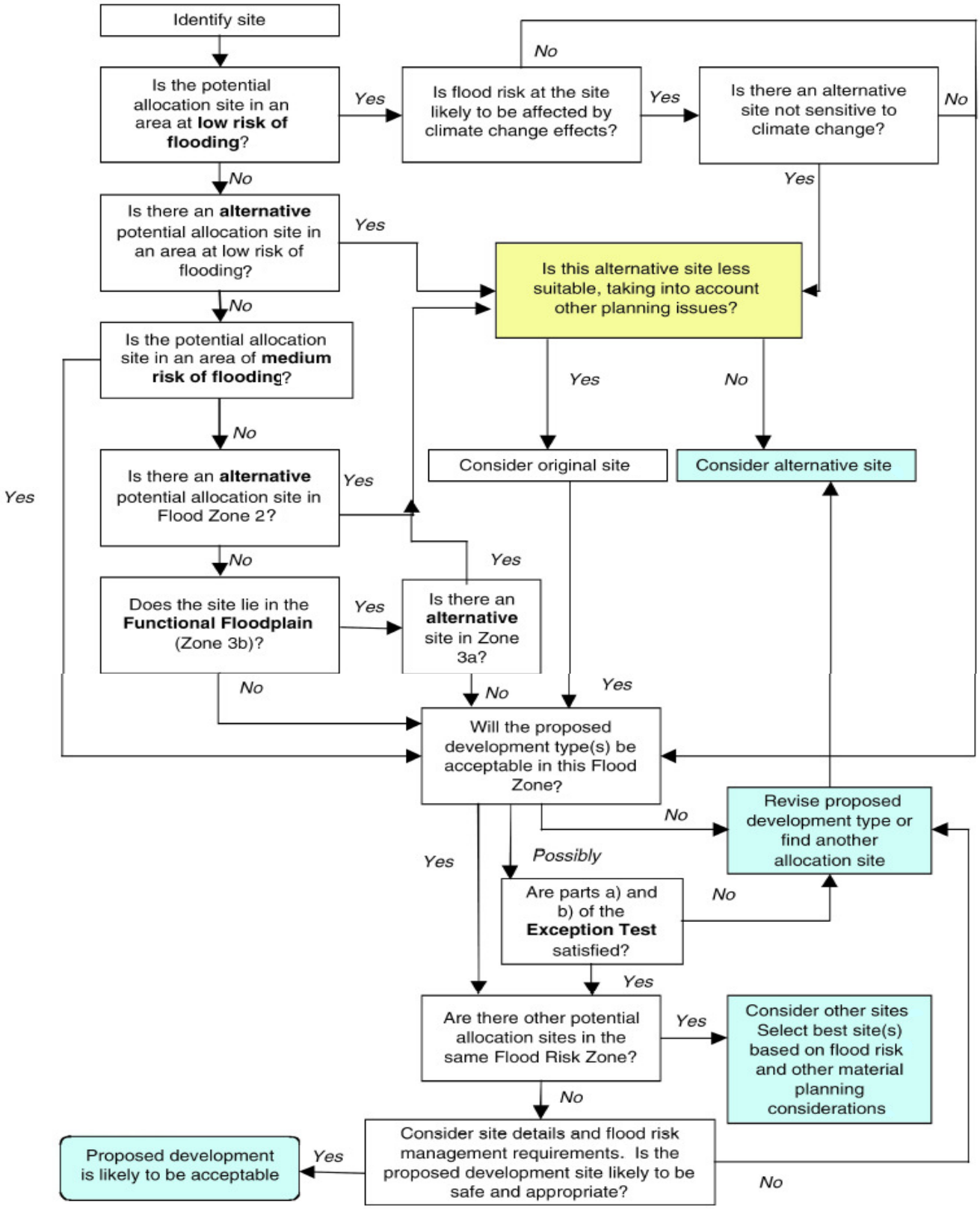
Please ask for: Jane Field

Direct Dial: 01543 404878
Direct Fax: 01543 444161
Direct email: jane.field@environment-agency.gov.uk

End

Appendix B

SEQUENTIAL TEST PROCESS



Appendix C

Details of the Environment Agency Flood Zones

Introduction

A more detailed understanding of the Environment Agency Flood Zones and their limitations is important, as these are often used (unless more accurate flood outlines are available) for the production of SFRA flood maps.

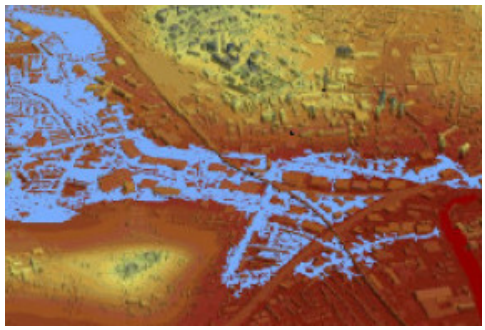
Environment Agency Fluvial Maps

Data for fluvial Flood Zones 3 and 2 is derived from a number of sources. Most fluvial flood outlines are derived from the "JFlow" generalised computer modelling, which is a 'coarse' modelling approach. Some observations of flooding by the Environment Agency's predecessors are included, for instance the extent of the severe 1947 floods, and this usually applies to Flood Zone 2. If a flood event extends further than Flood Zone 2 then the outline would be changed to reflect the wider flood risk area.

Caution must be exercised in interpreting JFlow derived flood outlines due to the large number of
assumptions incorporated into the JFlow model. For instance, at some locations the river centreline incorporated into the model was found to be erroneous with the result that the associated floodplains deviate from the natural valleys.

All Environment Agency Flood Zone Maps show the flood extent without the influences of defences.

Updates of the Environment Agency Flood Maps from Modelling



In many places the results of flood mapping studies have superseded the JFlow model. Generally these studies included high quality hydrological research, surveyed river cross sections, and more precise digital modelling such as ISIS, TuFlow and HecRas.

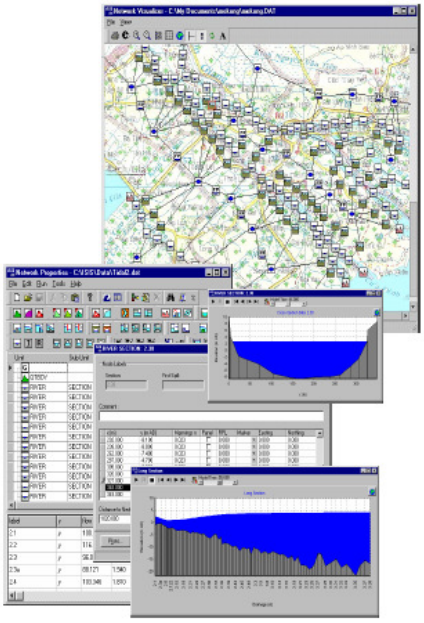
Although fluvial flooding is dependent on the standard of maintenance of watercourses and structures, the degree of maintenance allowed for tends to vary from model to model, with the result that flood maps based on modelling do not offer a uniform approach in this respect. As a consequence, serious blockages occurring during a flood might produce much more flooding than shown on previous modelling for a similar hydrological event.

Updates of the Environment Agency Flood Maps from Recent Events

Records of recent flood events have been used to modify the flood map. In these cases the Environment Agency has determined the return frequency of the observed event and modified the appropriate flood zone accordingly.

When evidence of flooding is based on aerial photographs, there is often uncertainty about a) whether the flooding has emanated from the river or is the result of other land drainage, b) the precise flood return period and c) whether the flooding was the result of blockage or some other maintenance factor.

ISIS Software Graphic Interface



Non Main River flooding in the Environment Agency Flood Maps

Fluvial Flood Zone maps show some non main river watercourse flooding as well as main river watercourse flooding. Main rivers are principal watercourses defined by Section 93 of the Water Resources Act, 1991 and shown on a formal map held by the Environment Agency – the Environment Agency flood zones. Larger ordinary watercourses are shown on the background Ordnance Survey mapping.

It should be noted that not all minor watercourses have had Flood Zone maps produced for them. Only watercourses with a catchment area greater than 3km² have been modelled using JFlow software and, therefore, smaller watercourses as identified on the 25K OS map within Flood Zone 1 may not be covered by the Environment Agency Flood Maps. As such, for any development site located adjacent to an unmapped watercourse within Flood Zone 1, it is recommended that an 8m development easement from the top of bank is applied, and a site specific FRA is undertaken.

Areas Benefiting from Defences

The current flood maps, although they are based on the “undefended situation”, show selected raised formal flood defences (built since 1998), and selected “areas benefiting from defences” (ABDs). This is land where flooding is prevented by defences, although it is assumed that the defences are robust, leak free and maintained, which is not always the case. Improved channels are not normally regarded as defences for the purposes of flood zone mapping.

Climate Change Effect on Flood Zones

In the absence of better information, the current fluvial Flood Zone 2 can be considered an estimate of the extent of fluvial Flood Zone 3 within 100 years. Similarly, Flood Zone 3a can be considered an estimate of the extent of fluvial Flood Zone 3b within 100 years.

As noted, current Environment Agency formal flood maps generally do not take into account the effect of climate change on winter rainfall and tide levels, or the effect of changes in the levels of tectonic plates on tide levels.