



**South Worcestershire Joint
Core Strategy**

**Level 1 and Level 2 Strategic
Flood
Risk Assessment**

November 2009

FINAL REPORT

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EXECUTIVE SUMMARY

This report is a Strategic Flood Risk Assessment (SFRA) for South Worcestershire Joint Core Strategy area, which includes the City of Worcester Council, Wychavon District Council and Malvern Hills District Council areas. It is a Level 1 and Level 2 SFRA. This SFRA has been prepared in accordance with current best practice, Planning Policy Statement 25 *Development and Flood Risk* (PPS25).

The SFRA constitutes one of a number of planning tools that enables the Local Authorities to select a d-0.0089435.1

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ABBREVIATIONS

ABD	Areas Benefiting From Defences
AEP	Annual Exceedance Probability
AONB	Area of Outstanding Natural Beauty
BRE 365	Building Research Establishment: Soakaway Design Guidance
CC	Climate Change
CFMP	Catchment Flood Management Plan
CIRIA 156	Construction Industry Research and Information Association: Infiltration Design Manual of Good Practice
CLG	Communities and Local Government
COWC	City of Worcester Council
DEFRA	Department for the Environment, Food and Rural Affairs
DF	Debris Factor
DPD	Development Plan Document
EA	Environment Agency
EU	European Union
FEH	Flood Estimation Handbook
FLL	Landscape Research, Development and Construction Society
FRA	Flood Risk Assessment
FRM	Flood Risk Management
FRMP	Flood Risk Management Plan
FZ	Flood Zone
GDPO	General Development Procedure Order
Ha	Hectare
IDB	Internal Drainage Board
JBA	Jeremy Benn Associates Ltd
LDD	Local Development Document
LDF	Local Development Framework
LPA	Local Planning Authority
MHDC	Malvern Hills District Council
m AOD	Metres Above Ordnance Datum
MSfW	Making Space for Water
NFCDD	National Flood Coastal Defence Database
OS NGR	Ordnance Survey National Grid Reference
PAG 2	Project Appraisal Guidance
PFRA	Preliminary Flood Risk Assessment
PPG25	Planning Policy Guidance Note 25
PPS25	Planning Policy Statement 25
RFRA	Regional Flood Risk Appraisal
RSS	Regional Spatial Strategy
SA	Sustainability Assessment
SEA	Strategic Environmental Assessment
SFR	Significant Flood Risk
SFRA	Strategic Flood Risk Assessment
SFRT	Sequential Flood Risk Test
SMP	Shoreline Management Plan
SSSI	Site of Specific Scientific Interest
STW	Sewage Treatment Works
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
WCC	Worcester City Council
WDC	Wychavon District Council
WFD	Water Framework Directive
WHS	World Heritage Sites

GLOSSARY

Actual Risk		The risk posed to development situated within a defended area (i.e. behind defences), expressed in terms of the probability that the defence will be overtopped, and/or the probability that the defence will suffer a structural failure and the consequence should a failure occur.
Annual Exceedance Probability	e.g. 1% AEP	Refer to „probability .
Brownfield		Brownfield (sites or land) is a term in common usage that may be defined as „development sites or land that has previously been developed . Prior to PPS25, the term „Brownfield was used in Governmental Guidance and Statements, but in PPS25 has been replaced with „Previously-developed land . See „Greenfield .
Catchment Flood Management Plan	CFMP	A strategic planning tool through which the Environment Agency will seek to work with other key decision-makers within a river catchment to identify and agree policies for sustainable flood risk management.
Compensatory Storage		A floodplain (flood storage) area introduced to compensate for the loss of storage as a result of filling for development purposes.
Core Strategy	CS	<p>This is the strategic vision of an area and is a central pillar of the Local Development Framework, comprising: A Vision, Strategic Objectives, a spatial land use strategy, core policies and a monitoring and implementation framework.</p> <p>The Core Strategy is a Development Plan Document which will determine overall patterns of future development, identifying site specific and broad locations where future growth will take place The revised PPS12 enables a local planning authority to allocate strategic sites within a core strategy. All other Development Plan Documents should be in broad conformity with the Core Strategy Document The Core Strategy is a mandatory document, and a timetable for production is set out within the Local Development Scheme.</p>
Defended Area		An area offered a degree of protection against flooding through the presence of a flood defence structure.
Development Plan Documents	DPDs	These documents have Development Plan Status and consequently form part of the statutory development plan for the area. A DPD will be subject to a

		of flood risk may be permitted. For the Exception Test to be passed, all three of its components must be fulfilled.
Flood Estimation Handbook	FEH	Provides current methodologies for estimation of flood flows for the UK.
Flood Hazard		A classification system developed by DEFRA/Environment Agency that gives an assessment of the hazard posed by a flood event at a given location. It is defined using the maximum modelled flood depth, velocity and a factor to allow for debris.
Floodplain		Any area of land over which water flows or is stored during a flood event or would flow but for the presence of defences.
Flood Risk Assessment	FRA	A detailed site

„Undeveloped land See „Brownfield

Informal Defence

A structure that provides a flood defence function, however is not owned nor maintained by the Environment Agency.

Internal Drainage Board is a statutory body that provides water management by operating and maintaining an
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		The Proposals Map will show planning policy designations and land allocations identified within DPDs, statutory land use and landscape designations and other land and area based designations. It will form part of the statutory development plan.
Residual Risk		The risk that inherently remains after implementation of a flood mitigation measure (option).
Return Period	e.g. 1 in 100-Year	The expected (mean) time (usually in years) between the exceedance of a particular extreme threshold. Return period is traditionally used to express the frequency of occurrence of an event, although it is often misunderstood as being a probability of occurrence.
Risk		The threat to property and life as a result of flooding, expressed as a function of probability (that an event will occur) and consequence (as a result of the event occurring).
Sequential Flood Risk Test	SFRT	The assessment and „categorisation“ of flood risk on a catchment-wide basis in accordance with PPS25.
Site Specific Allocations Development Plan Document		A mandatory document, the Allocations Development Plan Document is a high priority item for preparation, details of

1 INTRODUCTION

1.1 Background

In October 2008 JBA Consulting was commissioned to undertake a Level 1 and Level 2 Strategic Flood Risk Assessment (SFRA) for South Worcestershire Joint Core Strategy, including the areas of Wychavon District Council (WDC), Worcester City Council (WCC) and Malvern Hills District Council (MHDC). Major towns within the area include Worcester, Evesham, Upton upon Severn, Droitwich Spa, Malvern, Pershore and Tenbury Wells.

This SFRA has been prepared in accordance with current best practice, Planning Policy Statement 25 *Development and Flood Risk* (PPS25)¹. The SFRA will assist the Local Planning Authorities (LPA) to make the spatial planning decisions required to inform their Local Development Framework (LDF).

The SFRA is a planning tool that enables the LPA to select and develop sustainable allocations away from the highest flood risk areas. This report sets out the procedure to be followed when assessing sites for development in the future.

The SFRA should be treated as a „dynamic document that is periodically reviewed as further information becomes available to provide a better understanding of flood risk, for example strategy reports or additional river modelling, or if conditions change that impact on the nature of flood risk, for example the presence and characteristics of flood defences.

1.2 Scope and objectives

The overall objective for this SFRA is to provide sufficient information for the application of the Sequential Test and to identify whether application of the Exception Test is likely to be necessary. It involves a broad scale assessment of flood risk to identify sites at flood risk from fluvial and other sources of flooding, utilising existing available information. In addition to this, the SFRA will allow the

Worcester

The main causes of flooding within Worcester are the River Severn, River Teme, Barbourne Brook, several smaller watercourses and surface water flooding from sewers and overland flow. Canal flooding has also been recorded in the past which has been attributed to vandalism of the lock gates.

Evesham

The main causes of flooding within Evesham are the River Avon, River Isbourne, Battleton Brook,

1.5 Existing Flood Defence Infrastructure

There are limited flood defences within the South Worcestershire Joint Core Strategy area. Agricultural defences are located along the River Severn downstream of Worcester. These are permanent earth embankments which exist along the rural areas of the River Severn and are mostly constructed to a 1 in 10-year (0.5% AEP) level, designed to protect agricultural land against the more frequent floods but to allow the larger floods to overtop and fill washland areas behind them. The effect of filling these washland areas is to provide attenuation of flood flows going downstream and hence they are extremely important for the flood protection of the larger towns such as Upton upon Severn, Tewkesbury and Gloucester. In addition, temporary defences in Upton on Severn give some protection from flooding for more frequent flood events. A demountable and permanent defence has recently been completed at Hylton Road in Worcester which offers 1 in 100 year standard of protection. However it must be noted that the 1 in 100 year standard of protection does not include an allowance for climate change.

1.6 Historic Flooding

Fluvial flooding has occurred in the South Worcestershire Joint Core Strategy area on several occasions in the past. The most recent noticeable events occurred in 1998, 2000 and 2007, when several hundred properties flooded on each occasion. The floods in 1998 were attributed to a large storm event whilst the November and December 2000 events were the largest flood events since 1947. In 2007, there were over 1600 recorded incidents of flooding in Wychavon alone and nearly 200 properties flooded in Worcester. This particular event was a combination of fluvial and surface water flooding.

Although hydraulic computer modelling can give a good estimate of the flood risk to properties and areas of land for various return period flood events, records of actual flooding incidents will provide a better indication of where problems are likely to occur. In this respect flood incidents from the 1998 and 2007 flood events have been considered in this SFRA.

1.7 Emergency Planning

Under the Civil Contingencies Act (2004) Worcester City, Wychavon and Malvern Hills Councils are

undertaken if there are any major national policy changes new detailed hydraulic models become available for the larger watercourses.

There are a number of key outputs from possible future studies and datasets which are known to be regularly updated. These should be incorporated in any update to the SFRA.

climate change challenges including, more frequent extreme weather events causing a greater risk of flooding and drought, increased population, increased water demand and more water quality problems. It provides the Environment Agency with a strategic overview role for flood risk in England and Wales and gives local authorities in England a clear leadership role in local flood risk management encompassing all sources of flooding. An improved integrated and risk based approach is proposed to the future management of flood risks, and this requires other concerns such as sustainability, biodiversity and the whole water cycle to be taken into account by local authorities and other relevant organisations.

A core policy thread running through all current policy drivers is the fundamental shift in emphasis from building defences to prevent flooding, to one of managing flood risk by using a suite of measures. All operating authorities are required to invest in the provision of sustainable flood risk management and this includes LPAs adopting a flood risk management hierarchy of assessing, avoiding, substituting, controlling and mitigating flood risk through the land use planning system. They should have regard to flooding from all sources (particularly surface water and not just from rivers and the sea). Government does however; recognise that in some circumstances, appropriate mitigation measures may still involve new flood defences, or improving and maintaining existing flood defences where justified, to protect increasingly vulnerable communities.

Current key policy related documents provide LPAs with important and valuable knowledge on the strategic direction of flood risk management and assist their strategic land use planning decision making for re-generation, inward investment and growth etc.

Key documents currently influencing FRM policy are:

- EU Floods Directive – (2007)
- Draft Floods and Water Management Bill – Defra (2009)
- Future Water (2008)
-

2.2.3 Improving Surface Water Drainage

The “Improving Surface Water Drainage” consultation document was produced in support of the Government’s water strategy and in line with Sir Michael Pitt’s initial conclusions. Many of the proposals identified have been carried forward into the new draft Flood and Water Management Bill.

One of DEFRA's and CLG's early outputs from the Making Space for Water Programme was the publication, of PPS25 in December 2006. This work, together with the Practice Guide forms the Government's required approach to managing and reducing flood risk through the land use planning system.

A valuable piece of work looking at "Developing a Broader Portfolio of Options to Deliver Flooding and Coastal Solutions" has been carried out as part of this programme and is very useful to local authorities and other operating authorities, in their strategic planning of flood risk management. Outputs from this work are available from Defra.

Quarterly update reports are released providing details of progress made and key achievements. These reports can be accessed

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2.3.2 A Practice Guide Companion to PPS25

The Department for Communities and Local Government produced a consultation companion guide to PPS25 in February 2007. The practice guide was published in its final form in June 2008⁴.

The practice guide provides guidance on the implementation of the policy set out in PPS25. The document provides further guidance on the preparation of FRAs and SFRA, implementation of the Sequential and Exception Tests and outlines potential mitigation measures (e.g. SuDS) and risk management techniques.

Local Authority planners and developers are advised to refer to and use PPS25 and the practice guide in conjunction with the further advice contained within this report.

2.3.3 Other Planning Policy Statements

PPS1 *Delivering Sustainable Development* published in February 2005 sets out the overarching planning policies for the delivery of sustainable development across the planning system and sets the tone for other planning policy statements. PPS1 explicitly states that development plan policies should take account of flooding, including flood risk. It proposes that new development in areas at risk from flooding should be avoided. Planning authorities are also advised to ensure that developments are “*sustainable, durable and adaptable*” including taking into account natural hazards such as flooding.

PPS1 also places an emphasis on „spatial planning in contrast to the more rigid „land use planning approach which it supersedes. Planning authorities will still produce site specific allocations and a proposals map as LDDs, but their Core Strategy will be more strategic and visionary in content and will take into account the desirability of achieving integrated and mixed use development and will consider a broader range of community needs than in the past. With regard to flood risk, it will be important for the Core Strategies and accompanying Supplementary Planning Documents to recognise the contribution that non-structural measures can make to flood management.

Planning Policy Statement: Planning and Climate Change, a supplement to PPS1, published in December 2007, sets out how the Government expects the planning system to address climate change. It explains that there is a compelling scientific consensus that human activity is changing the world's climate. The evidence that climate change is happening, and that man-made emissions are its main cause, is strong. The Intergovernmental Panel on Climate Change highlights that we are already experiencing the effects of climate change and if these changes deepen and intensify, as they are predicted to do without the right responses locally and globally, we will see even more extreme impacts.

One of the predicted impacts of climate change is more intense periods of rainfall and consequent flooding. The PPS1 supplement requires Regional Spatial Strategies and Local Development Frameworks to shape sustainable communities that are resilient to such effects. A key objective of the planning system being to secure new development and shape places that minimise vulnerability and provide resilience to climate change in ways that are consistent with social cohesion and inclusion. Accordingly new development should be planned to minimise future vulnerability in a changing climate. The SFRA incorporating Sequential and Exception Test information is essential in meeting the objectives of the PPS1 supplement Planning and Climate Change.

Whilst not directly relevant to the development of an SFRA, it is important to recognise that the exercise takes place within the context of other planning policy guidance and statements, some of which also require sequential testing of site allocations and development proposals. PPS3 (Housing), emerging PPS4 (Planning for Sustainable Economic Development) and PPS6 (Planning for Town Centres) are intrinsic within the planning process and, therefore, an understanding of the constraints faced as a result of this additional policy guidance is required.

2.4 Regional Planning Policy

The Regional Spatial Strategy (RSS) for the West Midlands was published in 2008. The Regional strategy for the South Worcestershire Joint Core Strategy Area is contained within this document.

- The high overall flood risk in Worcester is higher than recorded in the 2007 Regional Flood Risk Assessment report, possibly due to more data being available.

The main conclusions from the Regional Flood Risk Appr Ried5(l)8BT2IRie ssm[(w)1113(R)re dar-73(t.)-30TJ

3 STRATEGIC FLOOD RISK ASSESSMENT OVERVIEW

3.1 Background to Strategic Flood Risk Management Objectives

Historically, the management of flood risk was undertaken in a reactive manner, addressing problems on an as-needed basis in response to flooding events. It was recognised by the Government that this approach was generally not cost effective and often failed to consider individual problem areas within the wider river system.

To address this, the Environment Agency is committed to a rolling programme of flood risk mapping and strategic flood risk management investigations. These include Catchment Flood Management Plans (CFMPs) and Flood Risk Management (PAG2) Strategies within fluvial systems and Shoreline Management Plans (SMPs) within coastal areas.

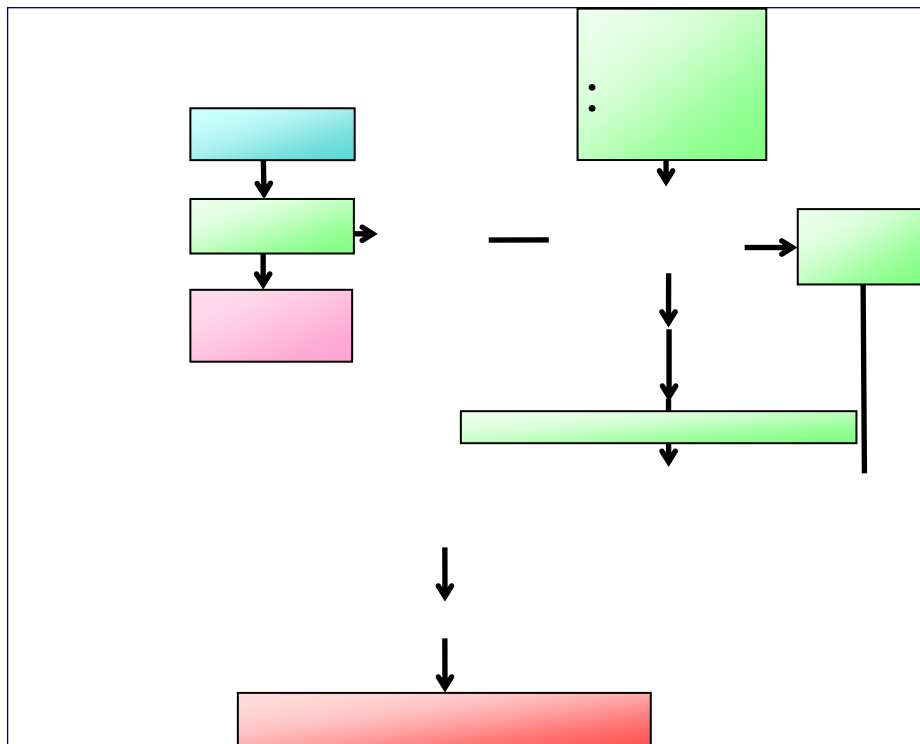
These studies take a catchment-wide approach to flood risk. They identify where flooding is known or perceived to be an existing problem and consider how flooding regimes are likely to alter as a result of climate and land use changes. The studies aim to understand the mechanism of flooding in an area and include assessments of how flooding can be managed in a cost effective and sustainable fashion over the next 50 to 100 years. These investigations also pay particular attention to the environmental implications of flood risk management and seek to provide opportunities for environmental benefit wherever possible.

The importance of influencing both the strategic planning process and development control, by preventing development within flood risk areas is recognised as a key objective by the Environment Agency. For this reason it is vital that the recommendations of the SFRA are consistent with the long-term strategy for flood risk management in the study area.

3.2 Overview of the SFRA Process

The SFRA is a planning tool that can be used to inform the spatial planning process. This process is shown in Figure 3-1 and discussed in more detail below.

Figure 3-1: The SFRA Process



3.3 Sequential Flood Risk Test (SFRT) – PPS25

Figure 3-2: Illustration of the undefended scenario under fluvial and/or tidal flood risk

A defended area (Figure 3-3) is considered to be an area of floodplain where the defences will result in a water level

Housing developments (more vulnerable development) should provide a minimum habitable space

For “more vulnerable” and “highly vulnerable” development, a safe dry pedestrian access/egress is required up to a 100-year (1% AEP) flood event with climate change, without the need for the intervention of the emergency services. For extreme flood events and when considering the residual flood risk, safe access routes should be provided, ideally these should be dry but at the very least they should be safe for the emergency services to evacuate and rescue.

3.7.2 Defended Areas – Flood Risk Mitigation

Within defended areas flood risk is primarily associated with overtopping and/or breach of defences (and localised flooding associated with drainage systems in some locations). These risks are related to the likelihood (standard of protection and structural integrity of defences) and the consequences of flooding.

The likelihood of overtopping can be estimated by comparison of modelled water levels (where available) and defence crest levels. An indication of the likelihood of defence breach can be gained

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20-year Return Period Flood extent unless the area is within one of the proposed Flood Zoning Policy maps provided in Appendix E. The 1 in 20-year Return Period Flood extent is shown for all watercourses where a detailed hydraulic model is available on the maps in Appendix C. For all other locations, the Functional Floodplain will be taken to be the greater of a) 8 metres from the top of bank of each watercourse or b) the current Flood Zone 3a (1 in 100-year flood outline). This can be revised by undertaking detailed hydraulic modelling at the Site Specific Flood Risk Assessment stage. It is also understood that it may be during the life time of this report that, as more detailed studies are undertaken for watercourses, this figure may change following the agreement of the LPA and EA.

3.9 Flood Zone 2 – Medium Probability

Flood Zone 2 is considered suitable for water-compatible, less vulnerable, more vulnerable and essential infrastructure. Highly vulnerable development is only allowed where the Exception Test is passed.

In this zone, developers and South Worcestershire Joint Core Strategy councils should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of SuDS.

For highly vulnerable development in Flood Zone 2, this SFRA also indicates whether part c. of the Exception Test is most likely to be met.

Where development is implemented, floor levels should be situated, as a minimum, above the 1% AEP fluvial flood level with sufficient freeboard to account for inherent uncertainties with respect to flood level prediction and potential climate change scenarios. Developments must take into account extreme flood events, as a residual risk development should be safe up to a 1 in 100 year event where occupants are able to remain safe inside the building. Further guidance is given on this in Chapter 8. A site-specific FRA should be undertaken at the planning application stage to facilitate the delineation and definition of the 1% AEP fluvial flood event envelope including an allowance for climate change.

3.10 Flood Zone 1 – Low Probability

the implementation of a sustainable drainage or flow retention system, constructed within the boundaries of the development site.

Ideally the LPA should work closely with the Environment Agency, sewerage undertakers and developers to enable surface water runoff to be controlled as near to the source as possible. For Greenfield developments, the aim is to not increase runoff from the undeveloped situation and for Brownfield re-developments, to reduce existing runoff rates. Wherever possible, this should be achieved through the implementation of a sustainable drainage or flow retention system, constructed within the boundaries of the development site.

A FRA will be required in each instance to design appropriate mitigation measures and demonstrate that the development will not adversely affect existing flooding conditions. The FRA should define and address the constraints that will govern the design of the drainage system.

The effectiveness of a flow management scheme within a single site is heavily limited by site constraints including (but not limited to) topography, geology (soil permeability), development density, adoption issues and available area. The design, construction and ongoing maintenance

4 DATA SOURCES

4.1 Data Collection

Table 4-1 below lists the data that was made available/obtained for the South Worcestershire Joint Core Strategy area SFRA. A critical phase in the project delivery is the collection and review of existing information. This data comprises known or perceived flood risk issues within the district, development pressures and constraints and

4.3 Flood Defences

As discussed above, the Environment Agency Flood Map does not take account of the presence of flood defences. PPS25¹⁰ states that defended areas (i.e. those areas that are protected to some degree against flooding by the presence of a formalised flood defence) are still at risk of flooding, and therefore sites within these areas must be assessed with respect to the adequacy of the defences.

5 APPROACH TO THE SOUTH WORCESTERSHIRE JOINT CORE STRATEGY STRATEGIC FLOOD RISK ASSESSMENT

5.1 Overview

A SFRA may be sub-divided into two degrees of detail: Level 1 and Level 2. The assessment approach taken for the South Worcestershire Joint Core Strategy SFRA is given below, detailing the requirements at both Level 1 and Level 2. The South Worcestershire Joint Core Strategy SFRA is at Level 2 and therefore incorporates the requirements of both a Level 1 and Level 2 SFRA.

5.1.1 Level 1 – Scoping Study SFRA

A Level 1 SFRA should be sufficiently detailed to allow application of the Sequential Test and to identify whether the Exception Test is likely to be necessary. Existing data is used to make an assessment of flood risk from all sources now and in the future.

Assessment of Current Flood Risk

Flood risk within South Worcestershire Joint Core Strategy is assessed, categorised and mapped to

There are several canals in the South Worcestershire Joint Core Strategy area. Details of past breaches or overtopping from canals are shown on the “other sources of flooding” maps in Appendix D.

PPS25 Table D1 defines Flood Risk Zones 3a (high probability) and 3b (functional floodplain). The

groundwater flooding is more common and is more relevant to the study area. Flooding in alluvial aquifers is likely to short because as the high permeability sediments will allow the groundwater to drain once the river levels fall.

As part of the DEFRA scoping study, provisional maps of areas vulnerable to groundwater emergence from consolidated aquifers were produced that reflect the groundwater conditions experienced in the exceptionally wet winter of 2000–2001. These maps, covering all consolidated aquifers of England, are presented as a provisional set of risk maps that, with further refinement, could be utilized in regional planning decisions and for flood risk management. The maps do not, however, show any groundwater from consolidated aquifers vulnerable areas in the South Worcestershire Joint Core Strategy area.

Groundwater flooding is not considered to be a major issue in the South Worcestershire Joint Core Strategy area, however there may be locations where rising groundwater is an issue and needs to

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most appropriate for urban areas. Table 6-1 depicts a matrix of flood hazard ratings, based on the maximum modelled flood depth, velocity and debris factor.

Once a Flood Hazard Rating has been calculated, it is categorised, as shown in Table 6-2.

Table 6-2: **Flood Hazard Rating Classification**

Flood Hazard Rating	Colour Code	Classification
Less than 0.75		Very Low Hazard – Caution

Figure 6-1: Barbourne Surface Water Sewer Catchments



Notes: labels (FEP_04) on the Barbourne Brook relate to flood estimation points in the Barbourne Brook hydraulic model.

It is recommended that a **Surface Water Strategy** i.e. a Surface Water Management Plan be developed in this area to further assess the local drainage and the operation of the Perdiswell Storage Area.

Local Flood Zones in Worcester

In the previous Local Plan for Worcester, there were policies that were linked to a sub-division of the

NE24 flood risk assessment

All proposals for development within or deemed to have an impact upon the flood plains referred to in policies NE21, NE22 and NE23 as shown on the proposals map, are required to provide a flood risk assessment.

The blue, yellow and red sub-divisions of the Flood Zones in Worcester are shown in Appendix E. The Barbourne Brook Flood Zones have been updated following the completion of the new Barbourne Brook hydraulic model.

Wychavon District Council

In Wychavon, flood risk is from the River Avon in Evesham and Pershore, the River Salwarpe the Droitwich Canals and many small watercourses in the rural areas. In addition surface water is an issue in many locations. The council has undertaken studies to identify and assess where possible, the floods that were recorded in 2007 and 1998. These studies and records are available to view at the council house in Pershore by contacting the main contact number at the Pershore One Stop Shop 01386 565000. Detailed flood risk for the River Avon is available by requesting data from the Environment Agency for the River Avon model. A new River Avon Model, including Depth and Velocity Maps is programmed for 2010/11.

A Broadscale surface water sewerage model was developed as part of the Level 2 SFRA for Droitwich. This confirms that surface water discharge in some areas of the town will exacerbate flooding from the River Salwarpe. A more detailed study of the surface water flooding issues in Droitwich is currently being prepared by Severn Trent Water following a hydraulic sewer model assessment by their Consultants. It is recommended, that when this study has been completed, a **surface water strategy** i.e. a Surface Water Management Plan should be developed for Droitwich.

It is recommended that a **Surface Water Strategy** i.e. a Surface Water Management Plan be developed for Pershore to assess the local drainage because of the reported surface water issues.

It is proposed to adopt a similar approach as Worcester in respect of the blue, yellow and red sub-divisions of the flood zones in Evesham, Pershore and Droitwich. These are shown in Appendix E.

Malvern Hills District Council

In Malvern Hills the main cause of flooding is local watercourses and surface water sewers. In particular, rapid response ca()-155(t)13(3po)-7p()-43(ate)4s28d-5()-239(r)-3(ec)-15(i)-177p()-4(th)-88te Drlt e co

There is a surface water flooding

Surface Water Map:

Local Authority Boundary

Potential Development Area

Surface Water Flooding

Priority Flooding Areas

Water Flooding Risk

More Risk

Intermediate Risk

Less Risk

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 Worcester City Council: 100018714 (2008)
 Wychavon District Council: 100024324 (2008)
 Malvern Hills District Council: 100018590 (2008)

Sources of Flood Risk:

Primary risk is from the Laughern Brook, resulting from overtopping of the watercourse channel. Surface water flooding may be a problem in some parts of the site. There are several ponds in this area that could pose another source of flooding. New development within this area will need to ensure that ponds and their overflow systems are adequately maintained.

Surface Water Drainage:

As an indication of requirements to manage surface water run-off at the Worcester North West development site an assessment of the soil types, discharge rates and estimated storage volume is included below. Storage volumes displayed are calculated with an assumption that 80% of the site will be developed impermeable ground. A plus 30% factor for climate change has also been included to give a conservative storage volume for residential development. A strategic SuDS solution will be required for the overall site.

Soil Type	Poorly drained clay and some sandy soils
Runoff	High
2 Year Maximum Allowable Discharge Rate (l/s)	1077 l/s



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 Worcester City Council: 100018714 (2008)
 Wychavon District Council: 100024324 (2008)
 Malvern Hills District Council: 100018590 (2008)

Sources of Flood Risk:

Primary risk is from overland surface water. With further development and creation of impermeable ground surfaces, surface water flooding may become a problem. In addition it is possible that a culverted watercourse runs through the site. In light of this developers must look at the opportunity of opening the culvert up, keeping the culvert in open space and making it form part of the sites SuDS system.

Surface Water Drainage:

As an indication of requirements to manage surface water run-off at the Worcester North development site an assessment of the soil types, discharge rate and estimated storage volume is included below. Storage volumes displayed are calculated with an assumption that 80% of the site will be developed impermeable ground. A plus 30% factor for climate change has also been included to give a conservative storage volume for residential development.

Soil Type	Silty soils and some poorly drained clay
Runoff	Moderate
2 Year Maximum Allowable Discharge Rate (l/s)	89.08 l/s
Estimated Storage Volume (m³)	12,215 m ³ (6% of site area)

Flood Defences:

None

Effects of Climate Change:

Increases in storm intensity.

Requirements for a Flood Risk Assessment:

For development proposals on sites comprising one hectare or above in Flood Zone 1 the vulnerability of flooding from other sources as well as from river flooding should be incorporated into a FRA. The potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off must also be included.

Developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development and through appropriate sustainable drainage techniques

Developers should carry out a FRA suitable for the Flood Zones the site lies within. Particular issues to

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Sources of Flood Risk:

Primary risk is from overland surface water. With further development and creation of impermeable ground surfaces, surface water flooding may become a problem. In addition Martin Brook runs to the east of the site and may pose some flood risk.

Surface Water Drainage:

As an indication of requirements to manage surface water run-off at the Fernhill Heath development site an assessment of the soil types, discharge rates and estimated storage volume is included below. Storage volumes displayed are calculated with an assumption that 80% of the site will be developed impermeable ground. A plus 30% factor for climate change has also been included to give a conservative storage volume for residential development.

Soil Type	Poorly drained clay
Runoff	High
2 Year Maximum Allowable Discharge Rate (l/s)	118.38 l/s
Estimated Storage Volume (m³)	20,661 m ³ (6% of site area)

Flood Defences:

None

Effects of Climate Change:

Increases in storm intensity.

Requirements for a Flood Risk Assessment:

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Sources of Flood Risk:

Primary risk is from the small watercourse flowing west to east through the site. No Flood Zones are shown for this watercourse; however, the detailed flood risk needs to be assessed. With further development and creation of impermeable ground surfaces, surface water flooding may become a problem. Again developers will need to ensure the watercourse is kept in open space and linked to appropriate SuDS techniques.

Surface Water Drainage:

As an indication of requirements to manage surface water run-off at the Kilbury Drive development site an assessment of the soil types, discharge rates and estimated storage volume is included below. Storage volumes displayed are calculated with an assumption that 80% of the site will be developed impermeable ground. A plus 30% factor for climate change has also been included to give a conservative storage volume for residential development.

Soil Type	Poorly drained clay
Runoff	High
2 Year Maximum Allowable Discharge Rate (l/s)	51.62 l/s
Estimated Storage Volume (m³)	8,875 m ³ (5% of site area)

Flood Defences:

None

Effects of Climate Change:

Increased watercourse flows and storm intensities.

Requirements for a Flood Risk Assessment:

For development proposals on sites comprising one hectare or above in Flood Zone 1 the vulnerability of flooding from other sources as well as from river flooding should be incorporated into a FRA. The potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off must also be included.

Developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development and through appropriate sustainable drainage techniques.

Developers should carry out a FRA suitable for the Flood Zones the site lies within. Particular issues to

Table 7-5: Worcester South		
OS NGR: SO 863 514	Area: 243 ha	Brown/Greenfield: Both
Flood Zone Coverage: FZ3a 1.5%; FZ3b 0.5%; FZ2 2%; FZ1 96%		
Exception Test required? Yes, for More Vulnerable and Essential Infrastructure development in FZ3a and Highly Vulnerable development in FZ2.		

consider include:

- River levels from fluvial flooding in the minor watercourse.
- Consider the effect of climate change over the next 100 years on fluvial river flows.
- Allow an 8m easement along the watercourses for maintenance access or flood risk. The surface water map gives an indication of where this will be required along ordinary watercourses.
- Demonstration that the development will meet necessary drainage requirements to avoid increasing flood risk elsewhere.
- Demonstration that development at this location can be made safe.
- The use of SuD8 5968

Table 7-7: Pulley Lane, Droitwich Spa		
OS NGR: SO 902 612	Area: 59 ha	Brown/Greenfield: Both
Flood Zone Coverage: FZ3a 0%; FZ3b 0%; FZ2 0%; FZ1 100%		
Exception Test required? No.		
FRA requirements:		

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Malvern Hills District Council: 100018590 (2008)

Sources of Flood Risk:

Primary flood risk is from surface water flooding and overland flows.

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Table 7-8: Hill End, Droitwich Spa

OS NGR: SO 907 636	Area: 14 ha	Brown/Greenfield: Both
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Flood Zone Coverage: FZ3a 4.5%; FZ3b 3.5%; FZ2 5%; FZ1 87%

Exception Test required? Yes, for More Vulnerable and Ess

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Table 7-9: Malvern North		
OS NGR: SO 792 490	Area: 61 ha	Brown/Greenfield: Greenfield
Flood Zone Coverage: FZ3a 0%; FZ3b 0%; FZ2 0%; FZ1 100%		
Exception Test required? No.		
FRA requirements:		

For development proposals on sites comprising one hectare or above in Flood Zone 1 the vulnerability of flooding from other sources as well as from river flooding should be incorporated into a FRA. The potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off must also be included.

Developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development and through appropriate sustainable drainage techniques.

Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

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Sources of Flood Risk:

Surface Water Drainage:

As an indication of requirements to manage surface water run-off at the Malvern North development site an assessment of the soil types, discharge rates and estimated storage volume is included below. Storage volumes displayed are calculated with an assumption that 80% of the site will be developed impermeable ground. A plus 30% factor for climate change has also been included to give a conservative storage volume for residential development.

Soil Type	Poorly drained clay
Runoff	High
2 Year Maximum Allowable Discharge Rate (l/s)	233.3 l/s
Estimated Storage Volume (m³)	39,154 m ³ (5% of site area)

Flood Defences:

consider include:

- Demonstration that the development will meet necessary drainage requirements to avoid increasing flood risk elsewhere.
- Allow an 8m easement along the watercourses for maintenance access or flood risk. The surface water map gives an indication of where this will be required along ordinary watercourses.
- Demonstration that development at this location can be made safe.
- The use of SuDS will be required for surface water discharge.
- Surface water flow rates should be restricted to existing Greenfield rates. Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

Table 7-10: Malvern East

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Sources of Flood Risk:

consider include:

- Obtain information on existing surface water and combined sewers.
- Demonstration that the development will meet necessary drainage requirements to avoid increasing flood risk elsewhere.
- Demonstration that development at this location can be made safe.
- The use of SuDS will be required for surface water discharge.
- Surface water flow rates should be restricted to previous Greenfield rates. Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

Table 7-12: Blackmore Park

OS NGR: SO 798 435	Area: 9 ha	Brown/Greenfield: Brownfield
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Flood Zone Coverage: FZ3a 0%; FZ3b 0%; FZ2 0%; FZ1 100%

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Wychavon District Council: 100024324 (2008)
Malvern Hills District Council: 100018590 (2008)

Sources of Flood Risk:

Primary risk is from surface water flooding and overland flows. With further development and creation of impermeable ground surfaces, surface water flooding may become a problem.

Surface Water Drainage:

As an indication of requirements to manage surface water run-off at the Blackmore Park development site an assessment of the soil types, discharge rates and estimated storage volume is included below. Storage volumes displayed are calculated with an assumption that 80% of the site will be developed impermeable ground. A plus 30% factor for climate change has also been included to give a conservative storage volume for residential development.

consider include:

- Obtain information on existing surface water and combined sewers.
- Demonstration that the development will meet necessary drainage requirements to avoid increasing flood risk elsewhere.
- Demonstration that development at this location can be made safe.
- The use of SuDS will be required for surface water discharge.
- Surface water flow rates should be restricted to previous Greenfield rates. Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

Table 7-13: Pershore		
OS NGR: S0 950 472	Area: 53 ha	Brown/Greenfield: Both
Flood Zone Coverage: FZ3a 10%; FZ3b 6%; FZ2 10%; FZ1 74%		
Exception Test required? Yes, for More Vulnerable and Essential Infrastructure development in FZ3a and Highly Vulnerable development in FZ2.		
Requirements for passing part c. of the Exception Test:		

To pass Part „c of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.

Preference should be

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| 2 Year Maximum Allowable Discharge Rate (l/s) | 162.28 l/s

|

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Sources of Flood Risk:

Primary risk is from surface water and overland flows. There is also an ordinary watercourse running through the site which will need to be investigated in a detailed FRA.

Surface Water Drainage:

As an indication of requirements to manage surface water run-off at the Hampton development site an assessment of the soil types, discharge rates and estimated storage volume is included below. Storage volumes displayed are calculated with an assumption that 80% of the site will be developed impermeable ground. A plus 30% factor for climate change has also been included to give a conservative storage volume for residential development.

Soil Type	Intermediate silty soils
Runoff	Moderate
2 Year Maximum Allowable Discharge Rate (l/s)	32.16 l/s
Estimated Storage Volume (m³)	8,000 m ³ (6% of site area)

Flood Defences:

None

Effects of Climate Change:

Increased storm intensities.

Requirements for a Flood Risk Assessment:

For development proposals on sites comprising one hectare or above in Flood Zone 1 the vulnerability of flooding from other sources as well as from river flooding should be incorporated into a FRA. The potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off must also be included.

Developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development and through appropriate sustainable drainage techniques.

Developers should carry out a FRA s

Table 7-15: Cheltenham Road, Evesham

OS NGR: SP 030 421

Area: 46 ha

Brown/Greenfield: Both

Flood Zone Coverage: FZ3a 4%; FZ3b 1%; FZ2 6%; FZ1 89%

Exception Test required? Yes, for More Vulnerable and Essential Infrastructure development in FZ3a and Highly Vulnerable development in FZ2.



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 Worcester City Council: 100018714 (2008)
 Wychavon District Council: 100024324 (2008)
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Sources of Flood Risk:

Primary risk is from the River Isbourne. With further development and creation of impermeable ground surfaces, surface water flooding may become a problem.

Surface Water Drainage:

As an indication of requirements to manage surface water run-off at the Cheltenham Road development site an assessment of the soil types, discharge rates and estimated storage volume is included below. Storage volumes displayed are calculated with an assumption that 80% of the site will be developed impermeable ground. A plus 30% factor for climate change has also been included to39(b)-9ive a conserva storage volume for residential development.

Soil Type	Intermediate silty soils
Runoff	Moderate
2 Year Maximum Allowable Discharge Rate (l/s)	147.88 l/s
Estimated Storage Volume (m³)	29,947 m ³ (5% of site area)

Flood Defences:

None.

Effects of Climate Change:

Increased design water levels in the River Isbourne. Increased rainfall intensities.

Requirements for a Flood Risk Assessment:

Developers should carry out a FRA suitable for the Flood Zones the site lies within. Particular issues to consider include:

- River levels from fluvial flooding in the River Isbourne.
- Allow an 8m easement along the watercourse for maintenance access.
- Consider the effect of climate change over the next 100 years on fluvial river flows.
- Demonstration that the development will meet necessary drainage requirements to avoid increasing flood risk elsewhere.

- Demonstration that development at this location can be made safe.
- The use of SuDS will be required for surface water discharge.
- Surface water flow rates should be restricted to existing Greenfield rates. Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.
- Consider using flood zones 2 and 3 as public open space.
- Consider de-culverting of existing watercourses where possible.

Table 7-16: Offenham Road, Evesham

OS NGR: SP 051442

Area: 39 ha

Brown/Greenfield: Both

Flood Zone Coverage: FZ3a 0%; FZ3b 0%; FZ2 0%; FZ1 100%

Exception Test required? No.

where appropriate based on Table D3 of PPS25, to pass the Exception Test. Where necessary this SFRA may assist in the sequential test, however a full sequential test should refer to alternative sites within lower flood risk areas in the first instance.

Table 8-1: Rationale for Flood Resilient and/or Resistant Design Strategies¹⁸

8.7 Pre- Planning Guidance for Developers

Early consideration of flooding and drainage issues is imperative. The flood risk at a site and the type of development that would be appropriate should be considered prior to site acquisition; as should the “land-take” required for flood storage, above ground surface water attenuation and SuDS, thus allowing a more informed assessment of the possible development density and land value.

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The location of the site within either Flood Zone 1, 2 or 3 should be established by consulting the Environment Agency Flood Zone Maps. It is possible the site will require a FRA or Drainage Impact Assessment depending on the development size, type and location. It should be noted that some developments are classed as more vulnerable than others as described in PPS25. Reference should be made to the later section on FRAs.

During the site walkover survey, the slope of the ground should be assessed. Notes should be taken on what lies around the site, whether the site could be vulnerable to flooding sources off site or

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- Develop joint strategies with sewerage undertakers and the Environment Agency to further encourage the use of SuDS.

Adoption and future maintenance of above ground SuDS facilities by the local authorities as public open space requires early discussion between the developer, the local authority and Severn Trent Water. Above ground attenuation can be adopted by the local authority as public open space, with the provision of a payment to the local authority via a Section 106 Agreement under a tenancy agreement.

8.8.1 Living (Green) Roofs and Walls

Living Roofs and walls can vary in type from Roof Gardens, Roof Terraces, Green Roofs and Green Walls.

This approach utilises plants and their substrate to provide temporary storage of rainfall. The water retained by the substrate and lost through evaporation and evapotranspiration minimises runoff from the roof. Even when saturated, the run-off rate is slowed by the roughness of the vegetation and so mimics more closely the run-off prior to development.

Commonly perceived problems are largely unwarranted. These include a lack of British Standards associated with green roofs. However, the German FLL, the Landscape Research, Development & Construction Society, covers all aspects of green roofs from waterproofing, soils, vegetation, installation methods and maintenance and members include major UK suppliers.

There is also a perception that dry vegetation during the summer months could lead to fires being started on green roofs, however, the FLL

Photos courtesy of livingroofs.org/greenroofconsultancy.com

8.8.5 Permeable Surfaces Tf5(C)T e687.38Qq87.3* nBT/TT3 9.96 Tf8 5

Courtesy of Charcon / Aggregate Industries

8.12 Making Development Safe

8.12.1 Safe Access and Egress

The developer must ensure that safe access and egress is provided to an appropriate level for the type of development. This may involve raising access routes to a suitable level.

As part of the FRA, the developer should review the acceptability of the proposed access in consultation with the Environment Agency.

More vulnerable development such as residential development should have safe access and egress up to the 1 in 100 year plus climate change event, whilst highly vulnerable development will need to consider safe access and egress up to the 1 in 1,000 year event. For less vulnerable development

8.13 Making Space for Water

8.13.1 Opportunities for River Restoration and Enhancement

All new development close to rivers should consider the opportunity presented to improve and enhance the river environment. Developments should look at opportunities for river restoration and enhancement as part of the development. Options include backwater creation, de-silting, in-channel habitat enhancement and removal of structures. When designed properly, such measures can have benefits such as reducing the costs of maintaining hard engineering structures, reducing flood risk, improving water quality and increasing biodiversity. Social benefits are also gained by increasing green space and access to the river.

8.13.2 Buffer Strips

As a minimum, developers should set back development 8 metres from the landward toe of fluvial defences or top of bank where defences do not exist. This provides a buffer strip to „make space for water , allow additional capacity to accommodate climate change and ensure access to defences is maintained for maintenance purposes.

For watercourses classed as „Main River a minimum 8 metre easement from the top of bank is recommended for maintenance purposes to avoid disturbing riverbanks, benefiting ecology and having to construct engineered riverbank protection. Building adjacent to riverbanks can also cause problems to the structural integrity of the riverbanks and the building, making future maintenance of the river much more difficult.

8.13.3 Drainage Capacity

The capacity of internal drainage infrastructure is often limited and is at or near capacity under existing conditions. Development that leads to increased peak runoff within the drainage catchments may lead to infrastructure capacity being exceeded, with the potential for increased flood risk. Development locations should be assessed to ensure capacity exists within both the on and off site network.

8.14 Future Planning Applications

The first document that local planners should refer to when considering future planning applications is the Environment Agency's *National Standing Advice to Local Planning Authorities for Planning Applications – Development and Flood Risk*, England (February 2009).

This SFRA is not intended to be a prescriptive document, but a planning tool to guide future

C Protection and Enhancement of Watercourses

Reasoned justification:

A (3) (Red Zone) –

Additional Policy on Caravans

Policy.... - Caravans and Flood Risk

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Reasoned justification:

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http://sciencesearch.defra.gov.uk/Document.aspx?Document=FD2320_7399_PR.pdf

¹⁶ DEFRA/Environment Agency. 2006. The Flood Risks to People Methodology. R&D Technical Report FD2321/TR1. http://sciencesearch.defra.gov.uk/Document.aspx?Document=FD2321_3436_TRP.pdf

¹⁷ Environment Agency Standing Advice Development and Flood Risk – England (2009).
http://www.pipernetworking.com/floodrisk/index.html?lang=_e

¹⁸ Communities and Local Government. 2008. *Planning Policy Statement 25: Development and Flood Risk – Practice Guide*. June 2008. (Figure 6.2).
<http://www.communities.gov.uk/publications/planningandbuilding/pps25practiceguide>

¹⁹ Communities and Local Government. 2008. *Planning Policy Statement 25: Development and Flood Risk – Practice Guide*. June 2008.
<http://www.communities.gov.uk/publications/planningandbuilding/pps25practiceguide>

²⁰ Communities and Local Government, May 2007. *Improving the Flood Performance of New Buildings – Flood Resilient Construction*. http://www.planningportal.gov.uk/uploads/br/flood_performance.pdf

Appendix A National Plans, Policies and Strategies

A.1.1 Planning and Compulsory Purchasing Act

The SFRA has been undertaken whilst planning authorities have been implementing the provisions of the Planning and Compulsory Purchase Act 2004, together with the accompanying planning guidance, including Planning Policy Statement 1 *Delivering Sustainable Development* (PPS1) and Planning Policy Statement 12 *Local Development Frameworks* (PPS12). The Act has affected all tiers of the planning system and has necessitated major changes at regional and local level.

Planning Policy Guidance (PPG) has been reviewed by Government and was updated and replaced 9()JTJ0 -11w1314(G)-4(be)-7ce, ()-34(ha)(en)-7Ficy(er11.52 TDh(ov)-3(e9)-31()JTJ0 -15.48 TD[(P)4(l)5(a)-9(nn

implying that only in exceptional cases should permission be granted against the Environment Agency's advice. In addition, the use of site-specific (local) Flood Risk Assessments as supporting documents to planning applications in areas of flood risk is encouraged. The document proposes that if mitigating measures are shown to be required, they should be fully funded as part of the development.

²¹ <http://www.communities.gov.uk/publications/planningandbuilding/planningpolicystatement1>

²² <http://www.communities.gov.uk/publications/planningandbuilding/ppsclimatechange>

²³ <http://www.communities.gov.uk/publications/planningandbuilding/pps3housing>

²⁴ <http://www.communities.gov.uk/publications/planningandbuilding/ppg4>

²⁵ <http://www.communities.gov.uk/publications/planningandbuilding/pps6>

²⁶ DEFRA. 2004. *Making Space for Water – Developing a new Government strategy for flood and coastal erosion risk management in England.*

²⁷

Appendix B Level 1 Flood Zones & Climate Change Flood Outlines

Appendix D Other Sources Flood Risk Mapping

Appendix F Guidance Flow Charts