

Shropshire Council

Strategic Flood Risk Assessment for

Local Development Framework

Level 1 - Update

Volume 1

June 2012

Halcrow Group Limited

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Shropshire Council

Strategic Flood Risk Assessment for Local Development Framework Level 1 - Update Volume 1

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Contents

Contents	1
Executive Summary	3
1 Introduction	5
1.1 Terms of Reference	5
1.2 Project Objectives	5
1.3 Methodology.....	6
1.4 Project Deliverables	6
1.5 SFRA Context	7
1.6 Shropshire Council.....	8
2 Planning Context	11
2.1 Introduction	11
2.2 National Planning Policy	11
2.3 Regional Planning Policy	11
2.4 Local Planning Policy	12
3 Flood Zone Maps	14
3.1 Introduction	14
3.2 NPPF Flood Zones.....	14
3.3 Environment Agency Flood Zones	15
3.4 SFRA Flood Maps.....	15
3.5 SFRA Climate Change Maps.....	15
4 Overview of the NPPF Technical Guidance on Flood Risk	17
4.1 Key Aims	17
4.2 Outcomes of the SFRA Process	18
4.3 The Sequential Test	18
4.4 The Exception Test	18
5 Study Methodology	20
5.1 The Practice Guide Companion to PPS 25.....	20
5.2 Level 1 SFRA	21
5.3 Approach to Data Gathering	22
5.4 Production of Flood Maps	23
5.5 Forms of Flooding and Data Limitations	27
5.6 Wider Published Studies and New Legislation	30

Shropshire Council

6	Flood Risk in the Study Area	32
6.1	Hydrology	32
6.2	Geology	34
6.3	Historical Flooding.....	35
7	Flood Warning Systems and Flood Management Measures	50
8	Flood Risk Management Policies	56
8.1	Catchment Flood Management Plans.....	56
8.2	Policy Considerations.....	61
9	Guidance on the Application of the Sequential Test.....	63
9.1	Step One: Strategic Overview of flood risk across all potential development areas	63
9.2	Step Two: Flood Risk Issues in Zone 1	63
9.3	Step Three: Sequential Test in Zones 2 and 3	64
10	Guidance for the Preparation of Flood Risk Assessments.....	65
10.1	Proposed Developments Within Flood Zone 3a	69
10.2	Proposed Developments Within Medium Probability Flood Zone 2	70
10.3	Proposed Developments Within Flood Zones 1 and 2	70
10.4	Raised Floor Levels and Basements (Freeboard).....	70
11	Guidance for the Application of Sustainable Drainage Systems (SuDS)	71
11.1	Introduction	71
11.2	Types of SuDS Systems.....	71
11.3	Application of SuDS for Shropshire	72
12	Gap Analysis.....	78
12.1	Introduction	78
12.2	Missing or Incomplete Data	78
12.3	Level 2 SFRAs	78
13	References/Glossary.....	81
	APPENDIX A	85
	APPENDIX B	87
	APPENDIX C	89

Executive Summary

The Districts and Boroughs of Shropshire as well as Shropshire County Council and the Unitary Authority Telford and Wrekin Council, commissioned Halcrow in 2007 to produce a Level 1 Strategic Flood Risk Assessment (SFRA) in accordance with Planning Policy Statement 25 (PPS 25). The project was delivered in September 2007, which comprised a series of reports (one for each District and Borough, plus the Unitary Authority of Telford and Wrekin).

On the 1st April 2009 Shropshire County Council and its Districts and Boroughs were replaced by the Unitary Authority Shropshire Council (excluding the Telford and Wrekin Council) and this is known as the administrative county of Shropshire. Following these changes, the Council commissioned Halcrow to update the Level 1 SFRA to combine all of the previous Districts and Boroughs (excluding Telford and Wrekin) into one document and to incorporate any new information that had come to light since the completion of the previous Level 1 SFRA.

This report, Volume 1, presents the findings of the updated SFRA for Shropshire Council, while Volume 2 contains the accompanying maps.

The objective of this assessment is to inform the plan-making process of the Local Planning Authority. It should be used as a tool by Shropshire Council to assess flood risk for spatial planning, producing development briefs, setting constraints, informing sustainability appraisals, identifying locations for emergency planning measures and requirements for flood risk assessments.

In accordance with the published document: Development and Flood Risk, a Practice Guide Companion to PPS 25 (February 2007 – since updated in December 2009), a Level 1 SFRA was undertaken in 2007 for the Unitary Authority, Boroughs and Districts within Shropshire. This 2011/12 study provides an update to the original study, taking into account updated data sets, new data, changes to legislation and published guidance.

The SFRA report provides general guidance and an overview of assumptions, uncertainties, approach, tasks undertaken and understanding of flood risk within the administrative county of Shropshire. It provides the information required for the application of the Sequential Test of PPS 25. The LPA should apply 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.

Policy ideas are provided together with comprehensive guidance for the preparation of flood risk assessments. Flood risk assessments will be required in most cases and the level of detail will depend on the proposed development footprint, its spatial distribution and the type and magnitude of existing and future flood risk.

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1 Introduction

1.1 Terms of Reference

In April 2007 the Districts and Boroughs of Shropshire as well as Shropshire County Council and the Unitary Authority Telford and Wrekin Council, commissioned Halcrow to produce a Level 1 Strategic Flood Risk Assessment (SFRA) in accordance with Planning Policy Statement 25 (PPS 25). This work was completed in September 2007.

On the 1st April 2009, Shropshire County Council and its Districts and Boroughs were replaced by a Unitary Authority (excluding the Telford and Wrekin Council) and this is known as the administrative county of Shropshire. Following these changes, the Council commissioned Halcrow to update the Level 1 SFRA to combine all of the previous Districts and Boroughs into one document and to incorporate any new information that had come to light since the completion of the previous Level 1 SFRA.

This report, Volume 1, presents the findings of the updated SFRA for Shropshire Council, while Volume 2 contains the accompanying maps.

1.2 Project Objectives

The objective of the SFRA is to inform the plan-making process of the Shropshire Local Development Framework (LDF). This SFRA has been updated to provide a detailed and robust assessment of the nature and extent of all types of flooding in the administrative area and the implications that this may have for land use planning.

The original Level 1 SFRA consisted of six individual reports covering the Districts and Boroughs of Bridgnorth, Oswestry, Shrewsbury and Atcham, North Shropshire, South Shropshire and, Telford and Wrekin. The main objectives of this new commission are to combine the previous reports that represent the Shropshire Unitary Authority, and to update with new data.

The SFRA will allow the LPA to:

- Prepare appropriate policies for the management of flood risk within the Local Development Documents (LDDs)
- Meet the needs of the LDF
- Identify the level of detail required for site specific Flood Risk Assessments (FRAs) in key locations
- Determine the acceptability of flood risk in relation to emergency planning capability
- Allocate appropriate sites for development
- Identify opportunities for reducing flood risk
- Ensure Shropshire Council meets its obligations under the latest planning guidance

Data has been collected for use in this study based on the best viable data within the study timescales. Where updated information has been incorporated from the First Edition of the Level 1 SFRA, this has been clearly shown in this document, and a broad summary of the changes presented. As with the previous SFRA, outputs from the study will require updating as additional data becomes available.

1.3 Methodology

Halcrow has carried out this project in accordance with the methodology outlined in the Shropshire Districts Strategic Flood Risk Assessment Project Proposal, dated March 2007, and the updated scope for the Level 1 SFRA update as outlined in the proposal cost estimate dated 29/06/2011. Whilst the National Planning Policy Framework (NPPF) has now superseded PPS25, the original Level 1 SFRA approach followed the guidance contained in “Development and Flood Risk: A Practice Guide Companion to PPS25” (December 2009) for a Level 1 SFRA. The SFRA has also followed advice from the Environment Agency, and the Environment Agency’s acceptance of the assessment can be found in Appendix C.

Given the changes to planning policy, this report has now been amended to take into account the latest NPPF guidance where applicable. Some PPS25 references and guidance has been retained to provide historical context, for continuity and where advice and information is still applicable.

1.4 Project Deliverables

The deliverables of this assessment are as follows:

- A technical report combining the previous Level 1 SFRA documents for Bridgnorth, Oswestry, Shrewsbury and Atcham, North Shropshire and South Shropshire (excluding Telford and Wrekin).
- An updated gap analysis report, and recommendations of requirements for Level 2 SFRA data
- A non-technical summary
- Strategic Flood Risk Maps, showing:
 - Flooding from all sources
 - Climate Change Scenarios
- GIS maps of collated data, including:
 - Main Rivers and Ordinary Watercourses (Major and Minor watercourses)
 - Flooding from all sources (due to the frequent update of the Environment Agency Flood Zone Maps, only Flood Zone 3b has been included on the maps. A link to the Shropshire Council website where the latest Flood Zones are stored is specified on each map)
 - Hydrometric data coverage
 - NFCDD data

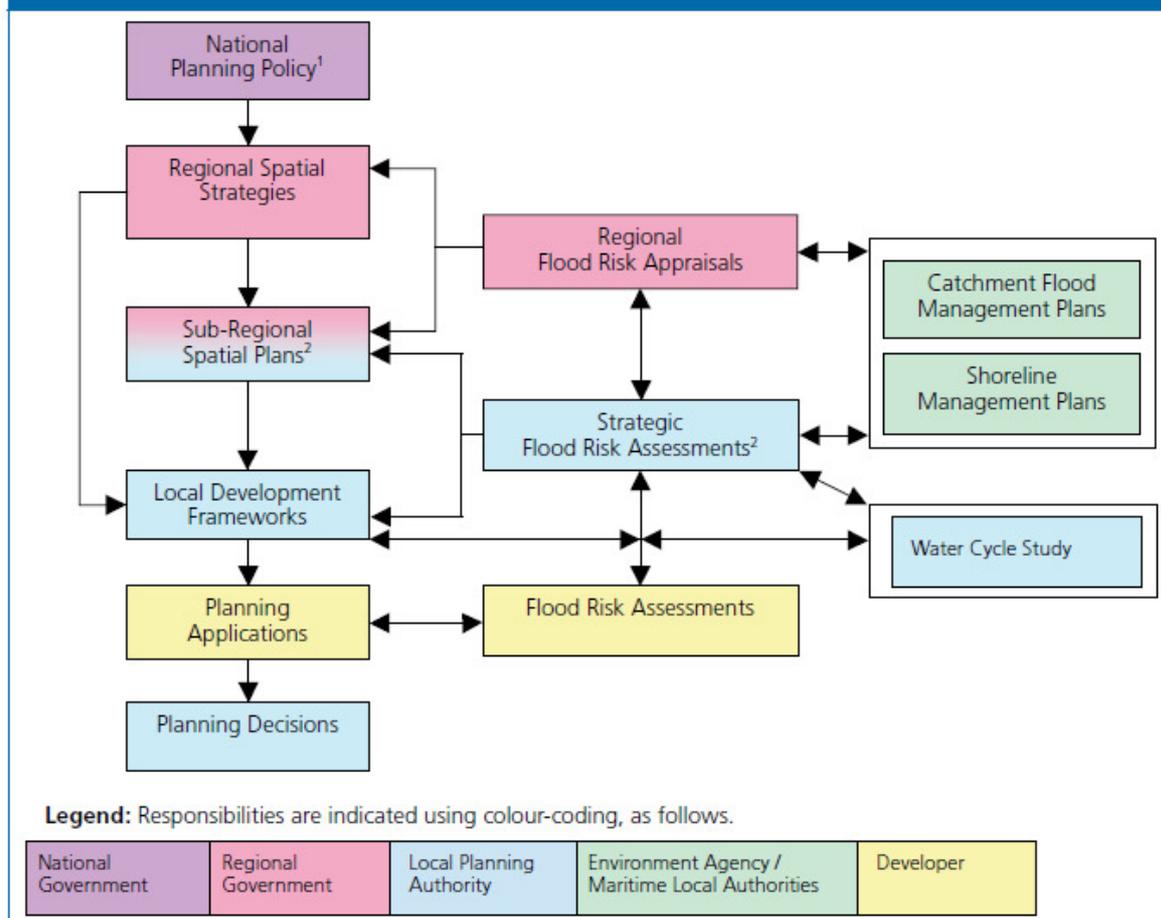
- Flood event data (historic flood outlines)
- Updated Flood Alert / Flood Warning Areas
- Geological maps
- Artificial drainage information

1.5 SFRA Context

An SFRA is a strategic document which refines information on the probability of flooding, taking other sources of flooding and the impacts of climate change into account. An SFRA provides the basis for applying the Sequential Test, a process which seeks to locate new development in appropriate flood zones, based on the development's vulnerability classification. An SFRA is also a living document and should be updated as new data becomes available, such as quarterly updates from the Environment Agency, who continuously refine and improve their Flood Zone Maps.

Figure 1.1 below, taken from the PPS 25 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.

Figure 2.2 Key documents in the spatial planning process and their links with other key strategies for managing flood risk



Notes

1 Including Planning Policy Statement 25 'Development and Flood Risk' and the other flooding-related national planning policies listed in Appendix A of this 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 1.1 – “Figure 2.2” from the previous PPS25 Practice Guide – Key Documents in the Spatial Planning

1.6 Shropshire Council

The Unitary Authority of Shropshire was established on the 1st April 2009. The Council area covers the Districts and Boroughs formally known as: Oswestry, North Shropshire, Shrewsbury and Atcham, South Shropshire and Bridgnorth. Telford and Wrekin has been a unitary authority since 1998 and is included within Shropshire for ceremonial purposes only. The Council area is some 3,187km² in size, and is bordered by Powys County Council to the west; Wrexham County Borough Council, Cheshire West and Chester Council and Chester East Council to the north; Staffordshire County Council and Telford and Wrekin Council the east; and, Herefordshire Council and Worcestershire County Council to the south.

Shropshire Council

The Shropshire Unitary Authority area is noted for its variety of small market towns, villages and rural countryside, being home to some of the nation's most beautiful and historic landscapes. Geographically, the Council area can be divided into two distinct areas: North and South Shropshire. The largest settlements can be found to the north and include Shrewsbury at the centre (population 70,560), Oswestry to the North West (population 15,600), Whitchurch to the north (population 8,900) and, Market Drayton to the north east (population 10,400). The North Shropshire Plain forms an extension of the flat and fertile Cheshire Plain, whilst the area around Oswestry is more rugged. South Shropshire is more rural in nature than the north, with fewer settlements and smaller towns. The area is characterised by significant hill ranges and river valleys, woods and other natural features. The Shropshire Hills Area of Outstanding Natural Beauty (AONB) is located to the south-west, covering an area of 808km², forming the only protected area within the Council area. The largest settlements within the southern half of the county include Ludlow in the south, and Bridgnorth, to the south-eastern side of the county.

A number of smaller Market Towns and villages are also found within the Council area including Ellesmere, Wem and Baschurch to the north, and, Pontesbury, Bayston Hill, Much Wenlock, Church Stretton, Bishop's Castle, Craven Arms, Clun and Cleobury Mortimer to the south.

There are good transport links with the Council area connected to the rest of the Country through a number of road and rail links. Shrewsbury forms the main transport hub, from which a radial network of roads emanate into the surrounding rural areas. Most of the larger rural settlements lie on these radial highways. The M54 forms the only Motorway within the Council area, connecting Shropshire to the rest of the UK motorway network and the West Midlands. The motorway runs for a short distance being situated to the north of Shifnal, continuing on as far as Wellington within the Unitary Authority of Telford and Wrekin. From here, the road continues on as the A5 towards Shrewsbury and the west. Other major trunk roads include the north-south A49, the A458, the A483 and the A41. A number of major railway lines traverse the Council area including the Welsh Marches Line, the Cambrian Line, the Shrewsbury to Chester Line and the Wolverhampton to Shrewsbury line.

Three main canals run through Shropshire including the Shropshire Union Canal (from north of Adderley to Knighton), the Llangollen Canal (from Chirk Aqueduct to Grindley Brook) and the Montgomery Canal (from Frankton Junction to Llanymynech).

The Council area contains a number of designated main rivers, the most prominent being the River Severn which runs through North Shropshire from Powys to the west, through Shrewsbury and the Ironbridge Gorge, before heading south into Bridgnorth. Its significance is notable in that it has influenced the historical make-up of the area and helped shape the communities that exist today. It is also particularly important for its wildlife, geological heritage, amenity value and is a focus for tourism and recreation. The River Tanat, River Vyrnwy, River Perry, River Tern, River Morda, Oswestry Brook, River Roden, Rea Brook and Rad Brook, flow through the northern half of the Council area, all of which form tributaries of the River Severn. Other main rivers within North Shropshire include Soulton Brook, Back Brook, Sleaf Brook, Bromley Brook, Bailey Brook, Tetchhill and Newnes Brook and Hen Afon. The River Teme, River Corve, River Onny, River Worfe, Albrighton Brook, Farley Brook and Wesley Brook form the designated main rivers within South Shropshire. A number of minor watercourses, non-main rivers, exist and have been analysed where data exists. A watercourse map, giving an overview of fluvial features in the study area, can be found in Volume 2, Tile A1.

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The Council Area is partially covered by two main Internal Drainage Boards (IDBs) which are responsible for local drainage networks: Meverley IDB to the North West, the Rea IDB to the mid west. A small area of the Powysland IDB also crosses into Shropshire to the west.

Severn Trent Water, Dwr Cymru and United Utilities are responsible for the operation and maintenance of the public sewerage networks across the Council area.

2 Planning Context

2.1 Introduction

This report conforms with National and Regional Planning Policy. It is a living document that provides the necessary information and guidance to allow the Council to make informed decisions relating to the use and allocation of land within the LDDs, to provide robust evidence to support the LDF at examination and to help formulate appropriate flood risk policies. An SFRA should be used as a tool by the LPA to assess flood risk for spatial planning, produce development briefs, set constraints, inform sustainability appraisals, and identify locations of emergency planning measures and requirements for flood risk assessments.

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

2.2 National Planning Policy

During the course of the update to this commission, the Government issued changes to national planning policy. Published on the 27th March 2012, the National Planning Policy Framework (NPPF) aims to make the planning system less complex and more accessible, to protect the environment and to promote sustainable growth

The advice and guidance in relation to flood risk is detailed in a companion document – the “Technical Guidance to the National Planning Policy Framework” (March 2012). The first section of this document deals with flood risk and is a direct transfer of the previous Planning Policy Guidance Notes (PPGs) 25 – Development and Flood Risk (March 2010).

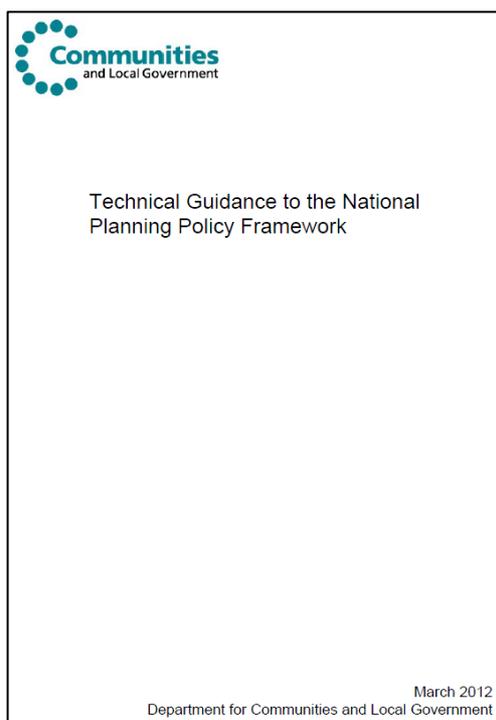
The new Flood Risk Technical Guidance of the NPPF reflects the general direction set out in ‘Making Space for Water’ (Defra, 2004), the evolving new strategy to shape

flood and coastal erosion risk over the next 10 to 20 years.

It is understood that the advice contained with the Flood Risk Technical Guidance of the NPPF may be reviewed and altered at some point in the future. If this does occur then it is recommended that this document is revisited to apply any required updates.

2.3 Regional Planning Policy

Prior to the commissioning of this Level 1 SFRA update, a number of major changes to the planning system were undertaken including the



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abolition of Regional Spatial Strategies (RSS) in May 2010. RSSs set out housing and employment targets at the regional level. Following the abolition of the West Midlands RSS, Shropshire Council must now establish its own development needs locally.

Shropshire Council formally adopted the Core Strategy Development Plan Document (DPD) on 24 February 2011. The Core Strategy sets out the strategic planning policy for Shropshire, including a 'spatial' vision and objectives. It also sets out a development strategy identifying the level of development expected to take place in Shropshire (excluding the Borough of Telford and Wrekin) up until 2026.

2.4 Local Planning Policy

2.4.1 Local Development Plans Framework

It is important to understand the historic context of the Level 1 SFRA studies. The Planning and Compulsory Purchase Act 2004 came into force in September 2004, requiring the Local Planning Authority to produce a Local Development Framework (LDF) rather than a Local Plan. The regulations relating to the new Act were published in September 2004 and in accordance with these, the Authority has produced a Local Development Scheme setting out the Local Development Documents which are to be produced and the timetable for their production.

The LDF was a collection of planning documents which consider a wide range of important planning issues such as housing, employment, retail, the environment, and transport. It was envisaged that the LDF would play a crucial role in prioritising and shaping the development in Shropshire over the next 20 years.

Within the text of the recently published NPPF guidance, is a presumption in favour of sustainable development, which should be seen as a golden thread running through both plan-making and decision-taking. Local Plans (superseding the former LDF documents) will allow Shropshire council to positively seek opportunities to meet the development needs of their area and provide sufficient flexibility to adapt to rapid change. The combined Shropshire Council Local Plans will eventually replace the saved policies contained in the Local Plans by the six former authorities and the Shropshire and Telford and Wrekin Structure Plan (jointly prepared by Shropshire and Telford and Wrekin Councils). When adopted, the policies and guidance contained in these will play an important role in the assessment of individual planning applications within Shropshire.

2.4.2 Core Strategy Development Plan Document

The Core Strategy sets out the Council's long-term spatial vision, objectives and strategy for development within the Unitary Authority Area. The Core Strategy will set a framework for all subsequent LDDs.

Shropshire Council formally adopted the Core Strategy Development Plan Document (DPD) on 24 February 2011. The Core Strategy sets out the strategic planning policy for Shropshire, including a 'spatial' vision and objectives. It also sets out a development strategy which identifies the level of development expected to take place within Shropshire (excluding the Borough of Telford and Wrekin) up until 2026 and a number of Core Policies which will help to achieve the vision. All subsequent

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Local Plan documents produced will build upon the Core Strategy, and apply policy CS18: Sustainable Water Management, which details Shropshire Council's approach to managing flood risk within a planning context.

2.4.3 Site Allocations and Management of Development (SAMDev) DPD

The SAMDev Plan is the Site Allocations and Management of Development Plan. It will allocate land for future development in Shropshire (excluding Telford and Wrekin) and contain new management of development policies which provide more detail to some of the policy areas covered within the Core Strategy. It will be used in determining planning applications. The SAMDev is currently being prepared and is scheduled for adoption in 2014.

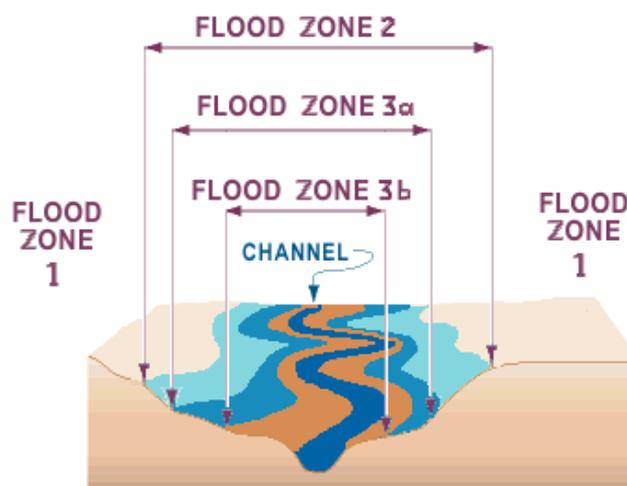
3 Flood Zone Maps

3.1 Introduction

A good understanding of PPS 25, the Environment Agency Flood Zones and SFRA Flood Maps is of fundamental importance for SFRAs.

3.2 NPPF Flood Zones

Table 1 of the NPPF Technical Guidance details the definition of Flood Zones within a planning context. The Flood Zones are adjacent areas that subdivide the spatial variation of flood probability from rivers and the sea. These are the functional floodplain and the high, medium and low probability flood zones. It is important to note that within each flood zone there is a spatial variation of flood probability and these are well defined. The functional floodplain, for example, comprises land where water has to flow or be stored in times of flood. The functional floodplain can be



drawn, therefore, on a map by combining the flood extents of many frequent floods, with high probability of occurrence. The range of frequency of these floods (or statistically, their average probability of occurrence in a given year) is the combination of floods that have an average probability of occurrence of 20%, or more, in a given year - 21%, 30%, 50%, 100%, 200%, etc. Other flood probabilities apply when the functional floodplain is acting to store water.

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

Shropshire Council

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

3.3 Environment Agency Flood Zones

The Environment Agency flood zones are published and updated quarterly in their website at:

http://www.environment-agency.gov.uk/subjects/flood/?lang=_e

These flood zone maps are also held on the Shropshire Council website:

<http://shropshire.gov.uk/maps/flood.htm>

Historically the Environment Agency and its predecessors have kept formal maps of tidal and fluvial flooding to the standards required by legislation. Originally this mapping recorded flood events, however in 1991, PPG 25 (the predecessor of PPS 25 – see Section 2.2) imposed a duty on the Environment Agency to produce flood zone maps. These maps needed to show the predicted extent of tidal and fluvial flooding for the high, medium and low flood zones (see Appendix A for more detail). The EA flood maps do not show the functional floodplain, which was a recent PPS 25 requirement which has been retained in the recently published NPPF guidance.



3.4 SFRA Flood Maps

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

SFRA flood maps also show 'localised' flooding areas from other sources/forms of flooding (see Volume 2, Tiles B1-B10, for maps showing 'flooding from all sources').

3.5 SFRA Climate Change Maps

The NPPF Technical Guidance sets out guidance for changes to flood risk as a result of climate change and this is summarised in Section 5.4. 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.

Where climate change outlines have been produced from existing models these outlines have been used. 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.

Shropshire Council

For watercourses where models do not exist, the most up-to-date Environment Agency flood zone maps have been used. A 1 in 100 year climate change scenario has been produced by assuming that Flood Zone 2 (1 in 1000 year return period) will become Flood Zone 3 (1 in 100 year return period). We have also assumed that the functional flood plain (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 our 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.

This is the level of detail which the NPPF guidance requires for a Level 1 SFRA. The climate change scenarios are provided in a series of maps covering the study area, found in Volume 2, Tile C1.

4 Overview of the NPPF Technical Guidance on Flood Risk

4.1 Key Aims

The key aims of the NPPF in the context of Flood Risk applies the principles previously established by PPS 25:

“Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere.”

Regional planning bodies and LPAs should prepare and implement planning strategies that help to deliver sustainable development by:

Appraising risk:

- Identifying land at risk and the degree of risk of flooding from rivers, the sea and other sources in their areas
- Preparing Regional Flood Risk Appraisals (RFRAs) or SFRAs as appropriate, as freestanding assessments that contribute to the Sustainability Appraisal of their plans

Managing risk:

- Framing policies for the location of development which avoid flood risk to people and property where possible, and manage any residual risk, taking account of the impacts of climate change
- Only permitting development in areas of flood risk when there are no reasonably available sites in areas of lower flood risk and benefits of the development outweigh the risks from flooding

Reducing risk:

- Safeguarding land from development that is required for current and future flood management e.g. conveyance and storage of flood water, and flood defences
- Reducing flood risk to and from new development through location, layout and design, incorporating sustainable drainage systems (SuDS)
- Using opportunities offered by new development to reduce the causes and impacts of flooding e.g. surface water management plans; making the most of the benefits of green infrastructure for flood storage, conveyance and SuDS; re-creating functional floodplain; and setting back defences

A partnership approach:

- Working effectively with the Environment Agency, other risk management authorities and other stakeholders to ensure that best use is made of their expertise and information so that plans are effective and decisions on planning applications can be delivered expeditiously
- Ensuring spatial planning supports flood risk management policies and plans, River Basin Management Plans and emergency planning”

These broad planning objectives effectively set the scope for the specific outcomes of the SFRA process. The SFRA in turn then informs planning and development control decisions that ensure the objectives set out above can be achieved.

4.2 Outcomes of the SFRA Process

An SFRA provides sufficient data and information to enable a planning authority to apply the Sequential Test to land use allocations and, where necessary, the Exception Test (see Sections 4.3 and 4.4).

The NPPF document also indicates that Sustainability Appraisals should be informed by the SFRA for their area. Under the Town and Country Planning (Local Development - England) Regulations 2004, a Sustainability Appraisal (SA) is required for all LDFs. The purpose is to promote sustainable development through better integration of sustainability considerations in the preparation and adoption of plans. The Regulations stipulate that SAs for LDFs should meet the requirements of the Strategic Environmental Assessment (SEA) Directive. An SFRA is also used as a tool by an LPA for the production of development briefs, setting constraints, identifying locations of emergency planning measures and requirements for FRAs.

It is important to reiterate that PPS 25 is not applied in isolation as part of the planning process. The formulation of Council 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.

4.3 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.

Preference should be given to locating new development in Flood Zone 1 (see Section 3.2). If there is no reasonably available site in Flood Zone 1, the flood vulnerability (or level of resilience to damages from flooding) of the proposed development can be taken into account in locating development in Flood Zone 2 and then Flood Zone 3 (see Appendix B).

Within each Flood Zone new development should be directed towards lower flood risk areas (i.e. towards the adjacent zone of lower probability of flooding).

4.4 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, taking into account 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.

For the Exception Test to be passed:

- a) It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. If the Development Plan Document has reached the 'submission' stage (see Figure 4 of PPS 12: Local Development Frameworks) the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal
- b) The development should be on developable previously-developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously-developed land
- c) A flood risk assessment must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall

The Exception Test will be possible following completion of the Level 2 SFRA.

5 Study Methodology

5.1 The Practice Guide Companion to PPS 25

The study methodology for the original Level 1 SFRA studies that were undertaken in Shropshire, and this update study, follows the guidance from the December 2009 “Development and Flood Risk: A Practice Guide Companion to PPS 25”. It is a ‘living draft’ web-based consultation paper (see <http://www.communities.gov.uk/publications/planningandbuilding/pps25guideupdate>); it is a comprehensive guide and incorporates many recommendations from previous guidance documents.

Despite the recent changes to planning policy legislation, the NPPF has not cancelled the Practice Guide Companion to PPS25. Given that the advice in the NPPF Technical Guidance on Flood Risk remains the same as that in PPS25, at the point in time of producing this update study document (May 2012) the advice contained within the Practice Guide Companion should still be considered when undertaking a Strategic Flood Risk Assessment.

The document reaffirms the adoption of a risk-based approach to flooding by following stepped hierarchical measures at all stages in the planning process. Assess is always the first measure, followed by Avoidance/prevention, substitution, control and then mitigation. This is summarised in Figure 2.1 of the Practice Guide Companion to PPS 25 (as reproduced below).

Table 5.1: Overview of how the spatial planning process can manage flood risk strategically (reproduced from Figure 2.1 of the PPS25 Practice Guide)

Flood Risk Management Stage	What it means	How the Planning System Deals with it	Who is responsible
Assess	Undertake studies to collect data at the appropriate scale and level of detail to understand what the flood risk is.	Regional Flood Risk Appraisals, Strategic Flood Risk Assessments and application of the sequential approach.	Planning bodies and developers.
Avoidance / Prevention	Allocate developments to areas of least flood risk and apportion development types vulnerable to the impact of flooding to areas of least risk.	Use the Sequential approach (including the Sequential Test and Exception Test where relevant) to locate development in appropriate locations.	Planning bodies and developers.
Substitution	Substitute less vulnerable development types for those incompatible with the degree of flood risk.	At the plan level, the Sustainability Appraisal should show how flood risk has been weighted against other sustainability criteria.	Planning bodies and developers.

Shropshire Council

Flood Risk Management Stage	What it means	How the Planning System Deals with it	Who is responsible
Control	Implement flood risk management measures to reduce the impact of new development on flood frequency and use appropriate design.	Use River Basin Management Plans, Shoreline Management Plans, Surface Water Management Plans, Flood Risk Management Strategies, appraisal, design and implementation of flood defences.	Planning bodies, Environment Agency and other coastal defence operating authorities, developers and sewerage undertakers. Developers are responsible for design of new developments.
Mitigation	Implement measures to mitigate residual risks.	Flood risk assessments. Incorporating flood resistance and resilience measures. Emergency Planning Documents. Implementation of flood warning and evacuation procedures.	Planning bodies, emergency planners, developers, the Environment Agency, other flood and coastal defence operating authorities and sewerage undertakers.

The Sequential Test of PPS 25 (now NPPF) is the most important flood risk management tool for spatial planning, as it implements the high level measures of avoidance/prevention and substitution (see Section 4.3).

5.2 Level 1 SFRA

A Level 1 SFRA is defined in the Practice Guide Companion to PPS 25, as the level that provides the necessary information for undertaking the Sequential Test. The scope of this study is a Level 1 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, the scope of the SFRA is widened to a more detailed Level 2 study.

5.2.1 Project Outputs for a Level 1 SFRA

The project outputs for Level 1 SFRA have been adopted for this study.

Following the advice from Section 2.34 of the Practice Guide Companion to PPS 25, the key project outputs are as follows:

- 1) Plans showing the administrative boundaries of the study area, main rivers, ordinary watercourses and defences (Volume 2, Map Tiles A)

- 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, Map Tiles B) – Due to the frequent update of Environment Agency Flood Zones, FZ2 and FZ3a have now been removed from the maps, and a link included to the latest versions on the Shropshire Council server. Flood Zone 3b has been retained due to the critical nature of the ‘Functional Floodplain’.
- 3) An assessment of the implications of climate change for flood risk in the study area over an appropriate time period (Volume 2, Map Tiles C)
- 4) Historical flood outlines (Volume 2, Map Tiles E) – not updated as part of this update due to no additional data
- 5) The location of any flood risk management measures, including both infrastructure (Volume 2, Tile A1) and the coverage of flood warning systems (Volume 2, Map Tiles F)
- 6) Locations where additional development may significantly increase flood risk elsewhere (see Section 6)
- 7) Guidance on the application of the Sequential Test (see Chapter 9)
- 8) Guidance on the preparation of Flood Risk Assessments for development sites (see Chapter 10).
- 9) Guidance on the likely applicability of different SuDS techniques for managing surface water run-off at key development sites (see Chapter 11)

5.3 Approach to Data Gathering

The main source of data for this study has been the Environment Agency, IDBs, web-based data, Shropshire Council and Severn Trent Water.

Priority has been given to the collection of geo-referenced information in electronic format, to ensure the effective management of the data within a GIS environment. All incoming data has been recorded on a project data register by a specialist document controller/GIS data manager, specifically designated for this project.

The quality review of the information has been carried out by an experienced core team. 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 existing information.

This Level 1 update study has obtained and utilised the latest versions of the original data sets, plus gathered any additional new information where appropriate. The subsequent sections of this report highlight where datasets have been updated, and any additional information incorporated. This report also provides a summary comparison between the differences identified between the original and new datasets.

5.4 Production of Flood Maps

The Environment Agency Flood Zone Maps and river models have been collected and used for the production of the SFRA flood maps (Volume 2, Map Tiles B).

For this Level 1 SFRA update the Environment Agency were consulted to obtain updated Flood Zone maps to ensure any new data had been captured. This information has been used to update the Flood Zone 3b maps in Volume 2 and the Flood Zone Climate Change maps. This data has been re-assessed to update the relevant sections of the report.

Given the frequent update of the Flood Zone maps by the Environment Agency, it was agreed that the maps produced as part of this Level 1 SFRA update commission, would not contain Flood Zones 2 and 3a. Instead, a link and reference to the location of the maps on the Shropshire Council website would be included:

<http://shropshire.gov.uk/maps/flood.htm>

5.4.1 Hydraulic (River) Models

River models have been collected and used for the production of the SFRA flood maps. Within the study area, Environment Agency hydraulic models exist for a number of watercourses. The table overleaf (Table 5.3) gives details of the modelled Flood Zone outlines, and the outlines presented in Volume 2, Map Tiles B. In all cases the approach has been discussed and agreed with the Environment Agency.

For this Level 1 update commission, there were two additional modelled watercourses that have been recently modelled by the Environment Agency (the River Rea and the River Roden). Results and flood extents from these new commissions have been incorporated into the GIS outlines, maps and information in this report.

For the remainder of watercourses in the study area, the Environment Agency's Flood Zone information is to be used (see Section 5.4). It should be noted that some smaller watercourses do not have Flood Zones produced for them.

Table 5.2: Environment Agency Hydraulic Models and Modelled Flood Zones within Shropshire Council

Modelled Watercourse	Modelled Extents Within LA area		Modelled Flood Zones				Notes
	Upstream	Downstream	3b	3a	2	3a Climate Change	
River Severn	SJ 3600 1700	SJ 7500 8100	√	√	X	X	The River Severn model extends through the central and south eastern parts of the Local Authority area, within the Districts and Boroughs previously known as Shrewsbury & Atcham, Bridgnorth and Telford and Wrekin. Mapped outlines for the 25 year and 100 year events have been used to represent Flood Zones 3b and 3a respectively. There is no available mapped outline for the 1000 year event. Therefore the Environment Agency's existing Flood Zone 2 has been used.
River Tern	SJ 6900 3500	SJ 5500 0900	√	√	X	√	The River Tern model extends through the north eastern part of the Local Authority area, within the Districts and Boroughs previously known as Shrewsbury and Atcham, North Shropshire and Telford and Wrekin. Mapped outlines for the 25 year and 100 year events have been used to represent Flood Zones 3b and 3a respectively. There is no available mapped outline for the 1000 year event. Therefore the Environment Agency's existing Flood Zone 2 has been used. Mapped outlines were available for the 200 year event. This was used in preference to the Environment Agency's existing Flood Zone 2 outline to represent the climate change scenario for this watercourse.
Battlefield Brook	SJ 5000 1700	SJ 5200 1400	√	√	X	X	The Battlefield Brook model extends through the central part of the Local Authority area, within the Borough previously known as of Shrewsbury and Atcham. Mapped outlines for the 25 year and 100 year events have been used to represent Flood Zones 3b and 3a respectively. There is no available mapped outline for the 1000 year event. Therefore the Environment Agency's existing Flood Zone 2 has been used. Mapped outlines were available for the 200 year event. This was used in preference to the Environment Agency's existing Flood Zone 2 outline to represent the climate change scenario for this watercourse.
Rea Brook	SJ 4300 1000	SJ 4958 1225	X	√	X	X	The Rea Brook model extends through the central part of the Local Authority area, within the Borough previously known as Shrewsbury and Atcham. The mapped outline for the 100 year event has been used to represent Flood Zones 3a. There is no available mapped outline for the 25 year or 1000 year event. Therefore the Environment Agency's existing Flood Zones 3a and 2 have been used. In addition, there is no mapped outline available for the climate change scenario. The Environment Agency's existing Flood Zone 2 has been used to represent this scenario.
Money Brook	SJ 4910 0900	SJ 4890 1060	X	√	X	X	The Money Brook model extends through the central part of the Local Authority area, within the Borough previously known as Shrewsbury and Atcham. The mapped outline for the 100 year event has been used to represent Flood Zones 3a. There is no available mapped outline for the 25 year or 1000 year event. Therefore the Environment Agency's existing Flood Zones 3a and 2 have been used. In addition, there is no mapped outline available for the climate change scenario. The Environment Agency's existing Flood Zone 2 has been used to represent this scenario.
Rad Brook	SJ 4510 1260	SJ 4900 1200	√	√	X	√	The Rad Brook model extends through the central part of the Local Authority area, within the Borough previously known as Shrewsbury and Atcham. Mapped outlines for the 25 year and 100 year events have been used to represent Flood Zones 3b and 3a respectively. There is no available mapped outline for the 1000 year event. Therefore the Environment Agency's existing Flood Zone 2 has been used. Mapped outlines were available for the 200 year event. This was used in preference to the Environment Agency's existing Flood Zone 2 outline to represent the climate change scenario for this watercourse.
Stags Brook	SJ 5501 4068	SJ 5289 4157	X	√	X	X	The Stags Brook model extends through the northern part of the Local Authority area, within the District previously known as North Shropshire. The mapped outline for the 100 year event has been used to represent Flood Zones 3a. There is no available mapped outline for the 25 year or 1000 year event. Therefore the Environment Agency's existing Flood Zones 3a and 2 respectively have been used. In addition, there is no mapped outline available for the climate change scenario. The Environment Agency's existing Flood Zone 2 has been used to represent this scenario.

Modelled Watercourse	Modelled Extents Within LA area		Modelled Flood Zones				Notes
	Upstream	Downstream	3b	3a	2	3a Climate Change	
River Teme	SO 4571 7523	SO 5374 6874	X	√	√	√	<p>The River Teme model extends through the southern part of the Local Authority area, within the District previously known as South Shropshire.</p> <p>Mapped outlines for the 100 year and 1000 year events have been used to represent Flood Zones 3a and 2 respectively. Whilst a mapped 25 year outline does exist, it was decided that the 25 year return period flood outline would not be suited to define Flood Zone 3b as this is known to have been derived from an older hydraulic model that was subsequently updated. The modelled 100 year flood outline has therefore been used to represent Flood Zone 3b.</p> <p>Analysis of inflows for the model indicated that the 200 year event best represented the 100 year climate change scenario. The modelled 200 year flood outlines was therefore used to represent the climate change scenario for this watercourse.</p>
Wesley Brook	SJ 7260 0930	SJ 7590 0280	√	√	X	√	<p>The Wesley Brook model extends through the south eastern part of the Local Authority area, within the District previously known as Bridgnorth.</p> <p>Mapped outlines for the 25 year and 100 year events have been used to represent Flood Zones 3b and 3a respectively. There is no available mapped outline for the 1000 year event. Therefore the Environment Agency's existing Flood Zone 2 has been used. Mapped outlines were available for the 200 year event. This was used in preference to the Environment Agency's existing Flood Zone 2 outline to represent the climate change scenario for this watercourse.</p>
Albrighton Brook	SJ 8172 0527	SJ 7811 0459	√	√	√	√	<p>The Albrighton Brook model extends through the south eastern part of the Local Authority area, within the District previously known as Bridgnorth.</p> <p>Mapped outlines were available for the 25 year, 100 year, 1000 year and 100 year climate change scenarios. These were used in preference to the Environment Agency's Flood Zone maps to represent Flood Zone 3b, 3a, 2 and, the climate change scenario respectively.</p>
River Rea	SJ 4630 3343	SJ 5940 1244	√	√	√	√	<p>The River Rea model extends from the upstream extent at Minsterley, and flows in a general north-easterly direction towards Shrewsbury. The river flows around the southern edge of the town, before turning and heading north at Sutton Farm, before swinging around to the west, where it joins the River Severn at its confluence just upstream of English Bridge.</p> <p>Mapped outlines for the River Rea were available for the 2, 5, 10, 20, 50, 75, 100, 100 climate change, 200 and 1000 year return periods. Relevant flood extents have been incorporated into the Environment Agency's Flood Zone maps to represent Flood Zone 3b, 3a, 2 and, the climate change scenario respectively.</p>
River Roden	SJ 3703 0589	SJ 4964 1226	√	√	√	√	<p>The River Roden model extends from the upstream extent at Northwood, where upon it flows in a general south easterly direction, through Wem, before turning south at Aston, on through Shawbury, to the confluence with the River Tern at Walcot.</p> <p>Mapped outlines for the River Roden were available for the 2, 5, 10, 20, 50, 75, 100, 100 climate change, 200 and 1000 year return periods. Relevant flood extents have been incorporated into the Environment Agency's Flood Zone maps to represent Flood Zone 3b, 3a, 2 and, the climate change scenario respectively.</p>

5.4.2 Walking Survey Flood Zone Maps

In addition to the Environment Agency's Flood Zones, flood outlines for the Church Stretton area were provided by the former South Shropshire District Council. These are estimated Flood Zone 3a flood outlines that were created after survey by the Environment Agency. Engineering judgement was also applied following a walking survey of the area that was undertaken for two purposes:

1. To provide a flood outline for the headwaters of the Quinny Brook between Church Stretton and Elms Lane, Little Stretton. To this point the catchment area of the brook is too small to have been picked up by the automatic generation of the Environment Agency's Flood Zones.
2. To improve the flood outline associated with the headwaters of the Cound Brook as it flows through Church Stretton. The DTM used in the generation of Environment Agency Flood Zones appears to have been too coarse to pick up the true route of the brook and subsequently directed flows on an unlikely course.

The Walking Survey flood outlines have therefore been incorporated into the Flood Zones provided. The Flood Zone 3a outline produced has been used in preference to the Environment Agency Zone 3a wherever it exists.

Since no Flood Zone 2 was produced under the Walking Survey, the Environment Agency Flood Zone 2 has been used. Wherever the Walking Survey Flood Zone 3a was found to exceed the Flood Zone 2 outline the two outlines have been merged. In the area that the original Flood Zone 3a was thought to be incorrect (principally in plotting the course of the brook adjacent to Carding Mill Valley and subsequent spills into the Churchill Road area) the assumption has been made that in an extreme event the brook might find its way into this area. On the headwaters of the Quinny Brook where no Environment Agency Flood Zone 2 outline exists it has not been possible to create one for this study.

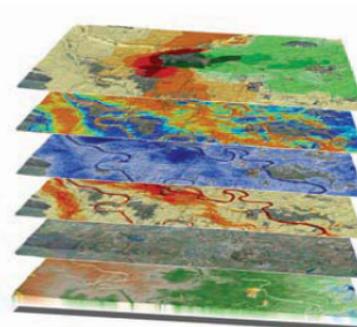
In common with all other watercourses where no modelled flood outline exists the Flood Zone 3a in Church Stretton (described above) has been used to represent Flood Zone 3b following climate change, while the existing Flood Zone 2 (also described above) has been used to represent Flood Zone 3a following climate change.

5.4.3 Surface Water Management Plan Flood Maps

Shropshire Council has undertaken hydraulic modelling in a number of locations as part of its Surface Water Management Plan programme. These include detailed models of watercourses and overland flow routes. The model results will, in time, be incorporated into the Environment Agency's Flood Zone Maps.

5.4.4 Environment Agency Flood Zone Maps

The main GIS delivery of the original Level 1 study was the production of strategic flood risk maps, incorporating the subdivision of Zone 3 into Zones 3a and 3b of PPS 25. The strategic flood risk maps are presented as GIS layers (with associated descriptive information) together with OS base maps and layers of watercourses.



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As discussed in Section 5.4, given the frequent update of the Environment Agency Flood Zone maps, it was agreed that the maps produced as part of this Level 1 SFRA update commission, would not contain Flood Zones 2 and 3a. Instead, a link and reference to the location of the maps on the Shropshire Council website would be included in the 'digital maps'.

<http://shropshire.gov.uk/maps/flood.htm>

It is therefore imperative that in any assessment made using this SFRA report and associated results, is used in conjunction with the very latest Environment Agency flood zone maps found at the web site above.

The following precautionary assumptions have been adopted in the absence of more detailed information:

1. Allow for a large uncertainty buffer zone for the functional floodplain Zone 3b, so that it overlaps with Flood Zone 3a (Flood Zone 3b equal to Flood Zone 3a).
2. Where specific modelled data does not exist, Flood Zone 2 is equal to Flood Zone 3a with climate change (the medium risk zone will become the high risk zone within 100 years – see Section 3.5). Many previous flood mapping studies by Halcrow have confirmed that increases in flows by 20% (the expected increase within 100 years, see table below) to Flood Zone 3, result in flood extents which are in general smaller than Flood Zone 2.

In its November 2006 publication of the predicted effects of climate change on the United Kingdom, DEFRA 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".

The main Climate Change table from PPS 25 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%		
Offshore wind speed	+5%		+10%	
Extreme wave height	+5%		+10%	

5.5 Forms of Flooding and Data Limitations

For the purpose of this assessment, forms of flooding (also defined as sources of flooding) are divided into four categories, the first covering fluvial flooding, the second flooding from artificial drainage systems and surface water runoff, the third covering flooding from impounded water bodies and the fourth from groundwater flooding. The reason for adopting this classification is to provide an understanding of data limitations and assumptions as there are different standards for the collection of each of these types of data.

5.5.1 Fluvial Flooding

This form of flooding (flood zones) is described in Chapter 3. See also Appendix A for further details, including assumptions and limitations.

5.5.2 Surface Water Flood Maps

It has been estimated that two-thirds of the flooding in summer 2007 was a result of surface water flooding (Environment Agency, 2007). Surface water flooding occurs when local drainage systems are unable to cope with the rainfall. With climate change predicted to cause more frequent, short-duration, high intensity rainfall and more frequent occurrences of long-duration rainfall, surface water flooding is likely to be an increasing problem.

It is difficult to predict precisely where surface water flooding will occur as it is dependent on a number of factors including ground levels, rainfall and the local drainage network. In comparison to fluvial mapping, surface water mapping is in its infancy. Following the summer 2007 floods, one of the key recommendations of the Pitt Review was that the Environment Agency, supported by Local Authorities and water companies, should identify areas that are at highest risk from surface water flooding. As part of this process, a series of broad scale maps were produced by the Environment Agency which are applicable to this area. These included:

- Environment Agency 'Areas Susceptible to Surface Water Flooding' (AStSWF) – a national map covering England and Wales. This map was released in June 2009 to provide a general indication of areas which are more likely to suffer from surface water flooding. These maps were a good starting point in understanding the broad areas where surface water flooding is likely to cause problems
- Environment Agency 'Flood Map for Surface Water' (FMfSW) – a national map covering England and Wales. This map was released in November 2010 and provides a revised approach to mapping surface water flooding including accounting for the presence of drainage systems and more realistic drainage paths being picked up by a more detailed Digital Terrain Model (DTM) – including buildings for example.

Both data sets are available for use in planning decisions and should be used in conjunction with this report.

5.5.3 Records of Flooding from Artificial Drainage Systems and Surface Water Runoff

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, and not to a uniform standard. All Water Companies have a statutory obligation to maintain a register of properties/areas which have experienced flooding from the public sewerage system and this is shown on the DG5 Flood Register. This includes records of flooding from foul sewers, combined sewers and surface water 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 following: the date of the most recent incident, the post town, locality, street, post code (four or six figures), a sewer problem description, sewer type description, if internal flooding occurred, details of curtilage flooding, and the eastings and northings of the flood incident. The recording of flood events by the authorities has often led to improvements intended to prevent reoccurrence, so historical flooding is not necessarily evidence of propensity for future flooding. Information on flooding caused by surface water runoff can also be obtained from local government, highway authorities, the Environment Agency and libraries.

5.5.4 Records of Flooding from Impounded Water Bodies

Records of flooding from reservoirs and canals are erratic as there is no requirement for the Environment Agency to show historic flooding from canals and raised reservoirs on plans. In particular, NFFP guidance does not require flood risk from canals and raised reservoirs to be shown on the flood map. This is surprising, as overflows from canals are 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.

The first publication of this Level 1 SFRA provided guidance based on the 1975 Reservoirs Act, which stated that reservoirs with an impounded volume in excess of 25,000m³ (cubic metres - measured above natural ground level) should be listed on a register held by the Environment Agency. The Flood and Water Management Act 2010 (see Section 5.6.2) calls for a more active, risk-based approach to reservoir regulation, by:

- reducing the capacity at which a reservoir will be regulated from 25,000m³ to 10,000m³;
- requiring all undertakers with reservoirs over 10,000m³ to register their reservoirs with the Environment Agency;
- ensuring that only those reservoirs assessed as high risk are subject to full regulation;
- requiring all incidents at reservoirs to be reported.

Due to high standards of inspection and maintenance required by legislation, normally flood risk from registered reservoirs is moderately low.

5.5.5 Records of Groundwater Flooding

Both the Environment Agency and planning authorities can keep records of individual groundwater flooding events. The Environment Agency holds a dataset called the Areas Susceptible to Groundwater Flooding (AStGWF). This is a strategic scale map showing groundwater flood areas on a 1km square grid. It was developed specifically by the Environment Agency for use by Lead Local Flood Authorities (LLFAs) for use in the Preliminary Flood Risk Assessment (PFRA) as required under the Flood Risk Regulations 2009. The data was produced to annotate indicative Flood Risk Areas for PFRA with information to allow LLFAs to determine whether there may be a risk of flooding from groundwater.

This dataset will provide a broad feel for the wider areas which might be at risk from groundwater flooding within the Shropshire Council Area, in addition to recorded historic events.

The AStGWF data has used the top two susceptibility bands of the British Geological Society (BGS) 1:50,000 Groundwater Flood Susceptibility Map and thus covers consolidated aquifers (chalk, sandstone etc., termed 'clearwater' in the data attributes) and superficial deposits. It does not take account of the chance of flooding from groundwater rebound. It shows the proportion of each 1km grid square where geological and hydrogeological conditions show that groundwater might emerge. The susceptible areas are represented by one of four area categories (listed below) showing the proportion of each 1km square that is susceptible to groundwater emergence. It does not show the likelihood of groundwater flooding occurring.

In common with the majority of datasets showing areas which may experience groundwater emergence, this dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding.

5.6 Wider Published Studies and New Legislation

Since the publication of the original Shropshire Level 1 SFRA, there have been a number of changes to legislation regarding flood risk, and therefore a number of recently published reports that will compliment this document. Rather than reproduce the contents of those reports here, a summary is provided below of the aims and key findings of these commissions, and information has been used to populate subsequent sections of this report.

5.6.1 Flood Risk Regulations 2009

The Flood Risk Regulations 2009 (FRR) transpose the European Floods Directive 2007/60/EC into English and Welsh law. These Regulations seek to manage flood risk from all sources by bringing together key partners to manage flood risk. As a result, Local Authorities are assigned responsibility for management of surface water flooding.

A key requirement was the completion of a Preliminary Flood Risk Assessment (PFRA) – with the PFRA for Shropshire being completed in May 2011, with maps and management plans being developed for the at risk areas.

5.6.2 Flood and Water Management Act 2010

The Flood and Water Management Act 2010 (FWMA) aims to facilitate the co-ordination and delivery of local flood risk management (surface water, groundwater and flooding from ordinary water courses). Shropshire Council, in becoming a Lead Local Flood Authority, has been empowered to manage local flood risk through new responsibilities for flooding from ordinary watercourses, surface water and groundwater.

5.6.3 Local Flood Risk Management Strategies

The FWMA 2010 requires each LLFA to produce a Local Flood Risk Management Strategy (LFRMS). Shropshire Council being the LLFA in this area has undertaken a number of commissions which compliment existing data from previous and new studies, providing the necessary evidence base to meet these requirements, as outlined in subsequent sections below.

5.6.4 Regional Flood Risk Appraisal

Produced by the West Midlands Regional Assembly in 2007, and updated in 2009, the document provided thirteen recommendations to address and manage flooding from all sources.

5.6.5 Shropshire Outline Water Cycle Study

A Shropshire outline Water Cycle Study (WCS) was completed by Halcrow in June 2010.

5.6.6 Surface Water Management Plans

The wide scale flooding experienced during 2007 led to the publication of the Pitt Review, in which a key recommendation was for the development of local Surface Water Management Plans - a tool to manage surface water flood risk on a local basis by improving coordination between relevant stakeholders.

Shropshire Council

Recommendation 18: “Local Surface Water Management Plans, as set out in PPS25 and coordinated by local authorities, should provide the basis for managing all local flood risk. “

Building upon the information in the original Shropshire Level 1 SFRA, five SWMPs were commissioned for Shropshire – Church Stretton, Shifnal and Craven Arms. The Church Stretton and Shifnal SWMPs have been published, whilst the Craven Arms commission remains in a draft format. The Shrewsbury and Oswestry SWMPs are currently being prepared.

Options and immediate, short term, medium term and continuous actions were developed, and guidance given as to how the SWMPs should integrate into the planning process- ideally informing the Core Strategy and Development Plan Documents.

5.6.7 Much Wenlock Integrated Urban Drainage Management Plan (IUDMP)

An Integrated Urban Drainage Management Plan was published in June 2011 for Much Wenlock. Undertaken due to the frequency and severity of past flood events in Much Wenlock, the study allowed the flooding mechanisms and the characteristics of the catchment to be better understood.

Hydraulic models were built in both 1D and 2D that had the capability to route any predicted flooding from the sewer / town culvert manholes over the ground to simulate the overland flow paths. Rural reaches of Sytche Brook, Shylte Brook and Farley Brook were also modelled. The models were used to assess the existing open watercourses and sewer network, and to model proposed flood mitigation options.

An Action Plan was compiled as part of the commission which set out objectives supported by the stakeholders.

6 Flood Risk in the Study Area

6.1 Hydrology

The Shropshire Unitary Authority area contains a number of designated main rivers, listed below:

- **River Severn:** The River Severn flows across the Shropshire Unitary Authority from the western edge of the boundary at Molverley (the River Vyrnwy confluence). From here, the river meanders through the rural landscape before looping round Shrewsbury town where it is fed by both the Rad Brook and the Rea Brook. The catchment area at the gauging station at Montford Bridge is approximately 2000km², however, during summer months flows in the river can be very low. The floodplain of the River Severn is very confined upstream and downstream of Shrewsbury, and indeed through most of the town.
- Downstream of Shrewsbury is the confluence with the River Tern which has a large contributing catchment of some 870km². The floodplain broadens again after leaving Shrewsbury and, with a slacker profile, meanders from Cressage down to Buildwas. From here the River Severn turns east towards Telford where it begins to cut through the bedrock to form the famous gorge at Ironbridge. From here the river turns and head southwards, flowing towards Bridgnorth. Here the catchment area of the River Severn is 4000km² and is diverse with the western part (50%) falling in impermeable Palaeozoic rocks and river gravels; and a drier northern part (50%) falling in drift covered Carboniferous to Liassic sandstones and marls. Land use within this local catchment is mostly forestry and mixed farming. Downstream of Bridgnorth, the river flows through a predominantly rural area, and on towards the edge of the Shropshire boundary near Highley.
- **River Morda:** The River Morda flows south from Oswestry draining steep valley sides before meeting the River Vyrnwy to the west of Pant shortly before the Vyrnwy Severn confluence.
- **River Perry:** The River Perry is a tributary of the River Severn and flows in a southerly direction from the north at Gobowen.
- **River Vyrnwy:** The River Vyrnwy runs from the Welsh mountains and heads east towards England before joining the River Severn near the village of Molverley on the Welsh border. The river runs for 37 miles (13 km); the last 8 miles forms a natural boundary between England and Wales.
- **River Tanat:** Only 6 km of the River runs through the Shropshire Council area, after which the river runs south back across the border into Wales where it feeds the River Vyrnwy.
- **River Tern:** From it's headwaters around Market Drayton the River Tern flows south through Rural Shropshire into the Telford and Wrekin Unitary Authority, fed by the River Meese the River Strine and the River Roden before joining the River Severn.
- **River Perry:** The River Perry is a tributary of the River Severn and flows in a southerly direction from the north near Ellesmere.
- **River Roden:** The River Roden runs from west to east through Wem before turning south through Shawbury and joining the River Tern before meeting the River Severn. The river is recognised for its abundance in wildlife and a large variety of fish.

Shropshire Council

- River Duckow: From its headwaters north east of Market Drayton the River Duckow flows in a northerly direction. Along with the Stags Brook in the north west of the area, this watercourse falls within the Environment Agency's North West Region.
- Cound Brook: The Cound Brook rises in the Carding Mill Valley above Church Stretton. Along with the River Camlad it is the only Environment Agency designated Main River in Shropshire that flows in a predominantly northerly direction.
- River Camlad: The eastern headwaters of the Camlad rise in western south Shropshire before converging at Church Stoke in Wales. From here the Camlad re-enters Shropshire for approximately 6km. The area surrounding the final stages of the river (along with the Aylesford Brook) is maintained by the Powysland IDB.
- Rea Brook: The Rea Brook rises to the west of Pontesbury, and flows north easterly before entering Shrewsbury, where it joins the River Severn. The drains and minor watercourses in this area are maintained by the Rea IDB.
- River Rea (south Shropshire): There is a second River Rea in this study area. This is a tributary of the River Teme, rising principally in the Bridgnorth area and cutting across Shropshire from Cleobury Mortimer feeding the River Teme at Newnham Bridge.
- River Clun: Together with the River Kemp and River Redlake this watercourse flows eastwards through the south western area of Shropshire, before meeting the River Teme at Leintwardine in Herefordshire. Along with the River Western Onny their watersheds form the Shropshire border with Wales.
- River Onny: The West Onny and East Onny have their headwaters in the hills in the north of the District and merge before joining the Quinny Brook to the north of Craven Arms. The River Onny then flows in a southerly direction to feed into the River Teme upstream of Ludlow.
- River Corve: The Corve rises in the north southern area of Shropshire, flowing predominately southwards, towards the River Teme immediately upstream of Ludlow.
- River Teme: The River Teme rises in Mid Wales and flow west through Ludlow in south Shropshire It is the largest tributary of the river Severn. The whole of the River Teme was designated as a SSSI, by English Nature, in 1996 (now Natural England). Water levels in the Teme are highly variable.
- River Worfe: Wesley Brook and Albrighton Brook in the north corner of the District join at Ryton where from hereon the watercourse is referred to as the River Worfe. The River Worfe commands a catchment of approximately 200km² and flows from north to south parallel with the River Severn through the rural landscape before turning west and feeding the River Severn just north of Bridgnorth.

A watercourse map, giving an overview of fluvial features in the study area, can be found in Volume 2, Tile A1.

6.2 Geology

Shropshire has a diverse geology with a wide range of mineral resources and rocks representing most of the major divisions of geological time. The thick glacial sands, gravels and boulder clays (glacial till) of the Cheshire basin extend southwards into north Shropshire, where they produce a flat or gently rolling landscape, which is punctuated with hummocks and lakes formed by receding glaciers (e.g. the country around Ellesmere). Glacial deposits also occur intermittently outside of north Shropshire, especially in the major river valleys south of Shrewsbury. Glacial sand and gravel is one of Shropshire's most important mineral resources. Lower Carboniferous dolomitic limestone (limestone containing magnesium) occurs in the Oswestry area, where it is worked for road stone and agricultural magnesium lime at Llyncllys Quarry.

The geology of the catchments in these areas gives rise to high permeability rates. The Triassic Sandstone aquifer in the north of Shropshire is an important part of the Shropshire Groundwater Scheme initiated to preserve flows in the River Severn.

Some of the oldest rocks in Shropshire are to be found in the central area of the Unitary Authority, near Shrewsbury, on Haughmond Hill. The sedimentary rocks here are Precambrian in age, and quarried for use on roads. The West Shropshire mining district was also a leading producer of vein minerals including lead, zinc and barytes in the 19th and early 20th centuries.

The Wrekin is a prominent hill near the town of Telford. The sedimentary rock types are varied around the area, but lava from various volcanic eruptions formed this landmark, however, The Wrekin itself is not a volcano, and never was. Intrusions of igneous rock have been quarried in the past at nearby Ercall Quarry.

Most of the geology of these reaches of the River Severn consists of alluvium deposits (clay, silt, sand and gravel, in varying proportions) up to 40 metres deep overlying mottled sandstone and mudstone with shales around the Cressage area. The exception is the Ironbridge Gorge which comprises outcropping Wenlock series shales and limestone through which the river carved its way when it changed direction after the last Ice Age.

The geology of the Clee Hills (Titterstone Clee and Clee Hill) are part of an outlier of Carboniferous sedimentary rocks, which in some locations lie on older Devonian and Silurian sedimentary rocks, and in other places are faulted against them. These are two of the three highest points in Shropshire, and serve as outcrops for sandstone, various coal measures and limestone (the high ground of the Clee Hills unusual for coal measures sediments which are generally not particularly resistant to weathering and erosion..

To the north west of Clee is Church Stretton, famous perhaps because it gives its name to the fault that runs through the town and the whole county. The Church Stretton hills were formed on a continental shelf, but buckled up into hills at the time of a continental collision, which formed the Variscan mountains. The most famous of these hills is probably the Long Mynd, which forms the west side of the Stretton Valley.

South West of Church Stretton, and at the westernmost border of England with Wales, is the very rural area of Clun. The rocks here are mainly Silurian in age, and whilst they are, on the whole, soft

rocks that are easily eroded, the topography is very varied with an impressive landscape, and the hills were put to good use in Iron Age times with the use of fortresses on the hills around Clun and Anchor.

Permo Triassic rocks occur extensively in the east of the county around Bridgnorth and emerge from beneath the thick glacial deposits in the north of Shropshire to form a series of attractive sandstone ridges (e.g. Nescliffe Hill, Hawkstone Park). These rocks were deposited in desert conditions at a time when Britain was nearer the equator. Permo Triassic sandstones are an important historic source of building stone and are still worked today for high quality cut stone (dimension stone) at Grinshill, near Wem. Permo-Triassic conglomerates are also a source of sand and gravel. This type of geology catchments gives rise to high permeability rates within the catchment.

For further details, see Volume 2 for the solid geology and drift geology maps.

6.3 Historical Flooding

Available historic flood extents have been provided by the Environment Agency and are included in the digital deliverables of this commission.

6.3.1 The Severn Catchment

The Severn catchment has a long and well-documented history of flooding, with records dating as early as 1258 detailing flooding in Shrewsbury. Recent high profile flood events on the Severn occurred, in October 1998, autumn 2000, February 2002, New Year 2003 and February 2004. Following submission of the draft SFRA in June 2007, a series of high-intensity rainfall events occurred in both June and July 2007, causing widespread flooding from all sources. In some places the magnitude of the flood events surpassed those witnessed during the great floods of 1947.

Generally flooding on the Severn is caused by rainfall in the upper reaches of the catchment causing a 'plug' of water to flow down the river to the sea. The Avon, Vyrnwy and Teme are the most significant tributaries of the Severn, though the flows from these rivers in isolation do not generally cause significant flooding on the Severn itself (however, despite the low frequency, they do still occur and can cause significant flooding. In February 2011, a rapid flood event in the River Vyrnwy catchment caused water levels to rise several metres in a few hours, which resulted in a number of people being evacuated from their homes near Four Crosses (just south of the Shropshire border).

The River Severn is a regulated river with a five day mean flow of 850MI/d to be maintained at Bewdley in the summer months. The river needs to support domestic, agricultural and industrial water uses without an adverse affect on the environment. Flows are augmented when required in summer with water stored in reservoirs over the winter months or abstracted from the ground as part of the Shropshire Groundwater Scheme. This is a vital part of the River Severn regulation. Increased demand during the 1970's compounded by the severed drought in 1976, resulted in an additional supply being sourced. The Shropshire Groundwater Scheme was developed which the Environment Agency state:

- is designed to be used, on average, once every three years to meet peak dry weather demands for water

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- water is pumped from groundwater reserves naturally stored within the sandstone underlying much of North Shropshire. This water is pumped out and released to the River Severn to enhance flows in the river
- the scheme has six development areas and is being constructed in eight stages. At the present time, four phases have been completed and the fifth is underway
- around each borehole, a pumping station is built, which is designed to have a minimal impact on the local environment.

Lake Vyrnwy and Llyn Clywedog, in the headwaters of the Vyrnwy and Clywedog, provide limited flood mitigation to the upper reaches of the Severn. Lake Vyrnwy, at the headwaters of the Vyrnwy, serves a dual purpose as a water storage and river regulation reservoir. Although not designed for flood storage, the reservoir does have a limited effect in managing flood risk in the vicinity of the dam.

Llyn Clywedog, which is located on the Afon Clywedog, was designed as a river regulation reservoir, generally to boost low flows during the summer months. It also provides a modicum of flood attenuation local to the dam. At the time of the autumn 2000 event the reservoir was emptier than usual and no floodwater was discharged but extensive flooding still occurred. However the continued rainfall caused the reservoir to spill for subsequent events, as there was insufficient time for the reservoir level to be reduced to allow flood storage (*River Severn Fluvial Strategy 2006*).

6.3.2 Notable events

Autumn 2000

This was the wettest autumn on record over England and Wales for 270 years. In certain parts of Wales rainfall was exceptional, with 331mm being recorded for the 11 day period between 28th October and 8th November 2000 at Dolydd in the Welsh Mountains. This equated to a 1% AEP, or 1 in 100 year, rainfall event. The event impacted the whole of the Severn valley and in places was worse than the floods of 1947. Prolonged rainfall was not limited to the upper reaches of the Severn and Vyrnwy, with other tributaries, such as the Camlad and Rhiw, contributing significant additional volumes to the flows coming down from the upper reaches. Ludlow was also hit by floods when the River Teme and River Corve bursts its banks (*Haw Bridge, November 2000, Environment Agency*).

The Environment Agency noted that “recent development in the floodplain was not as major an issue in Midlands Region as it may have been in other parts of the country. A relatively small proportion of the properties which flooded were less than 10 years old. Prior to the autumn 2000 flooding the most significant event in the catchment in living memory had been in 1947, which caused widespread damage and disruption. This flooding was triggered by the melting of heavy winter snow (*Dale End, Ironbridge 1947, Environment Agency*).

Indicative autumn 2000 event probabilities

Pentre	1.11%
Shrewsbury	1.54 - 1.82%
Ironbridge	2%
Bridgnorth	4 - 5%

February 2002

This event occurred during the beginning of February 2002 when flooding occurred at a number of locations along the Severn including Shrewsbury, Ironbridge, Bridgnorth, and Bewdley. At Pontrobert and Llanymynech on the River Vyrnwy, the peaks on the 11th February were the highest on record. Return periods at the top of the catchment were estimated to be greater than those at gauging stations further downstream. At Welsh Bridge in Shrewsbury, and at Bewdley, the event was less exceptional with return periods of 5-10 years (*Llanymynech Bridge February 2002, Environment Agency*).

New Year 2003

New Year 2003 was a relatively minor event caused by prolonged rainfall across the catchment. The demountable defences to protect properties in Severnside North, Bewdley, were erected for the first time during the event, as a precautionary measure, although the water levels did not actually reach the level of the defences (*Flood Report 28th October – 20th November 2000, Midlands Region*)

Summer 2007

Following submission of the first version of this SFRA document, a series of high-intensity rainfall events occurred in both June and July 2007, causing widespread flooding from all sources. In some places the magnitude of the flood events surpassed those witnessed during the great floods of 1947. Key flooding locations and recorded data from the Environment Agency are detailed below.

In Shropshire the EA recorded that in July 2007 the total rainfall for Shropshire was 165mm which equates to a 330% of the % of 1971-00 average). As part of the data gathering exercise for this update study, the EA have provided a number of digital flood extents from the 2007 events which have been included in the digital deliverables of this report (covering the River Corve and Teme at Ludlow and the River Teme between Gosford to Rochford).

Key Affected Areas

The Severn Valley Railway line from Bridgnorth suffered numerous landslips and was closed.

Shifnal received some of the worst flooding in living memory with the Wesley Brook coming out of bank and flooding around 60 properties.

At Tenbury Wells the two highest events on record occurring during the summer of 2007 – with the highest recorded maximum stage on the River Teme recorded by the EA being 53.97m AOD on the 21/07/07, and the second highest being 53.74m AOD in June 2007.

Just south of the study border on the River Clun Leintwardine, the EA have calculated the return period event of flooding was likely to be between a 1 in 21–50year event.

At Hook-a-gate near Shrewsbury, the Rea Brook was estimated to have experience between a 1 in 51–100 year event during the summer 2007 floods. This was also the case for the River Rea at Newnham Bridge (just south of the Shropshire border), where the River Rea was estimated to have experience between a 1 in 51–100 year event.

Shropshire Council

On the Dowles Brook (a tributary of the River Severn) at Oak Cottage (north west of Bewdley), the EA have estimated that the return period event for July 2007 was between a 1 in 101-150 year event, with an event great than 1 in 150 years for June 2007.

On the River Corve at Ludlow (a tributary of the River Teme) the EA estimated that the return period event for June 2007 flood was greater than a 1 in 150 year event. The event at Ludlow received widespread media coverage when a house collapsed following the collapse of the Burway Bridge into the River Corve.

2011

In February 2011 a flood event on the River Vyrnwy and Severn saw water levels rise over a number of hours. The EA defences at Ironbridge at Shrewsbury were deployed, and areas around Llanymynech were affected, with several homes evacuated in Four Crosses just south of the Shropshire Border. Further downstream in the Severn Catchment, areas around Bridgnorth were also affected

6.3.3 Frequency of Flooding

The frequency of flooding varies across the study area, with some communities regularly affected. Examples of the return periods at which flooding begins for a number of communities are shown below.

Average % chance of event at onset of flooding

Pentre	20%
Shrewsbury	20 - 33%
Ironbridge	50%
Bridgnorth	20 - 33%

6.3.4 Flooding from Fluvial Sources

Northern Shropshire

The north Shropshire area is at relatively low risk from fluvial flooding, however the Flood Zone maps do indicate that certain areas would be at risk from severe events.

The Staggs Brook flows through the town of Whitchurch. The Environment Agency's model has shown that flooding from this watercourse would affect a substantial area of the town centre for the 100 year return period event. However, the possibility that the current Flood Zones are inaccurate in this area has been raised. This is due to the limitations of the method used to generate flood zones in this area (see Appendix A for more details).

In the north west of Shropshire, a number of properties in and around Ellesmere are shown to be at risk of flooding from the Tetchill Brook and its tributaries (though a flood risk assessment submitted in November 2006 suggested that the flood outline for the Tetchill Brook might be overestimated). Further downstream the large areas of agricultural land are shown to be at risk of flooding from the River Perry and its various tributaries.

Shropshire Council

In the centre of the north of Shropshire, it is predicted that properties in the Green Hill area of Wem would be affected by flooding from the River Roden for the 1000 year flood event. Upstream, at the confluence of the Sleaf Brook and the River Roden a substantial area of agricultural land is predicted to flood.

Further downstream the River Roden flows through a number of villages, such as Poynton Green and Shawbury, which are shown to have areas located within Flood Zone 2 and Flood Zone 3.

In the north east areas the southern fringes of Market Drayton fall within Flood Zone 2 of the upper reaches of the River Tern.

The Morlas Brook has a generally narrow floodplain though this widens significantly in the Western Rhyn area. As a consequence a number of properties are included within Flood Zones 2 and 3 in this area.

Also in the north, parts of the village of Gobowen are shown to fall within the Flood Zone of the River Perry and a right bank tributary, however the majority of the area predicted to be affected by this watercourse is currently under agricultural land use. Further downstream, the fringes of the village of Ruyton-XI-Towns are also affected.

The River Morda skirts to the south of Oswestry and runs parallel to a minor tributary that it joins close to the hamlet of Woolston. Much of the area between the two watercourses is included within the Environment Agency's Flood Zones 2 and 3. This includes part of the main industrial area to the south of Oswestry and the area around Ball, Maesbury and Maesbury Marsh.

Also in the north west, the River Vyrnwy has an extensive floodplain with numerous small settlements included within Flood Zone 2.

The Borough the village of Pentre is shown to be situated within the River Severn floodplain despite being almost 1km from the river channel itself.

Central Shropshire

Shrewsbury is located on the River Severn and hence large areas of the town are at risk of flooding. Throughout the town Flood Zone 2 extends for up to 300m on either side of the main channel, and includes part of areas such as Frankwell, Castlefields, Monkmoor and Abbey Foregate. At the points where the Rad, Rea and Battlefield Brooks enter the River Seven the area predicted to be affected by flooding is wider, particularly in the case of the Rea Brook. In addition, the area, a SSSI, that occupies a former channel of the River Severn is shown to flood, affecting a large area in the Coton Hill, Greenfields, Spring Gardens and Mount Pleasant suburbs. The majority of this area within Flood Zone 3 is currently not developed though substantial areas of housing in Greenfields/Spring Gardens are shown to be located in Flood Zone 2. A Level 2 SFRA has been completed for Shrewsbury centre. This included a detailed model of the Severn and some of its tributaries.

Outside of Shrewsbury, a number of other communities, including Montford Bridge, Atcham and Buildwas are located on the River Severn and hence are at least partially contained within Flood Zone 2. Extensive areas of agricultural land are also at risk of flooding, particularly in the Severn/Vyrnwy confluence, Atcham and Cressage areas.

Shropshire Council

Away from the River Severn a number of properties fall within the Environment Agency's Flood Zones in the Rea Brook catchment. Locations include Westbury and Yockleton on the Westbury Brook (a left bank tributary of the Rea Brook), Minsterley and Pontesford (respectively on the Minsterley and Pontesford Brooks, right bank tributaries of the Rea Brook) and Cruckmeole and Hanwood, which are on the Rea Brook itself. Additionally, representatives of the Rea IDB have suggested that the hamlet of Malehurst and village of Shorthill might also be at risk of flooding, though they are not included in the Environment Agency's Flood Zones. The Rea IDB has also expressed its concern that possible withdrawal of Environment Agency funding combined with decreased maintenance of Main River watercourses may cause increased instances of flooding, particularly to the large areas of farmland that are currently shown within the Environment Agency's Flood Zones.

Further downstream the Rea Brook enters the south western suburbs of Shrewsbury. Along with its northerly neighbour, the Rad Brook, the watercourses affect areas such as Nobold and Meole Brace. Within the northern suburbs a significant number of properties are shown to be located within the Flood Zones of the Battlefield Brook, despite the small size of this watercourse. These properties are principally located within the Harlescott & Battlefield areas.

Of the other River Severn tributaries within the central area of Shropshire, the Cound Brook Flood Zones include parts of the villages of Leebotwood, Longnor and Conover while those attributable to the Cound Brook include parts of Forton Heath. The River Tern principally affects areas under agricultural land use.

Both the Rea Brook and the River Camlad have relatively wide Flood Zones. These are occupied mainly by farmland and drainage responsibilities away from the main rivers are undertaken by the Rea and Powysland IDBs.

South West Shropshire

A significant area of Church Stretton is shown to lie within Flood Zone 3a of the Cound Brook. This includes properties on Churchill and Essex Roads and a playing field known as Russells Meadow. When the Environment Agency's Flood Zone 2 is considered the number of properties potentially affected rises considerably to include much of the Brocksbury area and some parts of All Stretton.

The catchment of the River Clun is characterised by narrow Flood Zones, especially in the upper reaches. The rural nature of the area also means that the majority of areas within Flood Zone 2 and 3a is currently of agricultural land use. However the rivers do pass through numerous settlements, with parts of Clun and Clunton included within the Flood Zones of the River Clun, Colebatch and Brockton within the Flood Zones of the River Kemp and Bucknell affected by the River Redlake.

Flood Zones on the Western and Eastern Onny are similar in character to those in the River Clun catchment, in that they are generally narrow but do include a number of properties in riverside communities such as Hardwick and Moorhouse.

The Quinny Brook exhibits a rather different flooding pattern including, as it does within Flood Zone 3a, large areas of land to the south and east of Church Stretton. A little further south a substantial number of houses at Little Stretton between Crown Lane and Crown Close fall also within Flood Zone 3a. Downstream of Church Stretton the Quinny Brook meets the Byne Brook near Strefford, which in

Shropshire Council

its upper reaches (known as the Heath brook and Lakehouse Brook) affects properties in the villages of East Wall and Rushbury.

Close to The Grove the Quinny Brook and The River Onny meet and the Flood Zones become more substantial in this flatter area. Approximately 1km further downstream the River Clun enters Newington and Craven Arms where development thus far appears to have been directed away from the Flood Zones. However much of Craven Arms is included in Flood Zone 3a of an unnamed watercourse that meets the River Onny just downstream of the town. The Flood Zones for this watercourse appear large given its relatively small nature and in many locations do not coincide with the mapped route of the watercourse itself. Despite this, thus far no comments on the Flood Zones within the town have been received. It is worth noting, however, that the area is being modelled as part of the Craven Arms SWMP, and when complete, that study should be looked at in unison with this document when considering flood risk in this vicinity. In the area at the confluence of the River Onny and the River Teme some properties at Bromfield are located within Flood Zone 3a.

In its upper reaches the Flood Zones of the River Corve take in properties at Seifton, Tugford and Diddlebury, amongst other villages, hamlets and isolated properties. There appears to be a gap in the Flood Zones as the River Corve passes through the villages of Broadstone and Hungerford, the reason for which is not currently known. Downstream of Diddlebury the area within the Flood Zones widens out considerably as a number of brooks occur in a relatively flat area. This pattern continues after the Pye brook (which affects properties in Bouldon and Peaton) joins the River Corve downstream of Culmington (parts of which are also within Flood Zone 3a).

Of the remaining River Teme tributaries the Ledwyche Brook and its tributary, the Bitterley Brook include parts of the villages of Middleton Bridge and Bitterley while the Stoke Brook affects Whitton. In the upper reaches of the Stoke Brook (known as the Colly Brook) a report from the former South Shropshire District Council indicated that the blockage of a culvert had put properties at risk of flooding.

In its upper reaches, the River Teme itself follows a similar pattern to many of the watercourses described above, in that it has relatively confined Flood Zones that encompass few properties. Further downstream some areas and a small number of properties on the opposite bank of the river to Knighton fall within Flood Zones. At Ludlow a large area of land at the confluence of the River Teme and River Corve are included within the Flood Zones though most of this area has not been developed. Further upstream on the River Corve some properties in Ludlow are inside the current Flood Zones. The River Teme itself also affects some small parts of Temeside within the town. Again at Burford some small areas are within the Flood Zones though the area affected is shown to be much more limited than neighbouring Tenbury Wells across the Worcestershire border.

South East Shropshire

The River Worfe and its tributaries the Albrighton Brook and the Wesley Brook are relatively small watercourses with generally narrow Flood Zones. However they do affect a significant number of properties, particularly at Shifnal where around 80 properties fall within the modelled Flood Zone 3a. A further five properties were shown by modelling works to fall within Flood Zone 3a at Albrighton and a similarly low number might be expected to be affected at Ryton further downstream. The Hilton and

Stratford Brooks (Worfe tributaries) are also shown to include properties within their Flood Zones at Hilton and Wyken, indeed four properties are known to be at risk for low return period events.

Other eastern tributaries of the River Severn are shown to affect small areas of some villages. These include unnamed watercourses at Alveley and Quatt Bridge.

At Much Wenlock, the Shylte Brook, a tributary of the River Severn, is shown to include a substantial number of properties within Flood Zone 3. Improvement works to the culvert that carries flows through much of the town took place in 2003, though the capacity is unknown as flooding occurred during the summer flood events in 2007. A substantial flood alleviation scheme is programmed for the town, including flood storage ponds on the Shylte and Sytche Brooks. The implementation of SuDS for new developments in this area is essential, though the Environment Agency has noted that should these fail in a storm situation, the residual risks can be significant especially on catchments of this nature.

To the west of the River Severn a number of properties are included within the Flood Zones of the Mor Brook at Muckley, and The Lye and Harpswood Bridge. In addition the former Bridgnorth District Council reported flooding of the public house at Morville and four houses at Tiddlebrook Bridge following heavy rain. The properties are located adjacent to tributaries of the Mor Brook. At the confluence of the Severn and another western tributary, the Cantern Brook approximately 15 properties on Brook Hollow, Bridgnorth, are shown within Flood Zone 2.

On the River Severn itself there are numerous properties that fall within the various modelled and Environment Agency Flood Zones within the Bridgnorth area. Within Bridgnorth itself are many riverside areas and a substantial area of Low Town is included within Flood Zone 2. Also in the town, properties between Mill Street and Bridge Street are included in the more frequently flooded zones 3a and 3b. South of Bridgnorth properties in the riverside communities of Danesford, Quatford and Hampton are amongst those that are within Flood Zone 2.

On the River Corve some parts of the villages of Bourton and Brockton fall within the Environment Agency's Flood Zones. A seemingly isolated problem that causes flooding to property at Ditton Priors and a large area of farmland at the confluence of the Rea Brook, Winterburn Brook and Cleobury Brook are all located in the catchment of the River Rea. Additionally the entire village of Aston Botterell currently falls within Flood Zone 2 of the Cockshall, Moor and Wallemore Brooks (right bank tributaries of the River Rea).

6.3.5 Flooding from Artificial Drainage Systems and Surface Water Runoff

Information on flooding from public sewers has been provided by Severn Trent Water (STW) Welsh Water and United Utilities in the form of four digit postcode locations as recorded within their DG5 Flood Register.

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. For clarity, the term Artificial Drainage Systems in the context of the DG5 register and this report consists of the foul, surface water or combined systems (public).

Shropshire Council

When a flood incident is reported, a decision chart is used to assess whether the properties / areas are 'at risk' and then the record is added to the appropriate register. The following registers are currently maintained:

- Properties / areas at risk of flooding twice in ten years or more are added to the 2 in 10 year (2:10) register (FLOODS2 acronyms I05 / E05– Internal / External)
- Properties / areas at risk of flooding once in ten years but less than twice in ten years are added to the 1 in 10 year (1:10) register (FLOODS2 acronyms I10 / E10 – Internal/ External)
- Properties / areas at risk of flooding more once in twenty years but less than once in ten years are added to the 1 in 20 year (1:20) register (FLOODS2 acronyms I20 / E20 Internal / External)
- Properties / areas at risk of flooding on a greater than 20 year return period are added to the 1:>20yr register (FLOODS2 acronyms IXX / EXX Internal / External)

Due to the implications of the Data Protection Act on the data held on the DG5 flood register, this report cannot pin-point the exact locations of properties on the register; however, the number of properties affected within each post code area, type of register and date of flooding (where available) has been identified and detailed in the table overleaf. The Environment Agency 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 6.1 below shows the number of recorded incidents in the existing DG5 database. Note that a full version of this table is provided in Volume 3, Folder 8 – this provides an 'edited for release version' – providing a breakdown of the DG5 register data, with postcode areas, numbers of properties affected and dates of incidents (which is too large a data set to include in this section of the main report). A GIS version of this dataset is also included in the digital deliverables.

Table 6.1 – DG5 Summary Data

ID	Postcode Polygon	General Area	Number of Recorded Incidents
1	DY14 8	Cleobury Mortimer	1
2	SY1 2	Coton Hill	8
3	SY1 3	Shrewsbury	1
4	SY1 4	Shrewsbury	4
5	SY2 5	Monkmoor	1
6	SY3 0	Bayston Hill	2
7	SY3 5	Shrewsbury	1
8	SY3 7	Shrewsbury	7
9	SY3 8	Shrewsbury	10
10	SY3 9	Shrewsbury	2
11	SY4 3	Bomere Heath	9
12	SY4 4	Shawbury	1
13	SY4 5	Wem	10

Shropshire Council

ID	Postcode Polygon	General Area	Number of Recorded Incidents
14	SY5 0	Pontesbury	6
15	SY5 9	Ford	3
16	SY6 6	All Stretton	7
17	SY6 7	Church Stretton	1
18	SY7 8	Clun	1
19	SY8 1	Ludlow	16
20	SY8 2	Ludlow	2
21	SY8 4	Ludlow	1
22	SY9 5	Bishops Castle	1
23	SY10 8	Oswestry	1
24	SY11 1	Oswestry	4
25	SY11 3	Gobowen	1
26	SY13 3	Nr Whitchurch	2
27	SY21 8	Chirbury	1
28	SY22 6	Shropshire	1
29	TF8 7	Coalport	1
30	TF9 1	Market Drayton	2
31	TF9 3	Market Drayton	1
32	TF11 8	Shifnal	4
33	TF11 9	Shifnal	1
34	TF12 5	Broseley	1
35	TF13 6	Much Wenlock	2
36	WV16 4	Bridgnorth	2
37	WV16 5	Bridgnorth	1
38	WV16 6	Bridgenorth	2

The subsequent sections provide a commentary on this data set, divided into geographical areas for ease of navigation:

Northern Shropshire

It is clear that surface water drainage is an issue in some parts of northern Shropshire, particularly in areas such as SY4 5 (covering areas of Wem and Tilstock) where there are 10 properties identified as being at risk, and also in SY11 1 & SY108 (Oswestry) and the area west of Whitchurch. Within the Oswestry vicinity, there are postcode areas identified with properties at risk of flooding from artificial drainage systems and surface water runoff.

To the north east at Market Drayton (TF9 1 and TF9 3) there are 3 recorded incidents.

Shropshire Council

Anecdotal evidence has stated that land drainage is known to be a problem in some parts of this area, one example being Whixall Moss. However, the area is largely rural and not the target of large scale development.

Information from the former Oswestry Borough Council indicates that, historically, at times of heavy and prolonged rainfall, flooding incidents from surface water runoff have occurred at various locations, affecting land and property in both Oswestry town and the rural area. In recent years the most notable incidents have occurred in the following locations:

- Gobowen: In January 2007, flooding occurred in the Station Road area of the village affecting both the highway and individual properties. The flooding incident was attributed to a culvert on the A5 being unable to cope with the water flows and a stream which runs under Station Road. Problems have been less severe on subsequent occasions.
- Weston Rhyn: During the storm of 2000/2001, runoff from the hillside above the village caused problems for the Cerriog Option, a re-routed watercourse from Weston Rhyn to the River Cerriog. Runoff caused erosion on the hillside, flooding fields.

Central Shropshire

Within the central areas of Shropshire, around Shrewsbury and the areas to the east and west of the town, there are a number of recorded incidents of properties at risk of flooding from artificial drainage systems and surface water runoff.

In the town of Shrewsbury there are a number of postcode polygons which reveal a number of recorded incidents – SY1 2 in the north of the town being the most at risk, with eight properties identified, and SY3 7 to the south having seven properties identified.

The area to the north east of Shrewsbury also has a high number of properties identified as being at risk – with the polygon SY3 8 (covering the area towards Shelton) having 10 properties at risk.

To the west of Shrewsbury in polygon SY5 9, there are three recorded incidents.

Anecdotal evidence of flooding due to the artificial drainage systems was reported in the village of Westbury. This is due to the regular failure of a STW pumping station and occurs regularly following heavy rainfall. The latest incident is thought to have occurred in May 2000 and in the past the problem has affected up to seven properties.

South Central / South Shropshire

There are a number of areas within south Shropshire that have been identified as having postcode polygons with properties at risk of flooding from artificial drainage systems and surface water runoff.

There are two key significant areas at risk of flooding from artificial drainage systems and surface water runoff in south Shropshire. The first is the area around and including Church Stretton, where in polygon SY6 6 there are seven recorded incidents. The second, and by far the most problematic area being Ludlow, is covered by the postcode area SY8 1. In this area there are 16 properties which appear on the DG5 Flood Register. Additional information from Shropshire Council (see below) supports this.

Shropshire Council

To the south of Ludlow, postcode area SY8 4 has a further eight properties on the register, with flooding recorded on five separate dates. Seven properties in SY5 0 are also on the register however this postcode area contains the larger villages of Pontesbury and Minsterley.

Anecdotal evidence of flooding associated with highways and surface water problems was reported in three locations within southern Shropshire by Shropshire Council.

In Ludlow an issue affected the highway and one property and is thought to be a combination of problems with highway drainage and a lack of capacity in a STW combined sewer. The two remaining problems refer to incidents affecting the highway and property in Brockton and All Stretton.

East / South East Shropshire

The region of Shropshire to the south and east of Telford contains two areas which have a number of recorded incidents on the DG5 register. Area TF12 5 to the south (around the Broseley area), has one recorded incident, whilst TF11 8 & TF11 9 to the west (around the Shifnal area) has a total of 5 recorded incidents.

Within the Bridgnorth area (polygons WV16 4 & WV16 5) there are three recorded incidents of properties at risk of flooding from artificial drainage systems and surface water runoff.

South west of Telford at Much Wenlock (TRF13 6) there are 2 recorded incidents.

Information from the original 2007 commission received from Severn Trent and the Environment Agency highlighted that the area of Albrighton suffered extensive flooding from pluvial and fluvial sources in the summer of 2006. Since then, Severn Trent Water, the Environment Agency and Shropshire Highways undertook an investigation into the causes of the flooding. Following the investigation, Severn Trent undertook a scheme to increase the capacity of the foul/combined sewerage system, making the network more resilient to flood events. In addition the Environment Agency undertook works to improve the watercourse through Albrighton and Shropshire County Council improved Highway drainage in the area.

Additional information has been gathered from Shropshire Council:

Between Albrighton and Ryton flooding of a minor road has been recorded. This is thought to be due to surface water flooding.

Close to Brockton the B4379 and nearby farmland have been affected by flooding in the vicinity of the Mad Brook. It is thought that this problem might be associated with surface water problems.

In the east of Shropshire, the flooding of properties at Hopstone near Claverley has been assigned to surface water runoff. This has affected up to five properties and has occurred at least three times since 1982.

Shifnal could be affected by flooding from the Telford and Wrekin area through any increased surface water discharges into Welsey Brook (a particularly flashy catchment). Telford and Wrekin Council do, however, have surface water management policies in place to ensure that appropriate steps are taken as part of all development.. Two balancing reservoirs exist upstream of Shifnal and serve parts of

Shropshire Council

Priorslee, Telford. The discharge from the lower of the two reservoirs was taken into account as part of the detailed modelling undertaken in the Shifnal Surface Water Management Plan..

6.3.6 Flooding from Impounded Water Bodies

No flooding issues from impounded water bodies have been reported in Shropshire, however, there are a number of canals that pass through the area:

- Shropshire Union Canal
- Llangollen Canal
- Montgomery Canal (a branch of the Shropshire Union Canal)

6.3.7 Flooding from Groundwater

Enquiries for information on groundwater flooding produced no responses within Shropshire. However, attention must be drawn to the Environment Agency's AStGWF database as discussed in Section 5.5.5 of this report.

6.3.8 Flooding from all sources – 2007 / 2011 comparison

The following images show the differences between the 'flooding from all sources' datasets used in the original 2007 study, and this updated commission (Volume 2, Tiles B contain the maps showing 'flooding from all sources'. It can be seen that a significant amount of additional data has been obtained for this commission, and provided as GIS layers, which should be consulted when undertaking any assessment of flood risk in Shropshire. Note that the data for the Telford and Wrekin area has deliberately been retained in this data set, as it will be important to consider potential runoff or flow routes from this neighbouring urbanised area.

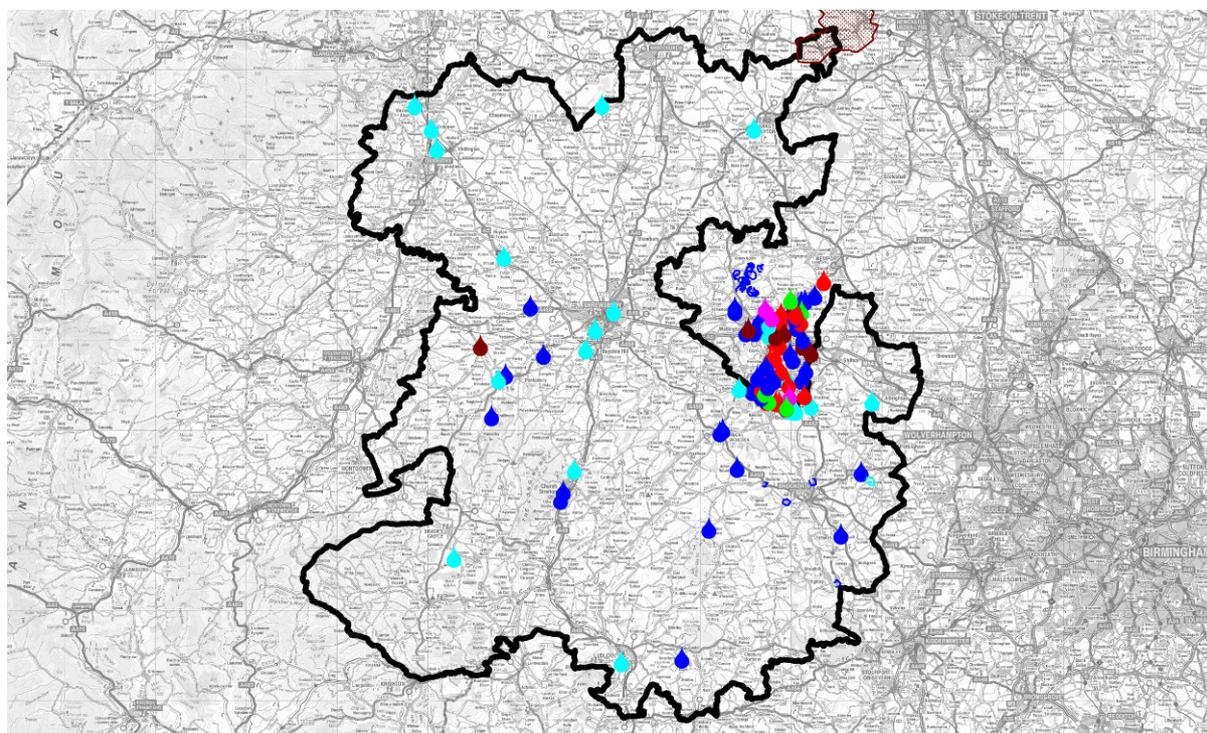


Figure 6.1 – Original Flooding From All Sources Data (2007 Study) – Now Superseded

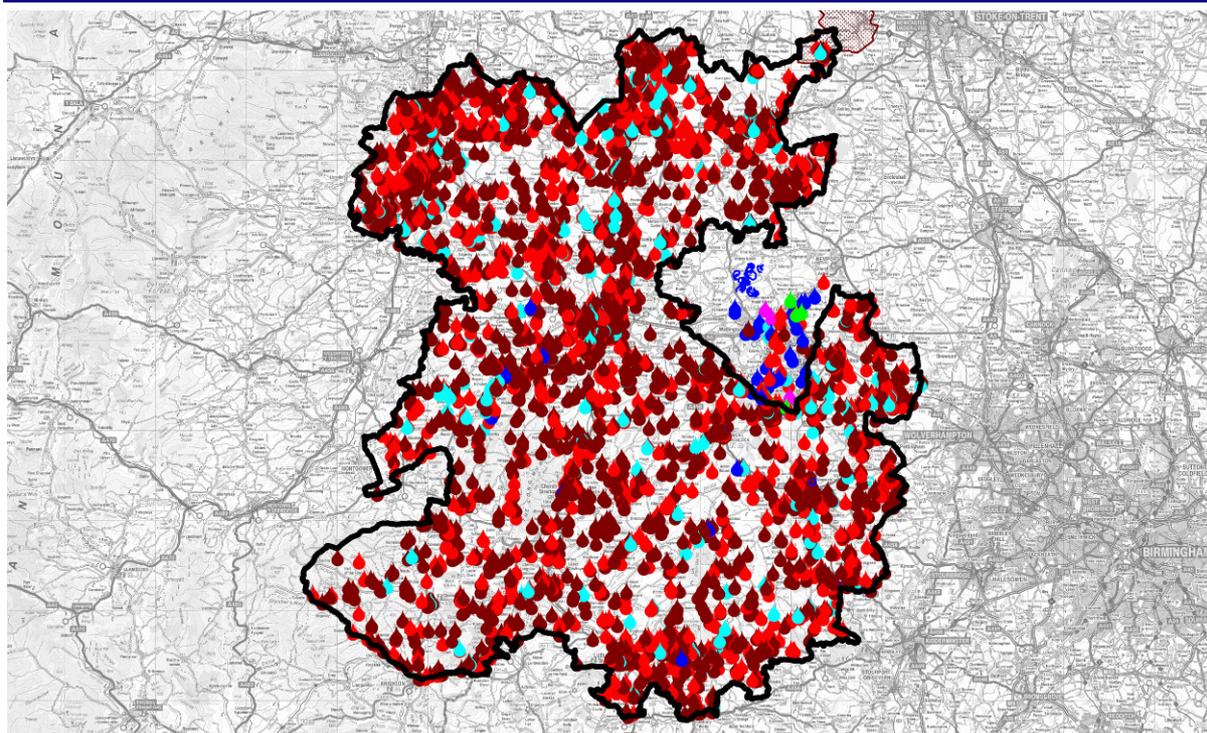


Figure 6.2 – Updated Flooding From All Sources Data (2011 Study)



Due to the large number of entries in this dataset, it isn't possible to provide a commentary on areas where incidents have been recorded, and the image above in Figure 6.2 does not allow the reader to identify specific areas (it is included here for illustration purposes only). Therefore it is important that the digital map images (contained in Volume 2 Appendix A) and more importantly, the GIS files (Volume 3), are consulted when undertaking any investigation into flood risk.

As a brief summary for this report, the following observations can be easily made.

The dataset indicates that there are a high number of artificial drainage recorded incidents within many urban areas of Shropshire, in particular Oswestry, Whitchurch, Shrewsbury, Church Stretton, Ludlow, Shifnal, Albrighton and Bridgnorth. This information compliments the DG5 register data and findings.

Shropshire Council

As outlined in Section 6.3.5, surface water flooding can be seen to affect many areas of Shropshire, however, there are a number of clusters that can be seen from the maps which, like with the flooding from artificial drainage, compliments the DG5 register data. Key areas are located at Market Drayton, Shrewsbury, the western area of Shropshire around the Brockton, Hope, Minsterley vicinity (due to the local steep topography of the Rea Brook catchment and Hope Valley), Ludlow, areas to the south and east of Titterstone Clee Hill, Bridgnorth, Albrighton and Shifnal.

Whilst there are no recorded incidents of flooding from mine water within Shropshire, there are 3 close to the Shropshire border at Coalbrookdale, Ironbridge and Coalport.

For a detailed discussion on areas susceptible to fluvial flooding, see section 6.3.4

7 Flood Warning Systems and Flood Management Measures

7.1.1 Flood 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.

A Catchment Flood Management Plan (CFMP) is a 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. A CFMP for the fluvial reaches of the River Severn was first issued in 2005 in draft format, with a revised edition being published in 2009. The document assesses the size, nature and distribution of the current flood risk whilst providing an indication of future flood risk in the catchments. It then provides a complementary set of long-term flood risk management policies and an indication of the types of response that could be implemented to meet them.

The key policies relating to the study area are outlined in the next chapter.

The River Severn Fluvial Strategy follows on from the CFMP study and identifies preferred flood risk management measures that would deliver the CFMP policies in a specific area or river reach. Flood risk areas were defined to cover communities at risk options for flood management were then considered and technical, environmental and economic appraisals were carried out. The results of the three appraisals were used to identify a preferred option for each of the flood risk areas.

7.1.2 Flood Defences

Only a few of the communities at risk of flooding from the Severn are currently protected by permanent defences, such as Newtown on the Upper Severn and Commonwood. Demountable defences, with permanent civil engineering works, have recently been used to protect areas in Bewdley, Shrewsbury and Ironbridge. Both temporary and demountable defences are not considered permanent and PPS 25 differentiates between temporary and demountable defences as the latter is associated with a particularly high risk of failure (as they may not be deployed rapidly enough).

Low lying agricultural land at the confluence of the Severn and the Vyrnwy is frequently flooded and a series of low earth embankments, known locally as argaes, have been constructed to provide some protection. These banks prevent flooding at low return periods, typically protecting properties and agricultural land up to the events with between 10 and 20% chance of occurrence. A series of outfall structures release water back to the Severn and the Vyrnwy once river water levels have decreased but the argaes can prolong localised flooding by retaining floodwater trapped behind them after an event has passed. Previous studies have shown that the argae system provides significant protection to downstream communities, such as Shrewsbury, by storing substantial volumes of floodwater and releasing it back to the Severn after the event.

A study of informal defences has not been made as part of this assessment.

7.1.3 Flood Warning

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;
- provision of specialist advice;
- giving warnings to those likely to be affected;
- monitoring the effects of an incident, and;
- investigating causes.

This requires the Environment Agency, local authorities and the emergency services to work together to protect people and properties.

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, relevant local authorities, public and, if available, flood wardens. It is the responsibility of individuals in the community to receive flood warnings via Flood Warnings Direct (FWD) which passes messages over the telephone network.

On 30 November 2010 the Environment Agency made changes to its flood warning service. As part of this change, the flood symbols and warning messages have been updated so they are easier to understand, provide more local information and give clearer guidance about what people need to do. The new codes and details of the changes are as follows:



Flood Alert - this replaces the Flood Watch. A Flood Alert means that flooding is possible and that you need to be prepared.

What it means

Flooding is possible – be prepared

When it's used

Two hours to two days in advance of flooding.

What to do

- Be prepared to act on your flood plan
- Prepare a flood kit of essential items
- Monitor local water levels and the flood forecast on the Environment Agency website



Flood Warning - means that flooding is expected and that you should take immediate action. You should take action when a flood warning is issued and not wait for a severe flood warning.

What it means

Flooding is expected. Immediate action required.

When it's used

Half an hour to one day in advance of flooding.

What to do

- 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



Severe Flood Warning - means that there is severe flooding and danger to life. These are issued when flooding is posing significant risk to life or disruption to communities.

What it means

Severe flooding. Danger to life.

When it's used

When flooding poses a significant threat to life.

What to do

- 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

Warnings no longer in force

What it means

No further flooding is currently expected in your area.

When it's used

When river or sea conditions begin to return to normal.

What to do

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

The Flood Alert and Flood Warning areas in Shropshire are provided as digital deliverables in Volume 2 - Map Tiles F.

7.1.4 Flood Alert and Warning Areas

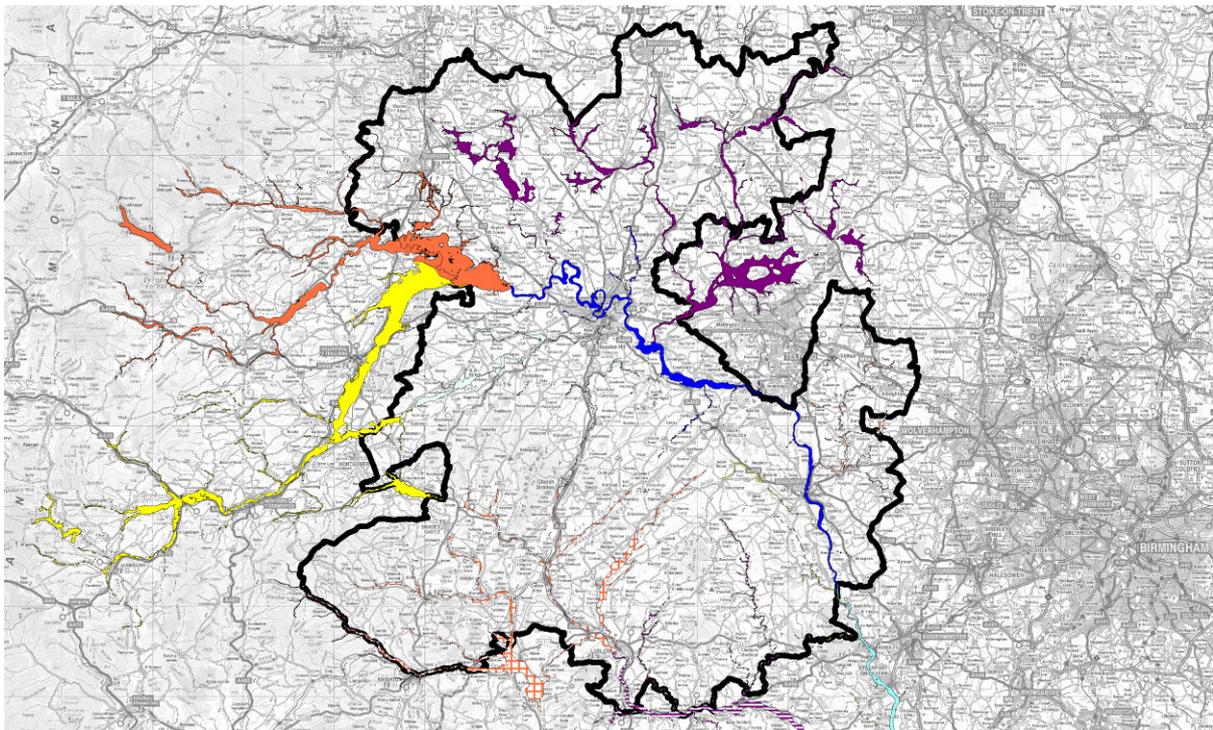


Figure 7.1 – Flood Alert Areas

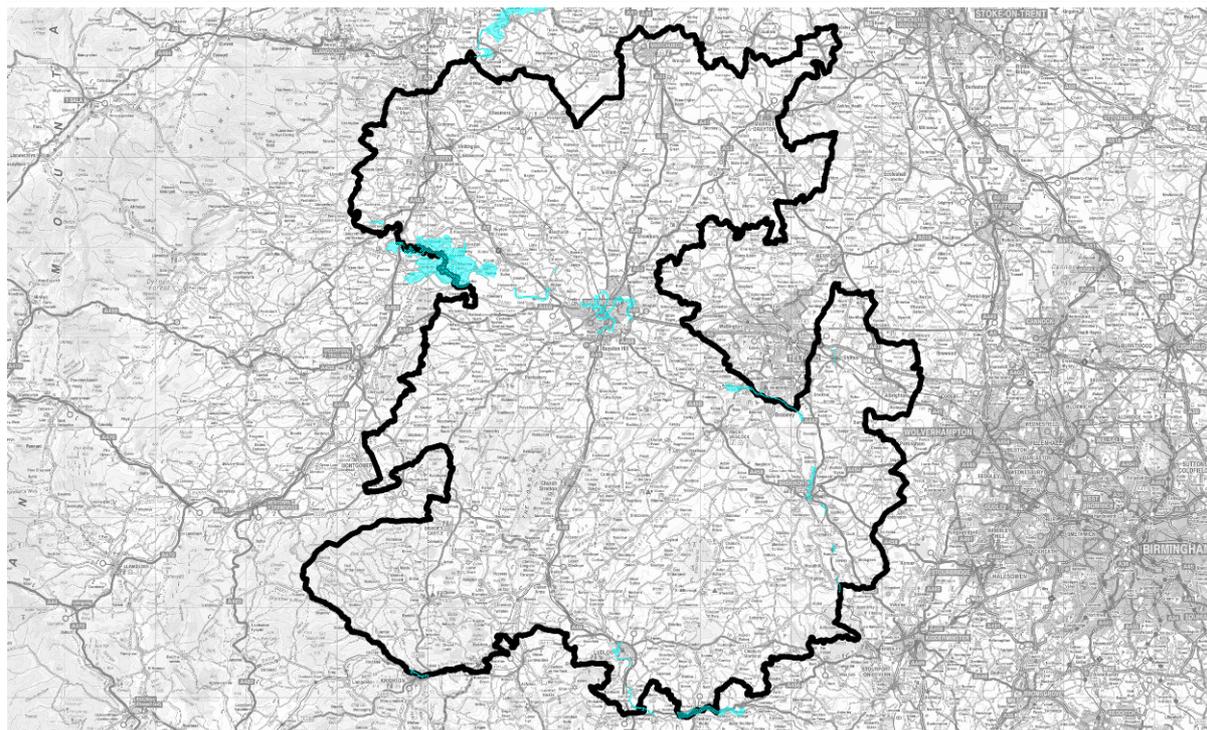


Figure 7.2 – Flood Warning Areas

7.1.5 Multi Agency Flood Plan (MAFP)

Shropshire's Multi Agency Flood Plan describes the response to serious flooding in Shropshire and the measures to be taken by the various agencies involved. The plan is supplemented by the following:

- 'Flooding in Shrewsbury Joint Action Plan' produced by Shropshire Council, the Environment Agency and Severn Trent Water.
- 'Operation Tangent' Plan produced by Telford and Wrekin Council, West Mercia Police, Shropshire Fire and Rescue Service, Shropshire Ambulance Service, Shropshire Council, and the Environment Agency.
- Multi Agency Flood Plan produced by Telford and Wrekin Council

No two flood events are ever likely to be identical but the process can be broken down into four phases. The plan covers the following phases and outlines the actions required during each phase:

- Phase 1 - Flood Warning Phase
- Phase 2 - Preparatory Phase
- Phase 3 - The Flood Occurs
- Phase 4 – Recovery

Additional flood response plan details from within Shropshire are outlined below:

Shropshire Council

The **Oswestry** area covers the confluence of the River Severn and the Vrynwy. Flooding of roads and agricultural land can persist for lengthy periods and can cover an area of approximately 20 square miles.

On receipt of a Flood Alert at the Severn Vrynwy Confluence, access into the area can become progressively more difficult, initially affecting the Maesbrook area and then extending down towards the Melverley basin. As the basin fills the Melverley area is gradually cut off other than for vehicles with high ground clearance. Access for the population becomes difficult and emergency vehicles may find the roads impassable. Up to threshold levels at the Llanymynech Gauge of 4.3 metres and at the Crew Green Gauge of 6.35 metres, property is not at risk of flooding, however, above these levels flooding of property including the Pentre area can be expected.

In the former **Shrewsbury** and **Atcham** Borough Council area, the following actions are undertaken in the event of flooding. For more detailed information reference should be made to the Shropshire Council emergency plans and procedures. On the issue of flood warnings, council staff will liaise with the EA on predicted flood levels, estimated timing of flood peaks and deployment of Demountable Defences and other temporary defences. They will also liaise with Shropshire Council's Highways Central Division with regards to any road closures. Assistance may be provided to property holders in flood affected areas (e.g. provision of sandbags etc.). Advice and information will be offered to the general public and the Emergency Services will be utilised as required in minimising the effects of a flood in the town.

In **South Shropshire**, Shropshire Council is aware of several vulnerable properties in Ludlow and Clun. The Multi Agency Flood Plan will include full relevant details of warning systems and other actions required to inform people affected by a flood incident.

On the issue of flood warnings in the **Bridgnorth** area, council staff will liaise with the EA on predicted flood levels, estimated timing of flood peaks. They will look to gain information on flood responses already deployed higher in the Severn catchment as these are a good indicator for Bridgnorth. Advice and information will be offered to the general public and the Emergency Services will be utilised as required.

8 Flood Risk Management Policies

8.1 Catchment Flood Management Plans

The policies and recommendations from the River Severn Catchment Flood Management Plan (CFMP), (Summary Document published by the Environment Agency in 2009, and re-published in February 2010) are identified below and indicate the types of response that could be implemented to deliver a policy.

The CFMP utilised six generic flood risk management policies:

Policy 1: Areas of little or no flood risk where we will continue to monitor and advise

- This policy will tend to be applied in those areas where there are very few properties at risk of flooding.
- It reflects a commitment to work with the natural flood processes as far as possible.

Policy 2: Areas of low to moderate flood risk where we can generally reduce existing flood risk management actions

- This policy will tend to be applied where the overall level of risk to people and property is low to moderate.
- It may no longer be value for money to focus on continuing current levels of maintenance of existing defences
- if we can use resources to reduce risk where there are more people at higher risk. We would therefore review
- the flood risk management actions being taken so that they are proportionate to the level of risk.

Policy 3: Areas of low to moderate flood risk where we are generally managing existing flood risk effectively

- This policy will tend to be applied where the risks are currently appropriately managed and where the risk of
- flooding is not expected to increase significantly in the future. However, we keep our approach under review,
- looking for improvements and responding to new challenges or information as they emerge. We may review
- our approach to managing flood defences and other flood risk management actions, to ensure that we are
- managing efficiently and taking the best approach to managing flood risk in the longer term.

Policy 4: Areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where

- we may need to take further actions to keep pace with climate change
- This policy will tend to be applied where the risks are currently deemed to be appropriately-managed, but
- where the risk of flooding is expected to significantly rise in the future. In this case we would need to do more
- in the future to contain what would otherwise be increasing risk. Taking further action to reduce risk will require
- further appraisal to assess whether there are socially and environmentally sustainable, technically viable and
- economically justified options.

Policy 5: Areas of moderate to high flood risk where we can generally take further action to reduce flood risk

- This policy will tend to be applied to those areas where the case for further action to reduce flood risk is most
- compelling, for example where there are many people at high risk, or where changes in the environment have
- already increased risk. Taking further action to reduce risk will require additional appraisal to assess whether
- there are socially and environmentally sustainable, technically viable and economically justified options.

Policy 6: Areas of low to moderate flood risk where we will take action with others to store water or manage run-off

- in locations that provide overall flood risk reduction or environmental benefits
- This policy will tend to be applied where there may be opportunities in some locations to reduce flood risk
- locally or more widely in a catchment by storing water or managing run-off. The policy has been applied to
- an area (where the potential to apply the policy exists), but would only be implemented in specific locations
- within the area, after more detailed appraisal and consultation.

Shropshire Council

The Severn CFMP identified that the Severn catchment has a long and well-documented history of Flooding, with the most recent significant event occurring in June/July 2007 as a result of a period of exceptional rainfall. The report recognises that the Environment Agency needs to work with Local Authorities to influence the location, layout and design of new and redeveloped property and ensuring that only appropriate development is allowed on the floodplain through the application of [the now] NPPF guidance document, and (TAN 15 in Wales, 2004).

The River Severn CFMP divided the study area into 20 sub-sections called policy units, which would enable the most sustainable approach to managing flood risk to be taken. For the River Severn CFMP Summary Report (2009) the sub areas have been amalgamated into nine areas (locations that have similar physical characteristics, sources of flooding and levels of risk). Each of these nine areas has been given one of the six flood risk management policies, after considering how social, economic, and environmental objectives are affected by flood risk management.

The following Sub Areas are located within the scope of this Level 1, and their policies and key messages are summarised below:

Sub Area 1 – The Vyrnwy Confluence Area (Policy Unit 2)

The following policies and key messages have been identified by the Severn CFMP for the Vyrnwy Confluence Area of Shropshire, which is located on the western boundary of the county at Molverley.

Policy Option 6

- Areas of low to moderate flood risk. The Environment Agency will take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits.
- The Environment Agency long term vision for this sub area is to set a framework to deliver a sustainable approach to flood risk management that considers the natural function of the river and reduces long term dependence on raised flood defences. This includes identifying opportunities to better utilise areas of natural floodplain to store floodwaters and to attenuate rainwater that will reduce flood risk within this sub area and downstream.

Key Messages

- Rely less on raised flood defences in the long term as this is not sustainable. Take opportunities to restore sustainable natural storage of floodwater on undeveloped floodplains, benefitting communities downstream such as Shrewsbury

Sub Area 3 – Shropshire Tributaries (Policy Unit 4 - South Shropshire Tributaries & Unit 5 – North Shropshire Tributaries)

The following policies and key messages have been identified for these two Policy Unit areas:

Policy Option 2

- Areas of low to moderate flood risk where existing flood risk management actions can gradually reduce as current and future risks do not warrant as much intervention (for example on maintaining existing defences). The risk of flooding can increase naturally over time in a managed way so that unacceptable risks are not created. The Environment Agency have

assets in place now, and we will look at the options and timing of stopping maintenance or retreating flood defences where appropriate, via the System Asset Management Plans (SAMPs).

Key Messages

- Rely less on raised flood defences in the long term as this is not sustainable, by taking opportunities to restore sustainable natural storage of floodwater on undeveloped floodplains.
- Surface water flooding is a growing problem in these areas. The Environment Agency has identified that whilst Local Authorities are mainly responsible for managing this, it often has to be integrated with other organisations' assets, for example their sewers or rivers.
- Flooding cannot be entirely eliminated and so residents, owners, and businesses need to manage some risks themselves. For example, registering for the Floodline Warnings Direct (FWD) service and flood warden schemes; being aware of emergency plans; and adapting vulnerable buildings.

Sub Area 4 – Middle Severn Corridor (Policy Unit 8)

Policy Option 4

- Areas of low, moderate or high flood risk where the Environment Agency are already managing the flood risk effectively but where further actions may be needed to keep pace with climate change. Although the risk is currently managed appropriately, it is expected to rise significantly in the long term, requiring additional action to reduce the expected increase in risks.

Key Messages

- The Environment Agency plan to reduce dependence on raised flood defences as this is not a sustainable long term option. This will be achieved by taking opportunities to restore sustainable natural storage of floodwater on undeveloped floodplains.
- Surface water flooding is a growing problem in these areas. The Environment Agency has identified that whilst Local Authorities are mainly responsible for managing this, it often has to be integrated with other organisations' assets, for example their sewers or rivers.
- Development/redevelopment must be managed to minimise flood risks. Methods must be sustainable over the long-term. For example, making more space for rivers through urban areas via 'blue corridors' (i.e. Restoring access for floodwater onto key strips of floodplain. This requires redevelopment to be limited to flood-compatible land-uses e.g. parkland.)
- Flooding cannot be entirely eliminated and so residents, owners, and businesses need to manage some risks themselves. For example, registering for the Floodline Warnings Direct (FWD) service and flood warden schemes; being aware of emergency plans; and adapting vulnerable buildings.

Sub Area 5 – Telford & Black Country (Policy Unit 6)

Policy Option 5

- Areas of moderate to high flood risk where further action can be taken to reduce flood risk. This policy is about reducing the risk where the existing flood risk is too high through action in the short term to reduce this level of risk.

Key Messages

- Surface water flooding is a growing problem in these areas. The Environment Agency has identified that whilst Local Authorities are mainly responsible for managing this, it often has to be integrated with other organisations' assets, for example their sewers or rivers.
- Development/redevelopment must be managed to minimise flood risks. Methods must be sustainable over the long-term. For example, making more space for rivers through urban areas via 'blue corridors' (i.e. Restoring access for floodwater onto key strips of floodplain. This requires redevelopment to be limited to flood-compatible land-uses e.g. parkland.)
- Offset the increasing flood risk from trends including climate change, by taking opportunities to restore sustainable natural storage of floodwater on undeveloped floodplains.
- Flooding cannot be entirely eliminated and so residents, owners, and businesses need to manage some risks themselves. For example, registering for the Floodline Warnings Direct (FWD) service and flood warden schemes; being aware of emergency plans; and adapting vulnerable buildings.

Sub Area 8 – Teme (Policy Unit 19)

Policy Option 3

- Areas of low to moderate flood risk where the Environment Agency are generally managing existing flood risk effectively. The risks are currently managed appropriately and the risk of flooding is not expected to increase significantly in the long term. There may be a need to review the management approaches for the longer term, but the Environment Agency are confident that managing these risks will need to continue. This policy may lead to reviewing the flood warning services and/or how assets are managed.

Key Messages

- The Environment Agency plan to reduce dependence on raised flood defences as this is not a sustainable long term option. This will be achieved by taking opportunities to restore sustainable natural storage of floodwater on undeveloped floodplains.
- Surface water flooding is a growing problem in these areas. The Environment Agency has identified that whilst Local Authorities are mainly responsible for managing this, it often has to be integrated with other organisations' assets, for example their sewers or rivers.
- Flooding cannot be entirely eliminated and so residents, owners, and businesses need to manage some risks themselves. For example, registering for the Floodline Warnings Direct (FWD) service and flood warden schemes; being aware of emergency plans; and adapting vulnerable buildings.

- Development/redevelopment must be managed to minimise flood risks. Methods must be sustainable over the long-term. For example, making more space for rivers through urban areas via 'blue corridors' (i.e. Restoring access for floodwater onto key strips of floodplain. This requires redevelopment to be limited to flood-compatible land-uses e.g. parkland.)

8.2 Policy Considerations

Given the broad nature of the policies identified in the Severn CFMP, more specific policy considerations are put forward below to drive the Council's flood risk management policies.

To Seek Risk Reduction through Spatial Planning and Site Design:

- Use the Sequential Test to locate new development in areas of lowest risk, giving highest priority to Flood Zone 1
- If a Sequential Test is undertaken and a site in a floodplain is identified as the only site for development, after application of Exception Test, use the sequential approach to inform the site design and seek opportunities to reduce risk
- Ensure that any redevelopment within the floodplain that is justified on wider sustainability grounds is resilient to flooding
- Identify long-term opportunities to remove development from the floodplain through land swapping
- Ensure development is 'safe'. For residential developments to be classed as 'safe', dry pedestrian egress from the floodplain and emergency vehicular access should be possible
- Raise floor levels above the 1 in 100 year plus climate change water level

To Reduce Surface Water Runoff from New Developments and Agricultural Land:

- SuDS are required as part of all new development
- Set-aside space for SuDS on all allocated sites
- Promote environmental stewardship schemes to reduce water and soil runoff from agricultural land

To Enhance and Restore the River Corridor:

- Assess condition of existing assets and renew if required to ensure their lifetime is commensurate with lifetime of the development
- Seek opportunities to undertake river restoration/enhancement as part of a development to make space for water
- Avoid further culverting and building over of culverts. All new developments with culverts running through their site should seek to de-culvert for flood risk management and ecological benefit
- Set development back from rivers, seeking an 8 metre wide undeveloped buffer strip. Making space for water and additional capacity to accommodate climate change

To Protect and Promote Areas for Future Flood Alleviation Schemes

- Protect greenfield functional floodplain from future development
- 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

To Improve Flood Awareness and Emergency Planning

- Seek to improve the emergency planning process following future updates to the SFRA
- Enhance awareness of the areas covered by the Flood Warnings Direct service operated by the Environment Agency
- Ensure robust emergency (evacuation) plans are implemented for new developments greater than 1 Ha in size (the Environment Agency has noted that criteria will need to be produced to ensure validation of robustness and the consequent production of effective, enforceable operational plans)

9 Guidance on the Application of the Sequential Test

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

9.1 *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 guidance. 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 to identify allocations that could increase flood risk elsewhere (flood incident points, localised flooding areas, flood zones) and lack of dry access.

9.2 *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 the Shropshire Council Flood and Water Management Team and the Environment Agency). 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 is identified within Zone 1, it should be considered as if it was in the High Probability Zone 3a, for further application of the Sequential Test in Zone 3a (see Section 9.3), 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 policies are in place for mitigating the risk (for example contributions may be required from the developer for the upgrade of the surface water drainage 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 flood risk assessments. For development proposals on sites comprising one hectare or greater, the vulnerability to flooding from other sources (as well as from river flooding) and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water runoff, should be incorporated in a FRA. This need only be brief unless the factors above or other local considerations require particular attention. It is recommended that FRAs are still produced for Zone 1 sites of less than one hectare, at locations where there are records of previous flood incidents.

9.3 Step Three: Sequential Test in Zones 2 and 3

The third step is to sequentially allocate sites as described in Section 4.3 and as part of a Sustainability Appraisal (SA). It is recommended that prior to incorporating the Sequential Test within the SA, the following actions take place:

- Apply the measure of avoidance/prevention (see Section 5.1) 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. This is generally the case at locations where the loss in area is of the order of 10%.
- Provisionally adopting land uses that are fully compatible with the vulnerability classification of NPPF, to try to avoid the need to apply the Exception Test where possible.

10 Guidance for the Preparation of Flood Risk Assessments

The SFRA should be used as a starting point for flood risk assessments, to understand the level of risk posed to a particular site. General details about FRA requirements can be found in Table D.1: Flood Zones, in PPS 25. For quick reference, this table has been provided on the strategic flood risk maps in Volume 2.

It is imperative that site-based FRAs are discussed early in the planning process and submitted as an integral part of the planning application. It is a government directive that planning applications seeking approval for development within flood affected areas can be regarded as invalid if not supported by a detailed FRA. FRAs should also be incorporated into Environmental Statements, where one is required.

FRAs will be required for most proposed developments, but the level of detail will be dependant upon the existing level of flood risk posed to the site. FRAs should always be proportionate to the degree of flood risk and the scale, nature and location of the proposed development. The scope of FRAs should be agreed with the LPA, in consultation with the Environment Agency and other relevant bodies. The table matrix overleaf has been taken from the Environment Agency's local (Midlands West Area) 'flood risk standing advice matrix' which was issued by the Environment Agency to their Local Planning Authorities in January 2009; as part of our 'Development and Flood Risk User Guidance Note'

The consultation matrix sets out when the Environment Agency needs to be consulted by Local Planning Authorities, together with guidance on what that consultation should contain.

Should new developments be permitted in Flood Zones 2 and 3, it is important to consider Flood Resilient Construction. It is also important that vulnerable uses of development have safe dry access, and less vulnerable developments have safe refuges and evacuation plans.

Shropshire Council

A1 Development Category	B1 Development (including boundary walls etc.) within 8 METRES of the top of a bank of a Main River	C1 Includes culverting or control of flow of any river or stream	D1 Within Flood Zone 3	E1 Within Flood Zone 2	F1 Within Flood Zone 1
A2 Householder development and alterations + Non residential extensions with a footprint of less than 250m ²	B2 Consult EA on flood defence consent requirements	C2 Consult EA with FRA showing design details of any culvert or flow control structure proposed	D2 No Consultation - see standard comment	E2 No Consultation - see standard comment	F2 No EA consultation required
A3 Change of use FROM 'Water Compatible' TO 'Less Vulnerable' Development*	B3 Only consult EA if site also falls within Flood Zone 3. FRA required	C3 No EA consultation required	D3 Consult EA with FRA (see 'development in Flood Zone 3 process note')	E3 No EA consultation required	F3 No EA consultation required
A4 Change of use RESULTING IN 'Highly Vulnerable' or 'More Vulnerable' Development*	B4 Only consult EA if site also falls within Flood Zone 3 or 2. FRA required	C4 No EA consultation required	D4 Consult EA with FRA (see development in Flood Zone 3 process note)	E4 No EA consultation required see 'development in Flood Zone 2 process note'; unless RED BOX i.e. if 'highly vulnerable' or camping and caravans.	F4 No EA consultation required
A5 Operational Development less than 1 hectare	B5 Consult EA on flood defence consent requirements	C5 Consult EA with FRA showing design details of any culvert or flow control structure proposed	D5 Highly vulnerable - apply standard OBJECTION, no need to consult EA Other Vulnerabilities - consult EA with FRA and Sequential test evidence and where required confirm Exception Test has been applied (see 'development in Flood Zone 3 process note')	E5 No EA consultation required see 'development in flood zone 2 process note' unless RED BOX in the process note.	F5 No EA consultation required see surface water management advice note / see standard comment
A6 Operational Development between 1 and 5 hectare	B6 Consult EA on flood defence consent requirements	C6 Consult EA with FRA showing design details of any culvert or flow control structure proposed	D6 Highly vulnerable - apply standard OBJECTION, no need to consult EA Other Vulnerabilities - consult EA with FRA and Sequential test evidence and where required confirm Exception Test has been applied (see 'development in Flood Zone 3' process note)	E6 Development between 1 and 5ha - Consult EA with FRA and Sequential test evidence and where required confirm Exception Test has been applied - see 'development in Flood Zone 2 process note'	F6 Development between 1 and 5ha - No EA consultation required - see 'operational development (+1ha) in Flood Zone 1 process note'
A7 Operational Development of 5 hectares or greater	B7 Consult EA on flood defence consent requirements	C7 Consult EA with FRA showing design details of any culvert or flow control structure proposed	D7 Highly vulnerable - apply standard OBJECTION, no need to consult EA Other Vulnerabilities - consult EA with FRA and Sequential test evidence and where required confirm Exception Test has been applied (see 'development in Flood Zone 3 process note')	E7 Development over 5ha - Consult EA with FRA and Sequential test evidence and where required confirm Exception Test has been applied - see 'development in Flood Zone 2 process note'	F7 Development over 5ha - Consult EA with FRA - see 'operational development (+1ha) in Flood Zone 1 process note'
	Consult Environment Agency with information as detailed. Note: Highly vulnerable development is NOT appropriate in Flood Zone 3 and only water compatible development is appropriate in functional floodplain (Flood Zone 3b). Essential Infrastructure would need to pass Exception Test (see PPS25 Table D3)				
	Do NOT consult the Environment Agency - no comment				
	Standing advice / standard comments (note cell E4 and cell E5 may be red box depending on the scale and type of development proposed).				
*	EA has no comment to make regarding change of use applications not included within this matrix.				

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There are three levels of FRA which can be undertaken by a developer:

- **Level 1: Screening Study:** To identify whether there are any flooding or surface water management issues related to a development site that may warrant further consideration. This should be based on readily available existing information. The SFRA document, as well as the strategic flood risk maps (which reproduce the Environment Agency's Flood Maps and also show flooding from other sources) will allow the LPA to ascertain whether an FRA is required.

The Level 1 FRA should refer to Table 1 of the NPPF Technical Guidance document, which is provided on the strategic flood risk maps, when cross-referencing proposed development sites with flood risk areas.

- **Level 2 – Scoping Study:** To be undertaken if the Level 1 FRA indicates that the site may lie within an area that is at risk of flooding or that the site has the potential to increase flood risk due to increased rates of surface water runoff. This study should confirm the sources of flooding which may affect the site. The study should also include the following:
 - An appraisal of the availability and adequacy of existing information
 - A qualitative appraisal of the flood risk posed to the site, and potential impact of the development on flood risk elsewhere
 - An appraisal of the scope of possible measures to reduce the flood risk to acceptable levels

The scoping study may identify that sufficient quantitative information is already available to complete an FRA appropriate to the scale and nature of the development.

Typical sources of information for this level of study include: Regional/Local policy statements, Regional Flood Risk Appraisals, the SFRA, CFMPs (summarised in this document), Surface Water Management Plans, consultation with the Environment Agency, Historic maps, local information and a walkover survey of the proposed site (to assess potential sources of flooding, likely routes for flood water, site's key features). A site survey to determine ground levels across the site and levels of formal and informal flood defences should also be ascertained.

- **Level 3 – Detailed Study:** To be undertaken if the Level 2 FRA concludes that further quantitative analysis is required to assess flood risk issues related to the development site. The study should include:
 - Quantitative appraisal of the potential flood risk to the development
 - Quantitative appraisal of the potential impact of the development site on flood risk elsewhere
 - Quantitative demonstration of the effectiveness of any proposed mitigation measures

Typical sources of information for this level of study are as for the Level 2 FRA, as well as a detailed topographical survey, detailed hydrologic survey, site-specific hydrological and hydraulic modelling study, model calibration/verification (where data exists to do so) and continued consultation with the LPA, the Environment Agency and other flood risk consultees.

The following reflects best practice on what should be addressed within a detailed FRA.

10.1 Proposed Developments Within 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 river 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.
- Whether the development contributes towards reducing flood risk. This is an important test of any new development in the context of the NPPF flood risk guidance.
- The potential of the development to increase flood risk elsewhere through the addition of hard 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 should also be assessed. The latter point refers to the impact that the development will have on flood flow routes and flood storage. This will require a detailed assessment to be carried out by a suitably qualified engineer. It should be noted that new development must not result in an increase in flood risk elsewhere.
- It is highlighted that all forms of flooding need to be considered as localised flooding may also occur, typically associated with local catchment runoff following intense rainfall passing directly over the borough. This localised risk of flooding must also be considered as an integral part of the detailed Flood Risk Assessment.
- 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.

10.2 Proposed Developments Within Medium Probability Flood Zone 2

For all sites within Medium Probability Zone 2, a high level FRA should be prepared based upon readily available existing flooding information, sourced from the Environment Agency. It will be necessary to demonstrate that the residual risk of flooding to the property is effectively managed through, for example, the provision of raised floor levels and the provision of planned evacuation routes.

10.3 Proposed Developments Within Flood Zones 1 and 2

Within all areas of Shropshire, the risk of alternative sources of flooding (e.g. surface water, sewage, and/or groundwater) must be considered, and sustainable drainage techniques must be employed to ensure no worsening of existing flooding problems 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.

10.4 Raised Floor Levels and Basements (Freeboard)

The raising of floor levels above the 1% probability 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 flow over the next 20 to 100 years (see Table 5 of the NPPF Technical Guidance document).

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

Wherever possible, 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 channels, culverts or bridges. The height to which the floor level is raised above flood level is referred to as the 'freeboard', and is determined as a measure of the 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 300 mm 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.

11 Guidance for the Application of Sustainable Drainage Systems (SuDS)

11.1 Introduction

SuDS is a 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 its 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 Shropshire.

The change from PPS25 to the NPPF has resulted in a consultation phase being undertaken, the results of which, and subsequent guidance, have not yet been published at the time of completion of this study (May 2012).

It is therefore recommended in the interim period that the principles set out in PPS25 continue to be applied.

11.2 Types of SuDS Systems

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 public open 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 is likely to be small 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. The most commonly found components of a SuDS system are described below:

- Pervious surfaces: Surfaces that allow inflow of rainwater into the underlying construction or soil
- Green roofs: Vegetated roofs that reduce the volume and rate of runoff and remove pollution

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- 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 and wetlands areas 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 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).

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

- Practice Guide Companion to PPS 25 (December 2009)
- 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
- Interim Code of Practice for Sustainable Drainage Systems, National SuDS Working Group, 2004
- www.ciria.org.uk/suds/

11.3 Application of SuDS for Shropshire

Northern Shropshire

The northern part of Shropshire has a mixture of slowly permeable and freely permeable, slightly acidic, loamy and clayey soil areas (see Section 6.2). The more permeable sites should have priority given to infiltration drainage techniques, as opposed to discharging surface water to watercourses. Where less permeability is found and infiltration techniques that rely on discharge into the existing soils are not viable (also due to a high water table, source protection zones, contamination etc), discharging site runoff to watercourses is preferable to the use of sewers (with the addition of attenuation to reduce flow from the site). Integrated urban drainage should also be used throughout the design process.

The majority of the area has been highlighted by DEFRA as a Nitrate Vulnerable Zone (NVZ) and there is a significant area classified as a Groundwater Source Protection Zone (GSPZ) by the EA. Northern Shropshire includes Phases 3, 5 and 6 of the Shropshire Groundwater Scheme, which

Shropshire Council

shows the location of pipelines and pumping stations. Any water wells should also be identified and taken into account in the 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 GSPZ is situated over the Permo-Triassic Sandstone Aquifer and is designated as inner, outer and total catchment areas. The Inner Zones of the GSPZ are the most sensitive areas and vary in diameter from 0.1 to 0.3 Kilometres. The Outer Zones are also sensitive to contamination and vary in diameter from 0.2 to 3.6 Kilometres in this borough. The GSPZ requires attenuated storage of runoff to prevent infiltration and contamination.

Ten GSPZ Inner Zones have been identified by the EA in this area and they are situated in the following areas:

- North of Shrewsbury: Merrington
- North Central area: Preston Brockhurst, Lee Brockhurst and Marchamley
- Northern area: Prees and Norton
- North eastern area: Wistanswick, Longford, Tyrley Castle and Broomhall Grange

Runoff which is likely to be heavily contaminated must be treated by a proprietary device, which should be carefully considered to ensure the correct system is selected to remove pollutants. PPS 3 (2006) states that source control SuDS must be considered and incorporated where suitable. For example; surface water drained from a car park should implement 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 the mobilisation of contamination. In such cases lined underground attenuation storage can be used to store a 1 in 100 year +20% (for climate change) storm event and then discharged into a nearby watercourse.

Oswestry Area

Due to the relatively permeable, slightly acidic, loamy and clayey soils within the area around Oswestry (see Section 6.2) it is recommended that priority is given to the use of infiltration drainage techniques, as opposed to discharging surface water to watercourses. Where infiltration techniques that rely on discharge into the existing soils are not viable (due to a high water table, local impermeable soils, source protection zones, contamination etc), discharging site runoff to watercourses is preferable to the use of sewers. Integrated urban drainage should also be used throughout the design process.

Approximately 40% of this area, in the east, has been highlighted by DEFRA as a Nitrate Vulnerable Zone (NVZ). Two significant areas in the centre and south-east of the Borough are also classified as

Shropshire Council

Groundwater Source Protection Zones (GSPZ) by the EA. The area includes Phase 7 of the Shropshire Groundwater Scheme, which shows the location of pipelines and pumping stations. Any water wells should also be identified and taken into account in the design process.

The GSPZ is situated over the Permo-Triassic Sandstone Aquifer and is designated as inner, outer and total catchment areas. The Inner Zones of the GSPZ are the most sensitive areas and vary in diameter from 0.1 to 0.2 Kilometres. The Outer Zones are also sensitive to contamination and vary in diameter from 1.1 to 3.5 Kilometres in this Borough. The GSPZ requires attenuated storage of runoff to prevent infiltration and contamination.

Five Inner Zones have been identified by the EA in this area and they are situated in the following areas:

- North-East of Shrewsbury: Ruyton – XI – Towns and Kinnerley
- East of Oswestry: Rednal and Welsh Frankton
- North-west of Oswestry: Selattyn

Runoff which is likely to be heavily contaminated must be treated by a proprietary device, which should be carefully considered to ensure the correct system is selected to remove pollutants. PPS 3 (2006) states that source control SuDS must be considered and incorporated where suitable. For example; surface water drained from a car park should implement 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. In such cases lined underground attenuation storage is used to store a 1 in 100 year +20% (for climate change) storm event and discharges into a nearby watercourse.

Central Shropshire / Shrewsbury Area

This area in Shropshire is predominantly made up of low permeability; acidic loamy and clayey soils (see Section 6.2). The more permeable sites should have priority given to infiltration drainage techniques, as opposed to discharging surface water to watercourses. Where less permeability is found and infiltration techniques that rely on discharge into the existing soils are not viable (also due to a high water table, source protection zones, contamination etc), discharging site runoff to watercourses is preferable to the use of sewers. Integrated urban drainage should also be used throughout the design process.

Approximately 20% of this area, predominantly in the north-east, has been highlighted by DEFRA as a Nitrate Vulnerable Zone (NVZ). Significant areas in the north-east, around Shrewsbury, and the north-west, around Telford, are classified as Groundwater Source Protection Zones (GSPZ) by the Environment Agency. This area includes Phase 2 of the Shropshire Groundwater Scheme, which shows the location of pipelines and pumping stations. Any water wells should also be identified and taken into account in the design process.

The GSPZ is situated over the Permo-Triassic Sandstone Aquifer and is designated as inner, outer and total catchment areas. The Inner Zones of the GSPZ are the most sensitive areas and vary in

Shropshire Council

diameter from 0.1 to 0.6 Kilometres. The Outer Zones are also sensitive to contamination and vary in diameter from 0.2 to 7.7 Kilometres in this Borough. The GSPZ requires attenuated storage of runoff to prevent infiltration and contamination.

Seven Inner Zones have been identified by the Environment Agency in the southern Shropshire area and they are situated in the following areas:

- Near Shrewsbury: Spring Gardens, Shelton, Hanwood Bank, Shoot Hill and Alberbury.
- East of Telford: Uppington and Wroxeter.

Runoff which is likely to be heavily contaminated must be treated by a proprietary device, which should be carefully considered to ensure the correct system is selected to remove pollutants. PPS 3 (2006) states that source control SuDS must be considered and incorporated where suitable. For example; surface water drained from a car park should implement 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. In such cases lined underground attenuation storage is used to store a 1 in 100 year +20% (for climate change) storm event and discharges into a nearby watercourse.

Southern Shropshire

Due to the relatively permeable, slightly acidic loamy and sandy soil within the southern areas of Shropshire it is recommended that priority is given to the use of infiltration drainage techniques, as opposed to discharging surface water to watercourses. Where infiltration techniques that rely on discharge into the existing soils are not viable (due to a high water table, local impermeable soils, source protection zones, contamination etc), discharging site runoff to watercourses is preferable to the use of sewers. Integrated urban drainage should also be used throughout the design process.

Two small areas in the south-west and south-east have been highlighted by DEFRA as Nitrate Vulnerable Zones (NVZ). Several small areas in the centre and on the southern boundary of the District are also classified as Groundwater Source Protection Zones (GSPZ) by the EA. Any boreholes, water wells or other extraction points should also be identified and taken into account in the design process.

The GSPZ is situated over the Permo-Triassic Sandstone Aquifer and is designated as inner, outer and total catchment areas. The Inner Zones of the GSPZ are the most sensitive areas and vary in diameter from 0.1 to 1.2 Kilometres. The Outer Zones are also sensitive to contamination and vary in diameter from 0.6 to 4.3 Kilometres in this borough. The GSPZ requires attenuated storage of runoff to prevent infiltration and contamination.

Five GSPZ Inner Zones have been identified by the EA in this District and they are situated in the following areas:

- Near Church Stretton: Munslow, Diddlebury and Ashbrook
- Western area of the District: Bishops Castle
- Southern border area of the District: Clungunford

Shropshire Council

Runoff which is likely to be heavily contaminated must be treated by a proprietary device, which should be carefully considered to ensure the correct system is selected to remove pollutants. PPS 3 (2006) states that source control SuDS must be considered and incorporated where suitable. For example; surface water drained from a car park should implement 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. In such cases lined underground attenuation storage is used to store a 1 in 100 year +20% (for climate change) storm event and discharges into a nearby watercourse.

Eastern Shropshire / Bridgnorth Area

This area of Shropshire has a mixture of slowly permeable and freely permeable, slightly acidic, sandy, loamy and clayey soil areas. The more permeable sites should have priority given to infiltration drainage techniques, as opposed to discharging surface water to watercourses. Where less permeability is found and infiltration techniques that rely on discharge into the existing soils are not viable (also due to a high water table, source protection zones, contamination etc), discharging site runoff to watercourses is preferable to the use of sewers. Integrated urban drainage should also be used throughout the design process.

The majority of the western side of Shropshire has been highlighted by DEFRA as a Nitrate Vulnerable Zone (NVZ). The same area, around Wolverhampton, is also classified as a Groundwater Source Protection Zone (GSPZ) by the EA. Any boreholes, water wells or other extraction points should also be identified and taken into account in the design process.

The GSPZ is situated over the Permo-Triassic Sandstone Aquifer and is designated as inner, outer and total catchment areas. The Inner Zones of the GSPZ are the most sensitive areas and vary in diameter from 0.1 to 0.3 Kilometres. The Outer Zones are also sensitive to contamination and vary in diameter from 1.5 to 6.0 Kilometres in this borough. The GSPZ requires attenuated storage of runoff to prevent infiltration and contamination.

Fifteen GSPZ Inner Zones have been identified by the EA in this area and they are situated in the following areas:

- North-eastern area of the Bridgnorth area: Sheriffhales, Shifnal, Lizard Grange, Ruckley Grange, Rooker Farm, Brook Farm, Hatton Hill and Grindle
- Much Wenlock
- East of Bridgnorth: Worfield, Wyken, Hilton and Ackleton
- On the eastern Shropshire border: Copley Farm and Halfpenny Green

Runoff which is likely to be heavily contaminated must be treated by a proprietary device, which should be carefully considered to ensure the correct system is selected to remove pollutants. PPS 3 states that source control SuDS must be considered and incorporated where suitable. For example; surface water drained from a car park should implement a filter bed wherever possible before considering an interceptor device to remove contaminants.

Shropshire Council

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. In such cases lined underground attenuation storage is used to store a 1 in 100 year +20% (for climate change) storm event and discharges into a nearby watercourse.

12 Gap Analysis

12.1 Introduction

Data gaps were assessed throughout the original Level 1 SFRA data collection and review exercise. This flagged the missing or incomplete data. This therefore became a key starting point for this update commission – seeking to complete gaps in the original data sets, in addition to obtaining revised and new data sets.

As with the original study, it should be noted that an SFRA is a living document which should be further updated as new and more detailed data becomes available.

12.2 Missing or Incomplete Data

The following data sets are either missing or have caveat assumptions regarding their use:

Data	Description	Source
Flood outlines	Modelled 20year return period (or similar) flood outlines exist for all modelled rivers except the Rea Brook, Money Brook and Stags Brook. A modelled 25yr outline exists for the River Teme – but this is deemed unsuitable for use to define flood zone 3b outlines.	Environment Agency (this data does not yet exist).

12.3 Level 2 SFRAs

This revised Level 1 SFRA will allow Shropshire Council to assess its current and future 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, further work will need to be undertaken as part of a Level 2 SFRA to determine the variations in flood risk in these zones. This will ensure that preference is given to the lowest risk areas within Flood Zones 2 and 3. Once this work has been carried out, the exception test will need to be applied in line with Table 3 of the NPPF Technical Guidance document. Three criteria need to be satisfied 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 SFRA where one has been prepared. If the DPD has reached the ‘submission’ stage the benefits of the development should contribute to the Core Strategy’s Sustainability Appraisal
- 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

Shropshire Council

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 scope of works for a Level 2 SFRA needs to be agreed in consultation with the Environment Agency.

The data required for a Level 2 SFRA within North Shropshire 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.

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. Halcrow is able to advise on further work required if this situation arises.

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 SFRA should include an appraisal of the extent of works to provide or raise the flood defence to appropriate standard. Should sites become allocated behind defences, Halcrow can advise on the cost of such work, and whether existing data is suitable for this purpose.

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

12.3.1 Completed Shropshire Council Level 2 SFRAs

Since the publication of the original Level 1 SFRA document, a number of Level 2 SFRA commissions were undertaken in the Shropshire Council area. In March 2008, Shropshire Council commissioned Halcrow to produce a Level 2 SFRA¹ in accordance with the then PPS25 guidance and its

¹ Shrewsbury SFRA Level 2, Halcrow, 2009

Companion Guide, Making Space for Water (2003) and the new Severn Catchment Flood Management Plan (2008).

The study comprised 1D-2D hydraulic modelling of the River Severn through Shrewsbury, to produce defended flood hazard maps for Flood Zones 2 (1 in 1000 year), 3a (1 in 100 year), 3a plus climate change (1 in 100 year +20%) and 3b (1 in 20 year). A series of breach hazard scenarios were produced for the 1 in 100 year event: two at the Frankwell defences and one at the Coleham defences, both in Shrewsbury. The Coleham defences have recently been improved to provide a 1 in 100 year Standard of Protection. .

The Level 2 SFRA study refined and built upon the work undertaken in the original Level 1 SFRA. The need to undertake a Level 2 SFRA for Shrewsbury was driven by the need for future redevelopment of brownfield sites in Shrewsbury, in order to maintain the long term prosperity of the town. Many potentially suitable development locations are often at risk of flooding posed by the River Severn (as well as Rea Brook in the Abbey Foregate area). The Level 2 SFRA commission therefore provided flood hazard information for a range of return periods and potential defence breach scenarios, in order to inform application of the Sequential and Exception Tests (by the Council), and the determination of the suitability of redevelopment of brownfield sites. Relevant policies for the management of flood risk and appropriate development of flood risk areas in Shrewsbury were subsequently developed and put forward.

The Level 2 SFRA study also included an assessment of some 73 potential development sites which may be taken forwards for development in the future. Their suitability for development was assessed against flood risk information, to assist the Council with the Sequential Test process. The Environment Agency was consulted throughout the study to ensure that the approach is robust and meets best practice.

The modelling results of the Level 2 study show that there are significant variations in flood hazard, both within the same return period and between different return periods, demonstrating that the hazard posed when an event occurs will not be uniform across the flooded area. The Frankwell and Coleham defences (which include proposed defences) have been shown to have a design standard of 1 in 100 years, but are both overtopped for the 100 year plus climate change event and the 1 in 1000 year event. Breach scenarios at Frankwell have also demonstrated that if a breach occurred during the 1 in 100 year event, inundation would be rapid, with fast, deep waters producing areas of extreme flood hazard. At Coleham, a defence breach would cause slower inundation, with lower velocities and depths, but hazardous nonetheless. This demonstrates that development behind the defence would be very susceptible to flood risk as a result of climate change, indicating that new development should not be considered here. However, it is acknowledged that brownfield redevelopment may be required to ensure the long-term prosperity of the area and therefore sites may be considered should Sequential and Exception Tests be passed, provided the relevant policy recommendations are followed.

13 References/Glossary

- 1) **AEP** - Annual Exceedance Probability, for example 1% AEP is equivalent to 1% probability of occurring in any one year (or, on average, once in every 100 years).
- 2) **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.
- 3) **DEFRA** - Department of Environment, Food and Rural Affairs Development.
- 4) **Development Plan Document (DPD)** - 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.
- 5) **Dry pedestrian egress** - Routes to and from buildings that will remain dry and allow pedestrian/wheelchair evacuation to dry land in times of flood.
- 6) **Environment Agency** - The leading public body for protecting and improving the environment in England and Wales.
- 7) **Environment Agency Flood Map** - Nationally consistent delineation of 'high' and 'medium' flood risk, published on a quarterly basis by the Environment Agency.
- 8) **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.
- 9) **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. PPS 25 sets out strict requirements for the application of the Test.
- 10) **Floodplain Mapping – River Stour and Smestow Brook (July 1993)** – Floodplain mapping report detailing the hydrological analysis and hydraulic modelling undertaken as part of the study.
- 11) **Flood Estimation Handbook** - The latest hydrological approach for the estimate of flood flows in UK.
- 12) **Flood Risk Management Hierarchy** - PPS 25 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.

- 13) **Flood Risk Vulnerability** - PPS 25 provides a vulnerability classification to assess which uses of land maybe appropriate in each flood risk zone.
- 14) **Formal Flood Defence** - A structure built and maintained specifically for flood defence purposes.
- 15) **Functional Floodplain Zone 3b** - Defined as areas at risk of flooding in the 5% AEP (20 year) design event.
- 16) **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.
- 17) **High probability Zone 3a** - Defined as areas at risk of flooding in the 1% AEP (100 year) design event.
- 18) **IDB** – Internal Drainage Board, responsible for non-main rivers and drainage within their boundary area.
- 19) **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).
- 20) **JFLOW** - A computer river model based on routing 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.
- 21) **Land Swapping** - looking 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.
- 22) **LiDAR** - Light Detection and Ranging (LiDAR) is an airborne terrain mapping technique which uses a laser to measure the distance between the aircraft and the ground.
- 23) **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.
- 24) **Low Probability Zone 1** - Defined as areas outside Zone 2.
- 25) **Main River** – A section of watercourse (including the structures and devices on it used to regulate flow) which is maintained by the Environment Agency.
- 26) **‘Making Space for Water’ (Defra 2004)** - The Government’s new evolving 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.

- 27) **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.
- 28) **NFCDD** – National Flood and Coastal Defence Database, owned by the Environment Agency, containing details of the location, standard and condition of all Environment Agency maintained defences
- 29) **Ordinary Watercourse (non-main river)** – Any section of watercourse not designated as a main river.
- 30) **Planning Policy Statements** - The Government has updated its planning advice contained within Planning Policy Guidance Notes (PPGs) with the publication of new style Planning Policy Statements (PPSs).
- 31) **Planning Policy Statement 25 (PPS 25): Development and Flood Risk** - PPS 25 reflects the general direction set out in 'Making Space for Water'.
- 32) **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.
- 33) **Residual Risk** - The risk which remains after all risk avoidance, reduction and mitigation measures have been implemented.
- 34) **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.
- 35) **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.
- 36) **Strategic Flood Risk Assessment (SFRA)** - 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.

- 37) **Supplementary Planning Document (SPD)** - 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.
- 38) **Sustainability Appraisal (SA)** - Appraisal of plans, strategies and proposals to test them against broad sustainability objectives.
- 39) **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).
- 40) **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.

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