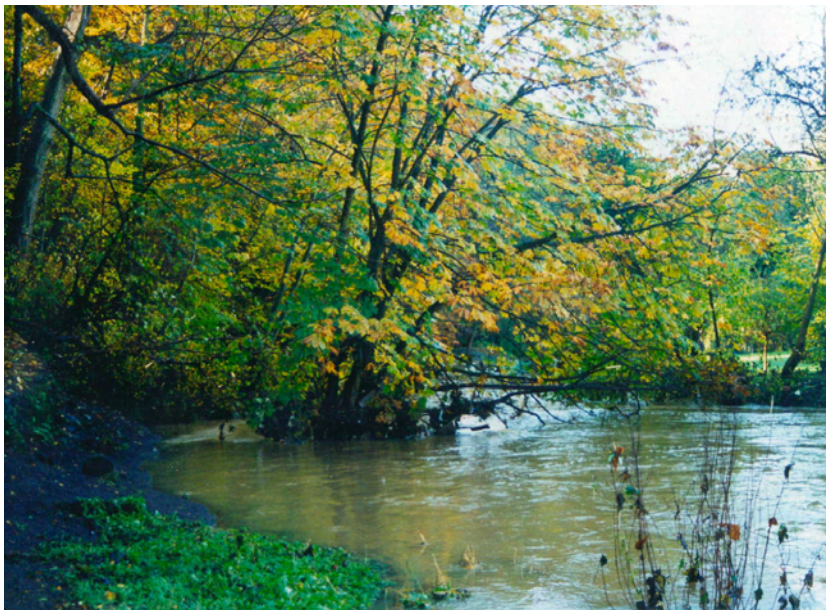
West Wiltshire District Council

Strategic Flood Risk Assessment

Level 1

Final Report
August 2008



Prepared for:

Revision Schedule

Level 1 Strategic Flood Risk Assessment
August 2008

Rev	Date	Details	Prepared by	Reviewed by	Approved by
01	October 2007	Draft Level 1 Strategic Flood Risk Assessment	**Mark Crussell** Assistant Hydrologist	**Carl Pelling** Senior Consultant	**Damon O'Brien** Technical Director
02	August 2008	Final Level 1 Strategic Flood Risk Assessment	**Mark Crussell** Assistant Hydrologist	**Rob Sweet** Senior Flood Risk Specialist	**Jon Robinson** Associate Director

Scott Wilson Ltd.,
The Crescent Centre,
Temple Back,
Bristol,
BS1 6EZ

Tel. 0117 917 1200
Fax. 0117 930 0342
www.scottwilson.com

Executive Summary

This Level 1 Strategic Flood Risk Assessment (SFRA) was produced by Scott Wilson for West Wiltshire District Council (DC). This Executive Summary has been produced to enable the wider user to understand the technical content of the Level 1 SFRA and accompanying appendices. A Glossary of Terms and Abbreviations are provided following this Executive Summary.

Strategic Flood Risk Assessments

The West Wiltshire DC SFRA provides an overview of flood risk from all sources within the West Wiltshire DC administrative area. This provides West Wiltshire DC, developers and other interested parties with general guidance on flood risk and issues associated with flooding. In general floods have the potential to cause damage and disruption to transport routes, homes, businesses and the environment. This is costly in both social and economic terms and can cause distress, harm and in the worst cases, the loss of life.

The Government published Planning Policy Statement 25 – Development and Flood Risk (PPS25) (DCLG, 2006) in December 2006, which requires flood risk to be considered within the strategic planning undertaken by Local Planning Authorities (LPAs). This recommends that land allocated for development should be located in areas with the lowest risk of flooding. Only where it can be demonstrated that there are no reasonably available sites in lower flood risk areas can development in higher flood risk areas be considered. This approach is referred to as the application of the Sequential Approach and is used to test preferred land allocations for development with respect to flood risk.

This Level 1 SFRA covers the area administered by West Wiltshire DC. The main objectives of this Level 1 SFRA are:

- To provide an assessment of the impact of all potential sources of flooding in accordance with PPS25 (DCLG, 2006), including an assessment of any future impacts associated with climate change;
- To provide the information needed to apply the Sequential Test for identification of land suitable for development in line with the principles of PPS25 (DCLG, 2006);
- To allow West Wiltshire DC to assess the flood risk for specific development and proposal sites, thereby setting out the requirements for site specific Flood Risk Assessments;
- To enable planning policies to be identified to minimise and manage flood risks;
- To provide specific advice regarding Sustainable Drainage Systems (SuDS) and a review of suitable techniques, in terms of the geology throughout the study area.

This Level 1 SFRA comprises a technical report that has been written to meet the criteria of PPS25 (DCLG, 2006). In order to apply the Sequential Test this report provides an

assessment of the probability associated with flooding from different flood sources within the West Wiltshire DC study area. The flood sources present within the study area are:

- Fluvial (River flooding occurs when the amount of water in them exceeds the flow capacity of the river channel);
- Groundwater (Groundwater flooding occurs when water in the ground rise above surface elevations);
- Overland Flow (Overland flow flooding occurs when intense rainfall is unable to soak into the ground and runs quickly off the land);
- Sewers (Sewer flooding occurs when the sewer overwhelmed by heavy rainfall, becomes blocked or is of inadequate capacity);
- Artificial Sources (Artificial flood sources include canals, ponds and reservoirs. Flooding may occur in the event of structural failure or breach of retaining wall).

The flood risk areas associated with the fluvial flood sources across the study area have been classified, where possible, as having either a low, medium or high probability of flooding. For groundwater, overland flow and sewer flood sources the current paucity of data makes definition of robust classifications of probability unreliable. In these situations the flood risk from the particular source should be considered as 'medium' until proven otherwise and should be investigated through a site specific Flood Risk Assessment.

The West Wiltshire Study Area

The study area is defined by the area administered by West Wiltshire DC. The study area covers an area of approximately 517km^2 and is predominantly rural with a number of larger urban areas:

- Trowbridge;
- Warminster;
- Melksham;
- Westbury; and
- Bradford on Avon.

These urban areas along with the smaller villages dispersed throughout the study area are predominantly at risk from river flooding.

Within the study area there are a number of watercourses, which drain two main river catchments, namely:

- The River Avon (Bristol) – This catchment drains land to the north of the study area. The River Avon (Bristol) flows into the study area from the north, and flows in a predominantly south west direction flowing out of the study area over the western district boundary. The River Avon (Bristol) is joined by a number of tributaries as it flows

through the district. The main towns along its course include Melksham and Bradford on Avon;

- The River Avon (Hampshire) – This catchment drains land to the south of the study area. The River Wylye, which flows through Warminster, is the main river draining this part of the study area.

The main rivers and catchments are illustrated in Figure 2 of this report.

The risk of flooding in some areas is, to an extent, reduced through the protection provided by either natural or man-made defences. Flooding from overland flow, generated from rainfall running off from the surrounding land, together with flooding from sewers has also been experienced within the study area. The risks of flooding from these sources are forecast to increase with the predicted effects of climate change.

There are no recorded incidents of groundwater flood within the study area, although groundwater contained within the study areas underlying geology plays an important role in the watercourses flow regimes.

There are a number of artificial watercourses, such as ponds and reservoirs within the study area. However the main artificial watercourse is the Kennet and Avon Canal entering the study area to the west of Bradford on Avon, and crosses the study area boundary to the east of Semington. There are a number of aqueducts within the study area, which include both historic and modern structures. With regards to infrastructure failure the most significant of these is the aqueduct crossing the A350 to the east of Semington.

Information Sources

Data for the production of this report was collected from the Environment Agency, West Wiltshire DC and Wessex Water and is the best available data at the time of writing. This Level 1 SFRA is a 'live' document and should be updated on a regular basis as new information becomes available.

The quality of the data collected and produced varies and where less reliable information or assumptions are necessary, a precautionary approach is taken when identifying the flood risk probability.

Prior to a decision being made about the suitability of a site for development in terms of flood risk, additional data will be required from the developer in the form of a site specific Flood Risk Assessment.

Explanation of Flood Risk Terminology

The PPS25 (DCLG, 2006) Flood Zones provided by the Environment Agency illustrate the extent of flooding from rivers and the sea. Table 1 illustrates the return period and probability associated with the PPS25 Flood Zones for river flooding. These maps do not illustrate the risk of flooding from groundwater, overland flow or sewer sources.

Table 1: Return Period and Probability of Fluvial Flooding for Flood Zones 2 and 3.

	Flood Zone 2		Flood Zone 3	
	Return Period	Probability	Return Period	Probability
River	1 in 1000 year	0.001 / 0.1%	1 in 100 year	0.01 / 1%

Flood Zone 1 covers all areas that are not within Flood Zones 2 and 3 and are those areas where the probability of flooding is less than 0.1% (less than 1 in 1000 years).

PPS25 (DCLG, 2006) uses the Flood Zones to differentiate between low probability (Flood Zone 1) and high probability (Flood Zone 3) areas. Flood Zone 3 is further divided into high probability (Flood Zones 3a) and Functional Floodplain (Flood Zone 3b). Functional Floodplain is land where water has to flow or be stored in times of flood. Defined as the 5% (1 in 20 year) annual probability floodplain or an area designed to flood, or as agreed between the LPA and the Environment Agency. It should be noted that areas that would normally flood in a 1 in 20 year event but do not due to the presence of solid buildings or infrastructure (roads, railways etc) would not normally be classified as Functional Floodplain.

A sequential approach to the allocation of land and the development of sites is advised by PPS25 (DCLG, 2006). Development in higher risk areas (Flood Zones 2 and 3) should only occur if there are no suitable areas within low risk zones.

Deliverables

The main deliverables from this study are the production of this report and a collection of Geographic Information System (GIS) layers that provide mapping of flooding related data across the study area. The GIS mapping provides a tool for planning and development control officers to identify areas where flood risk may be an issue. This will assist the LPA to make consistent and sustainable planning decisions with respect to flood risk. In addition, the GIS framework allows information to be readily updated when new data becomes available.

The GIS layers that have been produced provide mapping of the main rivers and catchments, existing flood risk, locations of historic flooding from all sources (with description), location of flood defences and flood warning areas.

The maps of existing flood risk illustrate those areas at risk of flooding during the 1 in 100 year (1% probability) and 1 in 1000 year (0.1% probability) flood event assuming that defences are not present. These are largely based on information provided by the Environment Agency. In locations where the Environment Agency has no data on floodplain extents a precautionary buffer of 28m from top of bank is considered as an area of potential flood risk. Where development is proposed in these locations, a site specific Flood Risk Assessment will be required.

The locations of historic and potential flood sources are indicated by individual circular symbols presented within Figure 4 A-D of this report and as GIS layers. The GIS provides information on the date, source and more detail on the location of flooding. This historic flooding information has been sourced from the Environment Agency's Flood Reconnaissance Information System (FRIS) and Wiltshire CC highway flooding incident database. The circular symbol indicates that flooding occurred in the general area and not the precise location/extent of the flooding.

The SFRA has identified existing flood defences that are maintained by the Environment Agency or West Wiltshire DC. These defences are either natural or man made. Flooding may occur behind these defences depending on the return period of an event.

An understanding of the potential effects of climate change on rainfall, river flows within the study area are required to account for climate change during the strategic land use planning process. In the absence of detailed hydraulic modelling the current Flood Zone 2 extent has been used to demonstrate the extent of the design event (1 in 100 year with climate change).

From the available data, the effects of climate change on groundwater, overland flow and sewer flood sources within the study area have not been possible to assess. The effects of climate change on these flood sources should be investigated through a site specific Flood Risk Assessment.

Technical Guidance

As part of the Level 1 SFRA, technical guidance has been provided for planning officers on the application of the Sequential Test and where needed, the Exception Test as outlined in PPS25 (DCLG, 2006). Further to this, guidance on Sustainable Drainage Systems, strategies related to wider policies such as the Regional Spatial Strategy, the Wiltshire and Swindon Structure Plan, the Environment Agency Catchment Flood Management Plans and site specific Flood Risk Assessments has been provided.

Summary and Recommendations

The following points provide a summary of the Level 1 SFRA Report and recommendations:

- West Wiltshire DC required a Level 1 SFRA for the progression of its Local Development Framework, to assist development control and to inform emergency planning;
- This report provides the findings of the Level 1 SFRA;
- West Wiltshire DC will use the findings of this Level 1 SFRA to perform the Sequential Test as part of the Local Development Framework process;
- If for sustainability reasons, following the application of the Sequential Test, potential developments lay within Flood Zones 2 and 3, then a Level 2 SFRA will be required to apply the Exception Test to those developments;

- Initial assessment of flood sources within the West Wiltshire District indicates that flooding is mainly fluvial. However, to a lesser extent a flood risk from overland flow exists within the study area, and flood risk from groundwater is considered minimal. There are localised sewer flooding issues within the study area due to limited sewer capacity;
- The broad scale assessments in Appendix C illustrate that some sites identified for development have areas that lie within Flood Zones 2 and 3. Application of the Sequential Test and consideration of the wider evidence base in relation to other policies and sustainability drivers may require application of the Exception Test to be considered at these sites;
- The available data collected for this Level 1 SFRA may not be sufficient to provide detailed information on a site specific basis, as may be required for a Level 2 SFRA. The requirements of a Level 2 SFRA, where required need to be confirmed between West Wiltshire DC and the Environment Agency. Where necessary additional hydraulic modelling may be required.

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Abbreviations

Acronym	Definition
AONB	Area of Outstanding Natural Beauty
CFMP	Catchment Flood Management Plan
DCLG	Department of Communities and Local Government
DC	District Council
DPD	Development Plan Documents
DTLR	UK Department of Transport, Local Government and Regions
FRA	Flood Risk Assessment
FRIS	Flood Reconnaissance Information System
GIS	Geographical Information Systems
LDDs	Local Development Documents
LDF	Local Development Framework
LDS	Local Development Scheme
LiDAR	Light Detection and Ranging
LPA	Local Planning Authority
LPD	Local Planning Documents
NFCDD	National Flood and Coastal Defence Database
ODPM	Office of the Deputy Prime Minister
PCPA 2004	Planning and Compulsory Purchase Act 2004
PPG25	Planning Policy Guidance Note 25: Development and Flood Risk
PPS25	Planning Policy Statement 25: Development and Flood Risk
RFRA	Regional Flood Risk Appraisal
RPG	Regional Planning Guidance
RSS	Regional Spatial Strategy
SAC	Special Area of Conservation
SA	Sustainability Appraisal
SFRA	Strategic Flood Risk Assessment
SPA	Special Protection Area
SPG	Supplementary Planning Guidance
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems
WHS	World Heritage Site

Glossary

Term	Definition
Aquifer	A source of groundwater comprising water-bearing rock, sand or gravel capable of yielding significant quantities of water.
Catchment Flood Management Plan	A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Culvert	A channel or pipe that carries water below the level of the ground.
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Floodplain	Area adjacent to river, coast or estuary that is naturally susceptible to flooding.
Flood storage	A temporary area that stores excess runoff or river flow often ponds or reservoirs.
Fluvial flooding	Flooding by a river or a watercourse.
Groundwater	Water that is in the ground, this is usually referring to water in the saturated zone below the water table.
Local Development Framework (LDF)	The core of the updated planning system (introduced by the Planning and Compulsory Purchase Act 2004). The LDF comprises the Local Development Documents, including the Development Plan Documents that expand on policies and provide greater detail on the strategic planning aims of a Local Planning Authority. The development plan includes a core strategy, site allocations and a proposals map.
Local Planning Authority	Body that is responsible for controlling planning and development through the planning system.
Main River	Main rivers are usually larger streams and rivers. However, they do include smaller watercourses of local significance. A main river is a watercourse marked as such on a main river map. The Environment Agency powers to carry out flood defence works apply to main rivers only.
Mitigation Measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere.
Ordinary Watercourse	An ordinary watercourse is every river, stream, ditch, drain, cut, dyke, sluice, sewer (other than a public sewer) and passage through which water flows and which does not form part of a main river. The Local Authority or the Internal Drainage Board where relevant has powers for Ordinary Watercourses.
Overland Flow	Flooding caused when intense rainfall exceeds the capacity of the drainage system or when, during prolonged periods of wet weather, the soil is so saturated such that it cannot accept any more water.
Risk	The probability or likelihood of an event occurring.
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
Sustainable Drainage System	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations meeting their own needs.
1 in 100 year event	Event that on average will occur once every 100 years. Also expressed as an event, which has a 1% probability of occurring in any one year.
1 in 100 year design standard	Flood defence that is designed for an event, which has an annual probability of 1%. In events more severe than this the defence would be expected to fail or to allow flooding.

1 Introduction

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

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

Planning Policy Statement 25 (PPS25): Development and Flood Risk (DCLG, 2006) and the PPS25 Practice Guide (DCLG, 2008) indicate that to assist LPAs in their strategic land use-planning, SFRAs should present sufficient information to enable LPAs to apply the Sequential Test (introduced in Chapter 6) to the development sites they will promote in their LDF. The SFRA should have regard to catchment wide flood issues and also involve a process which allows the LPA to determine the variations in flood risk across and from their area as the basis for preparing appropriate policies for flood risk management.

In areas where proposed development cannot be located in accordance with the Sequential Test as set out in PPS25 (i.e. to steer development towards areas of lowest risk) and where there are wider sustainability benefits of the development that outweigh the flood risk PPS25 suggests that:

'*The scope of the SFRA should be increased to provide the information necessary for the application of the Exception Test'* (introduced in Chapter 7).

1.1 The West Wiltshire DC SFRA

The draft Regional Spatial Strategy (dRSS) (SWRA, 2006) currently contains a target of 10,500 additional dwellings for the West Wiltshire District over the period 2006-2026. Proposed changes to the dRSS published in July 2008 indicate the number of additional dwellings within the district over the period 2006-2026 should increase to 12,300.

In accordance with Planning Policy Statement 3 (PPS3) 60% of these dwellings should be built on previously developed land. The West Wiltshire DC Core Strategy and Core Policy

LDDs will set out the vision and the spatial strategy for the West Wiltshire District. These LDDs will undergo a series of consultation phases involving the public and other stakeholders in order to decide on the preferred options for the West Wiltshire District. Potential growth areas for development are likely to be focused on the existing urban areas within the West Wiltshire District, namely:

- Trowbridge - Population 28,000;
- Warminster - Population 17,000;
- Melksham - Population 17,000;
- Westbury - Population 11,000; and
- Bradford on Avon - Population 9,000.

The spatial planning of new developments must be considered with regard to the current and future risk of flooding from a number of sources. The study area flood sources include:

- Fluvial;
- Groundwater;
- Overland Flow;
- Sewers; and
- Artificial Flood Sources.

It is therefore vitally important that flood risk is considered at a strategic scale to inform land allocations and future developments within the emerging LDF. Therefore to assess flood risk within the district at a strategic scale West Wiltshire DC commissioned Scott Wilson to undertake a SFRA of the West Wiltshire DC administrative area.

In tandem with this report Scott Wilson have also undertaken the Level 1 SFRAs for Kennet and North Wiltshire District Councils and the Wiltshire County and Swindon Borough Councils Minerals and Waste Level 1 SFRA.

1.2 Aim of SFRA

The aim of the Level 1 SFRA is to present sufficient information to enable the LPA to apply the Sequential Test to site allocations and to assist in identifying if application of the Exception Test will be necessary. Where the Exception Test is required the SFRA (Level 2) should present sufficient information to demonstrate that development will be safe from the

risks of flooding for the lifetime of the development, without exacerbating flood risk elsewhere and where possible contributes to an overall reduction in flood risk. In addition the SFRA (Level 1 and 2) should form a reference document for use by development control for advising and determining decisions on Windfall sites.

1.3 SFRA Objectives

The principle objectives of the West Wiltshire DC Level 1 SFRA are outlined below:

- To provide an assessment of the impact of all potential sources of flooding in accordance with PPS25, including an assessment of any future impacts associated with climate change;
- To provide the information needed to apply the Sequential Test for identification of land suitable for development in line with the principles of PPS25;
- To provide an evidence based report to inform the Sustainability Appraisal of Development Plan Documents (DPDs) with regard to catchment-wide flooding issues which affect the study area;
- To allow West Wiltshire DC to assess the flood risk for specific development and proposal sites, thereby setting out the requirements for site specific Flood Risk Assessments (FRAs);
- To enable planning policies to be identified to minimise and manage flood risks;
- To provide specific advice regarding Sustainable Drainage Systems (SuDS) and a review of suitable techniques, in terms of the geology throughout the study area;
- To enable West Wiltshire DC to use the SFRA as a basis for decision making at the planning application stage.

1.4 SFRA Structure

In accordance with the PPS25 Practice Guide (DCLG, 2008), Strategic Flood Risk Assessments should be completed in two consecutive stages, providing LPAs with tools throughout the LDF and SFRA process sufficient to inform decisions regarding development sites. The two stages are:

- Level 1 SFRA – Study Area Flood Source Review & Data Review;
- Level 2 SFRA – Development Site Assessments for Exception Testing.

The results of the Level 1 SFRA will enable a prompt start to the commencement of Level 2 (where required). The data review element of Level 1 also enables a robust specification and programme to be developed for Level 2.

1.4.1 Level 1- Study Area, Flood Source, Review and Data Review

The aim of a Level 1 SFRA is to present sufficient information to enable the LPA to apply the Sequential Test to potential development areas and to assist in identifying where application of the Exception Test will be necessary.

The objective of the Level 1 SFRA is to collate and review available information on flood risk for the study area. The information has been sourced from a variety of stakeholders including the Environment Agency, West Wiltshire DC and Wessex Water. The collation and review of this data provides information for a broad scale assessment of flood risk (Chapter 4).

The information provided in the Level 1 SFRA should facilitate application of the Sequential Test on proposed site allocations based on Flood Zones (see Chapter 5 and Table D1, Annex D, PPS25).

1.4.2 Level 2 SFRA – Development Site Assessments for Exception Testing

Where development in a floodplain needs to take place (i.e. when there are no reasonably available alternative sites in a lower risk flood zone for the development), a Level 2 SFRA should provide sufficient information to facilitate application of the Exception Test. This should refine the quality of the information available at development sites, sufficient for a robust assessment of flood risk to be made.

The information presented in this Level 1 SFRA should not be considered as an exhaustive list of all available flood related data for the study area. The Level 1 SFRA report is a presentation of flood sources and risk, based on data collected following consultation with and input from the LPA and stakeholders within the available timeframe. SFRAs are 'live' documents and should be updated on a regular basis as new information becomes available.

2 The West Wiltshire DC Study Area

The study area covers an area of approximately 517km^2 is defined by the administrative boundary of West Wiltshire DC (Figure 1) located within Wiltshire County. The West Wiltshire District is bordered to the west by Mendip District and Bath and North East Somerset, to the north by North Wilshire District, to the east by Kennet District and to the south by Salisbury District. The West Wiltshire District has a total population of 125,120 focused around five market towns:

- Trowbridge – Population 28,000;
- Warminster – Population 17,000;
- Melksham – Population 17,000;
- Westbury – Population 11,000; and
- Bradford on Avon – Population 9,000.

There are also many smaller villages scattered throughout the predominantly rural landscape. The smaller rural villages typically have lower density housing than the larger urban areas of the market towns. The sparsely populated undeveloped area of Salisbury Plain is located in the south east of the study area.

2.1 Local Rivers

Fluvial flooding is the main source of flooding within the study area. There is no tidal effect on the rivers, therefore tidal flooding is not considered further within this Level 1 SFRA as a potential source of flooding.

The study area contains a number of watercourses, which drain two main river catchments. The River Avon (Bristol) catchment drains land to the north of the study area. The River Avon (Bristol) flows into the study area from the north, and flows in a predominantly south west direction flowing out of the study area over the western district boundary. The River Avon (Bristol) is joined by a number of tributaries as it flows through the district. The main towns along its course include Melksham and Bradford on Avon.

The River Avon (Hampshire) catchment drains land to the south of the study area. The River Wylye, which flows through Warminster, is the main river draining this part of the study area. The main rivers and catchments are illustrated in Figure 2.

The main watercourses within the study area are presented below:

The River Avon (Bristol) Catchment (and sub-catchments)

- The River Avon (Bristol); and tributaries;
- The River Biss;
- The Biss Brook;
- The Semington Brook;
- The River Frome (partially drains the far western part of the district entering the River Avon (Bristol) at Freshford.

The River Avon (Hampshire) Catchment (and sub-catchments)

- The River Wylye;
- The River Were (tributary of the River Wylye draining land within Warminster).

2.1.1 The River Avon (Bristol) Catchment

The River Avon (Bristol) enters the study area to the north east and flows south through Melksham before flowing in a predominantly westerly direction. The River Avon (Bristol) south of Melksham is known to regularly flood agricultural land to the immediate south of the A350/Western Way Bridge. Further flooding has been experienced to the north of Western Way Bridge affecting the Wiltshire Wildlife Trust site. Areas of Melksham are potentially at risk from fluvial flooding from the River Avon (Bristol).

Continuing west, the Bristol Avon is joined by Semington Brook and then the River Biss as it flows to the north of Trowbridge. The River Avon then flows through Bradford on Avon before crossing the western boundary entering the district of Bath and North East Somerset. Fluvial flooding within Bradford on Avon and downstream is brought about by the narrowing of the River Avon (Bristol) as it flows through the confined river valley, exacerbated by increased surface water runoff from the town. Historic flood events within Bradford on Avon have been known to inundate the Town Bridge, effectively cutting the town into two sections.

This area of the catchment within which the study area is located is relatively low lying land, approximately 50 – 100m AOD (Above Ordnance Datum). The catchment is underlain by predominantly impermeable clays; however there are permeable limestones in the north west of the district. The land use is mainly agricultural.

2.1.2 The River Avon (Hampshire) Catchment

The Hampshire Avon catchment covers a total area of approximately 430km^2. The River Wylye (a tributary of the Hampshire Avon) drains land within the southern part of the study area. The River Were, a tributary of the River Wylye drains the land within the Warminster area. The River Were flows into the River Wylye to the south of Warminster. The River Wylye is a chalk stream, predominantly fed by groundwater discharge from the chalk geology. The River Wylye skirts the southern edge of Warminster before flowing south east across the boundary into the Salisbury District. The source of the River Wylye is in the Upper Greensand springs upstream of Kingston Deverill (125m AOD), and flows for a length of 54km in a south easterly direction until it reaches the River Nadder just downstream of Wilton within the Salisbury District. The underlying geology within the catchment is predominantly chalk, which is underlain by greensand. The major land use within the catchment is agriculture.

2.2 Hydrogeology/Groundwater

Groundwater flooding occurs when water levels in the ground rise above surface elevations. Typically chalk shows some of the largest seasonal variations in groundwater level, and is the most extensive source of groundwater flooding. Water levels below the ground rise during wet winter months, and fall again in the summer as water flows out into rivers and recharge of the aquifer due to rainfall is limited. In very wet winters, rising water levels may lead to the flooding of normally dry land, as well as reactivating flow in 'bournes', intermittent streams that only flow for part of the time, when groundwater levels are high.

The nature of the underlying geology within the study area means that groundwater flooding is not significant. The principal aquifers within the study area are the limestones of the Great Oolite Group underlying the north west of the study area. These have the potential to retain water for long periods of time.

Clays (Oxford Clay, Kimmeridge Clay and Ampthill Clay) underlie much of the central and northern areas of the study area. The Environment Agency classifies these deposits as non-aquifer because they do not readily store or transmit groundwater. Therefore these deposits would not normally be prone to groundwater flooding.

To the east of Westbury is a strip of Corallian, which is a mix of inter-bedded sandstones, limestones and clays and is classified as a Minor Aquifer. This type of geology can also give rise to perched groundwater and spring flow.

The majority of the south and south east of the district is predominantly chalk with the exception of the land to the south of Warminster which is underlain by Upper Greensand and Gault. The chalk and Upper Greensand are classified as Major Aquifers. These areas could be susceptible to groundwater flooding. However, this area of the district is sparsely

populated. River alluvium is deposited on the main valley floodplains throughout the study area.

2.3 Sewers

The majority of modern sewers are built to the guidelines within 'Sewers for Adoption' (WRC, 2006). As a minimum, these sewers are designed to manage runoff from a storm event of a size and intensity of 1 in 30 years. Therefore, it is likely that the majority of the existing sewer systems will surcharge to some degree during storm events with a return period greater than 30 years (e.g. 100 years) which can cause flooding of property and land both from surface water but also foul water from sewers.

Furthermore, older sewer systems were often constructed without consideration of a design standard and may in some areas (served by Victorian sewers) have an effective design standard of less than 30 years. In addition, development beyond the original design capacity of the sewer resulting from town and village expansion can result in the system being overloaded, reducing their effective design standard of 30 years.

It is therefore important to understand where the existing system is restricted in capacity by considering where historical sewer flooding has occurred and as such, where sewer flooding is considered to be higher risk.

Historically, flooding from surface water drainage has been an issue within Warminster where there are a number of culverted watercourses. Sewer flooding has occurred due to the age of the culverts and their limited capacity due to the towns development and expansion.

2.4 Overland Flow

Overland flow results from rainfall that fails to infiltrate the surface and flows along the ground. Surface water flooding is likely to occur at the base of hills, escarpments and low points in terrain. Overland flow is exacerbated by urban development and low permeability soils and geology (such as clayey soils). There are a number of steep escarpments within the study area the majority are located on the rising ground around the edge of Salisbury Plain. Specific locations where overland flow may occur due to the steep topography include: Kingston Deverill, Monkton Deverill, Corton, Upton Lovell, Knook, Heytesbury, Bratton and Edington. The eastern areas of Warminster, including the Warminster Training Centre may potentially be affected from flooding sourced from overland flow. Furthermore, as identified in Section 2.1.1, the topography downstream of Bradford on Avon has the potential to generate flooding from overland flow.

2.5 Artificial Sources

Artificial flood sources include raised channels such as canals or storage features such as ponds and reservoirs, where water is retained above natural ground level. Infrastructure failure may occur as a result of being overwhelmed and/or as a result of dam or bank failure. The latter can happen suddenly resulting in the rapid flow of deepwater that can cause significant threat to life and major property damage.

There are a number of minor artificial watercourses, such as ponds, within the study area. However, the main artificial watercourse is the Kennet and Avon Canal entering the study area to the west of Bradford on Avon, and crosses the study area boundary to the east of Semington.

There are a number of aqueducts within the study area, which include both historic and modern structures. With regards to infrastructure failure the most significant of these is the aqueduct crossing the A350 to the east of Semington. Failure of this during a flood event could have severe implications for the highway network and could contribute to flood risk along Semington Brook.

Additionally, the Wilts and Berks Canal restoration project, which seeks to connect the Kennet and Avon Canal with the Thames at Abingdon, may have future flood risk implications for both West Wiltshire and North Wiltshire Districts.

2.6 Climate Change

As stated in PPS25 the UK Climate Impacts Programme (UKCIP02) climate change scenarios for the UK suggest that winters will become wetter by as much as 20% by 2050. Rainfall patterns are also predicted to change, with summers and autumn becoming much drier, but the number of rain-days and average intensity of rainfall expected to increase.

Consequently, the future climate change scenario will mean that the risk of flooding from fluvial, groundwater and overland flow sources will increase during the winter months. There is also potential for flooding from overland flow and fluvial flooding during the summer months too, as experienced in Hull and Gloucestershire in 2007. Impermeable clay and urban areas will experience the greatest increase in flood risk.

The effects of climate change will also place additional demand on the sewer systems. The implications of climate change forecasts will increase the pressure on existing sewer systems reducing their design standard. It is possible that without infrastructure investment or a reduction in the volume and rate of storm water entering the sewer system an increase in the average intensity of rainfall may result in a higher number of properties suffering from both internal and external flooding from surcharged sewers.

3 Policy Context

In satisfying the growth targets set by the draft South West Regional Spatial Strategy (dRSS), West Wiltshire DC must consider many planning policies (of which those relating to flooding cover a relatively limited number) to ensure developments are sustainable. This chapter sets out the national, regional and local policies in place relating to development and flooding and/or flood risk management within the West Wiltshire DC study area.

3.1 National Policies

3.1.1 Making Space for Water (Defra, 2005)

The Government released Making Space for Water in March 2005 (Defra, 2005) after a consultation period. The purpose of the report is to introduce new strategies on the management of issues surrounding flood risk and coastal erosion for the next 20 years. The report recognises the requirement for a holistic approach between the various responsible bodies, including flood defence operating authorities, sewerage undertakers and highways authorities, to achieve sustainable development. Making Space for Water does not state specific policies but provides the Governments objectives on:

- Land use planning – it strongly encourages Flood Risk Assessments to be prepared at all levels of the planning process;
- Rural Issues – it promotes the environmental pillar of sustainable development through the use of wetlands and washlands, and managed realignment of coasts and rivers;
- The desire for national co-ordination of groundwater flood risk management within the overall flood and coastal erosion risk management framework;
- Integrated urban drainage management – it is committed to ensuring that SuDS techniques are incorporated in new developments;
- Coastal issues – it seeks to develop a more strategic and integrated approach to managing coastal flooding and erosion risks; and,
- Living with flood risk – it identifies that there is a need to raise awareness and preparation in local communities for the changing flood and erosion risks resulting from climate change. The protection of the Functional Floodplain (introduced in Chapter 5) forms an integral aspiration of the strategy.

3.1.2 Future Water - The Government's water strategy for England (Defra, 2008)

Future Water sets out the Governments long term vision for water and the framework for water management in England. Future Water's vision for policy and management with regards to surface water drainage and river and coast flooding aims to have achieved the following goal by 2030 at the latest:

- Sustainably managed risks from flooding and coastal erosion, with greater understanding and more effective management of surface water;

Future river and coastal flooding risk management and policy should contribute to sustainable development, in terms of social and environmental benefits with the protection of economic assets. An understanding of future risks of river and coastal flooding should be embedded into the spatial planning system.

Future surface water drainage management and policy should achieve more adaptable drainage systems reducing flood risk, improving water quality, and decreasing burdens on the sewer system.

Flood risk management and policy should also aim to improve public understanding and perception of the causes and consequences of all sources of flooding so that actions can be taken to help manage flood risk.

3.1.3 Planning Policy Statement 25: Development & Flood Risk (DCLG, 2006)

Planning Policy Statement 25 (PPS25) establishes the national policy for development and flood risk. The overarching aim of PPS25 is to support the Government's objectives for sustainable development.

'The aims of planning policy on development and flood risk are to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at high risk'.

The core principles of PPS25 include:

- Allocate all sites in accordance with the Sequential Test to reduce the flood risk and ensure that the vulnerability classification of the proposed development is appropriate to the flood zone classification;

- Flood Risk Assessments should be undertaken for all developments within Flood Zones 2 and 3 and sites with identified flood sources to assess the risk of flooding to the development and identify options to mitigate the flood risk to the development, site users and surrounding area;

- Flood Risk Assessments are required for all major developments in Flood Zone 1. Major developments are defined as residential developments consisting of sites greater than 0.5 ha or greater than 10 dwellings and commercial developments that are greater than 1 ha or have a floor area greater than 1000 m^2;
- Flood risk to developments should be assessed for all forms of flooding.

3.2 Regional Policies

3.2.1 Regional Planning Guidance for the South West (RPG10) (Adopted, 2001)

Although RPG10 will shortly be superseded by the Regional Spatial Strategy (RSS) for the South West (see 3.2.2), planners should technically still be working to RPG10 until the RSS is formerly adopted. Policy RE 2 addresses development and flood risk. .

3.2.2 Regional Spatial Strategies (South West Regional Assembly, 2006)

The South West Regional Assembly published the draft South West Regional Spatial Strategy (dRSS) in June 2006 (South West Regional Assembly, 2006). A Panel Report was published in December 2007, which follows a period of consultation and examination in Public (EiP). The Panel Report will be reviewed by the Secretary of State who will then issue proposed changes to the dRSS. The dRSS will replace the Regional Planning Guidance (RPG) and therefore supersede the County Structure Plan as the statutory development planning document, and covers the period up to 2026. One of the important roles of the dRSS is to 'translate strategies' into proposals for the provision of new homes.

The dRSS sets out an average housing provision of about 525 dwellings per annum within the West Wiltshire District within the period 2006-2026.

The dRSS sets out the South West Regional Assembly's approach to achieving the desired 'quality of life' in the region. Flood risk forms one of many key drivers of the pursuit to enhance the quality of life.

Policy F1 of the dRSS reflects those policies contained within PPS25 by prioritizing the sequential approach outlined in PPS25. The sequential approach seeks to direct development to areas with little or no risk of flooding, whilst existing development needs to adapt and defend against increase flood risk by considering their layout and design.

Policy SD2 of the dRSS outlines how the region will adapt to the anticipated effects of climate change. With regards to flood risk this policy also reflects the policies stated within PPS25. Vulnerable communities at the greatest risk from the impacts of climate change

should be identified, and mitigation measures provided. Policy SD2 also states that development should be directed away from flood risk areas and that the design and construction should reduce the potential impact of flooding.

3.2.3 Sub Regional Strategy

Wiltshire and Swindon Structure Plan 2016 (Adopted April 2006)

The Wiltshire and Swindon Structure Plan provides a strategic policy framework for land use planning, development and transport across the administrative areas of Wiltshire (incorporating Wiltshire County and Swindon Borough) up to 2016. This framework is used to inform the LDF produced by the Borough and District Councils. The Wiltshire and Swindon Structure Plan will be replaced by the new Regional Spatial Strategy for the South West which is currently at the draft submission stage. Policy C5 from the Wiltshire and Swindon Structure Plan reflects those policies contained within PPS25 and is therefore relevant to the SFRA process until the RSS for the South West is formally adopted.

Policy C5 identifies the importance of protecting the floodplains by ensuring that development does not increase flood risk. This policy seeks to ensure that proposed development in areas of flood risk are assessed in accordance with a risk-based sequential approach in liaison with the Environment Agency. Policy C5 also seeks to control development in order to protect, restore or enhance water resources which may be affected by the development.

3.3 Local Policies

3.3.1 West Wiltshire District Plan First Alteration (West Wiltshire DC, 2004)

The West Wiltshire District Plan First Alteration is a saved plan under the new West Wiltshire LDF. Initially the Plan was saved for a three year period, until October, 2007. The Plan policies will continue to be reviewed and assessed until they are progressively replaced by national, regional or LDF policy. Policy U3 which addresses flooding within the district has effectively been replaced by the national planning policy position set out under PPS25.

The LDF will present a spatial portrait of the West Wiltshire District, which will identify issues, and set out a vision, and objectives over the LDF period. The Core Strategy and supporting development plans will contain spatial policies and proposals as the means of delivering the spatial vision.

Until the LDF and the LDDs are formally adopted, a number of policies in the District Plan First Alteration that relate to water resources and flood risk are relevant to this SFRA. These policies are summarised in the following paragraphs.

Policy C9 – *(Rivers)*

This policy seeks to protect all aspects of rivers from development and realises the wide ranging services provided by the water environment. Policy C9 states:

> *'Development proposals should ensure that they do not adversely affect the water quality, quantity, amenity, visual quality or value as a wildlife habitat of a river or watercourse and associated wetlands. Permission will not be granted for works affecting a river or watercourse where there would be significant harm to landscape, visual amenity, nature conservation interests, public enjoyment or a risk of flooding. Bank protection works should include the use of appropriate materials and protect nature conservation interests'.*

Policy U2 – *(Surface Water Disposal)*

This policy seeks to prevent future development increasing the amount of surface water runoff by ensuring the use of Sustainable Drainage Systems (SuDS). Policy U2 states:

> *'Development will only be permitted where adequate surface water disposal systems are available or where suitable arrangements are made for their provision. Proposals must demonstrate that the use of Sustainable Drainage Systems (SuDS) have been incorporated where appropriate. Where inappropriate, surface water drainage systems, separate from all foul drainage systems, will be required'.*

Policy U4 – *(Groundwater Source Protection Areas)*

This policy ensures measures are taken to protect groundwater source protection zones. This is particularly relevant when considering the use of SuDS (Chapter 9). Policy U4 states:

> *'Development proposals will not be permitted which would adversely affect water resources, in particular the groundwater source protection areas as defined by the Environment Agency and shown on the Proposals Map'.*

3.4 Environment Agency Policies

3.4.1 Catchment Flood Management Plans

Catchment Flood Management Plans (CFMPs) are high level strategic documents produced by the Environment Agency that provide an overview of the main sources of flood risk and how these can be managed in a sustainable way over the next 50 to 100 years. The

Environment Agency engages stakeholders within the catchment in order to produce policies for sustainable flood management whilst also considering the land use changes and the effects of climate change.

The West Wiltshire DC administrative area is located within two principal river catchments (Chapter 2). Consequently the area is covered by two CFMPs namely:

- Bristol Avon (Environment Agency, 2007)
- Hampshire Avon (Environment Agency, 2006)

The policies presented below have been drawn from the CFMPs covering the district and should be considered and incorporated into future planning policy in order to facilitate a consistent approach to the management of flood risk within the study area between the Environment Agency and LPA.

3.4.1.1 Bristol Avon Catchment Flood Management Plan (May 2007)

The Bristol Avon CFMP proposes a number of objectives for catchment flood management that form the foundations for specific area policies. The objectives are based around three main categories:

- The Flood Risk to People objectives aim to reduce flood risk to human health and reduce disruption to emergency services;
- The Flood Risk to the Environment objectives aim to increase the area of wetlands and wet woodlands providing additional upland flood storage capacity. Within urban areas recreational areas should be utilised for flood risk management. This policy also aims to ensure that the environment and designated sites are protected during any changes to provide the above requirements;
- The Flood Risk to Property and the Economy objectives aim to reduce the damage caused by flooding with regards to properties, communication infrastructure and industry. These objectives relate to the economic impacts of flooding within, and outside urban areas.

The Bristol Avon catchment is divided into eight catchment policy units that share similar flood risk characteristics shown below:

- Type of flooding;
- Features exposed to flooding;
- Factors that affect future flood risk;

- Assets that are vulnerable to flooding.

The sub-catchments identified within the West Wiltshire DC study area have been assigned a number of Policy Units, which are presented below:

Policy 3 Continue with Existing or Alternative Actions

Area: Westbury and Lower Avon Rural Areas

The current scale of flood risk management for this area is sufficient and future increases in risk are acceptable. Therefore the current flood risk management in Westbury is considered to be an appropriate level.

Policy 4 Take Further Action to Sustain the Current Scale of Flood Risk into the Future

Area: Trowbridge and Melksham

This area is deemed to currently have acceptable levels of flood risk management, how future changes are expected to have a significant impact. Flood risk management needs to address the increases in flood risk posed by urban development, land use change and climate change. Increasing the size of the defences is an option for areas within this policy unit.

Policy 5 Take Further Action to Reduce Flood Risk (Now/or in the Future)

Area: Bradford on Avon

Flood risk within this area is currently felt to be too high and will continue to be high in the future. The existing level of flood risk management is not sufficient with significant risk to people and assets or environmental sites located within the policy area.

Policy 6 Take Action to Increase the Frequency of Flooding to Bring Benefits Locally or Elsewhere

Area: Rural Upper Avon Rural Areas (land within the district to the west of Trowbridge)

By increasing flooding in areas that may benefit from increased flood waters flood risk can be reduced in the catchment overall. This policy is likely to apply to the upper catchment where there is opportunity to restore the floodplain and store water in these areas.

3.4.1.2 Hampshire Avon Catchment Flood Management Plan (Consultation Scoping Report, June 2006)

The Hampshire Avon CFMP is currently at the scoping phase. The scoping phase provides an opportunity for stakeholders to review the information collected on the catchment and flood risk allowing further understanding. This understanding provides a basis for the social, environmental and economic catchment objectives to reduce the impacts of future flood events, to be developed.

Hampshire Avon CFMP aims:

- To reduce flood risk and minimise the resulting harmful impacts on people, and on the natural, historic and built environment;
- To maximise opportunities to work with natural processes, delivering multiple flood risk management benefits and contributing to sustainable development;
- To promote sustainable flood risk management;
- To support environmental legislation and targets, Government flood reduction targets, the Environment Agency's vision, the implementation of EU directives, and other key targets of the organisations involved in the catchment planning process;
- To provide information to spatial planners to help shape future development in the Hampshire Avon catchment, so that it does not compromise the natural function of the river and floodplain; and to support the implementation of the Water Framework Directive (WFD).

The CFMP aims presented above will feed into the CFMP objectives and specific catchment area policies. These policies should be incorporated into the SFRA when they become available and considered when forming future flood risk policies for this part of the study area.

3.5 Other Relevant Policies

3.5.1 British Waterways

British Waterways are statutory consultee under the planning process where development is thought to have a potential impact on their assets and have a number of policies which aim to protect their assets in relation to flood risk. It is the responsibility of the LPA and Environment Agency to consult British Waterways when deemed necessary. British Waterways should also be consulted to determine the impact of surface water discharges on the canal with regards to flood risk.

The main British Waterways asset within the study area is the Kennet and Avon Canal. Additionally, the Wilts and Berks Canal restoration project may have a future impact for both West Wiltshire and North Wiltshire Districts.

3.5.2 Sewer Authority Policies

No policies have been presented by the sewer authorities. However, there is national guidance for new sewer infrastructure which should be adhered to as part of any new development.

3.5.2.1 Sewers for Adoption (A Design and Construction Guide for Developers) (Water UK, 2006)

The Sewers for Adoption document provides guidance to developers undertaking new development when planning, designing and constructing conventional foul and surface water gravity sewers, lateral drains and pumping stations intended for adoption under an Agreement made in accordance with Section 104 of the Water Industry Act 1991. The developer is recommended to consult the sewage undertaker and all other relevant bodies at the earliest opportunity before a planning application has been made, so that drainage arrangements can be agreed.

4 Data Collection & Review

An objective of this Level 1 SFRA is to collect, collate and review the information available relating to flooding in the study area. This information is then presented in a format to enable West Wiltshire DC to determine the flood risk to potential sites for development, enabling application of the Sequential Test and identification of where the Exception Test may be required.

The review of data collected allows gaps in the data/information to be identified in order to ascertain additional requirements that may be needed to meet the objectives of a Level 2 SFRA. A data register presenting all the data collected for this Level 1 SFRA is available in Appendix A.

4.1 Project Approach

4.1.1 Programme of Works

The programme of works undertaken in the preparation of this Level 1 SFRA was as follows:

- Inception meeting with West Wiltshire DC and the Environment Agency on 23rd August, 2007;
- Identification of the local stakeholders;
- Issue of letters to stakeholders requesting data/information;
- Followed-up data requests (where necessary);
- Collation and review of available data (Appendix A);
- Review of received data against the SFRA objectives;
- Identification of gaps in data;
- Provision of options to address gaps in data, and;
- Undertaking of a broad scale and focused assessment of flood risk.

All tasks were completed between July 2007 and August 2008.

4.1.2 Stakeholder Consultation

The following stakeholders were contacted to provide data, information and the principles of flood risk within the study area required to inform the SFRA:

- West Wiltshire DC;
- Wiltshire County Council (CC);
- Environment Agency - The study area falls within the Environment Agency's South West Region. Staff at the Environment Agency's Wessex office at Bridgwater have been the main contact point for the provision of data for the catchments within the study area;
- Wessex Water - Management of storm water/foul water for the study area is the responsibility of Wessex Water and West Wiltshire DC. There are no internal drainage boards (IDBs) present within the study area. In addition, private individuals may be responsible for drainage systems that operate prior to discharge either into a watercourse or into a public sewer;
- British Waterways – Assets include the Kennet and Avon Canal. The South West Region is managed by staff from the Gloucester office.

4.1.3 Stakeholder Meetings

The inception meeting held with the Environment Agency and West Wiltshire DC on the 23rd August 2007 allowed discussion on the format of the SFRA and reviewed the data/information received from the various stakeholders.

4.2 Data Review / Overview

4.2.1 Environment Agency Flood Zone Maps

The Environment Agency has provided an extract of their Flood Map for the study area (Figure 3 A-D). The Environment Agency's Flood Map identifies those areas susceptible to flooding from rivers. Flood areas are defined as those areas susceptible to flooding from the 100 year flood (corresponding to Flood Zone 3a) and the 1000 year flood (corresponding to Flood Zone 2) for all main rivers and/or watercourses with identified critical drainage problems.

Flood Zones are produced ignoring the presence of existing flood defences. Flood defences can be 'overtopped' if a flood occurs which is greater than the defences are designed to withstand. The Environment Agency Flood Map does not provide information on flood

depth, speed or volume of flow. In addition, flooding from other sources, such as groundwater, overland flow or overflowing sewers is not shown.

The Flood Map has been developed by the Environment Agency using a combination of detailed information from appropriate hydraulic models (where available) and outputs from broad scale localised models. Hydraulic models use detailed topographic data and rigorously derived flow estimates to derive flood extents.

The coarse estimates of floodplain extents derived from broad scale localised models can be further refined using more detailed modelling techniques and data. Where the Environment Agency produce detailed models, broad scale localised models can be replaced with more refined 1D or 2D mapping.

Broad scale localised models have been used to generate Flood Zones for the following watercourses:

- River Avon (Bristol) downstream of Melksham;
- River Avon (Bristol) upstream and downstream of Bradford on Avon;
- Semington Brook;
- Chalfield Brook;
- Berryfield Brook;
- River Wylye downstream of Warminster.

The Flood Map provided by the Environment Agency does not define floodplains for all watercourses. Typically watercourses with a catchment area less than 3km^2 are omitted from Environment Agency mapping unless there is a history of flooding affecting a population. Consequently there will be some locations adjacent to watercourses that on first inspection of the flood maps, it is suggested there is no flood risk.

4.2.2 Hydraulic Modelling

Existing hydraulic models for watercourses in the study area have been identified from information provided by the Environment Agency. The models have been reviewed to assess their suitability for application within the Level 1 SFRA. At the Level 2 stage detailed models may be required to determine the rate of onset and depth of flood waters for the purposes of the Exception Test. The Environment Agency normally update their Flood Map every three months with the results of any detailed hydraulic modelling that meet their minimum standards. The floodplain outlines produced by these detailed hydraulic models are included within the Environment Agency Flood Map shown in Figures 3 A-D.

Table 4.1 Detailed hydraulic models in the West Wiltshire DC study area

	Trowbridge	**Trowbridge**	**Trowbridge**	**Bradford on Avon**	**Melksham**	**Melksham**	**Warminster**
Watercourse	River Biss and Bitham Brook	Hilperton Stream, Lambrok Stream and Blackball Brook	Paxcroft Brook	River Avon (Bristol)	River Avon (Bristol)	Forest Brook, Clackers Brook	River Wylye, River Were and Cannimore Stream
Included in Environment Agency Flood Map	✓	✓	✓	×	✓	✓	✓
Modelled By	Capita Symonds	Environment Agency	Capita Symonds	Environment Agency	Mot MacDonald	Haskoning	Environment Agency
Model Reference	River Biss and Bitham Brook SFRA (West Wiltshire DC)	Hydraulic Study	Flood Zone compliance project	Pre-Feasibility Studies 2001/2002 Batch	Section 105 Flood Risk Mapping	Section 105 Flood Risk Mapping	Warminster Flood Study Includes Boreham Mill FRA 13/02/04
Modelling Software	Tuflow	HEC-RAS	ISIS	HEC-RAS	-	HEC-RAS	HEC-RAS
Date Modelled	2006	1997	2005	2002	2007	1997	1997
Model Runs	100 year + 100 year + climate change	100 year	100 year + 100 year + climate change	100 year	100 year	100 year	100 year
Model Limitation	Buildings or other obstructions are not accounted for in the floodplain.	Does not account for flood defences	Lack of suitable flow gauging stations for model calibration and hydrology inputs	Does not account for flood defences	-	Does not account for flood defences	Building or other obstructions are not accounted in the flood plain

The detailed flood extents produced from these models have been used to refine the level of information available from the Environment Agency's Flood Map where suitable. The results of the detailed hydraulic models displayed in Table 4.1 have already been incorporated into the Environment Agency's Flood Map; however detailed flood mapping of the Upper River Avon (Bristol) in the vicinity of Bradford on Avon is not used by the Environment Agency in their Flood Maps.

4.2.3 Fluvial Flooding Records

A list of flooding incidents has been provided by the Environment Agency North Wessex and South Wessex area offices from the Flood Reconnaissance Information System (FRIS) database. The FRIS database contains records of fluvial flood events from the River Avon (Bristol) and its tributaries and the River Wylye for the period 1900 to 2006. Wiltshire CC has also provided a database of highway flooding incidents covering the study area. The database provides the location of highway flooding incidents, but does not identify the specific flood source. However, fluvial flooding is considered to be one of the sources of highway flooding within the study area. Both of these information databases have been provided in GIS format and have been included in Figure 4 A-D, which displays historical flood incidents for all sources of flooding within the study area. Table 4.2 displays selected fluvial flood events from recent years.

Table 4.2 Selected historical fluvial flood events sourced from the Environment Agency North and South Wessex FRIS database.

GIS reference	Year	Watercourse	Details of affected area
FI11	-	Tributary to Wylye: Inadequate stream & blocked culvert.	Warminster: properties flooded. Number of properties affected unknown.
FI98	1996	Stream to Biss Brook.	Westbury Leigh Number of properties affected unknown.
FI100	2000	River Avon (Bristol)	Bradford on Avon, flood event number of properties affected unknown.
FI101	2003	River Avon (Bristol)	Bradford on Avon area around town bridge flooded.
FI141	2000	River Avon (Bristol)	Melksham. Allotment Gardens, near Southbrook Road flooded.
FI154	1996	Tributary to River Avon (Bristol)	Nr Melksham, Broughton Gifford., Returned questionnaire.
FI179	1991	Trowbridge up to confluence with Lambrok Stream.	Ladydown Mill, buildings, transport route and land affected by flood.

4.2.4 Flood Defences

Flood defences are typically engineered structures designed to limit the impact of flooding. Flood defences take several forms including bunds/embankments, canalised channels, culverts and flood storage areas.

The Environment Agency has provided a GIS (Geographical Information System) layer of the National Flood and Coastal Defence Database (NFCDD) listing details of structures and flood defences. The NFCDD aims to provide the following information:

- The location, composition and condition of fluvial and coastal defences and watercourses referenced to identified risk areas;
- The types of asset (i.e. property, infrastructure, environmental) at risk within identified risk areas and including those protected by fluvial, tidal and coastal defences;
- The asset reference, the location, level of protection that the structure provides and the geographic extent of the structure or defence.

The NFCDD will be used to identify where structures may cause increased risk of flooding during a blockage scenario and/or could benefit from replacement or removal. Details of all manmade NFCDD flood defences in the study area are presented as a GIS layer and in Figure 5.

Whilst PPS25 ignores the presence of defences in Flood Zone 3a and 2, it is still important to recognise and acknowledge where flood defences exist and the residual risk associated with a failure of the defences.

4.2.5 Overland Flow

Intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems can quickly runoff land and result in localised flooding. Local topography and built form can have a strong influence on the direction and depth of flow. Flooding can be exacerbated if development increases the percentage of impervious area.

The North and South Wessex Environment Agency office have provided a GIS layer of overland flow flooding incidents from their FRIS database for the study area. As introduced in Section 4.2.3 Wiltshire CC has also provided a database of highway flooding incidents covering the study area. The database provides the location of highway flooding incidents, but does not identify the specific flood source. However, overland flow flooding is considered to be one of the sources of highway flooding. Neither of these databases provides an indication of the severity of the flooding and may not be always accurate in the extents.

Information from both of these databases have been included in Figure 4 A-D which displays historic flood incidents for all sources of flooding within the study area. Table 4.3 displays selected overland flow flood events from recent years.

Table 4.3 Selected historical overland flow flood events sourced from the Environment Agency North and South Wessex FRIS database.

GIS reference	Year	Location	Details of affected area
FI160	1992	Warminster	Warminster: Thunderstorm rainfall event, 18 properties confirmed as flooded. Surface water drain system inundated.
FI195	1996	Westbury	Football ground affected. Number of properties affected unknown.
FI116	1996	Broughton Gifford	Road affected Returned questionnaire. Number of properties affected unknown.
FI135	1978	Melksham	A350 road affected. Number of properties affected unknown.
FI161	1996	Norrington Common	Transport routes and land affected.

4.2.6 Groundwater Flooding

The FRIS flooding database has no groundwater flooding incidents recorded within the study area. The nature of the underlying geology of the study area means that groundwater flooding is not significant.

4.2.7 Sewer Flooding

Records of sewer flooding have been provided by Wessex Water, the statutory water undertaker within the study area.

Wessex Water have provided flood incidence maps produced through their DG5 register; these maps identify broad areas where sewer flooding is considered to pose a potential risk, rather than identify individual properties. These maps are presented in Appendix B of this report. Table 4.4 below summaries the number of properties within the Wessex Water area of the study area that have experienced sewer flooding or are at risk of sewer flooding. The sewer flooding information presented in Table 4.4 is presented in Appendix B.

Table 4.4 Number of properties at risk of foul sewage flooding as of September 2007 (DG5A – flooding frequency 2 in 10 years, DG5B - flooding frequency 1 in 10 years, DG5C - flooding frequency 1 in 20 years.

	Bradford on Avon	Trowbridge	Great Hinton
DG5A	1	13	-
DG5B	-	-	1
DG5C	-	-	-

There are likely to be a greater number of properties affected from larger storm events (e.g. 1 in 50 and 1 in 100 year) due to the design standard of sewers being predominantly for the 1 in 30 year storm event (Sewers for Adoption, 2006). Additionally, information on privately owned and maintained storm water management systems is generally unavailable.

4.2.8 Artificial Sources / Infrastructure Failure

Artificial flood sources include raised channels, reservoirs, canals, aqueducts and flood storage features. No information has been made available with regards to flooding incidents from artificial sources or infrastructure failure within the study area.

The Environment Agency National Reservoirs Team have provided information from their reservoir register, which identifies four reservoirs within the study area, namely:

- Half Mile Pond, near Warminster (ST 810435);
- Longleat Forest Sports Lake, near Warminster (ST 832425);
- Shearwater Lake, near Warminster (ST 853421);
- Fullingbridge Lake, near Trowbridge (ST 884539).

This information has been included in Figure 4 A-D which displays historic and potential flood sources from all sources of flooding within the study area.

Ordnance Survey (OS) Mastermap data is a topographic layer which includes classifications such as roads, buildings, terrain and waterbodies. Using GIS all the waterbodies have been extracted and identified. This information has been included in Figure 4 A-D which displays potential flood sources within the study area.

The Kennet and Avon Canal entering the study area to the west of Bradford on Avon, and crosses the study area boundary to the east of Semington. British Waterways were contacted during the data collection process but were unable to provide any records of flooding arising from the Kennet and Avon Canal.

5 SFRA Mapping

This section describes the data used in the production of mapping and GIS deliverables for the project. The Level 1 SFRA assessment methodology is based on available information and data provided by the stakeholders identified in Chapter 4. The information and data collected is sufficient to define the Flood Zones, enabling application of the Sequential Test and identification of where further investigation is required through either a Level 2 SFRA or a site specific Flood Risk Assessment.

Two sets of large scale Flood Zone maps have been produced for West Wilshire DC for application of the Sequential Test. Figure 3 A-D show the sources of fluvial flooding within the district based on the data collated. Figure 4 A-D show historic and potential flood sources based on previous fluvial, surface water, groundwater and sewer flooding incidents, and the location of reservoirs and artificial flood sources.

Figure C1 Appendix C shows all the potential sites allocated for development within the study area in relation to fluvial flood risk. The potential allocation sites identified as being located within Flood Zone 2 or 3, or bordering these flood zones have been included in the broad scale assessment also provided in Appendix C.

5.1 Requirements of PPS25 (DCLG, 2006)

Planning Policy Statement 25 (DCLG, 2006) and the PPS25 Practice Guide (DCLG, 2008) requires Strategic Flood Risk Assessments to present sufficient information on all flood sources to enable LPAs to apply the Sequential Test in their administrative areas. In order to apply the Sequential Test information is required on the probability (High, Medium and Low) associated with flooding from the different flood sources. This information should be presented graphically where possible as a series of figures and/or maps.

In addition, the assessment of probability should also account for the effects of climate change on a flood source for the lifetime of any development that would be approved through the emerging LDF.

For all but fluvial flood sources a general lack of suitable data makes definition of robust classifications of probability unreliable. For example to define high, medium and low probabilities for sewer flooding within the study area based on the coarse scale information provided by Wessex Water (with no corresponding record of the severity of that flood) is not robust. Consequently for all flood sources other than fluvial, where only anecdotal evidence of flooding is available, subjective assessments of probability have been made where the data allows.

However in some cases, definitions of probability are not practical or are unreliable; in these situations the flood risk from a particular source should be considered as ‘medium’ until proven otherwise and should be investigated through a site specific

assessment of flood risk submitted as part of a planning application. Details of the requirements for Flood Risk Assessments are presented in Chapter 11.

The following sections explain how the available data has been used to develop strategic flood risk mapping for use in undertaking the Sequential Test.

5.2 GIS Layers and Mapping

Geographical data such as flood extents and watercourse routes, for use in determining appropriate planning decisions, have been presented as maps (attached to this report) and using the Geographical Information System (GIS) MapInfo platform.

GIS acts as an effective management tool for the coordinated capture, storage and analysis of data of a geographical nature. GIS handles data in a hierarchical manner by storing spatial features within various layers, which are allied to an underlying database. GIS is a recognised tool for the efficient collation, storage and analysis of information and is also an increasingly valuable resource for LPAs.

5.3 Fluvial Flooding

5.3.1 Requirements

Table 5.1 Planning Policy Statement 25 Flood Zone Definitions

Flood Zone 1	Defined as land at risk from a flood event less than the 1 in 1000 year event (greater than 0.1% annual probability)	Low Probability
Flood Zone 2	Defined as land at risk from a flood event between the 1 in 100 and 1 in 1000 year event (between 1% and 0.1% annual probability)	Medium Probability
Flood Zone 3a	Defined as land at risk from a flood event greater than or equal to the 1 in 100 year event	High Probability
Flood Zone 3b	Functional Floodplain comprises of land where water has to flow or be stored in times of flood. Defined as the 5% (1 in 20 year) annual probability foodplain or an area designed to flood in an extreme (0.1%) flood, or another probability agreed between the Local Planning Authority (LPA) and the Environment Agency (The Environment Agency do not currently produce Flood Zone 3b mapping for England and Wales).	Functional Floodplain

The extent of Flood Zones 3a and 2 have been provided by the Environment Agency and are a combination of detailed hydraulic modelled extents and broad scale localised Flood Zones as described in Chapter 4. Flood Zone 3b is not identified by the Environment Agency's Flood Map. Any land that does not lie within Flood Zone 2 or 3a is classified as Flood Zone 1.

5.3.2 Functional Floodplain

PPS25 requires the exclusion of various vulnerable development types from the Functional Floodplain (Flood Zone 3b). Therefore it is important to consider the location and extent of the Functional Floodplain in the future spatial planning for an area.

PPS25 uses the following definition for the Functional Floodplain:

'An area of 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 flood (0.1%), or at another probability to be agreed between the LPA and the Environment Agency, including conveyance routes.'

PPS25 states that Functional Floodplain should be determined considering the effects of defences and other flood risk management infrastructure. The Functional Floodplain relates only to river and coastal flooding, it does not include areas at risk of flooding solely from other sources of flooding (e.g., surface water, sewers).

As a precautionary approach, in the absence of a modelled Functional Floodplain outline, all areas within Flood Zone 3a should be considered as Flood Zone 3b (Functional Floodplain). This will remain the case unless, or until, an appropriate Flood Risk Assessment shows to the satisfaction of the Environment Agency that an area can be considered as falling within Flood Zone 3a (High Probability).

For the purpose of this Level 1 SFRA, where detailed modelling of the Functional Floodplain is not available the total extent of Flood Zone 3a (where available) has been used to identify the Functional Floodplain. However, those urban areas marked as Functional Floodplain after transposition of Zone 3a should not be considered Functional Floodplain, as they are already developed.

In line with PPS25, for proposed developments within the Functional Floodplain there is the potential to redefine the extent of Flood Zone 3b. Where appropriate, redefinition of Flood Zone 3b can take place where detailed hydraulic modelling demonstrates the extent of Flood Zone 3b to the satisfaction of the Environment Agency. This can be achieved through a Level 2 SFRA and/or site specific Flood Risk Assessments.

5.3.3 Climate Change

Climate change is forecasted to lead to milder wetter winters and drier summers with increased risk of thunderstorms whilst overall increasing the unpredictability of our weather. This is forecasted to result in more frequent flooding and increase the magnitude of flood events. Therefore the effects of climate change on floodplains should be a material consideration in strategic land use planning.

PPS25 requires that Flood Zones are also mapped allowing for the predicted effects of climate change. Flood Zones should be mapped to account for the effects of climate change over the lifetime of any developments that may be granted planning permission within the lifetime of the emerging Local Development Framework. The indicative

lifetime of residential developments is taken to be 100 years; consequently Flood Zones should be defined accounting for the effects of at least 100 years of climate change. In the case of fluvial flooding, PPS25 forecasts that 100 years of climate change will result in a 20% increase in the peak flow of watercourses during any given flood event.

Flood Zones accounting for climate change produced using detailed hydraulic models have not been generated for the rivers within the study area. In the absence of modelled climate change outlines, Flood Zone 2 is considered to be indicative of Flood Zone 3 accounting for climate change.

If after the Sequential Test has been undertaken, developments are located within Flood Zones 2 or 3 the likely effects of climate change should be investigated as part of the works specified for application of the Exception Test.

5.3.4 Data Source

The mapping has been produced through the use of the Environment Agency's Flood Maps, generated using broad scale localised models and detailed hydraulic modelling techniques. In the absence of detailed modelling to identify Flood Zone 3b, Flood Zone 3b is assumed to be the same extent a Flood Zone 3a. With regards to climate change outlines the current Flood Zone 2 will be considered to be indicative of Flood Zone 3 accounting for the anticipated affects of climate change.

5.3.5 Unmodelled Watercourses

For the watercourses within the study area where no Flood Zones have been defined (typically watercourses with a catchment area less than 3km^2) and no modelling is available, an 'indicative' Flood Zone 3a and 3b (Functional Floodplain) has been defined as a precautionary approach. Flood Zone 3a and 3b for unmodelled watercourses throughout the study area is defined as:

- Flood Zone 3a – 28m from the top of each bank;
- Flood Zone 3b – 8m from the top of each bank.

The indicative Flood Zone 3b has been formally agreed with the Environment Agency and the indicative Flood Zone 3a provides an additional buffer zone.

Any development within these indicative Flood Zones should submit a site specific Flood Risk Assessment with the planning application.

Furthermore, as a precaution approach, where it appears that the floodplain may extend beyond the indicative Flood Zone 3a, an experienced flood risk management specialist should identify the level of flood risk to the development and the requirements for a site specific Flood Risk Assessment.

The Environment Agency's requirements for the site specific Flood Risk Assessment is likely to include detailed modelling to clearly define the Flood Zones in relation to the proposed development.

5.3.6 Mapping

The extent of fluvial Flood Zones are presented in the Sources of Fluvial Flooding Maps (Figure 3 A-D) These Flood Maps are based on the best available information generated using the Environment Agency's Flood Zone Maps and detailed hydraulic model extents. Figure 4 A-D show the location of historic fluvial flood incidents within the study area provided by the North and South Wessex Environment Agency FRIS database.

Based on guidance received by West Wiltshire DC an indicative outline of the historic floodplain for a minor watercourse south east of Melksham has been identified. This indicative outline is included in Figure C1 and the broad scale assessments provided in Appendix C

5.4 Overland Flow

5.4.1 Requirements

A number of escarpments/steep slopes within the study area have the potential to generate overland flow. Overland flow is exacerbated by impermeable areas within the study area.

5.4.2 Data Source

Records of overland flow incidents have been provided by the Environment Agency Wessex area office and Wiltshire CC highway flooding incidents database. These databases do not provide an indication of the severity of the flooding and do not always provide accurate information regarding the flood extents.

5.4.3 Mapping

The overland flow flood incident databases and highway flooding incidents database provided by the Environment Agency Wessex area office and Wiltshire CC respectively have been mapped using the GIS layers provided and have been presented on the Historic and Potential Flood Source Maps (Figure 4 A-D). Using Figure 4 A-D, where historic and potential flood sources are identified, these areas should be considered to be medium risk.

5.5 Groundwater Flooding

5.5.1 Requirements

Although groundwater flooding should be considered within the Level 1 SFRA, there are no recorded incidences from this source of flooding within the study area. Further to this, consultation of Geological Maps, Environment Agency Groundwater Vulnerability Maps and Environment Agency Groundwater Source Protection Zones indicates that the risk of flooding from this source is relatively minor when considered in proportion to other risks such as fluvial flooding. Details of the requirements for site specific Flood Risk Assessments seeking to assess risks from groundwater sources are presented in Chapter 11 and Appendix E.

5.5.2 Data Source

No groundwater flooding incidents have been reported within the study area.

5.5.3 Mapping

If future groundwater flooding incidents occur, the GIS database accompanying this Level 1 SFRA should be updated and the flood incident included on Figure 4 A-D. Figure 4 A-D can then be used to identify areas of potential groundwater flooding within the vicinity of existing, and proposed development allocations.

5.6 Sewer Flooding

5.6.1 Requirements

The probability of sewer flooding within the study area needs to be defined to meet the requirements of PPS25. Due to the lack of data collected within this Level 1 SFRA relating to sewer flooding and the limited time period (typically <10 years), the same approach to fluvial flooding probability cannot be adopted.

5.6.2 Data Source

Incidents of sewer flooding were identified from the Environment Agency FRIS database and Wessex Water. With regards to the data provided by the Environment Agency probabilities can be applied to assess the risk for areas of significant development (Trowbridge, Warminster, Melksham, Bradford on Avon and Westbury) and the rural settlements within the study area.

- Low – less than 5 incidences of sewer flooding within a settlement area;
- Medium – 5 to 10 incidences of sewer flooding within a settlement area;

- High – greater that 10 incidences of sewer flooding within a settlement area.

Data provided by Wessex Water indicates the settlement location of properties at risk of sewer flooding but does not identify individual properties within the settlement or frequency/timing of flooding. The Wessex Water Properties at Risk maps categorise sewer flooding areas as follows:

- DG5A - flooding frequency 2 in 10 years;
- DG5B - flooding frequency 1in 10 years;
- DG5C - flooding frequency 1 in 20 years.

Wessex Water has indicated that an extensive improvement program is in progress to alleviate these problems and will be completed by 2010.

5.6.3 Mapping

Mapping of historic records of sewer flooding provided by the Environment Agency Wessex area office are presented in Figure 4 A-D.

Properties at risk maps provided by Wessex Water indicating locations where sewer flooding has, or may occur within settlements are presented in Appendix B.

5.7 Artificial Sources (Infrastructure Failure)

5.7.1 Requirements

Artificial sources of flooding are present within the study area. As no record of flooding associated with artificial sources has been made available for this Level 1 SFRA, no data is available to determine the probability of flooding from artificial sources.

For the purpose of this Level 1 SFRA artificial sources have been identified as raised channels, canals and storage features. An assessment of the likely flood routes associated with overtopping and structural failure should form part of a site specific Flood Risk Assessment where required (see Chapter 11). An appreciation of the actual and residual flood risk can therefore be identified through this process.

5.7.2 Data Source

All water bodies within the study area have been extracted from the OS Mastermap topographic layer. The Environment Agency National Reservoirs Team have identified four reservoirs on their register within the study area.

5.7.3 Mapping

The artificial sources identified from the OS Mastermap topographic layer and the identified reservoirs have been highlighted and presented in Figure 4 A-D. Figure 4 A-D should be used to identify all artificial sources of potential flooding within the vicinity of existing, and proposed development allocations, to provide guidance on the requirements of the site specific Flood Risk Assessment (see chapter 11).

5.8 Residual Risk

Figure 5 displays all the manmade flood defences and structures from the NFCDD database within the study area. The flood defences held on the NFCDD database include manmade embankments, sheet piling and concrete structures. Railway and road embankments running adjacent to a watercourse are also regarded as a flood defence and are therefore included within the database. The location and dimensions of open channels and culverts are also classified as flood defences and included within the NFCDD database.

These defences are the responsibility of the Environment Agency, the Local Authority, or private individuals.

The NFCDD database normally provides reference to the design standard of the defences. However, the NFCDD data received covering the study area does not contain this information. Therefore, as a precautionary approach, the defences within the study area are not considered to offer protection for the 1 in 100 year flood event.

6 Guidance on applying the PPS25 Sequential Test

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

6.1 What is the Sequential Test?

The Sequential Test refers to the application of a sequential approach to the allocation of development sites by Local Planning Authorities in the preparation of Local Development Frameworks. This allows the determination of site allocations based on flood risk and vulnerability (see Table 6.1 and 6.2,). Overall the aim of the Sequential test is to direct new development sites within Flood Zone 1 wherever possible. Only where there are no reasonably available sites in Flood Zone 1 should sites in Flood Zone 2 be considered, and then sequentially to Flood Zone 3. The potential allocation sites being considered for development are presented in Appendix C.

Table 6.1: PPS25 Flood Zone Definitions (from PPS25, Appendix D, Table D1)

Flood Zone	**Definition**
Flood Zone 1	Low probability - Defined as zone where there is a less than 0.1% (1 in 1000 year) probability of flooding each year.
Flood Zone 2	Medium probability - Defined as having between 0.1% and 1% (between 1 in 1000 and 1 in 100 year) probability of fluvial flooding each year and between 0.1% and 0.5% (between 1 in 1000 and 1 in 200 year) probability of tidal flooding each year.
Flood Zone 3a	High probability - Defined for as having a 1% or greater (1 in 100 year or greater) probability of fluvial flooding each year and a 0.5% or greater (1 in 200 year or greater) probability of tidal flooding each year.
Flood Zone 3b	Functional floodplain - Defined as land where water has to flow or be stored in times of flood. Defined as the 5% (1 in 20 year) annual probability floodplain or an area designed to flood in an extreme (0.1%) flood, or another probability agreed between the Local Planning Authority (LPA) and the Environment Agency. (The Environment Agency do not currently produce Flood Zone 3b mapping for England and Wales). In this Level 1 SFRA Functional Floodplain has been defined using the 1 in 20 year annual probability flood where available. In the absence of this modelled outline Flood Zone 3a will be used to define the total extent of the Functional Floodplain.

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

Table 6.2: Flood Risk Vulnerability Classification (from PPS25, Appendix D, Table D2)

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

	Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, **subject to a specific warning and evacuation plan**.

West Wiltshire DC must demonstrate that it has considered a range of possible sites in conjunction with the Flood Zone information from the SFRA and applied the Sequential Test, in the site allocation process. In cases where development cannot be fully met through the provision of site allocations, it is expected that a realistic allowance is made for windfall development, based on past trends.

PPS25 acknowledges that some areas will (also) be at risk of flooding from flood sources other than fluvial systems. Consequently all sources of flooding must be considered when looking to locate development in any of the Flood Zones described in Table 6.1. The other sources of flooding requiring consideration when situating new development allocations include:

- Overland Flow;
- Groundwater;
- Sewers; and
- Artificial sources.

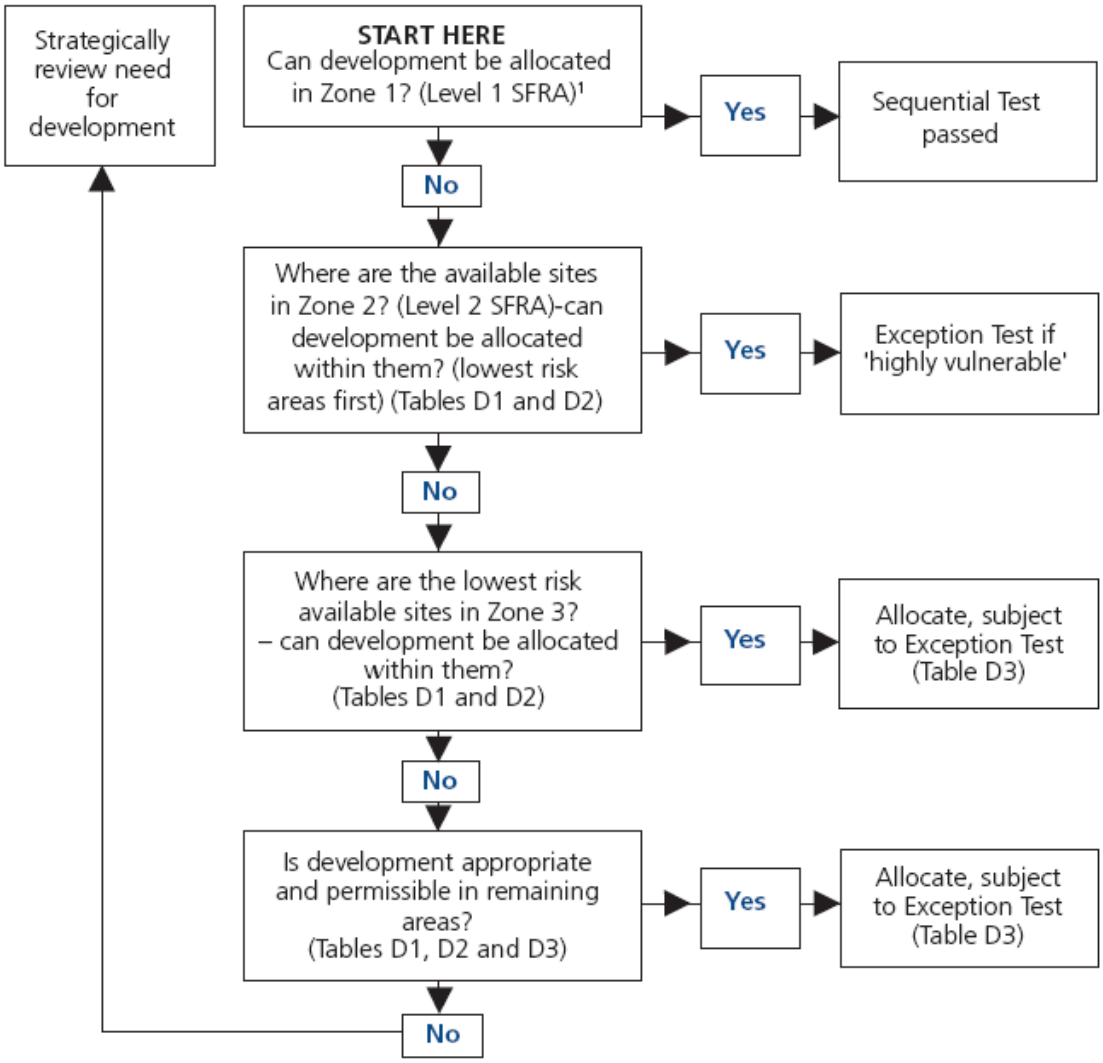
These sources (as sources of flooding) are typically less understood than fluvial sources. Consequently data often only exists as point source data or through interpretation of local conditions. In addition, there is no guidance on suitable return periods to associate with floods arising from these sources. For example modern storm water drainage systems are constructed to a 1 in 30 year standard. Any storm event in excess of the 30 year return period storm would be expected to cause flooding. Consequently when assessing these sources through the Sequential Test, if a location is recorded as having experienced repeated flooding from the same source this should be investigated further although does not necessarily provide sufficient basis for not developing the site on its own.

6.2 Application of the Sequential Test

The Sequential Test should be undertaken by West Wiltshire DC and be accurately documented to ensure decision processes can be transparently communicated and reviewed where necessary. The Sequential Test should be carried out on all development sites, seeking to locate all development in Flood Zone 1. Only where there

are no reasonably available alternative sites should development be considered in Flood Zones 2 and 3, where it will be necessary to balance the flood probability and development vulnerability of sites throughout the administrative area.

The Level 1 SFRA mapping provides the tools for West Wiltshire DC to undertake the Sequential Test. The recommended steps required in undertaking the Sequential Test are provided in the flow presented as Diagram 6.1. This is based on the Flood Zone and Flood Risk Vulnerability, as summarised in Table 6.3 (from PPS25, Appendix D, Table D.3).



Note
1 Other sources of flooding need to be considered in Flood Zone 1

Diagram 6.1: Flow diagram illustrating the application of the Sequential Test (taken form Figure 4.1 PPS25 Practice Guide).

Table 6.3: Flood Risk Vulnerability and Flood Zone 'Compatibility' (from PPS25, Appendix D, Table D.3)

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

✓ - Development is appropriate

× - Development not be permitted

6.3 Additional Guidance

The sequence of steps presented below in tandem with Diagram 6.1 is designed to guide West Wiltshire DC and developers through the Sequential Test. The steps are designed to ensure land allocations are primarily allocated in line with the principles of the Sequential Test or failing this the requirement for application of the Exception Test is clearly identified.

6.3.1 Recommended stages for West Wiltshire District Council

- Assign all potential developments with a vulnerability classification (Table 6.2). Where development is mixed, the highest vulnerability classification should be used;
- The location and identification of potential development should be recorded e.g. ST 859580, Trowbridge #1;
- The Flood Zone classification of potential development sites should be determined based on a review of the Flood Zones for fluvial sources as described in Chapter 5. Where these span more than one Flood Zone, all zones should be noted;
- The design life of the development should be considered with respect to climate change:

- 60 years – for commercial / industrial developments; and
- 100 years – for residential developments.

- Identify if there are existing flood defences serving the potential development sites based on the National Flood Coastal and Flood Defence Database GIS layer, as displayed in Figure 5;
- Highly vulnerable developments to be accommodated within the LPA area should be located in those sites identified as being within Flood Zone 1. If these cannot be located in Flood Zone 1, because the identified sites are unsuitable or there are insufficient sites in Flood Zone 1, sites in Flood Zone 2 can then be considered. If sites in Flood Zone 2 are inadequate then the LPA may have to identify additional sites in Flood Zones 1 or 2 to accommodate development or seek opportunities to locate the development outside their administrative area;
- Once all highly vulnerable developments have been allocated to a development site, the LPA can consider those development types defined as more vulnerable. In the first instance more vulnerable development should be located in any unallocated sites in Flood Zone 1. Where these sites are unsuitable or there are insufficient sites remaining, sites in Flood Zone 2 can be considered. If there are insufficient sites in Flood Zone 1 or 2 to accommodate more vulnerable development, sites in Flood Zone 3a can be considered. More vulnerable developments in Flood Zone 3a will require application of the Exception Test;
- Once all more vulnerable developments have been allocated to a development site, the LPA can consider those development types defined as less vulnerable. In the first instance less vulnerable development should be located in any remaining unallocated sites in Flood Zone 1, continuing sequentially with Flood Zone 2, then 3a. Less vulnerable development types are not appropriate in Flood Zone 3b – Functional Floodplain;
- Essential infrastructure should be preferentially located in the lowest flood risk zones, however, this type of development may be located in Flood Zones 3a and 3b, provided the Exception Test is fulfilled;
- Water compatible development has the least constraints with respect to flood risk and it is considered appropriate to allocate these sites last;
- For decisions made through the stages above, it will also be necessary to consider the risks posed to the site from other flood sources and where comparable, development sites in the same flood zone may be more suitable due to:
  - risks from other flood sources;
  - flood risk management measures;

- the rate of flooding;
- flood water depth; or,
- flood water velocity.

Where the development type is highly vulnerable, more vulnerable, less vulnerable or essential infrastructure and a site is found to be impacted by a recurrent flood source (other than fluvial), the site and flood sources should be investigated further regardless of any requirement for the Exception Test. This should be discussed with the Environment Agency to establish the appropriate time for the assessment to be undertaken, (i.e. Exception Test through a Level 2 SFRA or assess through a site specific flood risk assessment).

It should be noted that the effect of climate change for potential sites located within the fluvial Flood Zones was described in Chapter 5. It is recommended that site specific Flood Risk Assessments should investigate the effects of climate change in greater detail, where required.

Appendix D provides a template for completion of the Sequential Test by the LPA for each potential development site, using the approach and responses to the questions provided. This will aid the determination of the most suitable type of development for each site based on development vulnerability and flood risk. Where sites are identified as requiring the Exception Test, these should be transferred to a second template presented in Appendix D for the LPA to provide responses for parts ‘a’ and ‘b’ of the Exception Test.

7 Guidance on Applying the PPS25 Exception Test

7.1 What is the Exception Test?

The Exception Test, introduced in PPS25 comprises of three parts, all of which need to be satisfied if the Test is to be passed. The three parts of the test are described in more detail in section 7.3. This test can be applied where application of the Sequential Test is unable to meet the development requirements of the LPA, in particular where 'more vulnerable' development and 'essential infrastructure' cannot be located in Flood Zone 1 or 2 and 'highly vulnerable' development cannot be located on Flood Zone 1.

7.2 Why is there an Exception Test?

Where there are large areas of Flood Zone 2 and 3 and the Sequential Test cannot deliver acceptable sites but continuing development is necessary for wider sustainability reasons, then the Exception Test provides a method for ensuring and demonstrating the reasons for development outweigh the flood risk while also ensuring flood risks are robustly understood and mitigated. This enables the potential for social or economic blight to be avoided and for essential infrastructure to be constructed in high risk areas. In addition, where restrictive national designations exist, such as landscape, heritage and nature conservation (e.g. Areas of Outstanding Natural Beauty (AONB), Sites of Special Scientific Interest (SSSI) and World Heritage Sites (WHS)) prevent the availability of unconstrained sites at lower risk, then it may also be appropriate to apply the Exception Test.

7.3 What is required to pass the Exception Test?

The Exception Test consists of three parts that are detailed below. All of these parts must be satisfied before it can be deemed that a development would be appropriate within the given flood zone.

The following sub-sections introduce the three parts of the Exception Test and provide additional guidance on how the parts of the test can be satisfied.

7.3.1 Part A – Wider sustainability benefits to the community

Part A of the Exception Test states:

It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by the SFRA where one has been prepared. If the Development Plan Documents (DPDs) have reached the 'submission'

stage (Figure 4 of PPS12; Local Development Frameworks) the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal.

- The planning application should be scored against the sustainability criteria of the Sustainability Appraisal;
- Where a development fails to score positively against the Sustainability Appraisal West Wiltshire DC could consider planning conditions or Section 106 Agreements.

West Wiltshire DC prepared a Sustainability Appraisal Scoping Report in July 2005 (West Wiltshire DC, 2005) in which it lists six main objectives for the study area. Developments applying the Exception Test should satisfy West Wiltshire DC's Sustainability Objectives in order to pass Part A of the Exception Test.

West Wiltshire DC's Sustainability Objectives are:

Objective One: Improve health;

Objective Two: Support communities that meet people's needs;

Objective Three: Develop the economy in ways that meets people's needs;

Objective Four: Provide access to meet people's needs with the least damage to communities and the environment;

Objective Five: Maintain and improve environmental quality and assets;

Objective Six: Minimise consumption of natural resources.

7.3.2 Part B – Developable Previously Developed Land

Part B of the Exception Test states:

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.

Planning Policy Statement 3: Housing (PPS3) provides the following definition of previously developed land:

Previously developed land is that which is or was occupied by a permanent structure, including the curtilage of the developed land and any associated fixed surface infrastructure.

The definition includes Military of Defence (MoD) buildings, but excludes:

- Land that is or has been occupied by agricultural or forestry buildings;

- Land that has been developed for mineral extraction or landfill waste disposal where provision for restoration has been made through development control procedures;
- Land in built-up areas such as parks, recreation grounds and allotments, which, although it may feature paths, pavilions and other buildings, has not been previously developed;
- Land that was previously developed but where the remains of the permanent structure or fixed surface structure have blended into the landscape in the process of time (to the extent that it can reasonably be considered as part of the natural surroundings).

There is no presumption that land that is previously developed is necessarily suitable for housing development or that the whole of the site area should be developed.

7.3.3 Part C – Safe from flooding and no impact on neighbouring property

Part C of the Exception Test states:

'A flood risk assessment must demonstrate that the development will be safe, without increasing food risk elsewhere, and, where possible, will reduce flood risk overall'.

The PPS25 Practice Guide (DCLG, 2008) provides details on what should be covered in a flood risk management strategy to ensure the site is 'safe' in Chapter 4 – The Sequential and Exception Tests, these include:

- The design of any flood defence infrastructure;
- Access and egress;
- Operation and maintenance;
- Design of development to manage and reduce flood risk wherever possible;
- Resident awareness;
- Flood warning; and
- Evacuation procedures and funding arrangements.

Further information with respect to depths of flooding is provided in 'Flood Risk Assessment Guidance for New Developments: Phase 2, FD2320/TR2'. This provides categories of flood hazard that indicate the danger to people based on flood water depth, velocity and debris (see Table 7.1). In addition, most cars and vans are unstable in flood depths in excess of 0.5 m of still water. This depth reduces as the velocity of floodwater increases.

Table 7.1: Danger to people for different combinations of depth and velocity. (Table 13.1 from 'Flood Risk Assessment Guidance for New Developments: Phase 2, FD2320/TR2).

Velocity (m s^{-1})	Depth (m)											
	0.05	0.10	0.20	0.30	0.40	0.50	0.60	0.80	1.00	1.50	2.00	2.50
0.00												
0.10												
0.25												
0.50												
1.00												
1.50												
2.00												
2.50												
3.00												
3.50												
4.00												
4.50												
5.00												

Key:	
	Danger for some
	Danger for most
	Danger for all

It is recommended that pre-application discussions between the developer, Environment Agency and West Wiltshire DC are undertaken to clarify and agree the definition of 'safe' for individual developments based on location and source of flood risk.

8 Flood Risk Management

Flood risk management measures can be defined as those measures put in place to reduce the risk to people and property from the hazard of flooding. Current flood risk management measures can be divided into two types:

- Flood Defences;
- Flood Warning.

8.1 Flood Defences

Information on defence structures within the study area have been provided by Environment Agency from the National Flood and Coastal Defence Database (NFCDD). The NFCDD holds information on natural and manmade defences including their location, type, condition and design standard. Figure 5 displays the location of NFCDD defences throughout the study area.

The NFCDD database covering the study area does not contain information on the design standard of the defences. As a precautionary approach, the defences within the study area are not considered to offer protection for the 1 in 100 year flood event. Consequently the 100 year flood would be expected to result in flooding despite the presence of flood defences.

In addition, due to the ability for flood defences to be breached by flood waters if flood defences are neglected or overtopped during a flood event with a return period greater than the defences design standard, areas of land situated behind defences are still identified as flood risk areas on the Environment Agency Flood Maps.

Many of the NFCDD flood defences identified throughout the study area are open channels and culverts designed to convey river flows through the area as quickly as possible. The maintenance of these open channels and culverts is essential to ensure that the standard of flood defence within the study area is not reduced. Maintenance duties should be carried out by the responsible authority such as the Environment Agency, Local Authority or the riparian owner on a regular basis.

8.2 Flood Warning

The flood warning system operated by the Environment Agency provides an essential service in all areas at risk of flooding. Informing people of the potential flood risk within their area is key in ensuring that the necessary preparations can be made to protect property or/and evacuate affected areas.

Flood warnings are disseminated through a variety of mediums that include TV, radio, Automated Voice Messaging service direct to a phone/fax/pager, internet and/or

loudhailer. There is also an emergency Floodline number (0845 988 1188) and a quick dial number for individual rivers. The flood warning service is also available on the Environment Agency website (www.environment-agency.gov.uk).

The Environment Agency aim to give a minimum of two hours warning prior to the onset of a flood event. However the rapid onset of some flood events, within small catchments or when a high intensity rainfall event occurs within an urban catchment, means that sometimes there is insufficient time to raise a warning.

There are four flood warning codes that indicate the level of flood risk to the area. These are presented in Table 8.1.

Table 8.1 Environment Agency Flood Warning Codes

Flood Warning Code	Description
Flood watch	Flooding of low lying land and roads is expected. Make the necessary actions to prepare for a flood event.
Flood warning	Flooding of homes and businesses is expected. Take immediate action.
Severe flood warning	Severe flooding is expected. Extreme danger to life and property is expected. Take immediate action.
All clear	Flood watches or warnings are no longer in force for this area

Figure 6 shows the location of six flood warning areas within the study area. These are identified by the areas they cover, namely:

- Bristol Avon (middle) from Melksham to Bathford;
- River Wylye from Brixton Deverill to Warminster including Longbridge Deverills, Henfords Marsh, Boreham, Water Lane and Norton Bavant;
- Bristol Avon (upper) at Melksham;
- Bristol Avon (Upper) from downstream Malmesbury to upstream Melksham;
- Semington Brook from upper reaches to Semington;
- River Wylye from Warminster to Wilton including Heytesbury, Suffers Bridge, Boyton, Codford St Peter, Wylye and Great Wishford.

9 Drainage of Development Sites

9.1 Background

Traditionally, built developments have utilised piped drainage systems to manage storm water and convey surface water run-off away from developed areas as quickly as possible. Typically these systems connect to the public sewer system for treatment and/or disposal to local watercourses. Whilst this approach rapidly transfers storm water from developed areas, the alteration of natural drainage processes can potentially impact on downstream areas by increasing flood risk and reducing water quality. Receiving watercourses are therefore much more sensitive to rainfall intensity, volume and catchment land uses after a catchment or areas of a catchment have been developed.

Due to the difficulties associated with up grading sewer systems it is uncommon for sewer and drainage systems to keep pace with the rate of development/re-development and there are increasingly stringent controls placed on discharges to watercourses. As development progresses and/or urban areas expand these systems become inadequate for the volumes and rates of storm water they receive, resulting in increased flood risk and/or pollution of watercourses. Allied to this are the implications of climate change on rainfall intensities, leading to flashier catchment/site responses and surcharging of piped systems.

In addition, as flood risk has increased in importance within planning policy, a disparity has emerged between the design standard of conventional sewer systems (1 in 30 year) and the typical design standard flood (1 in 100 year + climate change). This results in drainage inadequacies for the flood return period developments need to consider, often resulting in potential flood risk from surface water/combined sewer systems.

A sustainable solution to these issues is to reduce the volume of and/or rate of water entering the sewer system and watercourses.

9.2 What are Sustainable Drainage Systems (SuDS)?

The term Sustainable Drainage Systems (SuDS) covers a wide range of drainage techniques that provide an alternative to the traditional piped drainage system for draining impermeable/developed areas. The philosophy behind SuDS is to replicate as closely as possible the natural drainage of a site. By doing so SuDS should:

- Manage runoff flow rates and reduce the risk of downstream flooding;
- Protect or enhance water quality;
- Be sympathetic to the environment;
- Provide habitats and enhance biodiversity; and,

- Encourage groundwater recharge.

The suitability of a selection of drainage techniques in terms of achieving the SuDS objectives are presented in Table 9.1 with a brief description of each technique.

9.3 SuDS Policies

Chapter 3 outlines a number of policies that promote the implementation of SuDS in new developments within the West Wiltshire DC study area. SuDS are promoted in 'Making Space for Water' (Defra, 2005); PPS25 (DCLG, 2006) RPG10 (DETR, 2001); the Draft RSS (SWRA, 2006) and the Wiltshire and Swindon Structure Plan.

9.3.1 PPS25 (DCLG, 2006)

In terms of identifying a requirement to consider SuDS on a development project the following general principle (set out in PPS25) should be followed:

'The surface water drainage arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than rates prior to the proposed development, unless specific off-site arrangements are made and result in the same net effect'.

This is to alleviate the pressure on sewer systems that are often antiquated, serving a catchment area greater than their original design and/or designed to a standard less than that required to mitigate development from a 1% annual probability flood event.

If a proposed development results in an increase in surface water, then the Environment Agency will expect to see SuDS forming part of the proposed mitigation. With their new powers of direction over planning applications in flood zones or for major development, any developments that do not incorporate SuDS can expect them to be required through Section 106 conditions to their planning applications. Where the consented discharge rates are low, this can significantly impact on the viability of development proposals.

9.3.2 Code for Sustainable Homes (DCLG, April 2008)

The Code for Sustainable Homes identifies reduction of surface water runoff and flood risk as a component towards achieving a rating of between Level 1 to Level 6 (with Level 6 being the most sustainable). The surface water element is worth up to two credits within the scoring system. Through incorporating suitably designed systems into a development, SuDS can also contribute to other assessment criteria under Code for Sustainable Homes including ecology and potable water consumption.

9.4 SuDS Methods

SuDS incorporate a wide variety of drainage techniques. As a result, there is no one correct drainage solution for a site. Components for a suitable drainage scheme should

be selected on a site-by-site basis and integrated to deliver the drainage requirements of the area. In seeking to achieve the drainage requirements a developer should employ the 'Management Train' methodology as set out in CIRIA C697. The Management Train has the following components:

a. **Prevention** - good site design and upkeep to prevent runoff and pollution (e.g. limited paved areas, regular pavement sweeping);
b. **Source control -** runoff control at/near to source (e.g. rainwater harvesting, green roofs, pervious pavements);
c. **Site control** - water management from different onsite compartments (e.g. route water from roofs, impermeable paved areas to one infiltration/holding site); and,
d. **Regional control** - integrate runoff manage from a number of sites (e.g. into a detention pond).

Table 9.1 Drainage Techniques

Management Train	Component	Description	Water Quantity	Water Quality	Amenity Biodiversity
Source – Prevention	Green roofs	Layer of vegetation or gravel on roof areas providing absorption and storage.	●	●	●
Source – Prevention	Rainwater harvesting	Capturing and reusing rainwater for domestic or irrigation uses.	●	○	○
Source – Prevention	Permeable pavements	Infiltration through the surface into underlying layer.	●	●	○
Source	Filter drains	Drain filled with permeable material with a perforated pipe along the base.	●	●	✖
Source	Infiltration trenches	Similar to filter drains but allows infiltration through sides and base.	●	●	✖
Source	Soakaways	Underground structure used for store and infiltration.	●	●	✖
Source	Bio-retention areas	Vegetated areas used for treating runoff prior to discharge into receiving water or infiltration	●	●	●
Source	Swales	Grassed depressions, provides temporary storage, conveyance, treatment and possibly infiltration.	●	●	○
Source	Sand filters	Provides treatment by filtering runoff through a filter media consisting of sand.	●	●	✖
Site	Basins	Dry depressions outside of storm periods, provides temporary attenuation, treatment and possibly infiltration.	●	●	○
Site	Ponds	Designed to accommodate water at all times, provides attenuation, treatment and enhances site amenity value.	●	●	●
Regional	Wetland	Similar to ponds, but are designed to provide continuous flow through vegetation.	●	●	●

Key: ● – highly suitable, ○ - suitable depending on design, ✖ - not suitable

9.5 Where can SuDS be utilised?

The underlying ground conditions of a development sites capacity to infiltrate surface water, will often determine the type of SuDS approach to be used at development sites. This will need to be determined through ground investigations carried out on-site. However an initial assessment of a sites suitability to the use of SuDS can be obtained from a review of the available soils/geological survey of the area.

Based on a review of the following maps Table 9.2 and 9.3 present an indication of the suitability of SuDS techniques, as listed in Table 9.1, which would be compatible with the underlying geology:

- The British Geological Survey - GeoIndex, Bedrock and Superficial Deposits. Online: http://www.bgs.ac.uk/magazine/geology/;
- Soil Survey of England and Wales, 1:250,000 Soil Map of England and Wales.

In the design of any drainage system and SuDS approach, consideration should be given to site specific characteristics and where possible be based on primary data from site investigations. The information presented in Table 9.2 and Table 9.3 is provided as a guide and should not be used to accept or refuse SuDS techniques.

Table 9.2 Suitable SuDS techniques dependent on geology within the study area

SuDS Technique	Component Example	Permeability	Geology	Description	Location
Infiltration or Combined Infiltration and Attenuation	Permeable pavements	Moderate	Great Oolite	Jurassic Sedimentary Rocks	This underlying rock is found to the north west of the district, forming the upland hills of the Cotswolds.
		Moderate	Cornbrash	Jurassic Sedimentary Rocks	This rock type is found in the north west corner around Bradford On Avon. Another isolated area of this rock underlies Trowbridge.
	Soakaways	Moderate	Corallia	Jurassic Sedimentary Rocks	This rock type underlies a small area of the catchment. It can be found to the east of Trowbridge and follows a diagonal line passing Westbury to the north west.
	Swales	Moderate	Upper Green Sand and Gault	Cretaceous Sedimentary Rock	This rock type is the dominate rock type in Westbury. This rock type underlies a thin strip orientated east to west in the central part of the district.
		Moderate	Chalk including Red Chalk	Cretaceous Sedimentary Rock	This type of geology can be found underlying Salisbury Plain, located to the east of Westbury and Warminster.
'	-	Variable	Alluvium	Sand and gravel	These superficial deposits are located on raised ground within the river valleys.

SuDS Technique	Component Example	Permeability	Geology	Description	Location
Attenuation	Basins	Low	Oxford Clay and Kellaways Beds	Jurassic Sedimentary Rocks	This rock type underlies the district following a diagonal line, from the north east to the north west of the district. It is the dominate geology underlying Melksham and Trowbridge.
	Ponds	Low	Kimmeridge Clay and Kellaways Beds	Jurassic Sedimentary Rocks	This rock type lies to the east of the Corallia rock and follows the same diagonal line. This rock type is the predominate rock underlying the north west corner of Westbury.

Table 9.3 Suitable SuDS techniques dependent on soil types within the study area

SuDS Technique	Permeability	Soil Association	Geology	Description
Infiltration or Combined Infiltration and Attenuation	High/Moderate	FRILFORD	Mesozoic and Tertiary Sands	Deep permeable sandy and coarse loamy soils. Some ferruginous sandy and some coarse loamy soils affected by groundwater.
	High/Moderate	FYFIELD 4	Mesozoic and Tertiary Sand and Loam	Deep well drained often stoneless coarse loamy and sandy soils. Some fine loamy soils with slowly permeable subsoils and slightly seasonal waterlogging.
	Moderate	ICKNIELD	Chalk	Shallow mostly humose, well drained calcareous soils over chalk on steep slopes and hill tops.
	Moderate	UPTON 1	Chalk	Shallow well drained calcareous silty soils over chalk.
	Moderate	ELMTON 2	Jurassic Limestone and Sandy Limestone	Shallow, well drained brashy calcareous fine loamy soils over limestone.
	Moderate	SHERBORNE	Jurassic Limestone and Clay	Shallow, well drained brashy calcareous clayey soils over limestone, associated with slowly permeable calcareous clayey soils.
	High/Moderate	FRILFORD	Mesozoic and Tertiary Sands	Deep permeable sandy and coarse loamy soils. Some ferruginous sandy and some coarse loamy soils affected by groundwater.
	High/Moderate	FYFIELD 4	Mesozoic and Tertiary Sand and Loam	Deep well drained often stoneless coarse loamy and sandy soils. Some fine loamy soils with slowly permeable subsoils and slightly seasonal waterlogging.
	Moderate	ANDOVER 1	Chalk	Shallow well drained calcareous silty soils over chalk on slopes and crest. Deep calcareous and non-calcareous fine silty soils in valley bottoms.

SuDS Technique	Permeability	Soil Association	Geology	Description
	Moderate	ANDOVER 2	Chalk with Clay and Flints	Shallow well drained calcareous silty soils over chalk.
	Moderate	COOMBE 1	Chalky drift and chalk	Well Drained calcareous fine silty soils, deep in valley bottoms, shallow to chalk on valley sides in places over argillaceous chalk. Some fine silty over clayey soils with slowly permeable subsoils and slight seasonal waterlogging
	Moderate	BADSEY 1	River Terrace Gravel	Well drained calcareous and non-calcareous fine loamy soils over limestone gravel. Some deep fine loamy soils and fine loamy soils over gravel, and similar but shallower soils affected by groundwater.
	Moderate	BADSEY 2	River Terrace Lacustrine Gravel	Well drained calcareous fine loamy soils over limestone gravel. Some similar soils affected by groundwater.
	Moderate	BROMSGROVE	Permo-Triassic and Carboniferous Sandstone and Siltstone	Well drained reddish coarse loamy soils mainly over soft sandstones, but deep in places. Associated fine loamy soils with slowly permeable subsoils and slightly seasonal waterlogging. Risk of water erosion.
	Moderate	ARDINGTON	Cretaceous Glauconitic Sand, Loam and Clay	Deep well drained fine and coarse loamy glauconitic soils. Some valley bottom soils affected by groundwater.
	Moderate	CARSTENS	Plateau Drift and Clay with Flints	Well drained fine silty over clayey, clayey and fine silty soils.
	Moderate	BLOCK	Chalky Drift	Moderately permeable calcareous loamy soils over chalky gravel variably affected by groundwater.
	Moderate/ Low	HARWELL	Cretaceous and Jurassic Sandstone, Siltstone and Clay	Well drained loamy soils over sandstone and similar soils with slight seasonal waterlogging. Shallow stony soils locally. Some slowly permeable seasonally waterlogged fine loamy or fine silty over clayey soils mainly on scarp slopes.

SuDS Technique	Permeability	Soil Association	Geology	Description
	Moderate/ Low	Bursledon	Eocene and Jurassic Loam and Clay	Deep fine loamy soils with slowly permeable subsoils and slight seasonal waterlogging associated with deep coarse loamy soils variably affected by groundwater.
Attenuation	Low	Evesham 1	Jurassic Clay and Limestone	Slowly permeable calcareous clayey soils associated with shallow well drained brashy calcareous soils over limestone.
	Low	EVESHAM 3	Jurassic and Cretaceous Clay	Slowly permeable calcareous clayey, and fine loamy over clayey soils. Some slowly permeable seasonally waterlogged non-calcareous clayey soils.
	Low	WICKHAM 2	Drift over Jurassic and Cretaceous Clay or Mudstone	Slowly permeable seasonally waterlogged fine loamy over clayey, fine silty over clayey and clayey soils.
	Low	WICKHAM 3	Drift over Mesozoic and Tertiary Clay and Loam	Slowly permeable seasonally waterlogged fine loamy over clayey and coarse loamy over clayey soils, and similar more permeable soils with slight waterlogging.
	Low	DENCHWORTH	Jurassic and Cretaceous Clay	Slowly Permeable seasonally waterlogged clayey soils with similar fine loamy over clayey soils. Some fine loamy over clayey soils with only slight seasonal waterlogging and some slowly permeable calcareous clayey soils.

9.5.1 SuDS Constraints

There are several constraints that may limit the application of SuDS. These will vary between locations and may include:

- Ground Contamination;
- Ground Conditions;
- Groundwater Use / Vulnerability;

- Capacity of the receiving watercourse.

9.5.1.1 Ground Contamination

Ground contamination has the potential to contaminate groundwater and/or surface water resources if incorrectly managed. In some cases the nature of the ground contamination may be such that certain types of SuDS are not appropriate. Ground contamination should be determined by site investigation on a site be site basis.

9.5.1.2 Groundwater Use / Vulnerability

Groundwater resources can be vulnerable to contamination from both direct sources (e.g. into groundwater) or indirect sources (e.g. infiltration of discharges onto land). Groundwater vulnerability within the study area has been determined by the National Rivers Authority (now the Environment Agency), based on a review of aquifer characteristics, local geology and the leaching potential of overlying soils. To identify the groundwater vulnerability on and surrounding a potential development site the map reference below covers the study area:

- National Rivers Authority Groundwater Vulnerability Map, Sheets 37, 38, 43 and 44.

The vulnerability of the groundwater is important when determining the suitability of SuDS. The Environment Agency are the responsible drainage authority for any discharges to groundwater and should be consulted on proposals to discharge to ground.

9.5.1.3 Groundwater Source Protection Zones

The Environment Agency also defines groundwater Source Protection Zones (SPZ). SPZs are defined to protect areas of groundwater that are used for potable (drinking) supply, including public/private potable supply, (including mineral and bottled water) or for use in the production of commercial food and drinks.

Depending on the nature of the proposed development and the location of the development site with regards to the SPZs, restrictions may be placed on the types of SuDS appropriate to certain areas. Consideration should be given to the SPZs when determining the suitability of SuDS for development sites. The Source Protection Zones within the study area available on the Environment Agency website: www.environment-agency.gov.uk.

SPZs are defined based on the time it takes for pollutants to reach an abstraction point. This transmission time enables the Environment Agency to define three zones around a groundwater abstraction point. The four zones are:

- **Zone 1 (Inner Protection Zone)** – This is defined as ‘any pollution that can travel to the borehole within 50 days from any point within the zone is classified as being

inside zone 1'. Developments proposed within this area are likely to have the tightest constraints on SuDS.

- **Zone 2 (Outer Protection Zone)** – This is defined as the area that 'covers pollution that takes up to 400 days to travel to the borehole, or 25% of the total catchment area – whichever area is the biggest'.
- **Zone 3 (Total Catchment)** - The total catchment is the total area needed to support removal of water from the borehole, and to support any discharge from the borehole.
- **Zone 4 (Zone of special interest)** – In the study area a fourth zone has been defined. 'This is usually where local conditions mean that industrial sites and other polluters could affect the groundwater source even though they are outside the normal catchment area'. These areas are likely to have the least constraints on SuDS.

9.5.2 Planning Considerations for SuDS

The application of SuDS may require space on development sites to be set-aside. Early consideration of SuDS will assist in determining the space required and identify methods to spread the management of storm water throughout a site using the Management Train principle presented in the CIRIA report C697.

The design of SuDS measures should be undertaken as part of a drainage strategy proposed during the master planning of development sites. A ground investigation will be required to access the suitability of using infiltration SuDS, with this information also being used to assess the required volume of on-site storage. Hydrological analysis should be undertaken using industry-approved procedures; to ensure a robust design storage volume is obtained. The consideration of utilising SuDS as part of a development will depend on many factors such as:

- The underlying geology and drift layers;
- The depth of the groundwater table;
- Site slopes;
- run-off quality;
- Site restrictions;
- Maintenance requirements;
- Economical viability; and,
- Groundwater protection and ecological considerations.

The final drainage scheme and SuDS for a site should consider each of these elements in its design.

All relevant organisations should meet at an early stage of the drainage design process to agree on the most appropriate drainage system for the particular development. These organisations may include the Local Authority, the sewerage undertaker, Highway Agency, and the Environment Agency. Liaison with these organisations should focus on establishing a suitable design methodology, any restrictions and provision for the long-term maintenance of the feature.

There are, at present, no legally binding obligations relating to the provision and maintenance of SuDS. However, PPS25 (DCLG, 2006) states that:

'Where the surface water system is provided solely to serve any particular development, the construction and ongoing maintenance costs should be fully funded by the developer.'

The most convenient vehicle for agreeing long-term management responsibilities is through Section 106 of the Town and Country Planning Act. Under this, agreement for SuDS maintenance can be a requirement of the planning application, forcing the issue to be addressed.

9.6 Further Information

The above information is intended to provide an introduction to the use of SuDS. The options available for the provision of SuDS is not limited to those presented here and new techniques are frequently developed.

The following reference documents provide further information on SuDS, their benefits and limitations and how they can be employed:

- BRE. Digest 365 (2003) Soakaway Design. Building Research Establishment.
- British Water (2005) Technical Guidance, Guidance to Proprietary Sustainable Drainage Systems and Components – SuDS. In partnership with the Environment Agency
- BSRIA Ltd. (1997) Water Conservation: Implications of Using Recycled Greywater and Stored Rainwater in the UK. Report 13034/1. Drinking Water Inspectorate, Department of the Environment.
- DEFRA (2004) Preliminary Rainfall Runoff Management for Developments Revision D.
- CIRIA 625 (2003) Model Agreements for Sustainable Water Management Systems – Review of Existing Legislation. RP664.

- CIRIA 626 (2003) Model Agreements for Sustainable Water Management Systems – Model Agreement for Rainwater and Greywater Use Systems. P Shaffer, C Elliott, J Reed, J Holmes and M Ward.
- CIRIA C521 (2000) Sustainable Urban Drainage Systems - Design Manual for Scotland and Northern Ireland. Sustainable Urban Drainage Scottish Working Party.
- CIRIA C522 (2000) Sustainable Urban Drainage Systems - Design Manual for England and Wales. Department of Environment Transport Regions.
- CIRIA C523 (2001) Sustainable Urban Drainage Systems, Best Practice Manual for England, Scotland, Wales and Northern Ireland.
- CIRIA C539 (2001) Rainwater and Greywater Use in Buildings: Best Practice Guidance. D J Leggett, R Brown, D Brewer, G Stanfield and E Holiday. Department of Trade and Industry.
- CIRIA C609 (2004) Sustainable Drainage Systems, Hydraulic, Structural and Water Quality Advice. S Wilson, R Bray and P Cooper. Department of Trade and Industry.
- CIRIA C635 (2006) Designing for exceedance in urban drainage - good practice. C Digman, D Balmforth, R Kellagher, D Butler. Department of Trade and Industry.
- CIRIA C697 (2007) The SuDS Manual. Woods Ballard B; Kellagher R et al.
- Construction Industry Research and Information Association. 1996. Report 156 – Infiltration Drainage – Manual of Good Practice. Roger Bettess. Highways Agency and National Rivers Authority.
- National SuDS Working Group. 2004. Interim Code of Practice for Sustainable Drainage Systems. National SuDS Working Group. ISBN 0-86017-904-4.

10 Policy Recommendations

The following section presents policy recommendations for consideration within the emerging LDF and LDDs for West Wiltshire DC. The recommendations are based on the review of existing national and local policies, objectives identified by the Environment Agency within the local Catchment Flood Management Plans (CFMPs) and evidence compiled and presented through this Level 1 SFRA. The recommendations have been developed under the headings:

- Flood Risk;
- Flood Risk Management;
- Sustainable Drainage; and,
- Water Resources and the Environment.

Integration of these policy considerations into the LDF / LDD should ensure that the objectives and aspirations of the Environment Agency and national policy are met whilst strengthening the position of the West Wiltshire DC with regard to flood risk management.

10.1 Flood Risk

10.1.1 Catchment Wide Strategies

To ensure flood risk is embedded within emerging policies in the LDF and LDDs for the area the LPAs should require all development proposals to adhere to the policies presented within PPS25 (DCLG, 2006).

To ensure continuity between the policies operated by the different drainage authorities throughout the study area the councils should also:

- Require Flood Risk Assessments are prepared for any planning application for developments of 10 dwellings or more or for areas greater than 0.5ha;
- Require that in areas of Flood Zone 1, 2 and 3, the Flood Risk Assessment should focus on the sustainable management of storm water generated by a development, and in doing so have regard to the cumulative impact draining development sites can have on existing infrastructure and flood risk;
- Consult with the Environment Agency and West Wiltshire DC for all planning applications within 20m of the bank of a watercourse;

- Potential artificial flood sources within the vicinity of the site should be considered within a site specific Flood Risk Assessment in order to assess the risk of a failure in containment;
- Consult with the Environment Agency through all stages in the assessment and management of flood risk;
- Consult with the Environment Agency for sites in Flood Zone 1 less than 1ha where located within critical drainage problem areas;
- Engage with developers and local regulators throughout the development process to develop and instigate initiatives for the reduction of flood risk, including consideration of the role development sites could have to alleviate flood risk elsewhere.

10.1.2 Area Specific Strategies

- Surface water flooding should be investigated in detail as part of the Flood Risk Assessment for development within the study area. There should be early liaison with the Environment Agency and West Wiltshire DC for appropriate management techniques.

10.2 Flood Risk Management

Evidence collected through the Level 1 SFRA, which is presented in the Tables in Chapter 4 and the accompanying figures, indicate flood risk throughout the study area is increased by the poor conveyance of structures such as open channels and culverts. Future climate change forecasts will result in increased flooding due to these structures being overwhelmed with flood waters. To mitigate for this West Wiltshire DC should consider the following recommendations:

- Consult with the Environment Agency through all stages in the management of flood risk;
- Protect undeveloped floodplain from future development and where opportunities arise seek to increase the area of floodplain within urban areas, to restore natural river forms and floodplains (through managed reinstatement of floodplain where possible) and in so doing restore river corridors and floodplains as areas of biodiversity and improved amenity value;
- Seek opportunities for developers to contribute to the flood defence of existing developments through commuted sums;
- Development behind flood defences in principle flood risk areas should be controlled to reduce social and economic disruption.

- Routine monitoring of all watercourses should be undertaken to ensure they are clear of debris that could reduce flow conveyance and water quality;
- Agreement on finished floor levels for developments in flood zones 2 and 3 should be sought with the Environment Agency and West Wiltshire DC.
- The provision of safe access, egress and evacuation during the 1 in 100 year event including climate change needs to be agreed with the Environment Agency, West Wiltshire DC and the Emergency Services for developments in flood zones 2 and 3.

10.2.1 Area Specific Strategies

- In Bradford on Avon, where fluvial and surface water flooding can occur, opportunities to direct water away from areas of high social impact should be identified;
- In rural areas upstream of Melksham opportunities should be sought to increase flood storage areas capacity, including an additional storage allowance for increases in flow accounting for climate change;
- The conservation of strategic flood storage areas maintained by West Wiltshire District Council. Opportunities should be sought for maintenance of these areas by developer contribution for the lifetime of the development;
- In Warminster, opportunities should be sought to open culverted watercourses, where possible, to return them to a natural system. When opening up culverted watercourses consideration should be given to ensure flood risk is not exacerbate downstream.

It is recommended that these suggestions are integrated into the forthcoming LDF and LDD policies.

10.3 Sustainable Drainage

Information on Sustainable Drainage Systems (SuDS) is provided in Chapter 9. Sustainable drainage policies should address the following issues:

10.3.1 Catchment Wide Strategies

- SuDS should be included in all new developments to manage flood risk, improve water quality, amenity and biodiversity, unless it is demonstrable that it is not possible to manage surface water using these techniques;
- Runoff rates from new developments on Greenfield sites should not exceed Greenfield runoff rates pre-development and should allow for increased runoff as a result of climate change. Runoff attenuation should be provided through the use of SuDS;

- Runoff rates and volumes from previously developed, developable land should not exceed existing rates of runoff and should seek betterment. In addition, an allowance should be made for climate change;
- Runoff and/or discharge rates should be restricted to Greenfield runoff rates in areas known to have a history of sewer and/or surface water flooding;

The developer should consult the Environment Agency and West Wiltshire DC when considering the design of SuDS.

10.4 Water Resources & Environment

10.4.1 Catchment Wide Strategy

- Development should not have a detrimental impact on the water environment through changes to water chemistry or resource and this should be ensured through the use of drainage systems which limit the occurrence of pollution to the water environment;
- Developments should look to incorporate water re-use and minimisation technology for example green roofs, water butts. This will aid developments in contributing to the Code for Sustainable Homes and will help in adoption of source control SuDS as part of PPS25 requirements;
- Where possible a buffer zone should be maintained adjacent to the river bank (except for access and crossings). This buffer zone will ensure access for maintenance, and ensure a wildlife corridor for improvement of the riverine environment, by allowing natural processes to operate within the floodplain.

11 Site Specific Flood Risk Assessment Guidance

Flood risk is a fundamental consideration for any development project regardless of scale or type. Understanding the flood risk to and arising from a development is essential for managing the risk to people and property reducing the risk of injury, property damage or even death.

Climate change is of particular concern to flood risk. Current predictions suggest the UK will experience milder wetter winters and on average hotter drier summers. This will lead to an increase in rainfall and therefore flood events in winter months and increase the risk of large thunderstorms in the summer months, as well as increasing the unpredictability of our weather.

Flooding is not limited to just rivers, in fact flooding can arise from a number of sources, each presenting their own type of risk and requiring management. In addition some areas currently defended from flooding may be at risk in the future as the effects of climate change take hold or defence condition deteriorates with age.

However, development can work with flood risk if it is accurately understood and managed. Using a sound understanding of flood risk to locate, and design developments enables flood risks to be managed through positive planning. This positive planning needs to consider the risks to a development from local flood sources but also the consequences a development may have on increasing flood risk. Early identification of flood risk constraints can ensure developments maximise development potential whilst achieving the principles of sustainability.

Level 1 SFRAs present sufficient information to assist LPAs to apply the 'Sequential Test' and identify where the Exception Test may be required to be undertaken as part of a Level 2 SFRA. These documents are predominantly based on existing data. However, the scale of assessment undertaken for a Level 1 SFRAs is typically inadequate to accurately assess the risks faced by a particular discrete development at a given location within the study area. In addition, the information presented in the Level 1 SFRA does not necessarily fully address all the flood sources. For example, Flood Zones provided by the Environment Agency are not defined for all watercourses (see Chapter 5).

Therefore, as part of planning applications which come forward in the future for both allocated and non-allocated sites, site specific Flood Risk Assessments will be required to assess the flood risk posed to individual discrete proposed developments and to ensure that where necessary, and appropriate, suitable mitigation measures are included in the development.

This section presents the recommendations for site specific Flood Risk Assessments prepared for submission with planning applications in the West Wiltshire DC administrative area.

The site specific Flood Risk Assessment guidance presented in the following sections has been developed based on:

- The recommendations presented in PPS25 (DCLG, 2006) and the PPS25 Practice Guide (DCLG, 2008);
- A review of local policies and bye-laws throughout the study area; and,
- The information gathered and findings of the Level 1 SFRA process.

11.1 When are Flood Risk Assessments Required?

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

In the following situations a Flood Risk Assessment should always be provided with a planning application:

- The development site is located in Flood Zone 2 or 3;
- Where a residential proposed development comprises 10 or more dwellings and/or the site area is greater than 0.5 hectares (even if the site is located in Flood Zone 1). This is to ensure storm water generated by the site is managed in a sustainable manner and does not increase the burden on existing infrastructure and/or flood risk to neighbouring property;
- Where a non-residential proposed development has a floor area greater than 1000 m^2 or the site area is greater than 1 hectare;
- The development site is located in an area known to have experienced flooding problems from any flood source; and,

In addition a Flood Risk Assessment may also be required:

- Where development is proposed within 20m of any watercourse regardless of Flood Zone classification.

11.2 Flood Risk Assessment Requirements

Annex E of PPS25 (DCLG, 2006) presents the minimum requirements for Flood Risk Assessments. The PPS25 Practice Guide (DCLG, 2008) advocates a staged approach to site specific Flood Risk Assessment with the findings from each stage informing both the next level and the site masterplan, iteratively throughout the development process.

The staged approach comprises:

- Level 1 Screening Study;
- Level 2 Scoping Study;
- Level 3 Detailed Study.

11.2.1 Level 1 - Screening Study

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

11.2.2 Level 2 - Scoping Study

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

11.2.3 Level 3 – Detailed Study

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

Further details of the elements a Level 2 and/or a Level 3 site specific Flood Risk Assessment should consider are presented in Appendix E. This also presents those elements a developer should consider through a Flood Risk Assessment that will have additional and/or strategic benefit to their development and/or surrounding area.

11.3 Flood Risk Assessment Guidance Table

The Flood Risk Assessment Guidance Table (Appendix E) is provided to give guidance to developers and LPAs on the requirements of Flood Risk Assessments for those areas or flood sources for which the Environment Agency is not a statutory consultee.

The Flood Risk Assessment Table (Appendix E) should be used by development control officers and developers to identify the requirements for Flood Risk Assessments and the mitigation measures that may be required for a development to be considered appropriate. Appendix E is intended to be used working from the column on the left through to the column on the right as indicted by the column legend. A summary of the details included in each of the columns is detailed below:

1. The initial column identifies those flooding situations in which the Environment Agency should be consulted.

2. The second column sets out the minimum requirements that the Environment Agency would expect to be presented within a Flood Risk Assessment as part of a planning application for those areas in which they should be consulted.

3. The third column identifies situations where the Environment Agency are not the principal consultee and where the Local Authority would be expected to advise on flood risk (i.e. where the SFRA has identified that an area may be at risk from flood sources other than fluvial). The column provides details on the requirements of Flood Risk Assessments. In areas where a site is also at risk from fluvial sources the Flood Risk Assessment should address the minimum requirements of columns 2 and 3. Column 3 also identifies the mitigation measures that could be incorporated into developments and where these recommendations tie in with other existing policies.

4. Column 4 provides details on specific development locations, and what constraints and issues may be associated with these development locations. Possible mitigation measures / design requirements that could be integrated into such development locations to mitigate flood risk, and tie in with existing policies have also been incorporated.

5. Column 5 provides definitions of terms used in the table.

11.3.1 Risks of Developing in Flood Risk Areas

Developing in flood risk areas can result in significant risk to a development and site users. Through following the advice provided in Appendix E developers and development control officers should identify the minimum requirements for Flood Risk Assessments for a range of flood sources throughout the study area. Failure to follow the recommendations of Appendix E may result in:

- A lack of consideration of wider plans prepared by the Environment Agency or other operating authorities which may result in a proposed scheme being objected to;

- A failure to identify flood risk issues early in a development project which may result in failure of a development proposal, requiring redesign of the site to mitigate flood risk;
- Failure to adequately assess all flood risk sources and design of a development that is safe over its lifetime, which could increase the number of people at risk from flooding and/or increase the risk to existing populations;
- Failure to mitigate the risk arising from development which may lead to claims against the developer if an adverse effect can be demonstrated (i.e. flooding didn't occur prior to development) by neighbouring properties/residents;
- Uninsurable and therefore un-saleable properties if flood risk management is not adequately provided for the lifetime of the development.

12 Emergency Planning

Emergency plans are produced with the aim of establishing clear operating procedures in the event of an emergency. When extreme flood events occur it is essential to have an emergency plan in place to provide clear procedural instructions. The mobilisation and organisation of the emergency services and supporting agencies, for example the County and District Council, is required to rescue, treat and transport potentially large numbers of people. During and after a flood event the role of West Wiltshire DC may include providing transport for the evacuees and safe rest centres to house people in the event of homes being flooded. Further health and welfare issues are inevitable as a result of serious flood event.

Ensuring emergency services are fully aware of their flood risk and the risk around them is fundamental if they are to provide an efficient service to the local population during times of emergency. In addition local authorities should be aware of those services which may be put out of commission during flood events and with the emergency services, develop contingencies to deal with such situations.

12.1 Developing Robust Emergency Plans

The Wiltshire County and Districts Flood Plan (WCDFP) Version 1.5 was compiled in August 2007. This document outlines the responsibilities of the local authorities and provides clear operational procedures in the case of an emergency.

A district level Local Incident Plan (LIP) for each district will form part of the WCDFP when completed. The LIP should include the following information to ensure the development of robust emergency plans in the event of a serve flood event:

- Where to coordinate / focus efforts during a flood;
- Which routes are likely to be affected during a flood;
- Which facilities can be used to accommodate evacuated residents.

The suggested methodology for establishing an understanding of the above questions and others for the development of a robust Emergency Plan is to map vulnerable and essential services and infrastructure with flood risk. From this mapping local authorities, emergency services and county councils should review the data and develop understandings of the implications of a flood event and the limitations that may be placed on during a flood.

The minimum suggested installations that should be mapped include -

- Police Stations;
- Ambulance Stations;

- Fire Stations;
- Command Centres;
- Telecommunications installations required to be operational during flooding; and,
- Emergency dispersal points.

Other installations may include those electricity supplies (sub-stations) required for the operation of emergency services.

In addition to the above emergency services mapping should also include those institutions most vulnerable during flood events. This may include (but not necessarily limited to):

- Hospitals;
- Residential institutions such as residential care homes, childrens homes, social services homes, prisons and hostels;
- Student halls of residence; and,
- Non-residential uses for health service, nurseries and educational establishments.

Once mapped, this information should be used to promote dialogue with key stakeholders, likely to be involved during flood events or essential to maintaining a standard of service and to establish the provisions they have in place to manage flood events. This may include:

- Review and or establishing the contingencies in place for any essential emergency infrastructure and ensuring this information is worked into the LIP, for example in the event that a fire station is flooded, how will the fire service manage this and continue to provide an appropriate level of service; and,
- Establishing the standards of protection present at key service and infrastructure sites such as strategic power supply, telecommunications, command centres, water supply and sewerage supply and the risks associated with defending these installations. For example, flood defence may be available but require the transport of the defence system (such as demountable barriers or sand bags), this should be understood and the risks associated with transportation during flood events considered.

13 Recommendations

13.1 The Next Stage

13.1.1 Planning Policy

Based on the information presented in this Level 1 SFRA and the accompanying GIS layers, West Wiltshire DC have sufficient information to apply the PPS25 Sequential Test to their development sites, seeking to guide development to areas of lowest flood risk wherever possible.

Where there are insufficient sites in Flood Zone 1 to accommodate the required growth, consideration should be given to the vulnerability classification of the development to ensure that it is located in an area of acceptable risk as defined in PPS25 (DCLG, 2006). In some cases this may require application of the Exception Test.

Where application of the Exception Test is required it will be necessary to undertake a Level 2 SFRA. The scope of the Level 2 SFRA consists of a more detailed assessment of the flood hazard to the development, which includes considering the following:

- Flood probability;
- Flood depth;
- Flood velocity; and,
- Rate of onset of flooding.

This will allow informed decisions to be made regarding the safety of the development.

Where the Exception Test is required for a development, hydraulic modelling is normally required to define the above flood characteristics. Therefore in the absence of existing detailed hydraulic modelling additional modelling may be needed.

Until West Wiltshire DC have undertaken the Sequential Test it is not possible to determine the requirements and scope of the Level 2 SFRA.

In addition, West Wiltshire DC should assess allocation sites in relation to geology, soils and local issues when considering the use of SuDS as detailed in Chapter 9 and seek to incorporate the recommended policies in Chapter 10 into their emerging LDF.

13.1.2 Development Control

Development Control Officers within the LPAs should familiarise themselves with the Level 1 SFRA and ensure that Flood Risk Assessments are provided where necessary and prepared against the recommendations presented in Appendix E.

13.2 Further Work

13.2.1 Data Collection

Through the preparation of this Level 1 Strategic Flood Risk Assessment, obtaining suitable data on which to determine flooding probabilities for all sources of flood risk in the study area has been problematic. Whilst detailed assessments can overcome many of these difficulties, more robust recording of flood events will be of considerable benefit in future updates of the SFRA and enable calibration of modelled data, reducing uncertainty.

West Wiltshire DC should develop a database to record flood events that occur within their administrative area, this should be recorded on a GIS system and include (as a minimum) information on:

- The date of the flood event;
- The location of the flood event;
- Properties affected by the flood;
- The extent of the flood event (mapped);
- The cause (source) of the flooding.

13.2.2 Emergency Planning

West Wiltshire DC should use the findings of this Level 1 SFRA to refine and inform emergency plans developed for the area. This should include liaison with local emergency services to share and discuss the available data and its implications for emergency planning.

13.3 When should the SFRA be updated?

PPS25 (DCLG, 2006) and the Environment Agency intend for SFRAs to be living documents, updated as new data is available. As new sources of data become available, West Wiltshire DC should liaise with the Environment Agency to determine a suitable period for review and update of the SFRA that is acceptable to all parties. This may include consideration of:

- New climate change updates;
- Modelling result updates;
- Development of new flood alleviation measures;
- New model data;
- Issue of new guidance documentation;

- Development of all allocations;
- BREEAM Guidelines on the Code for Sustainable Homes;
- The Groundwater Daughter Directive;
- The Water Framework Directive;
- Proposed large scale flood alleviation works.

13.3.1 EU Flooding Directive

In addition to the above considerations the integration of the EU Flooding Directive may also form a reason for revisiting the SFRA. Work on The EU Flooding Directive is progressing steadily. The Flooding Directive will create a mandatory statutory framework for flood risk management, requiring Member States to prepare preliminary risk assessments, flood mapping, and the preparation of flood risk management plans. It applies to all types of flooding, although inclusion of sewerage floods will be optional. It is likely that the plans required by the Directive will be developed for the River Basin Districts defined for the Water Framework Directive

Member States will designate competent authorities to implement the Directive; for England, this will be the Environment Agency. Whilst the final requirements of the Flooding Directive are still to be finalised, the Environment Agency hope to achieve the requirements of the Directive through the use of existing published information. This may include reference or use of Strategic Flood Risk Assessments, Catchment Flood Management Plans and/or Strategic Flood Risk mapping projects. In some cases the assessments may require new information to be generated to inform the stages of assessment required by the Directive.

The EU Flooding Directive is not due to be integrated into English law until 2009. The preparation or finalisation of Preliminary Risk Assessments, required by the Directive, may form a useful point in time to review the SFRA and assess its contribution to the Flooding Directives requirements or where an update to the SFRA may benefit from new data generated as part of assessments prepared to meet the requirements of the Flooding Directive.

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Figures