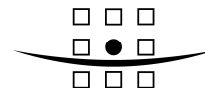


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EXECUTIVE SUMMARY

Study Objectives

This Level 1 Strategic Flood Risk Assessment (SFRA) for the Wyre Forest District Council (the Council) has been undertaken to provide a robust assessment of the extent and nature of the risk of flooding and its implications for land use planning. In addition, the SFRA sets the criteria for the submission of planning applications in the future and for guiding subsequent development control decisions. The key objectives of the study are to:

- Provide a reference and policy document to inform preparation of the Local Development Framework (LDF) for the District;
- Ensure that the Council meets its obligations under the Department of Communities and Local Government's (DCLG's) Planning Policy Statement 25 "Development and Flood Risk"; and
- Provide a reference and policy document to advise and inform private and commercial developers of their obligations under PPS25.

An increased scope Level 2 SFRA as per paragraph E6 of PPS25 will be required to facilitate possible application of Exception Test and to address significant flood risk issues within the District, prior to the submission of emerging LDF documents. This more detailed SFRA should consider the detailed nature of the flood hazard by building upon the findings of this Level 1 SFRA and by fully taking account of the presence of flood management measures through further detailed hydraulic modeling.

Outputs

The principal output from the study is a set of maps, which categorises the District into Flood Zones according to PPS25. It depicts the presence of flood defences where they exist. These maps have been produced adopting a robust assessment to give the Council sufficient information so as to have an overall view of flood risk areas for strategic planning purposes.

The maps and this accompanying report and guidance will provide a sound framework enabling consistent and sustainable decisions to be made when making future planning decisions. Methods of assessment and limitations of the SFRA outputs, including further recommendations to address them, are also presented. The Level 1 SFRA evaluates the present-day (year 2007) situation and the situation after 80 years time (year 2087) with increased peak flood flows to allow for projected climate change.

Figure 1 presents the study area and shows the main rivers within the District. The SFRA has considered all sources of flooding within the District, as explained in this report and related figures.

Data Sources

Appendix D documents the data that was made available for the study.

Co-operation

The SFRA was carried out for the Council with the co-operation and support of the Environment Agency, Severn Trent Water, British Waterways and local consultees.

GLOSSARY

Attenuation	To reduce the peak flow and increase the duration of a flood event.
Basin	A ground depression acting as a flow control or water treatment structure that normally is dry and has a proper outfall, but which is designed to detain stormwater temporarily.
Brownfield site	Any land or site that has been previously developed.
Catchment	The area contributing flow or <i>runoff</i> to a particular point on a watercourse.
Catchment Flood Management Plan (CFMP)	A strategic planning tool through which the Environment Agency seeks to work with other key decision-makers within a river catchment to identify and agree policies for sustainable flood risk management.
Climate change	Long-term variations in global temperature and weather patterns both natural and as a result of human activity, primarily greenhouse gas emissions.
Critical ordinary watercourse	An <i>Ordinary watercourse</i> which the Environment Agency and other operating authorities agree is critical because it has the potential to put at risk from flooding large numbers of people and property.
Culvert	Covered channel or pipe that forms a <i>watercourse</i> below ground level.
Design flood level	The maximum estimated water level during the <i>design event</i> .
Development	The carrying out of building, engineering, mining or other operations in, on, over or under land or the making of any material change in the use of any buildings or other land.
Discharge	Rate of flow of water.
Enmained	The process of transferring responsibility of a watercourse to the Department for Environment, Food and Rural Affairs (DEFRA), i.e. becoming part of the Main River system.
Flood defence	Flood defence infrastructure, such as flood walls and embankments, intended to protect an area against flooding, to a specified <i>standard of protection</i> .
Flood event	A flooding incident characterised by its level or <i>flow hydrograph</i> .

Flood probability	The estimated probability of a flood of given magnitude occurring or being exceeded in any specified time period. See also <i>annual flood probability</i> .
Flood risk	An expression of the combination of the <i>flood probability</i> and the magnitude of the potential consequences of the <i>flood event</i> .
Flood risk assessment	A study to assess the risk of a site or area flooding, and to assess the impact that any changes or development in the site or area will have on <i>flood risk</i> .
Flood storage	The temporary storage of excess runoff or river flow in ponds, basins, reservoirs or on the <i>floodplain</i> during a flood event.
Flood Zones	Flood Zones are defined in Table D.1 of Planning Policy Statement (PPS) 25: Development and Flood Risk. They indicate land at risk by referring to the probability of flooding from river and sea, ignoring the presence of defences. The fluvial Flood Zones are usually derived using a two-dimensional hydraulic model called JFLOW, into which a national coarse Digital Terrain Model is fed. However, in some instances, more detailed modelling can be undertaken, using refined information.
Floodplain	Area of land that borders a watercourse, an estuary or the sea, over which water flows in time of flood, or would flow but for the presence of flood defences where they exist.
Fluvial flooding	Flooding from a river or other <i>watercourse</i> .
Freeboard	The difference between the <i>flood defence crest level</i> and the <i>design flood level</i> .
Functional floodplain	Land where water has to flow or be stored in times of flood. It includes the land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes.
Groundwater	Water in the ground, usually referring to water in the saturated zone below the <i>water table</i> .
Groundwater flooding	Flooding caused by <i>groundwater</i> escaping from the ground when the <i>water table</i> rises to or above ground level.
Highway authority	A local authority with responsibility for the maintenance and drainage of highways maintainable at public expense.
Hydrograph	A graph that shows the variation with time of the level or

discharge in a *watercourse*.

Impermeable surface	An artificial non-porous surface that generates a surface water <i>runoff</i> after rainfall.
Local Development Documents	Documents that set out the spatial strategy for local planning authorities which comprise development plan documents.
Local Development Framework	Framework which forms part of the statutory development plan and supplementary planning documents which expand policies in a development plan document or provide additional detail.
Local planning authority	Body responsible for planning and controlling development, through the planning system.
Main River	A watercourse designated on a statutory map of Main rivers, maintained by Department for Environment, Food and Rural Affairs (DEFRA).
Material consideration	Matters which need to be taken into account by a planning authority when determining an application for planning permission.
Mitigation measure	A generic term used in this guide to refer to an element of <i>development</i> design which may be used to manage <i>flood risk</i> to the <i>development</i> , or to avoid an increase in <i>flood risk</i> elsewhere.
Ordinary watercourse	A watercourse which is not a private drain and is not designated a <i>Main river</i> .
Overland flow flooding	Flooding caused by surface water <i>runoff</i> when rainfall intensity exceeds the infiltration capacity of the ground, or when the soil is so saturated that it cannot accept any more water.
Permeable surface	A surface that is formed of material that is itself impervious to water but, by virtue of voids formed through the surface, allows infiltration of water to the sub-base – for example, concrete block paving.
Pond	Permanently wet depression designed to retain stormwater above the permanent pool and permit settlement of suspended solids and biological removal of pollutants.
Return period	A term sometimes used to express <i>flood probability</i> . It refers to the estimated average time gap between floods of a given magnitude, but as such floods are likely to occur very irregularly, an expression of the <i>annual flood probability</i> is to

be preferred.

River flooding	<i>See fluvial flooding.</i>
Runoff	Water flow over the ground surface to the drainage system. This occurs if the ground is impermeable or saturated, or if rainfall is particularly intense.
Sequential test	A risk-based approach to <i>flood risk assessment</i> in accordance with Planning Policy Statement 25, applied through the use of flood risk zoning, where the type of <i>development</i> that is acceptable in a given zone is dependent on the assessed <i>flood risk</i> of that zone and <i>flood vulnerability</i> of the proposed development.
Standard of protection	The estimated probability of a <i>design event</i> occurring, or being exceeded, in any year. Thus it is the estimated probability of an event occurring which is more severe than those against which an area is protected by <i>flood defences</i> .
Strategic flood risk assessment	A study to examine <i>flood risk</i> issues on a sub-regional scale, typically for a river <i>catchment</i> or local authority area during the preparation of a development plan.
Sustainable drainage systems (SUDS)	A sequence of management practices and control structures, often referred to as SUDS, designed to drain surface water in a more sustainable manner. Typically, these techniques are used to attenuate rates of <i>runoff</i> from <i>development sites</i> .
Watercourse	Any natural or artificial channel that conveys surface water.
Wetlands	An area where saturation or repeated inundation of water is the determining factor in the nature of the plants and animals living there.

ABBREVIATIONS

AOD	Above Ordnance Datum
CFMP	Catchment Flood Management Plan
CLG	Communities and Local Government
COW	Critical Ordinary Watercourse
DEFRA	Department for Environment, Food and Rural Affairs
DTM	Digital Terrain Model
EA	Environment Agency
FAS	Flood Alleviation Scheme
FEH	Flood Estimation Handbook
FRA	Flood Risk Assessment
FZ	Flood Zone
GIS	Geographical Information System
LDD	Local Development Documents
LDF	Local Development Framework
LiDAR	Light Detection And Ranging
LPA	Local Planning Authority
NFCDD	National Flood and Coastal Defence Database
Ofwat	Office of Water Services
OS	Ordnance Survey
PBA	Peter Brett Associates
PPS25	Planning Policy Statement 25 – Development and Flood Risk
RFRA	Regional Flood Risk Assessment
RSS	Regional Spatial Strategy
SA	Sustainability Appraisal
SFRA	Strategic Flood Risk Assessment
SoP	Standard of Protection
SUDS	Sustainable Drainage Systems

1 BACKGROUND

1.1 General Overview

In August 2007 Royal Haskoning was appointed by the Wyre Forest District Council (hereafter “the Council”) to produce a Strategic Flood Risk Assessment (SFRA).

1.2 Scope

The scope for this SFRA is in accordance with PPS25 guidelines (Communities and Local Government, 2006, Planning Policy Statement 25: Development and Flood Risk), Development and Flood Risk a Practice Guide Companion to PPS25, “Living Draft”, and Royal Haskoning’s proposal dated 18th July 2007.

The Council is in the process of preparing its Local Development Framework (LDF) as required by the Planning and Compulsory Purchase Act 2004. It is expected that the Regional Spatial Strategy (RSS) for the West Midlands will require the provision of housing and employment growth. This will require the uptake of land in the District, which will need to be informed by the most accurate picture of flood risk possible to enable development to be sited in appropriate locations minimising damage to property and threat to life. Flood risk is a key consideration in the allocation of land for development especially with the current concerns of climate change.

The key aims of the Level 1 SFRA are to broadly assess all sources of flooding and the other key flood risk considerations expected by PPS25 across the entire Council’s area.

Royal Haskoning produced this Level 1 report in close consultation with the Council and the Environment Agency. Input to the SFRA was also provided by Severn Trent Water, British Waterways, the Highways Agency and other local consultees.

1.3 Study Area

Wyre Forest District is situated in North West Worcestershire and lies to the south west of the West Midlands conurbation. It covers an area of 75 square miles. In 2001 the population totaled 96,945 (2001 census) with 55,182 living in the principal town of Kidderminster. The three towns of Kidderminster, Bewdley and Stourport-on-Severn form a central triangle with the District and are surrounded by a number of outlying villages and hamlets.

The principal town of Kidderminster is located along the River Stour, which flows through the main town centre. The Staffordshire and Worcestershire Canal follows approximately the same route as the River Stour. Consequently there are a number of developed areas that exist within the floodplain, giving rise to concern over flooding.

Stourport-on-Severn, the second largest settlement, is affected by a number of watercourses. Most notable is the River Severn which flows to the South of the main town. The River Stour, one of the River Severn’s tributaries, joins the Severn at Stourport. Additionally, the Staffordshire and Worcestershire Canal terminates in Stourport and consequently there are a number of canal basins located near to the town centre.

Bewdley, the third main settlement, has historically suffered from large flooding events. This is due to the proximity and relationship of the town to the River Severn. Bewdley has recently benefited from multi-million pound flood defences along Severnside North and South, which indicates the pressures from flooding experienced within the town.

The District also has a network of streams, pools and brooks which all have the potential to cause flooding. There is a large water supply reservoir located at Trimpley, which is situated to the north of Bewdley and in close proximity to the River Severn.

Figure 1 shows the Wyre Forest District boundary and includes key features such as main towns, villages, watercourses, roads and railways.

The Wyre Forest is bounded by six planning authority areas:

- Bridgnorth District;
- South Staffordshire District;
- Bromsgrove District Council;
- Wychavon District Council;
- Malvern Hills District; and
- South Shropshire District

1.4 Data Used

The data used in the study derives from several sources, most notably the Environment Agency and the Council. The data register provided in **Appendix D** was prepared in accordance with Royal Haskoning's quality management system.

The key types of data obtained include:

- OS background mapping;
- Topographic survey – LiDAR, ground surveys and watercourse surveys;
- National Flood Zones and historic flooding records from all sources of flooding ;
- Flood defences, structures and flood alleviation measures;
- Flood risk studies and modelling reports;
- Catchment Flood Management Plan;
- Flood warning and Flood watch areas;
- Local plan and LDF documents and development proposals; and
- Guidance on flood risk management.

1.5 Limitations and Assumptions

The conclusions of this SFRA are based on information currently available. The areas of the proposed potential development sites are indicative only. The final sites will be subject to the outcome of ongoing studies commissioned by the Council that will provide the evidence base for the emerging Local Development Framework.

The Level 1 SFRA maps (1 in 10,000 scale) for the entire Wyre Forest District are based on the Environment Agency's latest released Flood Zone information, (September 2007).

2 CATCHMENT DESCRIPTION AND CAUSES OF FLOODING

2.1 Catchment Description

2.1.1 General

Figure 2 illustrates the river system within the Wyre Forest District which largely falls within the following two Main River catchments:

- River Severn; and
- River Stour.

2.1.2 River Severn Catchment

River Severn

The River Severn flows in a southerly direction through the District, and passes through the towns of Bewdley and Stourport-on-Severn. The River Severn rises in the Welsh Hills at Plynlimon, Powys and by Bewdley drains a catchment area of over 4,300 km². Through Bewdley it carries extreme flows of approximately 720m³/s in a 1 in 100 year event, (River Severn Strategy model). Due to the size of the catchment and the length of the watercourse, the critical storm duration for the River Severn is very long, approximately six days, which allows sufficient flood warning time to make temporary and demountable defences a viable option for flood defence.

The main tributaries of the River Severn within the Wyre Forest District are Dowles Brook, Snuffmill Brook, Riddings Brook, Burnthorpe Brook and the River Stour. Dick Brook and Gladder Book rise within the District and flow in a South Easterly direction before joining the River Severn to the South of the District.

Dowles Brook

- Flows in an easterly direction through the Wyre Forest and joins the River Severn at Dowles, just upstream of Bewdley.
- Due to the heavily afforested catchment channel maintenance is a key issue in respect to flood risk.

Snuffmill Brook

- Small tributary flowing in an easterly direction through the centre of Bewdley.
- The Brook flows through a number of on-line fishing ponds and lakes upstream of the town.
- The watercourse flows in an antiquated and poorly maintained culvert beneath back gardens and properties.

Riddings Brook

- This watercourse flows in a westerly direction in a culvert through the Wribbenhall housing estate.
- Following severe flooding in the summer of 2007 works have been carried out at the headwall to the culvert.

Burnthorpe Brook

- Small watercourse entering the River Severn at the western fringe of Stourport-on-Severn.
- Clearly defined incised valley with no adjacent development

Dick Brook

- This rural watercourse rises from the hills in the West of the District to the North of the village of Rock.
- Significant flood risk arises from this watercourse as observed in the summer of 2007. Flood risk is exacerbated by the risk of blockage due to the highly vegetated valley. The storms of 2007 resulted in the formation of a series of “dams” caused by channel blockage, which caused water to back-up to significant depths before breaking through to the next blockage.

Gladder Brook

- Rural watercourse which rises to the North of Dick Brook.
- Gladder Brook flows in a South Westerly direction before joining the River Severn to the South of the District.

River Stour

- Described in Section 2.1.3 below.

2.1.3 River Stour Catchment

The River Stour passes through the urban areas of Cookley, Wolverley and Kidderminster before discharging to the River Severn at Stourport-on-Severn.

At the confluence with the River Severn the River Stour drains a catchment area of approximately 370 km². The 1 in 100 year return period flow is 33 m³/s (CEH dataset). Kidderminster is currently protected to a 1 in 100 year standard by an online flood alleviation scheme, which was completed in 2003. The scheme operates by storing floodwater on Puxton Marshes. Flows are controlled by a concrete culvert through the dam structure, which limits the flows through the structure to a flow that can be accommodated within bank through Kidderminster town centre.

The main tributaries of the River Stour are Drakelow Brook (Hors Brook), Honey Brook, Blakedown Brook, Blake Brook and Hoo Brook.

Drakelow Brook / Hors Brook

- Drakelow Brook (Hors Brook) drains an area in the north of the District, which includes the settlements of Kingsford, Shatterford and Drakelow.
- The Drakelow Brook joins the River Stour at Wolverley.

Honey Brook

- The Honey Brook drains a predominantly rural catchment to the northwest of Kidderminster.
- The Honey Brook flows between Fairfield and Franche before entering the River Stour.

Blakedown Brook

- The Blakedown Brook drains an area of over 30 km², which includes much of the eastern side of the District.
- The Blakedown Brook and a number of its tributaries flow through the villages of Broome, Churchill, Blakedown and Hurcott, before discharging into the River Stour at Broadwaters.
- There are a number of online lakes and pools, including the Ladies Pool, Swan Pool, Mill Pool, Hurcott Pool and Podmore Pool. These lakes afford a degree of attenuation to flood flows.

Blake Brook

- The Blake Brook flows in a heavily urbanised catchment, where much of the inflow is received from surface water drainage.
- The Blake Brook is culverted for a significant reach beneath the Blakebrook area.

Hoo Brook

- The Hoo Brook enters the River Stour from the east of the District.
- The Brook flows through the settlements of Hillpool, Stone and adjacent to the Spennells housing estate.
- The Brook is also fed by a smaller tributary which drains from Stanklyn Pool and Captain's Pool.

2.1.4 Staffordshire and Worcestershire Canal

The Staffordshire and Worcestershire Canal runs parallel with the River Stour throughout the District, to its outfall into the River Severn via the Stourport Basin at Stourport-on-Severn. There are a number of lock structures along the course of the Canal through the District as listed below:

- Debdale Lock (Cookley)
- Wolverley Lock (Wolverley)
- Wolverley Court Lock (Wolverley)
- Kidderminster Lock (Kidderminster)
- Cauldwell Lock (Kidderminster)
- Falling Sands Lock (Kidderminster)
- Yorkstreet Lock (Stourport-on-Severn)
- Stourport Narrow Locks x2 (Stourport-on-Severn)

As well as a navigation function, the lock structures also serve to regulate water levels. This is achieved through a series of fixed and manually operated sluices and weirs, which

aim to maintain a freeboard of 300mm. Even during flood events, the canal system deals well with flows derived from the small catchments and feeder streams draining directly to it. However, as observed during the summer of 2007, problems occur when the system is overloaded with river water from the River Stour. This is discussed further in Section 3.1.6.

2.2 Causes of Flooding

The possible causes of flooding within the Wyre Forest District include:

- i. Overflow of watercourses and existing flood defences including water retention facilities such as flood storage reservoirs/washlands and storm water balancing ponds;
- ii. Breaching of flood defences (including flood storage areas);
- iii. Mechanical, structural or operational failure (including due to blockages) of hydraulic structures, pumps etc;
- iv. Localised surface water flooding (including sewer flooding, highway drainage flooding and overland flooding);
- v. Manmade waterways such as reservoirs and canals;
- vi. Functional Floodplains or Washlands; and
- vii. Groundwater flooding.

3 DATA COLLECTION AND REVIEW

3.1 Historic Flooding

3.1.1 General

Historical flood information from all sources of flooding has been collected from the Environment Agency, Council, Severn Trent Water, Highways Agency, British Waterways and local flood groups.

Historically, the key source of flooding within the District was from the Environment Agency's Main River network shown in **Figure 2**. However, the flooding that occurred as a result of the June and July 2007 events was attributable to drainage problems and flash flooding from the smaller tributaries, a number of which have not been enmained.

Figure 3 indicates the locations that are known to have flooded from all forms of flooding within the District. **Tables B1 to B4** in **Appendix B** summarise the different historic flood events including an indication of causes of flooding (if known). For ease of reference, each event has a unique identification number ("ID") enabling cross reference with **Figure 3**.

Whereas a single incident of Main River flooding has the potential to cause disruption to a large number of properties, very heavy rainfall within the District has the potential to result in large numbers of individual local floods. Surface water run-off management in the entire District therefore remains an important issue for all developments which highlight the need for Sustainable Drainage Systems (SUDS) thereby maximising the use of source control measures.

3.1.2 Flooding from Watercourses

Appendix B indicates that the River Severn and River Stour have caused a long history of flooding within the District. The highest observed flood levels occurred during the event in 1947. On the River Severn at Bewdley the 1947 event reached a level of 22.82m AOD.

However, the recent flooding events that occurred in the summer of 2007 derived principally from non-main river sources. In Bewdley, the Riddings Brook (recently enmained) and the Snuffmill Brook, experienced problems due to the surcharging of culvert entrances.

3.1.3 Sewer flooding

Severn Trent Water was consulted and asked to provide information on previous sewer flooding and those areas deemed to be at potential risk.

There are a number of properties on Severn Trent Water's "At Risk Flooding Register", which Severn Trent Water uses to capture reported incidents of sewer flooding within their area. Those properties affected by sewer flooding are reported to the Office of Water Services (Ofwat) as part of Director General Performance Measure 5 (known as DG5).

DG5 is the performance measure that Ofwat judges water companies by for sewer flooding. It covers two measures:

- The number of properties at risk of internal flooding from sewers due to hydraulic overloading within the last ten years; and
- Properties which are internally flooded. Sewer flooding can be caused by temporary problems, such as blockages or sewer collapses, or because of hydraulic overloading.

The locations of previously flooded properties are covered by the Data Protection Act. For this reason Severn Trent Water was unable to supply a map indicating properties at risk of sewer flooding but they agreed to supply this information in an alternative less detailed format such as truncated post codes. This makes it possible to broadly identify where sewer flooding occurred.

Figure 3 includes the locations that have been subject to some localised surface sewer flooding according to the information released by Severn Trent Water.

3.1.4 Highway drainage and overland flooding

The Highways Agency were consulted and asked to provide information on highway flooding related incidents. The Highways Agency is responsible for the maintenance of the A456 and A449 and provided records of flooding (2003 to 2007) associated with these two roads.

The Council identified a number of locations where flooding was attributable to problems associated with surface water flooding due to inadequate road drainage.

3.1.5 Groundwater flooding

The Environment Agency confirmed that they are not aware of any specific incidences of groundwater flooding within the District.

However, it should be noted that areas such as the Riddings Brook catchment and the low-lying areas of Wolverley are known to be very “marshy” due to the high levels of the watertable, which could potentially exacerbate surface flooding problems.

3.1.6 Canal Flooding

British Waterways were consulted in order to gain an understanding of the flood risk arising from the Staffordshire and Worcestershire Canal. The canal system is effectively self-regulating, with water levels controlled through a system of sluices and weirs, with the aim of maintaining a freeboard of 300mm. In isolation, the canal system operates effectively, and is able to accommodate the flows that enter it from feeder streams and its own small catchment areas.

However, as evidenced in the events of June and July 2007, problems arise when the River Stour interacts with the canal system. When river levels in the Stour exceed the bank heights of the canal, water enters the canal system and quickly uses the storage afforded by the available freeboard. The canal then acts as a conduit to flood water, passing flood water downstream. This situation was observed in the summer of 2007, when levels in the River Stour at Kinver, just north of the Wyre Forest District boundary, exceeded the towpath level of the canal. The canal was unable to cope with the additional flux of water resulting in bank failure and ultimately property flooding at Whittington (outside the District).

Further downstream, within the District, problems were encountered at Kidderminster Lock, where the towpath was completely flooded. River water also entered the canal system upstream of Falling Sands Lock, resulting in damage to the lock structure. Additional water was also passed downstream to Stourport, where a lock structure was overtopped. The threat of flooding was alleviated by opening the sluices to the River Severn.

3.1.7 Trimpley Reservoir

Severn Trent Water's Trimpley Reservoir is located approximately 3km north of Bewdley on the left bank of the River Severn. The reservoir is separated from the River Severn by a dam structure. Dam failure would therefore potentially result in the rapid release of a large volume of water to the River Severn. Such an event could have significant consequences in terms of flood risk to properties downstream in Bewdley.

However, it should be noted that the operation of reservoirs is strictly managed. Legislation has been in place since the 1930s when a dam failure resulted in the loss of life. This early legislation was updated by the Reservoirs Act 1975. Reservoir owners have ultimate responsibility for the safety of their reservoirs. The Environment Agency has the role of enforcing the Reservoirs Act 1975. The Reservoir Act 1975 places a demand on the reservoir owner to appoint a Panel Engineer to supervise and inspect the operation and management of the reservoir.

3.2 Topographical Data

The Environment Agency has LiDAR (Light Detection And Ranging) for the entire District with the exception of an area in the west covering the Wyre Forest. The Environment Agency also has several watercourse surveys as shown in **Appendix C**. The Council can obtain this information from the Environment Agency for producing the Level 2 SFRA at a future date as necessary.

The LiDAR spatial resolution in this area is 2m. Taken together with the generally accepted vertical accuracy of $\pm 11\text{cm}$ to 25cm, this indicates that in the areas covered by the LiDAR data would provide a good representation of ground surface for the required flood risk mapping where modifications to the current Flood Zones are required.

Figure 4 shows the extent of LiDAR currently available within the District.

3.2.1 Existing Studies and Hydraulic Models

Appendix C summarises the hydraulic models that have been undertaken for watercourses within the District. The extents of the models are also presented in **Figure 5**.

3.3 Land at Flood Risk

The sources of flooding and historic flooding information are identified above. **Figure 6** shows the Environment Agency's Flood Zones and the proposed development sites within the District. **Figure 6** also shows the Functional Floodplain (Flood Zone 3b) where defined as part of this SFRA. Further details on the definition of Flood Zone 3b is given in Section 4.3.2. The land at risk of flooding shown in this figure should also be considered in conjunction with historic flooding information given in **Figure 3** and Section 3.1.

The land at risk is depicted in terms of the Flood Zones and the locations known to have experienced flooding problems in the past. This includes the floodplain of the Rivers Severn and Stour including their Main River tributaries. Table D.1 and Table D.2 of PPS25 define the Environment Agency's Flood Zones and provide flood risk vulnerability classification, including policy aims and Flood Risk Assessment (FRA) requirements.

A review of the Flood Zones has identified a number of locations in which the Flood Zone is not aligned with the centreline of the watercourse. Such misalignments are a result of the methodology employed by the JFLOW modelling software. **Figure 3** categorises the misalignments into "major" and "minor". Misalignments are considered to be minor where the Flood Zone does not affect properties or residential areas. Two, major misalignments have been identified, one at the Spennels housing estate and the second in Blakedown.

It was agreed with the Council and the Environment Agency that these misalignments would not be corrected for the purposes of the Level 1 SFRA. However, it was considered necessary to address these errors at a later date, either as part of the Level 2 SFRA, a detailed FRA or as part of the Environment Agency's National Flood Risk Mapping programme.

3.4 Existing Flood Management Measures

3.4.1 General

Figure 7 identifies the key flood risk management structures within the District, which comprise:

- Raised flood embankments and flood walls; and
- Designated flood storage areas/ washlands;

The Environment Agency has the responsibility for looking after the formal defences that are owned by them. In addition to inspection and routine maintenance of their formal defences and other structures, the Environment Agency carries out the routine maintenance, such as bank clearance or in-channel work to remove weed growth and silt, and non-routine maintenance (e.g. removal of blockages) of the designated main rivers.

The maintenance and operation of all key hydraulic structures including flood defences has a significant impact upon flood risk management and it is therefore critical to identify the owners as well as the condition of such structures during a Level 2 SFRA.

A brief description of the existing flood risk management measures managed by various organisations is given below.

3.4.2 Environment Agency

River Stour

As can be seen from **Figure 7** Kidderminster is protected by a flood alleviation scheme, which was completed in 2003. The scheme comprises a concrete culvert which serves to limit the flow of the River Stour through a dam structure, causing flood water to back up on the Puxton Marshes. The flood alleviation scheme also includes channel improvements downstream through Kidderminster.

The flood alleviation scheme was observed to operate effectively during event on the 21st and 22nd July 2007.

River Severn

The town of Bewdley is protected from flooding from the River Severn through a combination of walls through the town and the operation of temporary and demountable flood defences. The nature of flooding from the River Severn at Bewdley is such that adequate warning is given in order to deploy the flood defences.

3.4.3 Council

At present, the Council does not maintain any raised defences within the District other than fulfilling general drainage aspects of non-main river watercourses and associated surface water balancing features.

3.5 Flood Warning and Emergency Response

3.5.1 Flood Warning

Within the Wyre Forest District, as elsewhere in England, the responsibility for flood warning rests primarily within the Environment Agency. It provides flood warnings for designated Flood Warning Areas that are based on risk categories, which take into account factors such as the likelihood and impact of flooding, and the resulting risk for each area. The Environment Agency has supplied the details of present flood warning arrangements for the District. However, the Environment Agency continuously updates its flood warning system and therefore the relevant Agency Area staff should be contacted for the latest information.

Currently flood warnings only cover the River Severn and the River Stour and not their respective tributaries.

3.5.2 Warning Dissemination

Flood Warnings are disseminated by the Environment Agency via a system known as Floodline Warning's Direct. The service is a free flood warning service that provides warnings direct to customers 24 hours a day by telephone, mobile, fax or pager. It replaces the older Automatic Voice Messaging System which was used to send out flood warnings direct to the public since 1996. The message details the level of warning issued, the area for which the warning is in force and advice on what action to take. As flood events develop the public is encouraged to phone Floodline for updates. This system requires residents of "at risk property" to register their telephone numbers with the Environment Agency. Concerned parties are able to obtain current flood warning information according to a particular river or Flood Warning Risk Area.

Other current methods of warning dissemination include:

- The media – warnings are issued through the media; they are broadcast on TV weather bulletins and on radio weather and travel reports. Flood warnings are also displayed on ITV Teletext regional weather pages (page 154) and on the BBC Ceefax (page 419).

- **Floodline 0845 988 1188** – offers callers the option to listen to recorded flood warning information 24 hours a day and speak to a trained operator for more advice.
- Internet – The EA’s website **www.environment-agency.gov.uk/flood** contains live warning information.

If anyone has not currently registered their phone number but is at risk of flooding, they should consider contacting the Environment Agency.

The EA issues flood warnings using a set of four easily recognisable codes which include:

- **Flood Watch**, where flooding of low-lying land and roads is possible;
- **Flood Warning**, where flooding of homes, businesses and main roads is expected;
- **Severe Flood Warning**, where severe flooding is expected. Extreme danger to life and property; and
- **All Clear**, where flood watches or warnings are no longer in force.

A **Flood Watch** would be issued when water levels along the river are forecast to cause out-of-bank flooding of low-lying land and roads.

A **Flood Warning** is issued when the Environment Agency anticipate flooding to property. The trigger levels currently set for this are based on the levels of permanent dwellings.

The trigger for issue of a **Severe Flood Warning** is dependent on a number of factors, but is essentially used when there is thought to be extreme danger to life.

The Environment Agency generally aims to give a two-hour lead time for all of the above levels of warning prior to any properties being flooded. However in certain cases of severe or “flash flooding” this may not always be possible. The Environment Agency can not provide flood warnings for surface water, road drains, sewer flooding and burst drains. The information on these will come from the Highways Agency, Council, Severn Trent Water and the public. Certain areas may be at additional risk due to their location downstream of heavily urbanised areas and urban areas that have the potential for “flash flooding”, surcharging the capacity of existing sewers and watercourses.

3.5.3 Emergency Response

Details of the emergency response procedures for the District are provided in the Worcestershire County Flood Plan. This plan provides details of the national flood warning system, describes what the flood warnings mean and what the responding organisations will do to mitigate the effects of severe flooding.

3.5.4 Wyre Forest Flood Defence Policy

The Council has recently updated its Policy Statement on Flood Defence. This policy is in accordance with the Government’s high level targets and it intended to provide a public statement on the Council’s approach to flooding in its area. The policy sets out plans for reducing or managing the risk of flooding and erosion, which fall within three broad objectives:

- Objective (a): To encourage the provision of adequate and cost effective flood warning systems.

- Objective (b): To encourage the provision of adequate, economically, technically and environmentally sound and sustainable flood defence measures.
- Objective (c): To discourage inappropriate development in areas at risk from flooding and erosion.

Copies of the Policy Statement are available from the Council's offices at Wyre Forest Customer Service Centre, Kidderminster Town Hall, Vicar Street, Kidderminster, DY10 1DB.

4 DEVELOPMENT AND FLOOD RISK ISSUES

4.1 Potential Development Sites

This Level 1 SFRA has been prepared mindful of the current potential development sites as provided by the Council. A number of these sites were identified in the Adopted Local Plan (Wyre Forest District Council, January 2004). The location of potential development sites is presented in **Figure 6**. For ease of reference each development site has been given a unique identification number for cross-reference with **Figure 6**.

4.2 PPS25 Requirements

PPS25 is a new-style PPS reflecting the expectations of the Government's Planning Green Paper, *Planning: delivering a fundamental change*. It focuses on national policy and provides clarity on what is required at regional and local levels to ensure that decisions are made at the most appropriate level and in a timely fashion to deliver sustainable planning for development and flood risk.

Section 2.34 of Development and Flood Risk a Practice Guide Companion to PPS25, "Living Draft" states the key outputs from a Level 1 SFRA to be as follows:

- Plans showing the LPA area, Main Rivers, ordinary watercourses and flood zones, including the functional floodplain where appropriate, across the local authority area as defined in Table D1 of PPS25, as well as allocated development sites.
- An assessment of the implications of climate change for flood risk at allocated development sites over an appropriate time period, if this has not been factored into the plans above.
- Areas at risk of flooding from sources other than rivers and the sea.
- The location of any flood risk management measures, including both infrastructure and the coverage of flood warning systems.
- Locations where additional development may significantly increase flood risk elsewhere.
- Guidance on the preparation of FRAs for allocated development sites.
- Guidance on the likely applicability of different sustainable drainage systems (SUDS) techniques for managing surface water run-off at key development sites.

(Development and Flood Risk: A Practice Guide Companion to PPS25 "Living Draft, Communities and Local Government, February 2007)

The remainder of Section 4 highlights how these outputs have been addressed in the production of this Level 1 SFRA.

4.3 Mapping, Flood Zones and Development Areas

Plans showing the LPA area, Main Rivers, ordinary watercourses and flood zones, including the functional floodplain where appropriate, across the local authority area as defined in Table D1 of PPS25, as well as allocated development sites.

4.3.1 General

Figure 1 of this report shows the Wyre Forest District boundary, the Main Rivers and ordinary watercourses.

The Environment Agency's Flood Zones 2 and 3 (1000 and 100 year return periods respectively) are presented in **Figure 6**, along with the current potential development sites.

4.3.2 Functional Floodplain

As defined in PPS25, the Functional Floodplain (i.e. Zone 3b) comprises land where water has to flow or be stored in times of flood. It includes the land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including planned water conveyance routes.

This zone takes into account the effect of existing flood risk management measures and other infrastructure in accordance with the guidance given in the 'Living Draft' Practice Guide. Functional Floodplain has been determined for all watercourses for which modelled flood levels are currently available. Functional Floodplain is also presented in **Figure 6**. It should be noted that flood levels were only provided for the 1 in 25 year flood for the Rivers Severn and Stour and therefore the Functional Floodplain has been based on these results. Further details describing the current availability of hydraulic modelling within the District is given in Section 3.3 of this report.

Additional hydraulic modelling is beyond the scope of the Level 1 SFRA and therefore the Functional Floodplain has still to be identified for the following watercourses, either as part of a future Level 2 SFRA or a site specific FRA:

- River Stour (upstream of the flood storage area);
- River Stour (between Mill Road and the River Seven);
- Dowles Brook;
- Riddings Brook;
- Snuffmill Brook;
- Burnthorpe Brook;
- Drakelow Brook;
- Honey Brook;
- Blakedown Brook;
- Blake Brook;
- Dick Brook;
- Gladder Brook; and
- Hoo Brook.

Until a Level 2 SFRA has been produced or appropriate site specific FRAs show this zone for the above watercourses to the satisfaction of the Environment Agency, it is recommended that all areas within the Flood Zone 3a should be considered as the Functional Floodplain.

4.3.3 Assessment of Fluvial Flood Risk to Proposed Development Areas

Table 1 indicates the details of the potential development sites within the District and whether they are located within Flood Zones 2 and 3. All planning applications for development proposals of 1 hectare or greater in Flood Zone 1 and all proposals for new

development located in Flood Zones 2 and 3 should be accompanied by a FRA to satisfy the requirements of PPS25.

Table 1: Potential Development Sites

Unique ID ¹	Location	Total Area (ha)	Within Flood Zone 2	Within Flood Zone 3a	Within Flood Zone 3b	Current Status
D1	Land to Rear of Crossley	1.14	Yes	Yes	No	Vacant brownfield land - currently zoned for employment uses (Offices)
D2	Riverside Business Centre	3.09	Yes	Yes	Yes	Current adopted employment area
D3	KTC.4	8.84	Yes	Yes	No	Area currently adopted for mixed use redevelopment
D4	Council Depot Site	1.22	Yes	No	No	Current Council Depot - May move
D5	Churchfields Business Park	7.09	No	No	No	Employment area - potential pressure for change
D6	Load Street	0.66	Yes	Yes	No	Potential redevelopment of Medical Centre
D7	Georgian Carpet Factories Site	4.55	No	No	No	Potential for Redevelopment
D8	Lime Kiln Bridge	0.45	No	No	No	Potential Redevelopment Site
D9	Park Lane Timber Yard	1.00	No	No	No	Zoned for residential development
D10	BT Site, Mill Street	0.60	Yes	Yes	No	Potential Housing Site
D11	Current Morrisons Application Site	3.59	Yes	Yes	No	Planning permission granted (06/0590)
D12	Park Lane	1.68	No	No	No	Adopted Local Plan Redevelopment Site
D13	STC2	6.06	Yes	No	No	Adopted Local Plan Development Site
D14	STC3	2.20	Yes	No	No	Adopted Local Plan Redevelopment Site
D15	Lichfield Basin	2.03	Yes	No	No	Planning Permission for 144 dwellings
D16	Shipleys Amusement Area	0.95	Yes	Yes	Yes	Potential Development Site
D17	Thomas Vale - Affordable Housing Site	0.77	Yes	Partially	Not defined	Under Construction
D18	Parsons Chain	3.71	No	No	No	Potential Development Site
D19	A.Harris and Sons	0.22	No	No	No	Planning application approved for light industrial
D20	Wilden Lane	2.10	Partially	Partially	No	Potential Development Site

D21	British Sugar Site	23.85	No	No	No	Potential Development Site - British Sugar
D22	Victoria Sports Ground	2.22	Yes	Yes	Not defined	Potential Development Site
D23	Park Lane	0.87	No	No	No	Potential Development Site
D24	Current Sealine Factory (Various Units)	6.48	Partially	Partially	No	Potential Development Site?
D25	Current Retail Area	0.63	Yes	No	No	Potential Development Site?
D26	New Road and Market Street	0.49	Yes	Yes	No	Potential Development Site
D27	Brintons Offices - Exchange Street	0.21	Yes	Yes	No	Potential Development Site
D28	Current Morrisons Site and other shops	1.16	Partially	No	No	Potential Development Site
D29	KTC.3 - Worcester Street Enhancement Area	0.61	No	No	No	Potential Development Site - Indicated in the Adopted Local Plan
D30	Church Street Car Park	0.09	Yes	Yes	No	Potential Development Site
D31	Puxton	7.34	Yes	Yes	No	Potential Development Site
D32	Lax Lane Craft Centre/WVRS/British Red Cross	0.26	Yes	Yes	No	Potential Development Site
D33	Summerfield - Straddles the District Boundary	55.12	No	No	No	Potential Development Site
D34	Baldwin Road	1.60	No	No	No	Potential Development Site
D35	STC.4	0.38	Yes	No	No	Development site as earmarked by the Local Plan and the STC.4 Supplementary Planning Document
D36	Lisle Avenue	5.25	No	No	No	Potential Development Site - Currently zoned for employment use within the Local Plan
D37	Titan Steel Wheels - Cookley	5.71	Partially	Partially	Not defined	Potential Development Site
D38	Puxton Site	1.70	No	No	No	Planning permission granted
D39	Stourport Relief Road	n/a	To be confirmed	To be confirmed	To be confirmed	Safeguarded within the Local Plan
D40	Hoo-Brook Link Road	n/a	To be confirmed	To be confirmed	To be confirmed	Potential road crossing

Notes:

1 - For Cross Reference with Figure 6

As can be seen from the Table 1, there are number of sites that are within Flood Zones 3a which will require passing the Exception Test following the application of Sequential Test under PPS25 guidance. The Council will need to clarify with the Environment Agency how to handle these sites when determining planning permission. Also, sites D2 and D16 are currently shown to be within the Functional Floodplain, (Flood Zone 3b). In accordance with PPS25, no development should be permitted within this zone and therefore additional analysis should be undertaken if these sites are to be considered further. Additional analysis should be undertaken to determine whether sites D17, D22 and D37 are within the Functional Floodplain.

At this stage the design of the two road crossings is not known. However, in designing the crossings regard should be given to the issue of flood risk. Consideration should be given to the location of embankments and bridge piers, if possible avoiding construction within the floodplain. The impact the crossings may have in terms of the obstruction to overland flow routes should be addressed. Measures should also be investigated to mitigate the impacts of runoff from the new roads.

4.4 Impacts of Climate Change

An assessment of the implications of climate change for flood risk at allocated development sites over an appropriate time period, if this has not been factored into the plans above.

PPS25 clearly emphasises the need for addressing climate change impacts to deal with the increased and new risks of flooding within the lifetime of planned development. Also, Planning Policy Statement 1: Delivering Sustainable Development and its supplementary draft Planning Statement on Planning and Climate Change (consultation completed in March 2007) provide further guidance on how to address the new threat of climate change within the planning system.

This Level 1 SFRA has assessed the impacts of climate change eighty years hence (2087) by assessing the impact on the existing Flood Zone 3, taking into account the impact of climate change on river flows. In accordance with PPS25 this process has only been undertaken in the vicinity of potential development sites.

Where 100 year water levels and flows were available from hydraulic models the approximate increase in flood level was determined by adding 20% to the flows.

For unmodelled watercourses and as a conservative approach, it was considered that this outline should be the same as the present-day Flood Zone 2, until demonstrated otherwise in a Level 2 SFRA or a detailed site specific FRA.

Using this approach, the currently allocated sites can be broadly assessed against the potential risk from climate change, as shown in **Table 2**. However, they will need further assessment as per the guidance in Annex B of PPS25 by fully taking into account the presence of existing flood defences through an updated Level 2 SFRA or site-specific FRAs.

Table 2 – Impacts of Climate Change

Unique ID	Location	Impact of Climate Change
D1	Land to Rear of Crossley	This site is currently protected by the FAS. The potential impact is dependent upon the capacity of the flood storage reservoir. It is beyond the scope of the Level 1 SFRA to model the consequences of overtopping of the reservoir. This should be undertaken as part of a Level 2 SFRA.
D2	Riverside Business Centre	Approximate increase in the 1 in 100 year flood level of 0.4m.
D3	KTC.4	This site is currently protected by the FAS. The potential impact is dependent upon the capacity of the flood storage reservoir. It is beyond the scope of the Level 1 SFRA to model the consequences of overtopping of the reservoir. This should be undertaken as part of a Level 2 SFRA.
D4	Council Depot Site	This site is currently protected by the FAS. The potential impact is dependent upon the capacity of the flood storage reservoir. It is beyond the scope of the Level 1 SFRA to model the consequences of overtopping of the reservoir. This should be undertaken as part of a Level 2 SFRA.
D5	Churchfields Business Park	Outside Flood Zone 2 (1 in 1000 year) and therefore risk of flooding not directly affected by climate change. However, the consequences of the development in terms of additional runoff and increased flood risk elsewhere due to climate change should be considered.
D6	Load Street	Approximate increase in the 1 in 100 year flood level of 0.6m.
D7	Georgian Carpet Factories Site	Outside Flood Zone 2 (1 in 1000 year) and therefore risk of flooding not directly affected by climate change. However, the consequences of the development in terms of additional runoff and increased flood risk elsewhere due to climate change should be considered.
D8	Lime Kiln Bridge	Outside Flood Zone 2 (1 in 1000 year) and therefore risk of flooding not directly affected by climate change. However, the consequences of the development in terms of additional runoff and increased flood risk elsewhere due to climate change should be considered.
D9	Park Lane Timber Yard	Outside Flood Zone 2 (1 in 1000 year) and therefore risk of flooding not directly affected by climate change. However, the consequences of the development in terms of additional runoff and increased flood risk elsewhere due to climate change should be considered.
D10	BT Site, Mill Street	This site is currently protected by the FAS. The potential impact is dependent upon the capacity of the flood storage reservoir. It is beyond the scope of the Level 1 SFRA to model the consequences of overtopping of the reservoir. This should be undertaken as part of a Level 2 SFRA.
D11	Current Morrisons Application Site	This site is currently protected by the FAS. The potential impact is dependent upon the capacity of the flood storage reservoir. It is beyond the scope of the Level 1 SFRA to model the consequences of overtopping of the reservoir. This should be undertaken as part of a Level 2 SFRA.
D12	Park Lane	Outside Flood Zone 2 (1 in 1000 year) and therefore risk of flooding not directly affected by climate change. However, the consequences of the development in terms of additional runoff and increased flood risk elsewhere due to climate change should be considered.
D13	STC2	Approximate increase in the 1 in 100 year flood level of 0.4m.
D14	STC3	Approximate increase in the 1 in 100 year flood level of 0.4m.
D15	Lichfield Basin	Approximate increase in the 1 in 100 year flood level of 0.4m.

D16	Shipleys Amusement Area	Approximate increase in the 1 in 100 year flood level of 0.4m.
D17	Thomas Vale - Affordable Housing Site	Approximate increase in the 1 in 100 year flood level of 0.4m.
D18	Parsons Chain	Outside Flood Zone 2 (1 in 1000 year) and therefore risk of flooding not directly affected by climate change. However, the consequences of the development in terms of additional runoff and increased flood risk elsewhere due to climate change should be considered.
D19	A.Harris and Sons	Outside Flood Zone 2 (1 in 1000 year) and therefore risk of flooding not directly affected by climate change. However, the consequences of the development in terms of additional runoff and increased flood risk elsewhere due to climate change should be considered.
D20	Wilden Lane	This site is currently protected by the FAS. The potential impact is dependent upon the capacity of the flood storage reservoir. It is beyond the scope of the Level 1 SFRA to model the consequences of overtopping of the reservoir. This should be undertaken as part of a Level 2 SFRA.
D21	British Sugar Site	Outside Flood Zone 2 (1 in 1000 year) and therefore risk of flooding not directly affected by climate change. However, the consequences of the development in terms of additional runoff and increased flood risk elsewhere due to climate change should be considered.
D22	Victoria Sports Ground	The adjacent watercourse has not been modelled. It is recommended that the existing Flood Zone 2 be used to represent Flood Zone 3 with climate change until the watercourse has been assessed in greater detail.
D23	Park Lane	Outside Flood Zone 2 (1 in 1000 year) and therefore risk of flooding not directly affected by climate change. However, the consequences of the development in terms of additional runoff and increased flood risk elsewhere due to climate change should be considered.
D24	Current Sealine Factory (Various Units)	This site is currently protected by the FAS. The potential impact is dependent upon the capacity of the flood storage reservoir. It is beyond the scope of the Level 1 SFRA to model the consequences of overtopping of the reservoir. This should be undertaken as part of a Level 2 SFRA.
D25	Current Retail Area	This site is currently protected by the FAS. The potential impact is dependent upon the capacity of the flood storage reservoir. It is beyond the scope of the Level 1 SFRA to model the consequences of overtopping of the reservoir. This should be undertaken as part of a Level 2 SFRA.
D26	New Road and Market Street	This site is currently protected by the FAS. The potential impact is dependent upon the capacity of the flood storage reservoir. It is beyond the scope of the Level 1 SFRA to model the consequences of overtopping of the reservoir. This should be undertaken as part of a Level 2 SFRA.
D27	Brintons Offices - Exchange Street	This site is currently protected by the FAS. The potential impact is dependent upon the capacity of the flood storage reservoir. It is beyond the scope of the Level 1 SFRA to model the consequences of overtopping of the reservoir. This should be undertaken as part of a Level 2 SFRA.
D28	Current Morrisons Site and other shops	This site is currently protected by the FAS. The potential impact is dependent upon the capacity of the flood storage reservoir. It is beyond the scope of the Level 1 SFRA to model the consequences of overtopping of the reservoir. This should be undertaken as part of a Level 2 SFRA.

D29	KTC.3 - Worcester Street Enhancement Area	Outside Flood Zone 2 (1 in 1000 year) and therefore risk of flooding not directly affected by climate change. However, the consequences of the development in terms of additional runoff and increased flood risk elsewhere due to climate change should be considered.
D30	Church Street Car Park	This site is currently protected by the FAS. The potential impact is dependent upon the capacity of the flood storage reservoir. It is beyond the scope of the Level 1 SFRA to model the consequences of overtopping of the reservoir. This should be undertaken as part of a Level 2 SFRA.
D31	Puxton	This site is currently protected by the FAS. The potential impact is dependent upon the capacity of the flood storage reservoir. It is beyond the scope of the Level 1 SFRA to model the consequences of overtopping of the reservoir. This should be undertaken as part of a Level 2 SFRA.
D32	Lax Lane Craft Centre/WVRS/British Red Cross	Approximate increase in the 1 in 100 year flood level of 0.4m.
D33	Summerfield - Stradles the District Boundary	Outside Flood Zone 2 (1 in 1000 year) and therefore risk of flooding not directly affected by climate change. However, the consequences of the development in terms of additional runoff and increased flood risk elsewhere due to climate change should be considered.
D34	Baldwin Road	Outside Flood Zone 2 (1 in 1000 year) and therefore risk of flooding not directly affected by climate change. However, the consequences of the development in terms of additional runoff and increased flood risk elsewhere due to climate change should be considered.
D35	STC.4	Approximate increase in the 1 in 100 year flood level of 0.4m.
D36	Lisle Avenue	Outside Flood Zone 2 (1 in 1000 year) and therefore risk of flooding not directly affected by climate change. However, the consequences of the development in terms of additional runoff and increased flood risk elsewhere due to climate change should be considered.
D37	Titan Steel Wheels - Cookley	The adjacent watercourse has not been modelled. It is recommended that the existing Flood Zone 2 be used to represent Flood Zone 3 with climate change until the watercourse has been assessed in greater detail.
D38	Puxton Site	This site is protected from water in the FAS storage area. It is beyond the scope of the Level 1 SFRA to assess the standard of these defences. This should be undertaken as part of a Level 2 SFRA.
D39	Stourport relief road	The design of the road crossing should address the impacts of climate change in terms of increased flood levels and hence flood extents, as well as increased runoff rates.
D40	Hoo-brook link road	The design of the road crossing should address the impacts of climate change in terms of increased flood levels and hence flood extents, as well as increased runoff rates.

4.5 Flood Risk from Sources other than Rivers and the Sea

Areas at risk of flooding from sources other than rivers and the sea.

Figure 3 shows the location of all sources of historic flooding including:

- Main River flooding;
- Non-Main River flooding;

- Sewer flooding;
- Surface water flooding; and
- Groundwater flooding.

4.6 Flood Risk Management Infrastructure and Flood Warning

The location of any flood risk management measures, including both infrastructure and the coverage of flood warning systems.

Section 3.5 of this report describes the existing flood risk management infrastructure within the District. This information is also presented graphically in **Figure 7**. The current Flood Warning procedures are documented in Section 3.6. **Table 3** identifies whether the potential development areas are protected by existing flood alleviation measures or flood warning systems. For such areas the future safety of the site from flooding will be dependent upon the future maintenance and operation of the flood defence.

Table 3 – Influence of Existing Flood Risk Management and Flood Warning Systems

Unique ID	Location	Current Status	Protected by Flood Defence?	Covered by Flood Warning?
D1	Land to Rear of Crossley	Vacant brownfield land - currently zoned for employment uses (Offices)	Defended by Kidderminster FAS.	Yes
D2	Riverside Business Centre	Current adopted employment area	No	Yes
D3	KTC.4	Area currently adopted for mixed use redevelopment	Defended by Kidderminster FAS.	Yes
D4	Council Depot Site	Current Council Depot - May move	Defended by Kidderminster FAS.	Yes
D5	Churchfields Business Park	Employment area - potential pressure for change	Outside Flood Zone 2, therefore defence not needed.	Not required.
D6	Load Street	Potential redevelopment of Medical Centre	Defended by temporary and demountable defences.	Yes
D7	Georgian Carpet Factories Site	Potential for Redevelopment	Outside Flood Zone 2, therefore defence not needed.	Not required.
D8	Lime Kiln Bridge	Potential Redevelopment Site	Outside Flood Zone 2, therefore defence not needed.	Not required.
D9	Park Lane Timber Yard	Zoned for residential development	Outside Flood Zone 2, therefore defence not needed.	Not required.
D10	BT Site, Mill Street	Potential Housing Site	Defended by Kidderminster FAS.	Yes
D11	Current Morrisons Application Site	Planning permission granted (06/0590)	Defended by Kidderminster FAS.	Yes

D12	Park Lane	Adopted Local Plan Redevelopment Site	Outside Flood Zone 2, therefore defence not needed.	Not required.
D13	STC2	Adopted Local Plan Development Site	No	Yes
D14	STC3	Adopted Local Plan Redevelopment Site	No	Yes
D15	Lichfield Basin	Planning Permission for 144 dwellings	No	Yes
D16	Shipleys Amusement Area	Potential Development Site	No	Yes
D17	Thomas Vale - Affordable Housing Site	Under Construction	No	Yes
D18	Parsons Chain	Potential Development Site	Outside Flood Zone 2, therefore defence not needed.	Not required.
D19	A.Harris and Sons	Planning application approved for light industrial	Outside Flood Zone 2, therefore defence not needed.	Not required.
D20	Wilden Lane	Potential Development Site	Defended by Kidderminster FAS.	Yes
D21	British Sugar Site	Potential Development Site - British Sugar	Outside Flood Zone 2, therefore defence not needed.	Not required.
D22	Victoria Sports Ground	Potential Development Site	No	No
D23	Park Lane	Potential Development Site	Outside Flood Zone 2, therefore defence not needed.	Not required.
D24	Current Sealine Factory (Various Units)	Potential Development Site?	Defended by Kidderminster FAS.	Yes
D25	Current Retail Area	Potential Development Site?	Defended by Kidderminster FAS.	Yes
D26	New Road and Market Street	Potential Development Site	Defended by Kidderminster FAS.	Yes
D27	Brintons Offices - Exchange Street	Potential Development Site	Defended by Kidderminster FAS.	Yes
D28	Current Morrisons Site and other shops	Potential Development Site	Defended by Kidderminster FAS.	Yes
D29	KTC.3 - Worcester Street Enhancement Area	Potential Development Site - Indicated in the Adopted Local Plan	Outside Flood Zone 2, therefore defence not needed.	Not required.
D30	Church Street Car Park	Potential Development Site	Defended by Kidderminster FAS.	Yes
D31	Puxton	Potential Development Site	Defended by Kidderminster FAS.	Yes
D32	Lax Lane Craft Centre/WVRS/British Red Cross	Potential Development Site	Defended by temporary and demountable defences.	Yes

D33	Summerfield - Stradles the District Boundary	Potential Development Site	Outside Flood Zone 2, therefore defence not needed.	Not required.
D34	Baldwin Road	Potential Development Site	Outside Flood Zone 2, therefore defence not needed.	Not required.
D35	STC.4	Development site as earmarked by the Local Plan and the STC.4 Supplementary Planning Document	No	Yes
D36	Lisle Avenue	Potential Development Site - Currently zoned for employment use within the Local Plan	Outside Flood Zone 2, therefore defence not needed.	Not required.
D37	Titan Steel Wheels - Cookley	Potential Development Site	No	Yes
D38	Puxton Site	Approved development site.	Yes	Yes

4.7 Flood Risk from Developments

Locations where additional development may significantly increase flood risk elsewhere.

4.7.1 General

The impact of each of the proposed development sites has been assessed in respect to the following:

- potential increase in surface water runoff;
- loss of floodplain storage area; and
- influence on flooding mechanisms.

4.7.2 Surface Water Drainage

The majority of the currently proposed development allocations are on Brownfield sites and will therefore unlikely to contribute additional runoff. However, there are four sites proposed on currently cleared areas as listed below:

- D1 – Land to Rear of Crossley;
- D13 – STC2;
- D23 – Park Lane; and
- D31 – Puxton.

For these areas it will be necessary to pay closer attention to the disposal of surface water in order to ensure that the development does not contribute additional runoff to receiving watercourses and thereby increase the risk of flooding to other areas.

However, it is anticipated that current awareness of sustainable drainage techniques (SUDS), which will be required as a prerequisite of any future development, will actually reduce the rate of runoff from the proposed sites.

4.7.3 Loss of Floodplain Storage

As shown in **Table 1**, there are a number of developments which fall within Flood Zones 2 and 3. Such areas therefore have the potential to reduce the potential storage volume of water during flood conditions. Each site should be assessed on an individual basis through a detailed site specific FRA, in order to identify the net gain or loss in terms of floodplain storage. Where there is a significant loss in floodplain storage the Environment Agency may request that compensatory storage be provided on a level for level basis, i.e. additional floodplain storage is made available to offset the impact of the development.

4.7.4 Impact on Flooding Mechanisms

In assessing the flood risk from all development sites, consideration should be given to localised drainage issues. This would include an assessment of the impact the development could have in terms of influencing existing flooding mechanisms, such as overland flow routes. These issues should be addressed in a site specific FRA.

4.8 Guidance

Guidance on the preparation of FRAs for allocated development sites.
 Guidance on the likely applicability of different sustainable drainage systems (SUDS) techniques for managing surface water run-off at key development sites.

4.8.1 General

Guidance on the preparation of site specific FRAs is provided in Chapter 2 of Development and Flood Risk a Practice Guide Companion to PPS25, “Living Draft”, (Communities and Local Government, February 2007). Guidance on the use of SUDS is provided in Section 4.

It is recommended that before any of the potential development sites are taken forward a site specific FRA should be undertaken, addressing the specific issues identified in Section 4 of this Level 1 SFRA.

Additional guidance for specific elements is given below.

4.8.2 Application of the Sequential Test

The policies in PPS25 require that all stages of the development planning process should take account of both the nature and spatial distribution of flood risk and the degree of vulnerability of different types of development. Reinforcing the philosophy of managing flood risk through avoidance/prevention, PPS25 requires that planners and developers do not simply match land use types to areas or zones with an ‘acceptable’ degree of flood risk. Rather, a sequential approach to location of new development is required, by application of the Sequential Test as defined in paragraphs 16 and 17 and paragraphs D1 to D8 of Annex D of PPS25.

The application of the Sequential Test requires the identification of Flood Zones as defined in Table D.1 of PPS25. Also, it will require LPAs to demonstrate that there are no reasonable available sites in areas with a lower probability of flooding that would be

appropriate to the type of development or land use proposed, by considering all forms of flooding based on a Level 1 SFRA (i.e. as reported in this report and accompanying maps).

It is the responsibility of the decision-maker (i.e. the Local Planning Authority) to undertake the Sequential Test (Paragraph 3.2, PPS25 Practice Guide). However, where there is no sequentially tested LDD policies the responsibility to provide the evidence for the Local Planning Authority to carry out the Sequential Test lies with the developer (Paragraph 3.4, PPS25 Practice Guide)

4.8.3 Flood Risk Assessment

Properly prepared assessments of flood risk will inform the decision-making process at all stages of development planning. Annex E of PPS25 stipulates requirements for three levels of flood risk assessment:

- Regional Flood Risk Assessments (RFRA);
- Strategic Flood risk Assessments (SFRAs); and
- Site-specific Flood Risk Assessments (FRAs).

The responsibility for preparing RFRA's will remain with Regional Planning Bodies and Local Planning Authorities are responsible for preparing SFRAs.

In order to provide relevant information and to steer the planning-process in the right direction, the minimum requirements for flood risk assessments are that they should:

- be proportionate to the risk and appropriate to the scale, nature and location of the development;
- consider the risk of flooding arising from the development in addition to the risk of flooding to the development;
- take the impacts of climate change into account as per Annex B of PPS25;
- be undertaken by competent people, as early as possible in the particular planning process, to avoid misplaced effort and raising landowner expectations where land is unsuitable for development;
- consider both the potential adverse and beneficial effects of flood risk management infrastructure including raised defences, flow channels, flood storage areas and other artificial features together with the consequences of their failure;
- consider the vulnerability of those that could occupy and use the development, taking account of the Sequential and Exception Tests and the vulnerability classification as per Annex D of PPS25, including arrangements for safe access;
- consider and quantify the different types of flooding (whether from natural and human sources and including joint and cumulative effects) and identify flood risk reduction measures, so that assessments are fit for the purpose of the decisions being made;
- consider the effects of a range of flooding events including extreme events on people, property, the natural and historic environment and river and coastal processes;
- include the assessment of the residual risk after risk reduction measures have been taken into account and demonstrate that this is acceptable for the particular development or land use;
- consider how the development will modify run-off and promote the use of Sustainable Drainage Systems (SUDS) to mitigate that impact; and

- be supported by appropriate data and information, including historical information on previous events.

At the planning application stage, an appropriate site-specific FRA should be carried out to demonstrate how flood risk from all sources of flooding to the development itself and flood risk to others would be managed by fully taking into account climate change impacts. Table D.1 of PPS25 defines the requirements for carrying out FRAs for development sites depending on their location within each type of Flood Zone.

Therefore, planning applications for development proposals of 1 hectare or greater in Flood Zone 1 and all proposals for new development located in Flood Zones 2 and 3 should be accompanied by an FRA, which satisfies the above minimum requirements..

4.8.4 Surface Water Management

Historically, surface water drainage systems have been designed to remove surface water from a site as quickly as possible by means of underground piped systems. This has the potential to increase flooding problems downstream and does not contribute to the natural recharge of groundwater levels. Such systems contribute to the transport of pollutants from urban areas to watercourses and groundwater.

With concerns surrounding the impacts of climate change and the requirements of the PPS25 and Water Framework Directive, a more sustainable approach to drainage is required to reduce flood risk, manage water quality and provide integrated amenity benefits. The effective disposal of surface water from development is a material planning consideration in determining proposals for the development and use of land. It will always be much more effective to manage surface water flooding at and from new development early in the land acquisition and design process rather than to resolve problems after development.

Regional planning bodies and local authorities are encouraged to promote the use of SUDS for the management of run-off. SUDS aim to mimic natural drainage processes and remove pollutants from urban run-off at source. They comprise a wide range of techniques, including green roofs, permeable paving, rainwater harvesting, swales, detention basins, ponds and wetlands. To realize the greatest improvement in water quality and flood risk management these components can be used in combination. 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 the rates prior to the proposed development, unless specific off-site arrangements are made and result in the same net effect.

Successful implementation of SUDS will require the early consideration of a wide range of issues surrounding their management, long-term adoption and maintenance. The design team and stakeholders should take every opportunity for early discussion about SUDS and should consider them at the feasibility stage of a development, to realize the optimum contribution.

All growth sites can increase flood risk on the receiving watercourses unless the additional runoff from the future development is adequately managed.

4.8.5 Flood Warning and Emergency Planning

New developments should consider the role of flood warning.

The Environment Agency operates a national flood warning system for a large number of existing properties currently at risk of flooding in order to enable householders to protect life or take early action to manage the effect of flooding on property. New developments should consider the role of flood warning in managing residual risks although they should not rely solely on them. Section 4.6 discussed the present availability of flood warning and emergency response arrangements within the District.

Developments which include areas likely to flood will need to provide appropriate flood warning and formulate appropriate emergency plans to ensure their safe occupancy in the future. As a minimum, where any such development takes place in flood risk areas it is important that there is adequate passive flood warning in place, with signs highlighting the susceptibility to flooding and clearly signed evacuation routes where necessary.

4.8.6 Residual Risk Management

Flood risk to people and property associated with new developments can be managed but it can never be completely removed; a residual risk will always remain after flood management or mitigation measures have been put in place. Residual risk can be defined as the risk remaining after applying the sequential approach and taking mitigating actions.

Local Planning Authorities and developers should always consider residual flood risk issues relating to a development. The potential sources of this residual risk will need to be identified in the FRA, along with their potential impacts, and the most significant will have to be mitigated through flood risk management measures. The costs of such measures may be low compared to the damages they avoid and may enhance the value of the development.

As with all aspects of development and flood risk, it is best to consider residual flood risk early in the planning process, as measures to manage it may impact on site layout and the extent of developable land.

Although flooding cannot be wholly prevented, its impacts can be reduced through good planning and management. Thus it is vital to make the most of opportunities to reduce existing flood risk to communities. For instance, opportunities to re-create and safeguard functional flood plain and washlands and to design more liveable developments combining sustainable defences, green/recreational space and increased flood storage should be investigated as early as possible when planning new developments.

Residual flood risk management needs to be coordinated with emergency procedures.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Flooding is a key issue in the District and one that should be considered in all stages of the planning process. Historically, one of the key sources of flooding was from the River Severn and River Stour. The recent construction of flood alleviation measures for the towns of Kidderminster and Bewdley has reduced the risk from these watercourses. However, more recent events have resulted in flooding from more minor watercourses and from surface water run-off.

The information and knowledge gathered through this Level 1 SFRA will inform the emerging LDF and future flood risk management needs of the District. It will also provide a sound basis for a future Level 2 SFRA. This Level 1 SFRA considers all sources of flooding within the District based on a desktop study and consultation carried out with the Environment Agency, the Council, Severn Trent Water, British Waterways and other local consultees. It broadly satisfies the requirements for SFRAs and more specifically the amplified guidance given in paragraphs 2.32 to 2.35 of PPS25 Practice Guide Companion for preparing Level 1 SFRAs.

The findings of the Level 1 SFRA are given in the form of this report and the accompanying 1 in 10,000 scale SFRA Flood Zone maps (as per Table D.1 of PPS25) covering the entire District. These maps provide the basis for the application of Sequential Test. If the Exception Test is to be applied when identifying the Preferred Options and allocating development sites then the Council will have to carry out a Level 2 SFRA to fully consider the effectiveness and standard of protection provided by the existing flood defences.

Management of surface runoff from the proposed sites should use a combination of site specific and strategic SUDS measures encouraging 'source control' where possible. These measures should be developed with a strategic approach to flood management in mind.

5.2 Recommendations

A sequential test must be undertaken by the Council for all development sites and other sites in accordance with this report's findings when preparing the emerging LDF documents for the District. An update of the existing SFRA (including a review of developer guidance) will be needed to bring it more inline with PPS25 Level 2 SFRA standard incorporating the latest guidance and studies.

In accordance with the PPS25 "Living Draft", the Level 2 SFRA should address the following:

- *An appraisal of the current condition of flood defence infrastructure and of the likely future policy with regard to its maintenance and upgrade.*
- *An appraisal of the probability and consequences of overtopping or failure of flood risk management infrastructure, including an appropriate allowance for climate change.*

This will include a more detailed assessment of the risk and consequence of overtopping of the Kidderminster flood alleviation scheme and the temporary and demountable defences in Bewdley.

The Level 2 SFRA should also address the residual risks to developments behind defences. This will involve assessing the consequence of breaching of flood defences in order to identify Rapid Inundation Zones, areas of “Deep Flooding” and areas of “Shallow Flooding”.

- *Maps showing the distribution of flood risk across flood zones.*

This will involve identifying flood probability (improved flood zones, including Functional Floodplain and 1000 year), flood depth, flood velocity and the rate of the onset of flooding, whilst including an allowance for climate change.

As identified in this report a number of watercourses have not been modelled to date. The Level 2 SFRA will therefore need to consider the requirements for additional modelling or alternative degrees of analysis should be agreed with the Council and Environment Agency.

- *Guidance on appropriate policies for the making of sites which satisfy parts a) and b) of the Exception Test, and requirements to consider at the planning application stage to pass part c) of the Exception Test.*
- *Guidance on the preparation of FRAs for sites of varying risk across the flood zone.*

6 REFERENCES

1. Planning Policy Guidance Note 25: Development and Flood Risk, Department for Transport, Local Government and Regions, July 2001
2. Planning Policy Statement 25: Development and Flood Risk, Department for Communities and Local Government, December 2006
3. Development and Flood Risk: A Practice Guide Companion to PPS25 'Living Draft' – A Consultation Paper, Department for Communities, February 2007
4. Groundwater Flooding Scoping Report (Volume 1 and 2), Defra, 2004