Solihull Metropolitan Borough Council

Strategic Flood Risk Assessment for
Local Development Framework
Level 1
Volume 1 - FINAL
January 2008

Halcrow Group Limited

Solihull Metropolitan Borough Council

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

Contents Amendment Record

This report has been issued and amended as follows:

Issue	Revision	Description	Date	Signed
1		Draft Report	23/11/07	RD
2		Final Report	22/01/08	RD

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Executive Summary

In August 2007 a group comprising Coventry City Council, Solihull Metropolitan Borough Council and the County, Districts and Boroughs of Warwickshire commissioned Halcrow to produce a Level 1 Strategic Flood Risk Assessment (SFRA) in accordance with Planning Policy Statement 25 (PPS 25). The purpose of this SFRA is to assess and map all forms of flood risk from groundwater, surface water, sewer and river sources, taking into account future climate change predictions, and use this as an evidence base to locate future development primarily in low flood risk areas. The outputs from the SFRA will help the Councils to prepare sustainable policies for the long-term management of flood risk and improve existing emergency planning procedures.

In accordance with the recently published document "Development and Flood Risk, a Practice Guide Companion to PPS 25" (February 2007), a Level 1 SFRA has been carried out and is contained herein. The study takes full account of the effect of climate change predictions as set out in PPS 25. The assessment also complies with the content of the accepted proposal dated August 2007. The SFRA should be regarded as a 'living' document and reviewed on a regular basis in light of new information as it becomes available.

In accordance with PPS25, areas of 'low', 'medium' and 'high' risk have been mapped using data collected from the Environment Agency, Solihull Metropolitan Borough Council, Severn Trent Water, the Highways Agency and British Waterways. This has included information on flooding from rivers, surface water (land drainage), groundwater, artificial water bodies and sewers. This provides the basis for the Sequential Test to be applied.

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

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

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

1 Introduction

1.1 Terms of Reference

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

1.2 Project Aims

The aims of PPS 25 planning policy on development and flood risk are to ensure that flood risk is taken into account at all stages of the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is necessary in such areas, exceptionally, the policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall. 'Safe' in the context of this study means that dry pedestrian access to and from the development is possible without passing through the 1 in 100 year plus climate change floodplain, and emergency vehicular access is possible during times of flood. It also means that the development includes flood resistance and resilience measures to ensure it is safe.

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

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

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

1.3 Project Objectives

Halcrow has carried out this project in accordance with the methodology outlined in the Coventry, Solihull and Warwickshire SFRA Project Proposal, dated July 2007, though the methodology and deliverables have been aligned to the document "Development and Flood Risk: A Practice Guide Companion to PPS 25'". The SFRA has also followed advice from the Environment Agency.

For this study, a Level 1 SFRA approach has been agreed with the Council and the Environment Agency. A Level 1 SFRA is defined in the Practice Guide Companion to PPS25 as a desk-based

study using existing information to allow application of the Sequential Test on the basis of Table D1 of PPS25, and to identify whether application of the Exception Test is likely to be necessary.

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

1.4 Project Deliverables

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

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

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

1) Plans showing the administrative boundaries of the study area, watercourse centreline, modelled watercourses, canals, defences, Areas Benefiting from Defences (ABDs) Internal Drainage Board (IDB) areas and culverted watercourse sections (Volume 2, Tiles A1-A3)

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

3) An assessment of the implications of climate change for flood risk in the study area over an appropriate time period (Volume 2, Tile C1)

4) The location of any flood risk management measures, including both infrastructure (Volume 2, Tiles A1-A3) and the coverage of flood warning systems (Volume 2, Tile F1)

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

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

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

1.5 Outcomes of the SFRA Process

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

PPS25 also indicates that SAs should be informed by the SFRA for their area. Under the Town and Country Planning (Local Development - England) Regulations 2004, a SA is required for all LDFs.

The purpose is to promote sustainable development through better integration of sustainability considerations in the preparation and adoption of plans. The Regulations stipulate that SAs for LDFs should meet the requirements of the SEA Directive. A SFRA is used as a tool by a planning authority for the production of development briefs, setting constraints, identifying locations of emergency planning measures and requirements for FRAs.

It is important to reiterate that PPS25 is not applied in isolation as part of the planning process. The formulation of Council policy and the allocation of land for future development must also meet the requirements of other planning policy. Clearly a careful balance must be sought in these instances, and the SFRA aims to assist in this process through the provision of a clear and robust evidence base upon which informed decisions can be made.

1.5.1 The Sequential Test

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

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

Flood Risk Vulnerability and Flood Zone 'Compatibility' (Table D3 of PPS 25)

Flood Risk Vulnerability classification (see Table D2)		Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone (see Table D.1)	Zone 1	✔	✔	✔	✔	✔
	Zone 2	✔	✔	Exception Test required	✔	✔
	Zone 3a	Exception Test required	✔	✗	Exception Test required	✔
	Zone 3b 'Functional Floodplain'	Exception Test required	✔	✗	✗	✗

Key:

✔ Development is appropriate

✗ Development should not be permitted

Table D2 of PPS 25 (reproduced below) classifies different types of development under different flood risk vulnerabilities, and should be used in conjunction with Table D1 in allocating new development as part of the Sequential Test.

Flood Risk Vulnerability Classification (Table D2 of PPS 25)

Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk, and strategic utility infrastructure, including electricity generating power stations and grid and primary substations.
Highly Vulnerable	• Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent.[19]
More Vulnerable	• Hospitals • Residential institutions such residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels. • Non-residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste.[20] • Sites used for holiday or short-let caravans and camping, subject to specific warning and evacuation plan.
Less Vulnerable	• Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non-residential institutions not included in 'more vulnerable'; and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment plants. Sewage treatment plants (if adequate pollution control measures

	are in place).
Water-compatible Development	• Flood control infrastructure • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel workings. • Docks, marinas and wharves. • Navigation facilities. • MOD defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

References:

[19] DETR Circular 04/00 – Para 18: Planning controls for hazardous substances.

www.communities.gov.uk/index.asp?id=1144377

[20]See Planning for Sustainable Waste Management: Companion Guide to Planning Policy Statement 10 for definition. www.communities.gov.uk/index.asp?id=1500757

1.5.2 The Exception Test

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

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

For the Exception Test to be passed:

a) It must be demonstrated that the development provides wider sustainability benefits to the community which outweigh flood risk, informed by a SFRA where one has been prepared. If the Development Plan Document has reached the 'submission' stage (see Figure 4 of PPS12: Local Development Frameworks) the benefits of the development should contribute to the Core Strategy's SA;

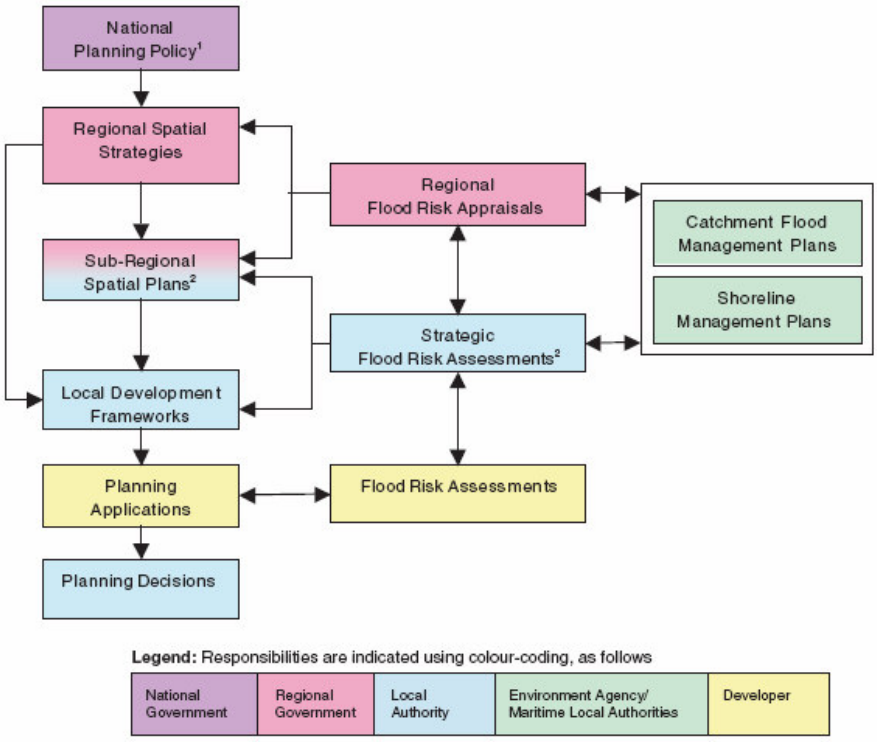
b) The development should be on developable previously-developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously-developed land; and,

c) A FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

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

1.6 SFRA Context

The figure overleaf, taken from the PPS 25 Practice Guide, illustrates the responsibilities for the production of key documents required to effectively manage flood risk through each stage of the spatial planning process, and, importantly, shows the link between other strategic documents.



Notes

1 Including Planning Policy Statement 25 *'Development and Flood Risk'* and the other flooding-related national planning policy listed in Appendix B of this Practice Guide.

2 SFRAs may cover more than one local planning authority region, and the adoption of a catchment-based approach by a number of LPAs working in partnership could be highly beneficial.

3 This diagram has been developed from the original within the Defra/EA 2005 report FD2320.

1.7 The Study Area

Solihull is a metropolitan Borough, covering an area of some 178km^2. The Borough lies to the east of Birmingham and west of Coventry and contains a mixture of residential areas, a thriving town centre, business parks, a variety of open spaces and many sites of archaeological and historic importance. Its close proximity to the major urban area of Birmingham and excellent road and rail links has resulted in the Borough absorbing a significant amount of house building with increasing pressures on the Green Belt as urban areas are unable to accommodate the increasing demand in housing. The total estimated population in 2001 was 199,517.

1.7.1 Main Rivers and Hydrology

The Borough is covered by seven Main River catchments: the River Blythe, Ravenshaw Brook, Shadow Brook, Hollywell Brook, Low Brook, Kingshurst Brook and the River Cole.

The River Blythe forms a right bank tributary of the River Tame entering the Borough at SP 114 742 to the east of Earlswood Lakes. The watercourse flows in a north-easterly direction through the Borough passing around the southern edge of Cheswick Green (SP 127 755) and the urban area of Solihull before turning to flow in a southerly then south-easterly direction. At SP 181 793 the Ravenshaw Brook joins the River Blythe after which the watercourse turns to flow in a southerly then south-easterly direction, meandering through predominantly rural floodplain passing around the edge

of a number of small settlements including Barston, Eastcote, Temple Balsall and Hampton in Arden. At SP 220 820 the watercourse forms the boundary between the Borough of Solihull and North Warwickshire Borough Council for approximately 1km, with the tributary of Shadow Brook joining the River Blythe at SP 216 825. The watercourse then continues to flow in a northerly direction continuing to form the boundary with Warwick District Council until exiting the Borough at SP 214 831.

The Ravenshaw Brook forms a small tributary of the River Blythe, rising by Copt Heath (SP 172 787) and flowing in a north-easterly direction through the Borough, passing around the northern edge of Brian's Water (SP 176 791) and beneath the Grand Union Canal (SP 178 791), before joining the right bank of the River Blythe at SP 180 793.

The Shadow Brook is a tributary of the River Blythe, rising to the west of Hampton in Arden (SP 193 809) and flowing in predominantly north-easterly direction through the Borough. The watercourse flows through predominantly rural floodplain, flowing briefly through the northern edge of the settlement of Hampton in Arden before continuing in a north-easterly direction and joining the left bank of the River Blythe by Diddington Hall on the north-eastern edge of the Borough (SP 216 793).

The Hollywell Brook forms a left bank tributary of the River Blythe at the eastern extent of the Borough, rising by Pendigo Lake (SP 196 836) to the south of the National Exhibition Centre. The watercourse flows in an easterly direction through the Borough through predominantly rural floodplain, exiting the Borough at SP 210 835 approximately 0.5km before joining the left bank of the River Blythe.

The Low Brook rises to the east of Elmdon Heath (SP 167 811) and flows in a predominantly northerly direction through rural floodplain, passing through Birmingham International Airport (SP 180 844). From its headwaters the watercourse is designated non-Main River until it passes beneath a railway at SP 178 845 after which it continues in a northerly direction through the western extent of Chelmsley Wood before joining the right bank of Kingshurst Brook at SP 171 863.

Kingshurst Brook forms a left bank tributary of the River Cole entering the Borough in the north-west at SP 166 860 and flowing in a north-easterly direction between the urban settlements of Fordbridge and Chelmsley Wood before joining the River Cole on the right bank at SP 179 874.

The River Cole is a left bank tributary of the River Blythe, which is a tributary of the River Tame. The watercourse enters the Borough on the south-western extent, flowing beneath the Stratford-upon-Avon Canal before continuing to flow in a northerly direction and passing through Solihull Lodge. Here the watercourse is designated Non-Main River. At SP 1034 7920 the watercourse exits the Borough and flows into the District of Birmingham where it continues to flow in a predominantly north-easterly direction before re-entering the Borough of Solihull in the north-western extent to the north of Fordbridge (SP 161 877) where the watercourse is now designated Main River. The River Cole then flows in a predominantly westerly direction, passing through urban floodplain between the towns of Kingshurst to the north and Fordbridge to the south. At SP 179 874 the Kingshurst Brook joins the River Cole on the right bank before the watercourse continues to flow in a easterly then northerly direction before exiting the Borough at SP 123 880. The catchment is of moderate relief. The overlying geology of the catchment (drift-covered clay) and the considerable urbanisation in the upper reaches produces fast runoff and heavy rain can result in sudden floods. However, the absence of significant tributaries means that the floodwaters subside quickly.

Watercourse maps, giving an overview of fluvial features in the study area, can be found in Volume 2, Tiles A1-A3. A number of minor watercourses and non-Main Rivers also flow through the Borough which have been analysed where data exists. These include: the Cuttle Brook, Pickford Brook, Hatchford Brook and, a series of unnamed watercourses.

There are no IDBs operating in the Council's area.

1.7.2 Geology and Topography

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

The geology of the Borough consists predominantly of sedimentary rocks and is represented by four major geology periods, with the oldest rocks from the Carboniferous period followed by the Permian, Triassic and then the younger Jurassic rocks. The Carboniferous rock sequences make up approximately 14% of the geology consisting of sandstones, conglomerates and argillaceous – clay rich rocks. The Permian period comprises sandstones and argillaceous rocks representing about 1% of the geology. The Borough is dominated by Triassic argillaceous rocks which make up 84% of the geology as well as sandstones. The final 1% of the geological record in the Borough is represented by Jurassic argillaceous rocks. The Borough is dominated by clay rich rocks where soils are not so well drained. The sandstone rocks generally provide for well drained soils.

Drift deposits of various origins are found within the Borough. Till is sediment that is deposited by glaciers and made up of clay; detritus that is indicative of the underlying argillaceous – clay rich rocks. There are also deposits of glacial sands and gravels, again due to the deposition of glaciers. Alluvium and lacustrine deposits, sediments deposited by rivers and lakes respectively, can be found throughout the Borough consisting of clays, silts and sands. (Volume 2, Tiles D1 (solid) and D2 (drift)). These superficial deposits are all indicative of the underlying geology.

The topography of the Borough is comprised of higher elevations and steeper slopes in the north-east, 180m AOD, north-east of Meriden, gradually decreasing in elevation in a westerly direction towards Hampton in Arden where the lowest elevations of 85m AOD are located. Higher elevations appear to radiate from Hampton in Arden with a gradual increase towards Solihull to the south-west and Berkswell to the south-east.

2 Planning Context

2.1 Introduction

This section provides an overview of the planning policy framework relevant to Solihull Metropolitan Borough Council.

This report conforms with National and Regional Planning Policy. Information contained in the SFRA will provide evidence to facilitate the preparation of robust policies for flood risk management. The SFRA should be used to inform the SA of LDDs and will enable informed decisions to be made relating to land use and development allocation within the respective DPDs.

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

2.2 Planning Policy Framework

The UK planning system has a comprehensive hierarchy of policies and plans, beginning with national guidance which provides a broad framework for regional plans through to development plans at the local level. Development plans are intended to provide clear guidance for prospective developers. They are prepared following public and stakeholder involvement and are intended to reconcile conflicts between the need for development and the need to protect the wider built and natural environment.

The Government is currently implementing reforms to the planning system with Planning Policy Statements (PPS) replacing Planning Policy Guidance (PPG), Regional Spatial Strategies (RSS) replacing Regional Planning Guidance (RPG) and Local Development Frameworks (LDF) replacing Structure and Local Plans and Unitary Development Plans.

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

2.3 National Planning Policy

2.3.1 PPS1: Creating Sustainable Communities (2005)

PPS1 sets out the Government's objectives for the planning system. It confirms that good planning should deliver the right development in the right place and time, and protect the environment. It identifies sustainable development as the core principle underpinning planning and requires that development plans ensure it is pursued in an integrated manner.

2.3.2 PPS3: Housing (2006)

PPS3 has been developed in response to recommendations in the Barker Review of Housing Supply (March 2004). Its principal aim is to underpin the necessary step change in housing delivery, improving the supply and affordability of housing in all communities including rural areas.

PPS3 states that the Government's key housing policy goal is to ensure that everyone has the opportunity of living in a decent home, which they can afford, in a community where they want to live. The specific outcomes that the planning system should deliver are:

- Well designed, high quality housing that is built to a high standard
- A mix of market and affordable housing for all households in all areas
- A sufficient quantity of housing, taking into account need and demand and seeking to improve choice
- Housing developments in suitable locations offering a good range of community facilities and with good access to jobs, key services and infrastructure
- A flexible, responsive supply of land; which is used efficiently and effectively, including the use of previously developed land

Housing policies should help to deliver sustainable development objectives, in particular seeking to minimise environmental impact taking account of climate change and flood risk, and take into account market information, in particular housing need and demand.

2.3.3 PPG4: Industrial, Commercial Development and Small Firms (1992)

PPG4 states that one of the Government's key aims is to encourage continued economic development in a way which is compatible with its stated environmental objectives. Economic growth and a high quality environment have to be pursued together. The Environment White Paper "This Common Inheritance" (Cm 1200) emphasised this relationship when it said that:

"Economic growth is not an end in itself. It provides us with the means to lead better and fuller lives. There is no contradiction in arguing both for economic growth and for environmental good sense. The challenge is to integrate the two."

Responsibility for the environment is not solely the preserve of central and local government. The planning system plays an important role integrating environmental and economic objectives. Development plans provide the policy framework, weighing the importance of industrial and commercial development with that of maintaining and improving environmental quality. The principles of sustainable development require the responsible use of man-made and natural resources by all concerned in a way that ensures that future generations are not worse off. Careful attention to environmental issues makes good economic sense for business and industry.

2.3.4 PPS9: Biodiversity and Geological Conservation (2005)

PPS9 sets out policies on protection of biodiversity and geological conservation through the planning system. The broad aim is that development should have minimal impacts on biodiversity and geological conservation interests and enhance them where possible. Appropriate weight should be attached to the need to protect international and national designated sites.

2.3.5 PPG15: Planning and the Historic Environment (1994)

PPG15 sets out policies on the protection of the historic environment and recognises that planning plays an important role in preserving built and natural heritage.

2.3.6 PPG17: Planning for Open Space and Recreation (2002)

PPG17 recognises the importance that public open spaces, green areas and recreational rights of way can play in supporting regeneration and contributing to local quality of life.

2.3.7 PPS25: Development and Flood Risk (2006)

PPS25 sets out a plan led approach to flood risk. It confirms that all forms of flooding and their impact on the natural and built environment are material planning considerations. It clarifies the Sequential Test, a process that matches types of development to degrees of flood risk and strengthens the requirement to include FRAs at all levels of the planning process. Regional planning bodies and local planning authorities (LPA) should, inter alia, reduce flood risk by safeguarding land from development that is required for current and future flood management e.g. conveyance and storage of flood water and flood defences.

2.3.8 Town and Country Planning Amendments

Amendments to the Town and Country Planning (General Development Procedure) Order 1995 came into force on 1 October 2006 introducing further requirements for LPA to consult the Environment Agency before determining applications for development in flood risk areas.

The Town and Country Planning (Flooding) (England) Direction 2007 was published in December 2006. To safeguard against inappropriate development in flood risk areas, it introduces a requirement for LPAs to notify the Secretary of State of any application for major development (e.g. 10 or more dwellings) in a flood risk area which it proposes to approve against Environment Agency advice. The Direction came into force on 1 January 2007.

2.4 Regional Planning Policy

Regional planning policies provide the overarching framework for the preparation of the LDF. Regional Planning Guidance for the West Midlands (RPG11) was published in June 2004 but under the Planning and Compulsory Purchase Act 2004, RPG11 was automatically replaced by a new Regional Spatial Strategy for the West Midlands. The purpose of the West Midlands Regional Spatial Strategy (WMRSS) is to provide a long term land-use and transport planning framework for the West Midlands region. The WMRSS framework guides the preparation of local authority development plans and local transport plans. It determines (amongst other things) the scale and distribution of housing and economic development for each Local Authority within the region, investment priorities for transport and sets out policies for enhancing the environment. The WMRSS has been prepared by the West Midlands Regional Assembly and has been guided by the national policy framework provided by Planning Policy Guidance, particularly PPG11, and other key policy documents and plans including the National Sustainable Development Strategy.

The WMRSS was published in June 2004. In approving the document the Secretary of State identified a number of issues where further work was required. The WMRSS Revision is being carried out in three stages.

The WMRSS identifies Solihull as part of the Major Urban Areas (MUAs) within the West Midlands Region and states that more development opportunities will be created to retain and attract people

and investment, with particular emphasis given to the provision of high quality employment sites, the regeneration of centres and other opportunity areas. Within the MUAs improving transport is a significant aspect of improving the overall quality of life, a key issue for the spatial strategy. Enhancing accessibility and mobility, whilst improving environmental quality, are both vital components of urban renaissance. It has been acknowledged that Solihull, Coventry and Warwickshire can create an important growth engine for the region with links to the growing parts of the South-east and East Midlands regions. The WMRSS identifies East Birmingham and Solihull as an Urban Regeneration Zone within the Regional Economic Strategy to provide a focus for action in areas of need and provide substantial opportunities for change. The WMRSS also identifies Coventry, Solihull and Warwickshire as 'High-Technology Corridors' within which cluster developments, closely linked to the Region's critical research and development capabilities and advanced technologies will be promoted.

The West Midlands Regional Flood Risk Appraisal was produced in October 2007. The document was prepared to enable the West Midlands Regional Assembly to take flood risk into account when preparing the WMRSS and takes into account requirements of the original Brief and national guidance provided in PPS 25 and the accompanying Practice Guide Companion. The appraisal included profiling of the principal river systems and tributaries, consideration of flood risk in each Local Planning Authority area and production of Flood Risk Profiles in each area. For the Borough of Solihull, it was reported that there are no significant locations which are not defended against flooding to a satisfactory standard.

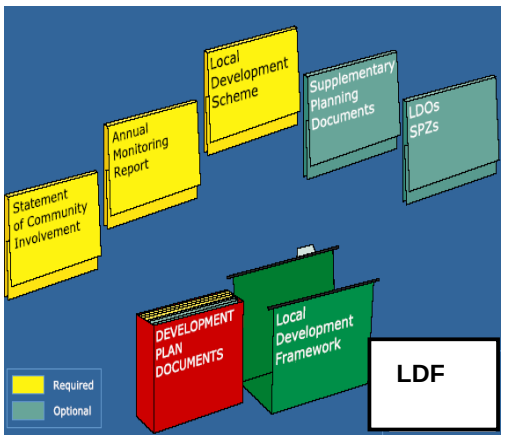
The "Development and Flood Risk" section of the WMRSS sets out the following in relation to Flood Risk Management:

> ***"8.42 The implications of climate change for the severity of floods is uncertain but the most realistic approach is to accept that flooding is an inevitable process. PPG25 [now PPS25] Development and Flood Risk sets out detailed guidance on how flood risk should be considered at all stages of the planning and development process, including a sequential approach to locating development. Local authorities should also consider local Environment Agency plans, Catchment Flood Management Plans and indicative floodplains (Quality of the Environment – Assets Diagram).***
>
> ***8.43 For the review of this RPG the RPB with the Environment Agency and other partners should identify where flooding issues are likely to be of Regional significance, assess their implications for the distribution of development and where appropriate, set out appropriate policies and measures to address them. This could include defining areas where sustainable drainage systems would best contribute to reducing flood risk, and improving water quality where the need to improve the performance of the floodplain, attenuate flows and provide local treatment of polluted run-off is greatest. However it should be borne in mind that sustainable drainage systems are unlikely to provide the complete answer to problems associated with large-scale river flooding episodes; in the longer term they can help attenuate flows and reduce the risk of flooding in urban areas downstream.***
>
> ***8.44 When considering the possible risks, implications and steps needed to prevent general flooding affecting new development, the potential for sewer flooding should also be considered by developers and planning authorities. Large new developments may require some new or updated infrastructure in the existing sewer network and treatment works in order to cope with the***

additional load. Sustainable drainage systems can, in the correct conditions, help alleviate sewer flooding problems by preventing surface water from entering the sewerage system."

2.5 Local Planning Policy

2.5.1 Local Development Framework



Existing development policies and proposals for Solihull are principally contained in the Solihull Unitary Development Plan (UDP) which was adopted in 2006. The Solihull UDP 2006 is the Council's statutory land-use plan which designates land to meet the Borough's housing and business requirements, contains policies that guide and control development, designates Green Belt and contains other policies on a range of issues such as transport, the environment, countryside, retail centres, recreation, mineral and waste. It also has a fundamental role of balancing the pressure for development against the need to protect the environment.

The Solihull UDP 2006 is the first review of the UDP adopted in 1997, and covers the period 2001-2011. Preparation of the 2006 UDP began in 1998 and, following a public local inquiry in 2004, the Plan was finally adopted in February 2006.

The planning system was revised in September 2004 and the Council's UDP policies and proposals will now gradually be replaced by a folder of different planning policy and proposal documents known as a LDF. Until such time as the UDP is replaced it will remain part of the LDF.

Within the LDF, DPDs will be produced e.g. the Core Strategy, site allocations documents and area action plans; supplementary planning documents and process documents (the Statement of Community Involvement, annual monitoring reports and the Local Development Scheme).

3 Study Methodology

3.1 Level 1 SFRA Methodology

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

a) Establishing relationships and understanding the planning context:

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

b) Gathering data and analysing it for suitability:

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

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

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

d) Providing suitable guidance

Sections have been written in the report providing guidance on policy considerations, the application of the Sequential Test, guidance for the preparation of FRAs and guidance for the application of Sustainable Drainage Systems (SUDS) in the study area. A planning workshop will also provide further guidance on the application of the Sequential Test. This will establish the principles of Sequential Test, provide mock Sequential Testing scenarios and help to develop broad policy recommendations.

3.2 Need for a Level 2 SFRA

Where the need to apply the Exception Test is identified, due to there being an insufficient number of suitably available sites for development within zones of lower flood risk or due to possible increases in

flood risk arising from climate change, the scope of the SFRA may need to be widened to a Level 2 assessment.

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

Level 2 SFRA outputs include:

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

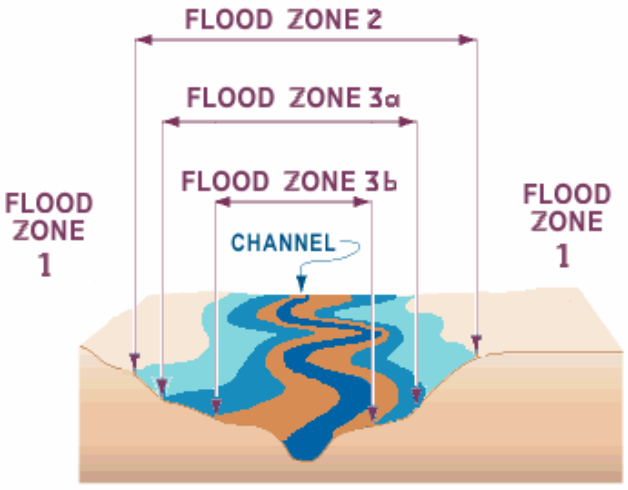
In general, the Level 2 SFRA should aim to provide clear guidance on appropriate risk management measures for adoption on sites within Flood Zone 3, which are protected by existing defences. This should minimise the extent to which individual developers need to undertake separate studies on the same problem. The scope of a Level 2 SFRA cannot be fully determined until the Sequential Test has been undertaken by each Council on all possible site allocations.

3.3 Technical Background

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

3.3.1 Flood Zones

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



PPS 25 defines the Flood Zones as follows:

Zone 1: Low Probability

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

Zone 2: Medium Probability

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

Zone 3a: High Probability

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

Zone 3b: The Functional Floodplain

This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone where possible (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes).

Flood Zone maps in this SFRA have been produced from two sources: Environment Agency Flood Zone maps, published and updated quarterly in their website, and detailed local hydraulic modelled outlines.

3.4 Environment Agency Flood Zone maps

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

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

The Environment Agency flood maps do not show the functional floodplain, Flood Zone 3b, which is a recent PPS 25 requirement.

4 Flood Risk in the Study Area

4.1 Approach to Data Gathering

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

Consultation has formed a key part of the data gathering stage of the SFRA. The above stakeholders were consulted during the SFRA and as part of the consultation process, an Inception meeting was held to allow key stakeholders to share their experience and knowledge of flooding issues across the study area. The benefits of adopting a partnering approach (as advocated by PPS25) are significant and have helped to ensure that the findings and recommendations of the SFRA are relevant and workable for the Council.

4.2 Historical Flooding

Recent years have seen a number of large scale flood events throughout the UK including October 1998, autumn 2000, February 2002, New Year 2003, February 2004 and more recently summer 2007. There is only one historic flood outline which has been produced by the Environment Agency for the Borough, and this pertains to the December 1992 event (Volume 2, Tiles E1-E2). A small area of the north-eastern end of the Borough was affected by a flood event on the River Blythe. This only affected the river's floodplain and did not encroach upon any properties.

During summer 2007 England experienced the wettest three months to the end of July since records began, with at least twice the average rainfall falling across parts of the country. The extreme conditions led to large scale urban and rural flooding across south-west England, north-east England and the Midlands. Much of the flooding was from a combination of surface water and fluvial flooding.

Records of flooding received from the Borough Council indicate that blockages to culverts were a big issue throughout the Borough which resulted in localised flooding in some locations.

4.3 Fluvial Flood Risk in Solihull Metropolitan Borough as defined by Flood Zone maps

Within the Metropolitan Borough of Solihull there are a number of urban areas that are at least partially contained within Flood Zone 2. The Environment Agency Flood Zone maps provide an indication of the locations at risk from fluvial sources within the Borough.

A number of properties are located within the Environment Agency Flood Zone 2 along the River Cole at Fordbridge (SP 1722 8787) and the Kingshurst Brook in the northern extent of the Borough to the west of Chelmsley Wood. Both commercial and residential properties are located within Flood Zone 2 along the Low Brook to the south-west of Chelmsley Wood as the watercourse flows through Birmingham International Airport and towards the confluence with Kingshurst Brook. However it should be noted that the flood outlines appear to be misaligned in places along the Low Brook and therefore caution should be taken when interpreting the information.

Flood Zone maps for the Hatchford Brook, Westley Brook and an unnamed tributary in the north-western corner of the Borough indicate that a substantial number of properties are located within Flood Zone 2. Analysis of the Flood Zone maps at these locations indicate that the flood outlines appear to be misaligned in places and therefore caution should be taken when interpreting the information.

The River Blythe flows through the centre of the Borough in a north-westerly then northerly direction. The Flood Zones extend predominantly into agricultural land incorporating a number of isolated farms as the watercourse flows through the Borough. A number of properties are also located within Flood Zone 2 adjacent to Cheswick Green (SP 1257 7564) and at the eastern edge of Solihull (SP 1633 7878).

In the south of the Borough, Flood Zone maps are available for three tributaries of the River Blythe including the Cuttle Brook and two unnamed tributaries. The Flood Zone maps extend predominantly into agricultural land, with only a few isolated buildings located within Flood Zone 2. It should be noted that the flood outlines appear to be misaligned in places and therefore caution should be taken when interpreting the information.

4.4 Flooding from Other Sources

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

4.4.1 Flooding from Artificial Drainage Systems and Surface Water Runoff

All Water Companies have a statutory obligation to maintain a register of properties/areas which are at risk of flooding from the public sewerage system, and this is shown on the DG5 Flood Register. This includes records of flooding from foul sewers, combined sewers and surface water sewers which are deemed to be public and therefore maintained by the Water Company. The DG5 register tends to show, to a greater or lesser extent: the date of the most recent incident, the post town, locality, street, post code, a type and problem description, if internal flooding occurred, details of curtilage flooding, and the eastings and northings of the flood incident. The recording of flood events by the authorities has often led to improvements intended to prevent reoccurrence, so historical flooding is not necessarily evidence of propensity for future flooding. Information on flooding caused by surface water runoff can also be obtained from local government, the Highway Authorities / Agency and the Environment Agency.

Information on flooding from surface water and artificial drainage sources has been provided by Severn Trent Water (STW) in the form of four digit postcode locations as recorded within their DG5 Flood Register. This information has been digitised and represented as post code areas within a GIS layer. Where a flooding incident has been recorded the whole area is shown as at risk and due to data protection requirements it is not possible to specify the exact location of the incident. Therefore, when the information is displayed on the paper maps the majority of the Borough appears to be affected by flooding, when in fact there may only be 1 property at risk within that particular postcode area. It was therefore decided not to display the affected postcode areas on the paper maps. Instead, a digital GIS layer has been provided which allows the user to view the data within a GIS

package and by clicking on a post code area establish the numbers of properties affected within each area. This can be found on the data CD attached to the front cover of this report.

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

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

- Properties / areas at risk of flooding twice in ten years or more are added to the 2 in 10 year (2:10) register
- Properties / areas at risk of flooding once in ten years but less than twice in ten years are added to the 1 in 10 year (1:10) register
- Properties / areas at risk of flooding more than once in twenty years but less than once in ten years are added to the 1 in 20 year (1:20) register
- Properties / areas at risk of flooding on a greater than 20 year return period are added to the 1:>20yr register

Within the Solihull Borough there are twenty nine postcode areas identified as at risk of flooding from artificial drainage systems and surface water runoff. Due to the implications of the Data Protection Act on the data held on the DG5 flood register, this report cannot pin-point the exact locations of properties at risk; however, the numbers of properties affected within each post code area has been identified and detailed in the table overleaf. The Environment Agency has asked that, should development take place in these areas, further work should be carried out to investigate the nature and scale of the risk posed, so that mitigation can be put in place and the areas can be targeted through appropriate policies for reducing flood risk.

Flooding From Artificial Sources as Recorded in Severn Trent DG5 Register

Postcode Area	No. Properties Affected
B36 0	1
B36 9	2
B37 6	3
B37 7	1
B46 1	1
B46 3	2
B90 1	3
B90 2	5
B90 3	1
B90 4	2
B91 1	37
B91 2	13
B92 0	4
B92 7	7
B92 8	11
B92 9	1
B93 0	2
B93 8	3
B93 9	3
B94 5	2
B94 6	4
CV35 7	4
CV4 8	1
CV4 9	1
CV5 7	5
CV5 9	1
CV7 7	15
CV7 8	4
CV8 1	32

It is evident from the table above that flooding from artificial sources occurs throughout the majority of the Solihull Borough. The post code areas with the most reported incidents were towards the western extent of the Borough (post code areas: B91 1, B91 2, B92 8 and CV8 1) and towards the eastern extent of the Borough within post code area CV7 7 (15 reported incidents) and CV8 1 (32 reported incidents. It should be noted that only a small percentage of post code area CV8 1 is actually located within the Borough of Solihull, and due to data protection requirements it is not possible to establish how many of the properties at risk are actually located within the Borough.

Severn Trent Water has stressed that Local Planning Authorities should adopt a planning policy requiring the use of Sustainable Drainage Systems (SUDS) as proposed in PPS25 and that PPS25 should be used to allocate land for development within Flood Zones so that the risk of fluvial flooding is minimised. This reduces the risk of fluvial flood waters entering public foul and surface water

sewers and resultant widespread flooding and pollution. Individual developments should be designed so that natural flood pathways are left free of buildings. Further guidance on the application of SUDS can be found in Section 11, and in the CIRIA Report C635, Designing for Exceedance in Urban Drainage (2006).

4.4.2 Flooding from Impounded Water Bodies

Records of flooding from reservoirs and canals are erratic as there is no requirement for the Environment Agency to show historic flooding from canals and raised reservoirs on plans. In particular, PPS 25 does not require flood risk from canals and raised reservoirs to be shown on the flood map. This is surprising, as overflows from canals are common due to flows from land drainage and their frequent lack of overflows. Occasionally major bank breaches also occur, leading to rapid and deep flooding of adjacent land.

Two canals are located within the Borough of Solihull: the Grand Union Canal and the Stratford-upon-Avon Canal. Consultation with British Waterways (BW) has indicated that there is one record of a canal breach within the Borough of Solihull on the Grand Union Canal by Copt Heath (SP 1829 7802). This breach occurred on the 20th November 1997 and was thought to be caused by a farmer excavating the toe of an embankment resulting in a 65m slope failure.

It is however important that canals are included in any SFRA as they form a vital land drainage function. Any FRA should therefore take account of canals. Not only do canals occasionally overtop in places due to high inflows from natural catchments (i.e. where inflows are higher than the capacity of the flood control structures), but they are also vulnerable where overtopping occurs from adjacent water courses. Additional water from adjacent watercourses must be routed/conveyed by the canal which may cause issues elsewhere, not only within the catchment of interest but also in neighbouring catchments, as the canal crosses catchment boundaries. Additionally, the canal itself can reduce flood risk where BW control flood flows within the canal, or accept flood waters either for temporary storage or transfer.

At present canals do not have a level of service for flood recurrence, although BW, as part of its function, will endeavour to maintain water levels to control the risk of flooding from canals to adjacent properties. It is important, however, that any development proposed adjacent to a canal be investigated on an individual basis regarding flooding issues and should be considered as part of any FRA.

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

Consultation with the Environment Agency indicated that two reservoirs are held on the Environment Agency's register. These are: Olton Reservoir (SP13500 81600) and Pendigo Lake (SP19300 83500). Investigation into the history of these reservoirs did not uncover any records of breach or overtopping. Analysis of OS Maps has indicated that there are a number of water bodies towards the eastern extent of the Borough to the east of Hampton in Arden. These bodies of water are on sand and gravel pits or within farm land. No information regarding historic breaching or flooding from the bodies of water was found as part of this study.

4.4.3 Flooding from Groundwater

The Environment Agency can monitor groundwater levels using boreholes and the records of these are held on the WISKI database. Both the Environment Agency and planning authorities can keep records of instances where a high water table has led to individual groundwater flooding events.

Consultation with the Environment Agency has suggested that there are no known problems with flooding from groundwater within Solihull Metropolitan Borough.

5 Strategic Flood Risk Mapping

5.1 Strategic Flood Risk Maps

A key output of the SFRA is a series of maps covering the LPA area, showing flood risk from sources including fluvial, surface water, foul and combined sewers, groundwater and impounded water bodies such as rivers and canals. The maps use the information detailed in section four. The strategic flood risk maps are presented as GIS layers, and can be interrogated to gain the associated descriptive information. These can be found in the CD attached to this report.

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

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

In the absence of a Flood Zone 3b outline, the implications of assuming Flood Zone 3b is equal to Flood Zone 3a can be summarised in the following example. PPS 25 says that 'more vulnerable' developments, such as a housing development, can be placed in Flood Zone 3a provided it passes the Exception Test, but cannot be placed in Flood Zone 3b. If such a development was placed in Flood Zone 3a following the Sequential Test, further modelling work would have to be carried out as part of a Level 2 SFRA to define the extent of Flood Zone 3b, thereby defining the area where the development could not be placed. In the event that detailed modelling work is not possible, the LPA should assume that Flood Zone 3b extends to the 3a extent, and should therefore remove the development from this area. Should a developer wish to prove otherwise, it is at this stage that developer contributions can be given in order to carry out further modelling work. Such a scenario would be expected in an area where the development pressures are significant and there is little other developable land in lower risk areas.

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

5.1.1 Hydraulic (River) Models

River models have been collected and used for the production of the SFRA flood maps. Within the Borough of Solihull, two Environment Agency hydraulic models are known to exist: the River Cole and River Blythe.

The River Cole model covers the whole of the Main River Cole channel within the northern extent of the Borough from the point at which the watercourse enters the Borough at the north-western extent close to Babb's Mill (SP 1616 8774) to the point at which it exits the Borough to the east of Fordbridge at SP 1837 8799. The hydraulic model does not extent as far upstream as the River Cole as it flows through Solihull Lodge. Modelled flood outlines for the River Cole were provided by the Environment Agency for Flood Zones 2 and 3. These have been used in preference to the current Environment Agency Flood Zones for Flood Zones 2 and 3. In addition, mapped outlines for Flood Zone 3b have been used to produce the Flood Zone 3b outline for the River Cole. This is in line with the current guidelines outlined in PPS 25.

The River Blythe model covers the whole of the Main River Blythe channel within the Borough from Earlswood Lakes (SP 1150 7430) to point at which the watercourse exits the Borough at its boundary with North Warwickshire Borough Council to the east of the National Exhibition Centre (SP 2137 8320). No modelled flood outlines were provided for this watercourse. Therefore the current Environment Agency Flood Zones were used for the SFRA maps.

5.2 Climate Change Maps

PPS 25 sets out guidance for changes to flood risk as a result of climate change and this is shown overleaf. These climate change scenarios are now included in most Environment Agency river models and flood outlines are produced; for older river studies this is less likely.

The main Climate Change table (adapted to demonstrate effects on rivers) from PPS 25 is shown below:

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

In its November 2006 publication of the predicted effects of climate change on the United Kingdom, DEFRA described how short duration rainfall could increase by 30% and flows by 20%, and suggests winters will become generally wetter. These effects will tend to increase both the size of Flood Zones associated with the sea and rivers, and the amount of flooding experienced from "other sources".

Modelled flood outlines for the River Cole model were provided for the 100 year return period increased by 20% (the current recommended means of representing the climate change within hydraulic models). These have been used in preference to the current Environment Agency Flood Zones for the climate change scenario. For models where no climate change outlines have been produced, analysis of other modelled scenarios has been undertaken to assess their suitability for use

as a climate change proxy. In general our past experience has shown that the 1 in 1000 or 1 in 200 year outlines often show similar extents to the climate change scenarios of the 100 year event.

For watercourses where models do not exist, the most up-to-date Environment Agency Flood Zone maps have been used. A 1 in 100 year climate change scenario has been produced by assuming that Flood Zone 2 (1 in 1000 year return period) will become Flood Zone 3 (1 in 100 year return period). We have also assumed that the functional flood plain (3b - 1 in 20 year return period) will become Flood Zone 3a (1 in 100 year return period). This is a precautionary approach but one which is consistent with our past modelling experience, which has shown that the 1 in 1000 year flood outline is often similar to the climate change scenario for the 100 year event. PPS 25 requires that present day Flood Zone maps are used to carry out the Sequential Test. However the LPA might wish to use the climate change maps to carry out the Sequential Test, in order to give a particularly long-term risk-based approach to planning.

This is the level of detail which PPS25 requires for a Level 1 SFRA, and gives an indication of how Flood Zones and flood probabilities are likely to change over time. The climate change scenarios are provided in Volume 2, Tile C1.

6 Flood Warning Systems and Flood Risk Management Measures

6.1 Flood Risk Management

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

6.1.1 Catchment Flood Management Plans

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

River Trent CFMP

The River Trent CFMP is currently being undertaken for the River Trent catchment and at the time of production of this SFRA, the document had been released for consultation (closing 28th January 2008). The study considers flooding over an area covering the River Trent catchment and all of its tributaries, which is a total area of over 10,000 square kilometres. The document gives an overview of flood risk in the River Trent catchment and sets out a preferred plan for sustainable flood risk management over the next 50 - 100 years. The document is currently in draft form and therefore it is possible that changes will be made to the text referred to below. The current draft and final document will be available on the Environment Agency's website.

The Environment Agency and their partners have developed policies to manage flood risk in the future. These policies set our the direction flood risk management will take in the future, and will help achieve their vision for a more sustainable, cost effective and natural approach to managing flood risk. The policies are detailed overleaf.

Trent CFMP Policy Options

Policy option	Policy
1	No active intervention (including flood warning and maintenance), Continue to monitor and advise
2	Reduce existing flood risk management actions (accepting that flood risk will increase over time).
3	Continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from this baseline).
4	Take further action to sustain current scale of flood risk in the future (responding to the potential increases in flood risk from urban development, land use change, and climate change
5	Take further action to reduce flood risk (now and in the future)
6	Take action to increase the frequency of flooding to deliver benefits locally or elsewhere, (which may constitute an overall flood risk reduction, for example for habitat inundation).

The Trent catchment and its tributaries has been divided into 10 policy units. Each policy unit has been assessed to decide which policy will provide the most appropriate level and direction of flood risk management for both now and the future. Out of the six standard flood risk management policies listed above, one has been applied to each policy unit. These policies have been agreed nationally and are being applied to CFMPs in a standard way across England and Wales.

The allocation of the policies to each unit involved the review of large amounts of information, alongside feedback and extensive consultation and consideration was given to how the policy units would interact with each other. The policy units of importance to this SFRA for Solihull Borough Council are policy units 6 and 10.

Policies were chosen on how well the policy actions would meet catchment objectives, the tables below provide a summary of the main factors considered when selecting the most appropriate policy option for each of the policy units. The section also indicates likely consequence of implementing each policy.

Relevant Trent CFMP Policy Units for Solihull

Policy unit 6	**Mid Staffs and Lower Tame**
Problem / risk	**Physical characteristics:** • South-east Lowland area of upper Trent is predominately pasture with open arable areas, wooded heights above the wide, shallow central valley. Arden area wooded farmland landscape with rolling hills. North eastern industrial area based around former Warwickshire coalfield. Lower broad flat flood plains of the Tame and Trent confluence. • Triassic mudstones dominate the geology within this Policy Unit. • Soil Predominantly loamy with small areas of sandy soil. Area vulnerable to high run-off rates and soil erosion. • Cannock Chase Area of Outstanding Natural Beauty (AONB). Area of high sandstone heather and bracken heathland with birch woodland and extensive pine plantations.
	Flood mechanism: • The watercourses within the policy unit are relatively natural with few flood defences. Flooding occurs as a result of overtopping banks or embankments.
	Receptor (Areas affected): • Main towns at risk are Rugeley, Tamworth and Rocester. • SAC – Pasturefields Salt Marsh, River Mease. • SSSI – Whitacre Heath, Middleton Pool, Alvecote Pools, Blithfield Reservoir, River Blythe. • NNR – Chartley Moss • Landscape designations: Cannock Chase – Area of Outstanding Natural Beauty (AONB)
	Flood risk: • Flood risk is assessed as generally low, but medium at Tamworth due to the number of relatively high number of properties located behind the existing defences. **Potential source of future flood risk** • Climate change • Land use change • Urbanisation

	Opportunities and constraints: ***Opportunities:*** • Improved efficiencies and more effective flood risk management. • Flood risk reduction through changes in land management. • Improved efficiencies through more focused and targeted maintenance. • Utilise disused aggregate workings for flood risk management. ***Constraints:*** • Large number of small settlements potentially at risk. • Existing aggregate extraction.
	Policy unit objectives: • Minimise disruption to people and communities caused by flooding in Tamworth and other smaller settlements along the Trent corridor, taking into account future climate change and development pressure. • Reduce the disruption caused by flooding to transport and infrastructure. • Sustain and protect cultural and social heritage in the policy unit. • Sustain and improve the status of environmentally designated areas through appropriate frequency, extent and duration of flooding, including using rivers and floodplains to benefit nature conservation. • Reduce soil erosion resulting from rapid surface water run-off, particularly where there has been significant ground disturbance caused by mining (Staffordshire) and where sandy soils are prone to erosion such as Cannock Chase. • Return watercourses to a more natural state, increasing biodiversity and opening up green river corridors through urban areas. • Sustain and increase the amount of BAP habitat in the catchment. • Support and encourage land management and drainage practices, particularly from Staffordshire coal mining areas that will protect and improve water quality.
Policy selected	**Policy option 6 -** Take action
Justification	Large rural area, with low flood risk (AAD = £17.8m). Future flood risk is unlikely to increase significantly in the future (Future scenario AAD = £26.9m) – main driver for change is climate change. Main source of flood risk is Tamworth which can be managed by attenuation

	elsewhere and by allowing more space for flood plain inundation through Tamworth itself. Flooding downstream in policy unit 5 (Burton, Derby and Nottingham) can be reduced in parts by applying policy 6 in this policy unit. Policy 6 meets policy unit objectives downstream in policy unit 5.
Alternative policies considered	Policy 1 - do nothing. The current level of management is considered justifiable to prevent an unacceptable increase in flood risk. Policy 2 – reduce current level of flood risk management. As with policy option 1, the potential damages and losses would be unacceptable under a 'do less' policy. Policy 3 – maintain current level of flood risk management. Although the current level of flood risk is considered acceptable, it has been shown that flood damages will increase in the future. Policy 4 – maintain the current level of flood risk into the future. The current level of risk is not considered excessive and so this policy is not justified.
Uncertainties and dependencies	This policy selection is largely dependant on our assessment of current and future flood risk being relatively low, and that more sustainable flood risk management options will be sufficient to maintain an acceptable level of flood risk within the policy unit. The success of this policy depends on being able to manage flood risk in Tamworth effectively.

Policy unit 10	**Birmingham and the Black Country**
Problem / risk	**Physical characteristics:** • This is the most heavily urbanised and populated area within the Trent catchment. Surface water and urban flooding from the drainage network are a concern. • Landscape dominated by urban development and associated urban edge landscapes. • Ground levels are relatively high in this policy unit where the River Tame rises south of Walsall and flows through Birmingham into the lower broad flood plains. • The predominant geology of the Tame catchment is Keuper Marl interspersed with Triassic Sandstone. Soil drainage is impeded by the loamy clay soil which overlies the geology and therefore quite a high percentage of the rainfall that falls on the catchment runs off.

	Flood mechanism: There is a range of complex flood mechanisms within this large urban policy unit. The main ones are: • Insufficient capacity of the Main Rivers passing through the urban areas, resulting in floodplain inundation, overtopping of embankments, surcharging of sewers and drains and by-passing intended flow routes into undefended areas; • Urban drainage systems being overwhelmed by heavy rain and rapid run-off from impervious surfaces; • The urban drainage system being unable to discharge into receiving watercourses due to high water levels; • Combined storm water and foul water systems being overwhelmed and spilling sewage into watercourses and into existing flood water.
	Receptor (Areas affected): • People, property, infrastructure, commerce and industry. • SAC – Fens Pools • SSSIs – Checkhill Bogs, Sutton Park.
	Flood risk: • Flood risk is assessed as high. **Potential source of future flood risk** • Climate change. • Land use change. • Urbanisation.
	Opportunities and constraints: ***Opportunities:*** • Long-term opportunities to move development away from the floodplain and create green river corridors through parts of Birmingham. ***Constraints:*** • Urban growth and development pressure.
	Policy unit objectives (section 5.1) • Minimise disruption to people and communities caused by flooding, taking into account future climate change and urban growth in the policy unit area.

	• Reduce the disruption caused by flooding to transport and infrastructure. • Reduce the cost of flood damage within the policy unit, particularly where it is high and may be economically viable, within Birmingham and the Black Country. • Promote and encourage urban drainage systems that will protect and improve water quality within the surrounding watercourses. • Sustain and increase the amount of BAP habitat in the catchment. • Return watercourses to a more natural state, increasing biodiversity and opening up green river corridors throughout the policy unit, particularly through city centre regeneration projects.
Policy selected	**Policy option 5 –** Take further action to reduce flood risk (now and/or in the future).
Justification	The level of current risk is high, potentially very high future flood risk. Action needs to be taken in the short term to reduce this level of risk.
Alternative policies considered	Policy 1 – do nothing. This policy would not recognise the need to reduce flood risk, currently considered unacceptable and with a significant increase in future flood risk likely. Policy 2 – reduce current level of flood risk management. As with policy 1, this policy would not recognise the need to reduce future flood risk, considered unacceptable now and with even more concerns for the future. Policy 3 – maintain current level of flood risk management. As with policy 1, this policy would not recognise the need to reduce flood risk. Policy 4 – maintain the current level of flood risk into the future. As with policy 1, this policy would not recognise the need to reduce flood risk. Policy 6 – increase flooding to reduce flood risk elsewhere. Although there are opportunities within this policy unit for this approach to reduce flood risk, there needs to be a range of measures to achieve a sustainable and effective overall solution. It is, therefore, considered more appropriate to select policy 5.
Uncertainties and dependencies	Accurately assessing flood risk throughout this policy unit would require a large & detailed study. Our CFMP assessment is based on a broadscale model and the coarse, low resolution SAR based DTM. Our results for flood damages are therefore indicative only. It is clear however that flood risk is high, supported by flood incident data and local catchment knowledge. This assessment underpins policy selection for this unit.

River Severn CFMP

The Severn Catchment Flood Management Plan (CFMP) is a document which aims to identify flood risk management policies for the Severn catchment. Being a high-level document, it does not stipulate how the policy should be achieved, but does indicate the types of response that could be implemented to deliver a policy. The excerpts referred to below are from the current Severn CFMP which was undertaken as a pilot project. The whole document is currently being revised and there are likely to be significant changes. The revised document is expected to be completed late 2008 and will be available through the Environment Agency's website.

The generic flood risk management policies which were considered for the Severn were:

- Do nothing – no active intervention, including flood warning and maintenance
- Do minimum – continue with maintenance of river channel and existing flood defences, including asset surveys and inspections, and continue with the existing flood warning service; it is accepted that flood risk may change over time. Activities such as promotion of local self help types of response and individual property protection would also continue
- Maintain the current level of flood risk in the face of future changes. This is likely to require intervention during the life of the Plan, such as improving existing flood defence infrastructure or introducing upstream storage
- Intervene to reduce the current level of flood risk and to maintain this level in the face of future changes
- Intervene to increase the level of flood risk in specified areas in order to gain benefits locally or elsewhere, for example flooding farmland upstream of a community to provide storage for floodwater.

For the purposes of the CFMP, the Severn catchment was divided into 20 sub-catchments. The sub-catchment(s) relevant to Solihull Metropolitan Borough Council are the Avon, however only a small part of the council boundary falls within this catchment.

Given the 50-year timescale of the Plan, and the potential effects of future change scenarios, policies for short and long term for each sub-catchment have been identified. Short term policies cover the first 10 years of the Plan period, while long term policies take into account future change scenarios and cover the remaining 40 years of the Plan.

The policies identified for these catchments are shown overleaf; more detail on how these could be achieved is contained in the report itself.

Catchment	Short Term Policy (0-10 years)	Long Term Policy (11 - 50 years)
Avon Defended areas	➢ Maintain current level of flood risk	➢ Maintain current level of flood risk
Avon North Littleton, Sedgeberrow	➢ Reduce current levels of flood risk	➢ Maintain the level of flood risk that will be obtained over the short term
Avon Remainder	➢ Do minimum	➢ Reduce level of flood risk for larger settlements ➢ Maintain current level of flood risk for smaller communities ➢ Recognise that the level of flood risk will increase for agricultural and undeveloped land and isolated properties

6.1.2 Flood Risk Management Strategies

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

River Trent Strategy

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

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

Nonetheless, the strategy identifies a number of options which are considered best practice and are recommended. These recommendations are supported by PPS 25 requirements and indeed the main messages of this SFRA, which considers these options in more detail. These include:

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

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

River Severn Strategy

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

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

6.2 Flood Defences

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

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

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

Within the Borough of Solihull no locations were identified within the Environment Agency NFCDD database that are currently protected by permanent defences. However, sections of culverted watercourse as identified within NFCDD have been demonstrated in Volume 2, Tiles A1-A3.

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

6.3 Residual Risk

Residual flood risks can arise due to:

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

Within the Borough of Solihull there are no Areas Benefiting from Defences (ABDs) contained within the Environment Agency's ABD database. There are however several major formal flood defences within the Borough. With each defence there is a residual risk of overtopping, breach or blockage, which could result in significant damage to buildings and highway infrastructure as well as posing danger to life. Information received from British Waterways has indicated that there is a risk of overtopping or breach of the Grand Union Canal by Knowle (SP 1830 7803). Although currently a predominantly rural area with no large residential areas or major infrastructure adjacent to the breach location, if any future development is proposed adjacent to the canal at this location the possibility of a breach occurring should be taken into consideration.

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

All culverts and defences are mapped in Volume 2, Tiles A1-A3. These should be referenced by those proposing development to identify the possibility of localised residual risks as well as opportunities for de-culverting and restoring the natural channel.

6.4 Storage Areas

No purpose-built storage areas have been identified within the Borough of Solihull area. However, it should be noted that it is imperative that any natural storage areas used as a means of attenuation of flood waters should be maintained to ensure their efficient operation during a flood event. If the storage areas are not maintained this may lead to an increased risk of flooding at locations downstream.

6.5 Existing Flood Warning System

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

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

A flood warning system is in operation for the Main Rivers within Solihull and is outlined below in four stages.

- **Flood Watch:** Flooding of low lying land and roads is expected. Be aware, be prepared, watch out! The following actions are recommended:
  - Watch water levels
  - Stay tuned to local radio or TV
  - Ring Floodline on 0845 988 1188
  - Make sure you have what you need to put your flood plan into action
  - Alert your neighbours, particularly the elderly
  - Check pets and livestock
  - Reconsider travel plans

Flood Watch Areas cover the entire Upper Trent and Severn areas, as can be seen in Volume 2, Tile F1. Flood Watches are issued for expected flooding, which could occur anywhere within the Flood Watch Area but with low or minor impact. The trigger for Flood Watch is a forecast that flooding of low impact land is expected.

Three flood watch areas are in operation within the Solihull Borough. These include:

- Midlands Central Area – Birmingham including Solihull, Walsall and Sandwell
- Midlands Central Area – Upper Avon Valley including Coventry, Rugby, Warwick and Leamington Spa

- Midlands Central Area – Lower Avon Valley including Stratford, Redditch, Evesham, Shipston and Alcester

- **Flood Warning:** Flooding of homes and businesses is expected. Act now! The following actions, in addition to those associated with Flood Watch, are recommended:
  - Move pets, vehicles, food, valuables and other items to safety
  - Put sandbags or floodboards in place
  - Prepare to turn off gas and electricity
  - Be prepared to evacuate your home
  - Protect yourself, your family and others that need your help

The flood warning areas in the Solihull Borough are illustrated in Volume 2, Tile F1. The service is currently set up to warn properties within the 1% Annual Exceedance Probability (1 in 100 year event) and the 0.1% Annual Exceedance Probability (1 in 1000 year event). The following locations are currently covered by the Environment Agency Flood Warning System:

- River Cole from Shard End to Coleshill
- River Blythe from Cheswick Green to Coleshill

- **Severe Flood Warning:** Severe flooding is expected. There is extreme danger to life and property. Act now! The following actions, in addition to those associated with Flood Warning, are recommended:
  - Be prepared to lose power supplies - gas, electricity, water, telephone
  - Try to keep calm, and to reassure others, especially children
  - Co-operate with emergency services and local authorities
  - You may be evacuated

- **All Clear:** Flood Watches or Warnings are no longer in force. The following is recommended:
  - Flood water levels receding
  - Check all is safe to return
  - Seek advice

6.6 Flood Response Plan

Solihull Metropolitan Borough's approach to providing emergency assistance during times of flooding is as follows:

- The Borough has no legal responsibility to provide assistance to residents during times of flood, however emergency assistance can be provided on an ad hoc basis depending on the situation

- The Borough will provide sandbags or other such equipment as appropriate, if they are available, to assist with the defence from flooding to persons or property within the area
- The Borough will keep a stock of filled sandbags during times of potential flooding to aid the speed of response. It is the responsibility of the property owner/occupier to dispose of the sandbags and their contents once they are satisfied the risk of flooding has subsided
- The Borough will provide engineering advice if requested on ways residents can alleviate the risk of flooding to their properties and issue general guidance to all properties in the area on their roles and responsibilities under the Land Drainage Act 1991. The Borough will provide, if possible, during times of severe flooding, engineering advice on site to assist with the use of resources and control the situation where appropriate.
- The Borough will assist with announcing Environment Agency flood warnings where appropriate. The Borough will keep the necessary equipment at their depot to carry out the above functions, or have facilities to get access to the appropriate equipment rapidly.
- Very serious flooding resulting in the need for evacuation of houses, provision of temporary accommodation and the like is covered by the Borough's Emergency Plan

At times of emergency, the Borough will be endeavouring to protect the public at large and is not be able to assist a large number of individual homeowners who may find their properties threatened.

The Council has an Emergency Plan in order to deliver services during a major incident. The plan contains details of actions to be taken following a request for assistance by the emergency services or the Council. The following are contained in the plan:

- Emergency call out list
- Flood Plan
- Severe Weather Warnings
- District Snow Plan
- Chemical/Biological Incident Plan
- Rest Centre Plan
- Media Plan

The emergency plan says that the Council:

- Provides a 24 hour emergency response, 365 days a year.
- Ensures that the effects of any incident are minimised.
- Advises and helps key organisations across the Borough create their emergency plans.
- Liaises and co-operates with the emergency services, voluntary organisations and neighbouring local authorities when preparing for and responding to emergencies.

- Makes sure that staff, residents and organisations across the Borough know about the role of the Council in an emergency.
- Ensures that our most critical services can keep going at times of disruption.

The Council advises that in an emergency, residents should keep themselves aware of what is happening by listening to local updates on the television or radio. Evacuation is only usually undertaken as a last resort during an emergency. If the decision to evacuate is taken, the Police will instruct local residents to go to a designated evacuation point. These are staffed by Council employees and volunteers, who will ensure that welfare needs are met.

It is recommended that the Council's Emergency Response Plan is reviewed and updated in light of the findings of the SFRA to ensure that safe evacuation and access for emergency services is possible during times of flood both for existing developments and those being promoted as possible sites within the LDF process. It is further recommended that the Local Authorities work with the Environment Agency to promote the awareness of flood risk to maximise the number of people signed up to the FWD service (previously this has involved targeted mail shots to those identified as living within Flood Zone 3a). Within the study area particular attention should be given to vulnerable people including those with impaired hearing or sight and those with restricted mobility.

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

How flood warning is to be provided:

- Availability of existing warning systems
- Rate of onset of flooding and available warning time and
- Method of dissemination of flood warning

What will be done to protect the infrastructure and contents:

- How more easily damaged items could be relocated
- The potential time taken to respond to a flood warning
- Ensuring safe occupancy and access to and from the development
- Occupant awareness of the potential frequency and duration of flood events
- Provision of safe (i.e. dry) access to and from the development
- Ability to maintain key services during an event
- Vulnerability of occupants and whether rescue by emergency services may be necessary and feasible
- Expected time taken to re-establish normal practices following a flood event

7 Flood Risk Management Policy Considerations

7.1 Overview

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

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

- **Planning Policy Statement 25: Development and Flood Risk** – sets out national policy for development and flood risk and supports the Government's objectives for sustainable communities.

- **River Trent Catchment Flood Management Plan** - strategic planning document through which the Environment Agency will work with other stakeholders to identify and agree policies for long-term flood risk management over the next 50 to 100 years. The Trent and Severn CFMPs have been issued in draft with consultation due to end in January 2008. It is recommended that the Council reviews its content once produced to ensure policies are in line with those outlined in the CFMP.

- **River Severn Catchment Flood Management Plan -** strategic planning document through which the Environment Agency will work with other stakeholders to identify and agree policies for long-term flood risk management over the next 50 to 100 years. The Severn CFMP is currently being revised and there are likely to be significant changes. The revised document is expected to be completed late 2008 and will be available through the Environment Agency's website. It is recommended that the Council reviews its content once produced to ensure policies are in line with those outlined in the CFMP.

- **Making Space for Water** - outlines the Government's proposals for forward planning of flood management over the next 20 years advocating a holistic approach to achieve sustainable development. The protection of the functional floodplain is central to the strategy.

- **Water Framework Directive** - European Community (EC) water legislation which requires all inland and coastal waters to reach good ecological status by 2015.

7.2 Policy Considerations

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

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

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

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

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

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

  - SUDS
  - Greenfield discharge rates with a minimum reduction of 20%, as required by the Environment Agency
  - 1 in 100 year on-site attenuation taking into account climate change
- Space should be specifically set aside for SUDS and used to inform the overall site layout
- Promote environmental stewardship schemes to reduce water and soil runoff from agricultural land

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

- An assessment of the condition of existing assets (e.g. bridges, culverts, river walls) should be made. Refurbishment and/or renewal of the asset should ensure that the design life is

commensurate with the design life of the development. Developer contributions should be sought for this purpose.

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

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

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

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

- Protect Greenfield functional floodplain from future development (our greatest flood risk management asset) and reinstate areas of functional floodplain which have been developed (e.g. reduce building footprints or relocate to lower flood risk zones)

- Develop appropriate flood risk management policies for the Brownfield functional floodplain, focusing on risk reduction

- Identify sites where developer contributions could be used to fund future flood risk management schemes or can reduce risk for surrounding areas

- Seek opportunities to make space for water to accommodate climate change

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

- Seek to improve the emergency planning process using the outputs from the SFRA

- Encourage all those within Flood Zone 3a and 3b (residential and commercial occupiers) to sign-up to Flood Warnings Direct service operated by the Environment Agency

- Ensure robust emergency (evacuation) plans are implemented for new developments greater than 1 Ha in size

7.3 Development Control Policies

For the purposes of development management, detailed policies will need to be set out to ensure that flood risk is taken account of appropriately for both allocated and non-allocated 'windfall' sites. The following reflects the minimum requirements under PPS25 (reference should be made to Tables D.1-D.3 in PPS25).

Future Development within Flood Zone 1

In this zone, developers and local authorities should realise opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development. There is no

significant flood risk constraint placed upon future developments within the Low Probability Flood Zone 1, although for sites larger than one hectare, the vulnerability from other sources of flooding should be considered as well as the effect of the new development on surface water runoff.

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

Future Development within Flood Zone 2

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

- A detailed site-specific FRA should be prepared in accordance with PPS25 and Council planning policies
- Floor levels should be situated above the 100 year plus climate change predicted maximum level plus a minimum freeboard of 300mm
- The development should be safe, meaning that dry pedestrian access to and from the development should be possible above the 1 in 100 year plus climate change flood level and emergency vehicular access should be possible during times of flood.
- SUDS should be implemented to ensure that runoff from the site (post development) is reduced. For all sites, the post development runoff volumes and peak flow rates should be attenuated to the Greenfield discharge rates with a minimum reduction of 20%, as required by the Environment Agency, for both Greenfield and Brownfield sites. Space should be set-aside for SUDS.
- The proposed development should be set-back from the watercourse with a minimum 8m wide undeveloped buffer zone, to allow appropriate access for routine maintenance and emergency clearance. This is an Environment Agency requirement.

Future development within High Probability Flood Zone 3a

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

- A detailed site-specific FRA should be prepared in accordance with PPS25 and Council planning policies. Properties situated within close proximity to formal defences or water retaining structures (reservoirs/canals) will require a detailed breach and overtopping assessment to ensure that the potential risk to life can be safely managed throughout the lifetime of the development. The nature of any breach failure analysis should be agreed with the Environment Agency.

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

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

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

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

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

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

Future development within Functional Floodplain Zone 3b

Development should be restricted to 'water-compatible uses' and 'essential infrastructure' that has to be there. Table D2 from PPS 25 (reproduced in Section 1.5.1 of this report) outlines the types of development included within this classification. It should be noted that 'essential infrastructure' includes essential transport infrastructure (including mass evacuation routes) which may have to cross the area at risk as well as strategic utility infrastructure such as electricity generating power station and grid and primary substations. Reference should be made to Table D2 of PPS 25 when considering development within Flood Zone 3b to ensure only appropriate development is considered. 'Essential infrastructure' in this zone must pass the Exception Test and be designed and constructed to remain operational in times of flood and not impede water flow.

7.4 Council Specific Policy Issues

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

7.5 Sensitive Development Locations

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

8 Guidance on the Application of the Sequential Test

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

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

The recommended initial step is to determine the extents of potential land allocations on large scale maps showing the most up-to-date Flood Zones, in accordance with PPS 25. Summary tables of flood risk issues should then be prepared for each location, indicating if the potential areas overlap Zones 2, 3, localised flooding areas or if there are records of previous flood incidents shown in the maps. It is then recommended that the summary tables and proposed locations are sent to the Environment Agency for verification. Particular care should be taken by identifying allocations that could increase flood risk elsewhere (flood incident points, localised flooding areas, Flood Zones) and lack of dry access.

8.2 Step Two: Flood Risk Issues in Zone 1

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

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

If a site with significant flood risk is identified within Zone 1, this would be considered as if it was in the High Probability Zone 3a, for further application of the Sequential Test in Zone 3a (see Section 9.3), bearing in mind that if a more vulnerable land use is required for the site, it will have to pass the Exception Test.

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

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

8.3 Step Three: Sequential Test in Zones 2 and 3

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

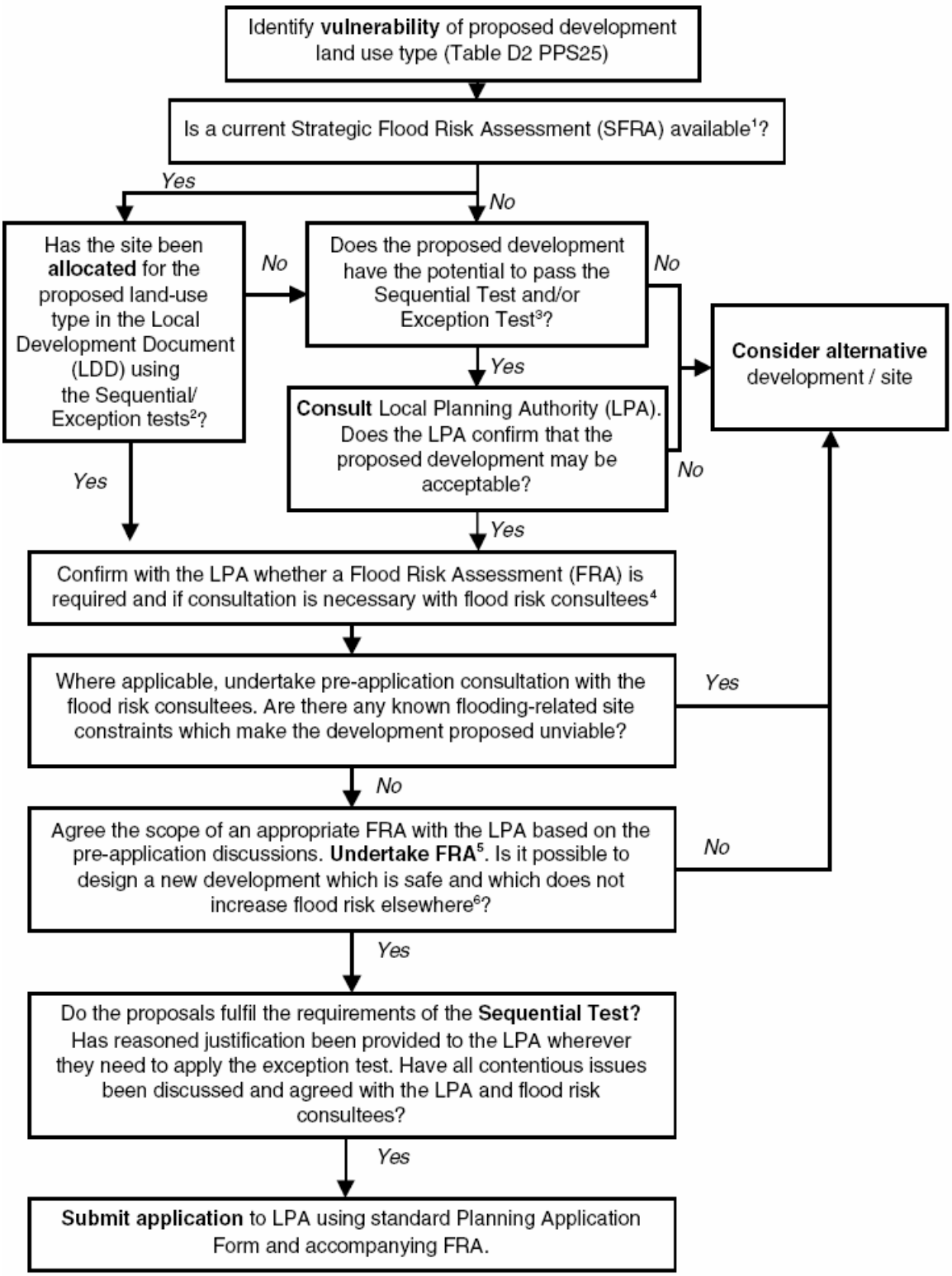
a) Apply the measure of avoidance/prevention (see Section 5.1) by moving the boundaries of the potential sites away from Zones 2, 3a and 3b, for those cases where the loss of site area is acceptable.

b) Provisionally adopting land uses that are fully compatible with the vulnerability classification of PPS 25, to try to avoid the need to apply the Exception Test where possible.

9 Guidance for Developers

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

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



Guidance for developers for individual planning applications

9.1.1 Proposed Developments within Functional Floodplain Flood Zone 3b

In line with PPS25, development will not normally be allowed in the Functional Floodplain unless it is classified as a 'water compatible' or 'essential infrastructure' use.

9.1.2 Proposed Developments within High Probability Flood Zone 3a

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

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

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

9.1.3 Proposed Development within Medium Probability Zone 2

For all sites within Medium Probability Zone 2, a scoping level FRA should be prepared based upon readily available existing flooding information, sourced from the Environment Agency. If a significant

flood risk from other sources (e.g. groundwater or sewer flooding) is identified then a more detailed FRA should be prepared. It will be necessary to demonstrate that the residual risk of flooding to the property is effectively managed throughout, for example, the provision of raised floor levels and the provision of planned evacuation routes or safe havens.

9.1.4 Proposed Development within Flood Zones 1 and 2

The risk of alternative sources of flooding (e.g. surface water, sewage, and/or groundwater) must be considered, and sustainable urban drainage techniques must be employed to ensure no worsening of existing flooding problems elsewhere within the area.

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

9.2 Raised Floor Levels and Basements (Freeboard)

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

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

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

The use of basements within flood affected areas should be discouraged. Where basements are permitted however, it is necessary to ensure that the basement access points are situated a minimum of 600 mm above the 1% probability flood level plus climate change. The basement must have unimpeded access and waterproof construction to avoid seepage during flooding conditions. Habitable uses of basements within Flood Zone 3 should not be permitted, while basement dwellings can be allowed in Flood Zone 2 provided they pass the Exception Test.

9.2.1 Development Behind Defences

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

Consideration of flood risk behind defences should be made as part of detailed FRAs. Developers should review Volume 2, Tiles A1-A3 to determine the location of structures and defences in proximity to the site and therefore identify the possibility of localised residual flood risk. The FRA should take into account:

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

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

9.2.2 Car Parks

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

9.3 Developer Contributions

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

10 Guidance for the Application of Sustainable Drainage Systems

10.1 Introduction

PPS1: Delivering sustainable development and PPS25 requires that LPAs should promote SUDS. LPAs should therefore include policies within their LDF to encourage sustainable drainage practices. SUDS is a term used to describe the various approaches that can be used to manage surface water drainage in a way that mimics the natural environment. The management of rainfall (surface water) is considered an essential element of reducing future flood risk to both the site and its surroundings. Indeed, reducing the rate of discharge from urban sites to Greenfield runoff rates is one of the most effective ways of reducing and managing flood risk within the Borough.

10.2 Types of SUDS Systems

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

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

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

There are numerous different ways that SUDS can be incorporated into a development. The appropriate application of a SUDS scheme to a specific development is heavily dependent upon the topography and geology of the site and the surrounding areas. Careful consideration of the site characteristics is necessary to ensure the future sustainability of the adopted drainage system. When designing surface water drainage systems, the Environment Agency states that climate change should be taken into account appropriate to the predicted lifetime of the development, and designed to account for the predicted increases in rainfall intensity, as outlined in the table in section 3.5.

The most commonly found components of a SUDS system are described below:

- Pervious surfaces: Surfaces that allow inflow of rainwater into the underlying construction or soil.
- Green roofs: Vegetated roofs that reduce the volume and rate of runoff and remove pollution. They comprise a multi-layered system that covers the roof of a building or podium structure with vegetation cover/ landscaping/ permeable car parking, over a drainage layer. They are designed to intercept and retain precipitation, reduce the volume of runoff and attenuate peak flow.

- Filter drains: Linear drains consisting of trenches filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage, to store and conduct water; they may also permit infiltration.
- Filter strips: Vegetated areas of gently sloping ground designed to drain water evenly off impermeable areas and to filter out silt and other particulates.
- Swales: Shallow vegetated channels that conduct and retain water, and may also permit infiltration; the vegetation filters particulate matter.
- Basins: Ponds and wetlands areas that may be utilised for surface runoff storage.
- Infiltration Devices: Sub-surface structures to promote the infiltration of surface water to ground. They can be trenches, basins or soakaways.
- Bioretention areas: Vegetated areas designed to collect and treat water before discharge via a piped system or infiltration to the ground.
- Pipes and accessories: A series of conduits and their accessories normally laid underground, that convey surface water to a suitable location for treatment and/or disposal (although sustainable, these techniques should be considered where other SUDS techniques are not practicable).

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

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

- PPS 25
- Practice Guide Companion to PPS 25
- The SUDS Manual – CIRIA C697 (2007) provides the best practice guidance on the planning, design, construction, operation and maintenance of Sustainable Drainage Systems and facilitates their effective implementation within developments.
- CIRIA c644 – Green Roofs (2007) provides guidance on the design, construction and operation of Green Roofs. The guidance also describes how ‘quick wins’ for biodiversity can be achieved in the built environment by incorporating nesting and roosting boxes for birds, bats and other animals.
- Interim Code of Practice for Sustainable Drainage Systems, National SUDS Working Group, 2004
- www.ciria.org.uk/suds/

10.3 Application of SUDS for Solihull Metropolitan Borough Council

This Borough has predominantly slow permeable, seasonally wet, acidic loamy and clayey soils, with some areas of naturally high groundwater. In permeable sites, priority is given to infiltration drainage techniques, as opposed to discharging surface water to watercourses. Where less permeability is

found and infiltration techniques that rely on discharge into the existing soils are not viable (due to a high water table, source protection zones, contamination etc), discharging site runoff to watercourses is preferable to the use of sewers. Integrated urban drainage should also be used throughout the design process.

The entire Borough has been highlighted by DEFRA as a Nitrate Vulnerable Zone (NVZ) and no areas are classified as a Groundwater Source Protection Zone (GSPZ) by the EA. Any boreholes, water wells or other extraction points should be identified and taken into account in the design process.

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

Runoff which is likely to be heavily contaminated must be treated by a proprietary device, which should be carefully considered to ensure the correct system is selected to remove pollutants. PPS 3 (2006) states that source control SUDS must be considered and incorporated where suitable. For example; surface water drained from a car park should implement a filter bed wherever possible before considering an interceptor device to remove contaminants.

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

11 Recommendations

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

11.1 Site Allocation Process

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

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

11.2 Council Policy

It is recommended that for the purpose of clarity, a Supplementary Planning Document should be developed in light of the suggested policies and guidance notes, outlining the minimum requirement of the Environment Agency in response to PPS25.

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

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

11.3 Emergency Planning

It is recommended that the Council's Emergency Response Plans are reviewed and updated in light of the findings of the SFRA to ensure that safe evacuation and access for emergency services is

possible during times of flood both for existing developments and those being promoted as possible sites within the LDF process. It is further recommended that the Council works with the Environment Agency to promote the awareness of flood risk and encourage communities at risk to sign-up to the Environment Agency Flood Warning Direct service.

11.4 Future Updates to the SFRA

The SFRA should be retained as a 'living' document and reviewed on a regular basis in light of better flood risk information and emerging policy guidance. It is recommended that outputs from the following studies are used to update future versions of the SFRA report and associated maps:

- Final version of the Trent CFMP
- Second version of the Severn CFMP
- Future flood risk mapping studies
- Future flood risk management strategies

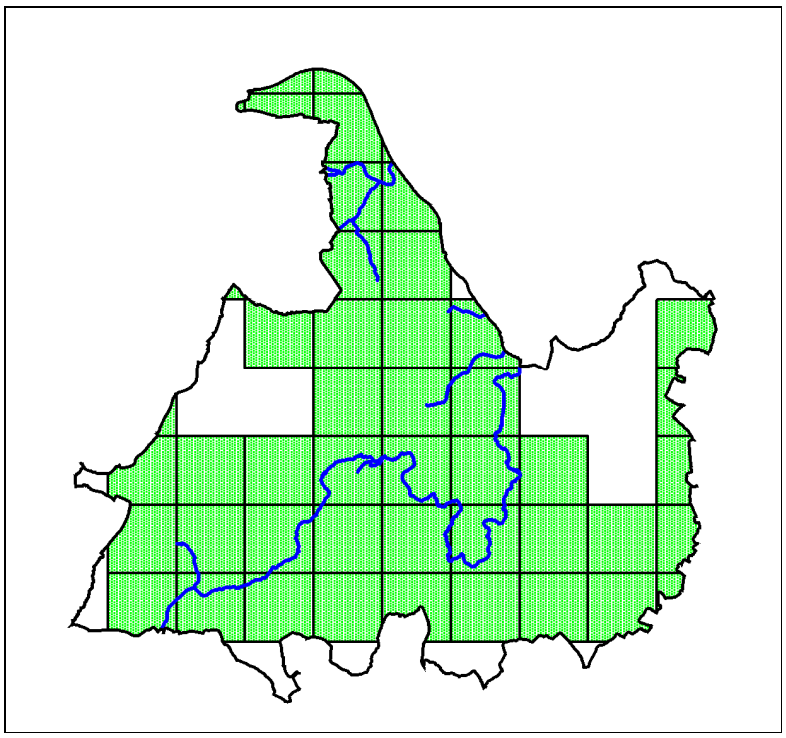
11.4.1 Missing or Incomplete Data

Data gaps have been assessed throughout the Level 1 SFRA data collection and review exercise. This has flagged the missing or incomplete data, which should be incorporated into the SFRA as it becomes available.

The following data has not yet been received or incorporated in the Level 1 SFRA. Receipt of this data will further refine the SFRA.

Data	Description	Source
Flood outlines	20year return period (or similar) flood outlines for all rivers except the River Cole. These would allow production of Flood Zone 3b	Environment Agency (this data does not yet exist)
Flooding Data	Flooding information for trunk roads within Borough	Highways Agency (pending)
LiDAR data	Topographical data required for breach scenarios	Environment Agency (pending)
FRA	Developers' Flood Risk Assessments	Solihull Metropolitan Council (pending)
CFMP	River Trent CFMP – Final Version	Environment Agency (Document in production)
CFMP	River Severn CFMP – Second version	Environment Agency (Document in production – expected to be complete late 2008)

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



11.5 Level 2 SFRA

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

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. If the DPD has reached the 'submission' stage (see Figure 4 of PPS12: Local Development Frameworks) the benefits of the development should contribute to the Core Strategy's SA
- The development should be on developable, previously-developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously-developed land

- A FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall

A Level 2 SFRA should be viewed as rather more site specific than a Level 1 SFRA, addressing flood risk to potential development sites which have gone through the Sequential Test and have been located in Flood Zones 2 or 3.

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

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

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

Level 2 SFRA outputs would include:

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

12 References/Glossary

1) **AEP -** Annual Exceedance Probability, for example 1% AEP is equivalent to 1% probability of occurring in any one year (or, on average, once in every 100 years).

2) **Core Strategy -** The Development Plan Document which sets the long-term vision and objectives for the area. It contains a set of strategic policies that are required to deliver the vision including the broad approach to development.

3) **DEFRA -** Department of Environment, Food and Rural Affairs.

4) **Development Plan Document (DPD) -** A spatial planning document within the Council's Local Development Framework which set out policies for development and the use of land. Together with the Regional Spatial Strategy they form the development plan for the area. They are subject to independent examination.

5) **Dry pedestrian egress -** Routes to and from buildings that will remain dry and allow pedestrian/wheelchair evacuation to dry land in times of flood.

6) **Environment Agency -** The leading public body for protecting and improving the environment in England and Wales.

7) **Environment Agency Flood Map -** Nationally consistent delineation of 'high' and 'medium' flood risk, published on a quarterly basis by the Environment Agency.

8) **Environmental Stewardship** - Environmental Stewardship is a new agri-environment scheme which provides funding to farmers and other land managers in England who deliver effective environmental management on their land. The scheme is intended to build on the recognised success of the Environmental Sensitive Areas scheme and the countryside Stewardship Scheme. Flood risk management is among its secondary objectives.

9) **Exception Test -** If, following application of the Sequential Test, it is not possible (consistent with wider sustainability objectives) to demonstrate that there are no reasonably available sites in areas with less risk of flooding that would be appropriate to the type of development or land use proposed, the Exception Test may apply. PPS 25 sets out strict requirements for the application of the Test.

10) **Flood Estimation Handbook -** The latest hydrological approach for the estimate of flood flows in UK.

11) **Flood Risk Management Hierarchy -** PPS 25 reaffirms the adoption of a risk-based approach to flooding by following stepped hierarchical measures at all stages in the planning process. Avoidance/prevention is the first measure, followed by substitution, control and then mitigation.

12) **Flood Risk Vulnerability -** PPS 25 provides a vulnerability classification to assess which uses of land maybe appropriate in each flood risk zone.

13) **Formal Flood Defence -** A structure built and maintained specifically for flood defence purposes.

14) **Functional Floodplain Zone 3b -** Defined as areas at risk of flooding in the 5% AEP (20 year) design event.

15) **Habitable Room -** A room used as living accommodation within a dwelling but excludes bathrooms, toilets, halls, landings or rooms that are only capable of being used for storage. All other rooms, such as kitchens, living rooms, bedrooms, utility rooms and studies are counted.

16) **High probability Zone 3a -** Defined as areas at risk of flooding in the 1% AEP (100 year) design event.

17) **IDB –** Internal Drainage Board, responsible for non-Main Rivers and drainage within their boundary area.

18) **Informal Flood Defence -** A structure that provides a flood defence function however has not been built and/or maintained for this purpose (e.g. boundary wall).

19) **JFLOW -** A computer river model based on routeing a flood calculated by Flood Estimation Handbook methodology along a river corridor the levels of which are derived from a Side Aperture Radar (SAR) remote sensed Digital Terrain Model.

20) **Land Swapping** - looking for long term opportunities to remove development from areas that flood at present and relocate in lower risk locations which is essentially restoration of the floodplain.

21) **LiDAR -** Light Detection and Ranging (LiDAR) is an airborne terrain mapping technique which uses a laser to measure the distance between the aircraft and the ground.

22) **Local Development Framework -** The Local Development Framework (LDF) consists of a number of documents which together form the spatial strategy for development and the use of land.

23) **Low Probability Zone 1 -** Defined as areas outside Zone 2.

24) **mAOD –** Metres above Ordnance Datum

25) **Main River –** A section of watercourse (including the structures and devices on it used to regulate flow) which is maintained by the Environment Agency.

26) **'Making Space for Water' (Defra 2004) -** The Government's new evolving strategy to manage the risks from flooding and coastal erosion by employing an integrated portfolio of approaches, so as: a) to reduce the threat to people and their property; b) to deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principles, c) to secure efficient and reliable funding mechanisms that deliver the levels of investment required.

27) **Medium probability Zone 2 -** Defined as areas at risk of flooding in events that are greater than the 1% AEP (100 year), and less than the 0.1% AEP (1000 year) design event.

28) **NFCDD –** National Flood and Coastal Defence Database, owned by the Environment Agency, containing details of the location, standard and condition of all Environment Agency maintained defences

29) **Ordinary Watercourse (non-Main River)** – Any section of watercourse not designated as a Main River.

30) **Planning Policy Statements -** The Government has updated its planning advice contained within Planning Policy Guidance Notes (PPGs) with the publication of new style Planning Policy Statements (PPSs).

31) **Planning Policy Statement 25 (PPS 25): Development and Flood Risk -** PPS 25 reflects the general direction set out in 'Making Space for Water'.

32) **Previously Developed (Brownfield) Land -** Land which is or was occupied by a building (excluding those used for agriculture and forestry). It also includes land within the curtilage of the building, for example a house and its garden would be considered to be previously developed land.

33) **Residual Risk -** The risk which remains after all risk avoidance, reduction and mitigation measures have been implemented.

34) **Return Period –** The probability of a flood of a given magnitude occurring within any one year e.g. a 1 in 100 year event has a probability of occurring once over 100 years. However, a 1 in 100 year event could occur twice or more within 100 years, or not at all.

35) **Sequential Test -** Informed by a SFRA, a planning authority applies the Sequential Test to demonstrate that there are no reasonably available sites in areas with less risk of flooding that would be appropriate to the type of development or land use proposed.

36) **Strategic Flood Risk Assessment (SFRA) -** A Strategic Flood Risk Assessment is used as a tool by a planning authority to assess flood risk for spatial planning, producing development briefs, setting constraints, informing sustainability appraisals and identifying locations of emergency planning measures and requirements for flood risk assessments.

37) **Supplementary Planning Document (SPD) -** Provides supplementary guidance to policies and proposals contained within Development Plan Documents. They do not form part of the development plan, nor are they subject to independent examination.

38) **Sustainability Appraisal (SA) -** Appraisal of plans, strategies and proposals to test them against broad sustainability objectives.

39) **Sustainable Development -** Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (The World Commission on Environment and Development, 1987).

40) **West Midlands Regional Spatial Strategy -** This is a new Regional Spatial Strategy which identifies the vision for the region. It will set a new housing requirement for each District or Borough.

APPENDIX A

Our ref: UT/2006/100274/BD-01/IC1-L03
Your ref: WBCSWC

Date: 21 January 2008

FAO Beccy Dunn,

Dear Madam,

COVENTRY, SOLIHULL AND WARWICKSHIRE STRATEGIC FLOOD RISK ASSESSMENT

Thank you for the e-mail dated 14 January 2008 and the subsequent telephone call regarding the amendments you intend to make to the above revised draft Strategic Flood Risk Assessment (SFRA).

We can confirm that the Environment Agency is satisfied with these amendments.

Yours faithfully

Miss Sarah Victor
Planning Liaison Officer

Direct dial 01543 404880
Direct fax 01543 444161
Direct e-mail sarah.victor@environment-agency.gov.uk

Halcrow
Lyndon House
62 Hagley Road
Edgbaston
Birmingham
B16 8PE

Our ref: UT/2006/100274/BD-01/IC1-L01
Your ref: WBCSWC

Date: 14 December 2007

FAO Beccy Dunn,

Dear Madam

COVENTRY, SOLIHULL and WARWICKSHIRE STRATEGIC FLOOD RISK ASSESSMENT

Thank you for consulting us of the above draft Strategic Flood Risk Assessment (SFRA) which was received 26 November 2007.

We have reviewed the information and wish to make the following comments:

All SFRAS

As much of the SFRAs are generic text we consider that a generic document with individual supporting documents for each council would be more useful. This would mean that only the supporting documents would have to be updated as more information became available, whilst the main generic document would introduce a consistent approach to flood risk for all the councils involved in this project and would only require alterations if there were changes in national planning policy.

1.2 Project Aims

The definition of a "safe" development only relates to safe pedestrian access and does not mention the safety of the development itself, or it's affect on downstream property. We would wish for this definition to be broadened.

3.4 Environment Agency Flood Zone Maps

The limitations of the Flood Zone outlines have still not been made clear in Appendix C, as per Sarah Mallett's e-mail of 4 Oct 07: -

The Agency's Flood zone maps do not show all minor watercourse flood plains, For any site (not just those over 1ha) adjacent to an unmapped watercourses (Shown as Flood zone 1) it is therefore necessary to undertake a site specific FRA to establish the true flood plain extent and flood risk to the site. The SFRA should therefore advise LPAs to look at extending the flood zone outlines on all watercourse in FZ1 shown on the 25k OS map,

particularly where these have been identified as being within potential development areas.

7.2 Policy Considerations

In principle we have no issues but think the wording could be clearer regarding runoff reductions;

Greenfield Rate or reduction of at minimum 20%

7.3 Development Control Policies

The issue of breach scenario as set out in part 1 of 'Future Development in Flood Zone 3' is relevant for all sites irrespective of the fluvial flood risk category and hence should be included in all the Flood Zone categories.

In Sections 7.3 and 9.1.1, it states that "essential infrastructure" can be located in flood zone 3b. We believe this needs further clarification. Transportation routes may have to cross river valleys and account would need to be taken for these circumstances however, development such as hospitals and police station in 3b may be deemed unacceptable.

10.2 Types of SUDS Systems
This section may also want to refer at the end to CIRIA c644 - Green Roofs and we would wish to see a requirement for SUDS in all cases not just sites over 1 hectare.

The Geological and Floodwatch areas on the mapping do not show up in the PDF, as the base mapping is overlain over the top of them.

Additional Points:

- Reference needs to be made to watercourses crossing sites which do not have any flood zone. All will require an assessment of risk associated with flooding from those particular watercourses.

- In Rugby, Warwick and Coventry the document refers to the River Trent CFMP. These two areas both drain to the Severn and therefore the Severn CFMP applies and not the Trent. This needs to be amended.

Specific comments relating to each LPA:

NUNEATON & BEDWORTH BOROUGH COUNCIL

1.7.1 Main Rivers and Hydrology - The Borough is covered by three designated Main Rivers:

- The following Main Rivers have been omitted from the list (but included in the NMRs paragraph) : -

- Wem Brook SP 3662 9118 to SP 3738 8932

- Breach Brook SP 3422 8494 to SP 3334 8526 (check Grid Ref with Main River Schedule)

- Bedworth Sloughs Brook SP 3504 8685 to SP 3502 8610 (check Grid Ref with Main River Schedule)

- Change Brook SP 3805 9368 to SP 3614 9284

- The following Non Main Rivers have been omitted from the minor watercourses paragraph: -

  - Holly Stitches Brook

  - Griff Brook

5. Strategic Flood Risk Mapping - 5.1 Strategic Flood Risk Maps

We would like to question whether the SFRA Maps should also identify at ground level (top water surface) water bodies that form a fundamental part of the Artificial Drainage/flood defence system, which should not be allowed to be filled in/developed. The document only mentions the Bar Pool Brook Storage Lake as being one of these systems, but other balancing pools may also have been constructed as part of development site for flood risk alleviation purposes.

N&B BC Ward Councillor Tony Lloyd has recently advised Sarah Mallett of the Agency that a balancing pool just north of The Willows performs such a function and he believes that it is currently proposed to be filled in, in order to allow development. This issue should be clarified further.

To discuss this issues further please contact Sarah Mallet, Tel. 01543 405029.

6.1.2 Flood Risk Management Strategies

We would like to know why the Tame Strategy has not been reviewed for inclusion in this document. This section clearly states that the options listed come from the Tame Strategy, and that Nuneaton & Bedworth Borough Council area does not feature in either the Trent or Severn Strategies. These issues need to be rectified. To discuss these issues further please contact Sarah mallet, Tel. 01543 405029.

Solihull Metropolitan Borough Council

5.1.1 Hydraulic (River) Models

The River Blythe which runs through the borough has also been modelled and needs to be included within the text in addition to the references regarding the River Cole.

In addition we have additional comments from our Flood Risk Mapping and Data Management Technical Specialist, Demi Korontzi, please see attached sheet, to discuss any of these issues please contact Demi direct on Tel. 01543 404983.

Yours faithfully

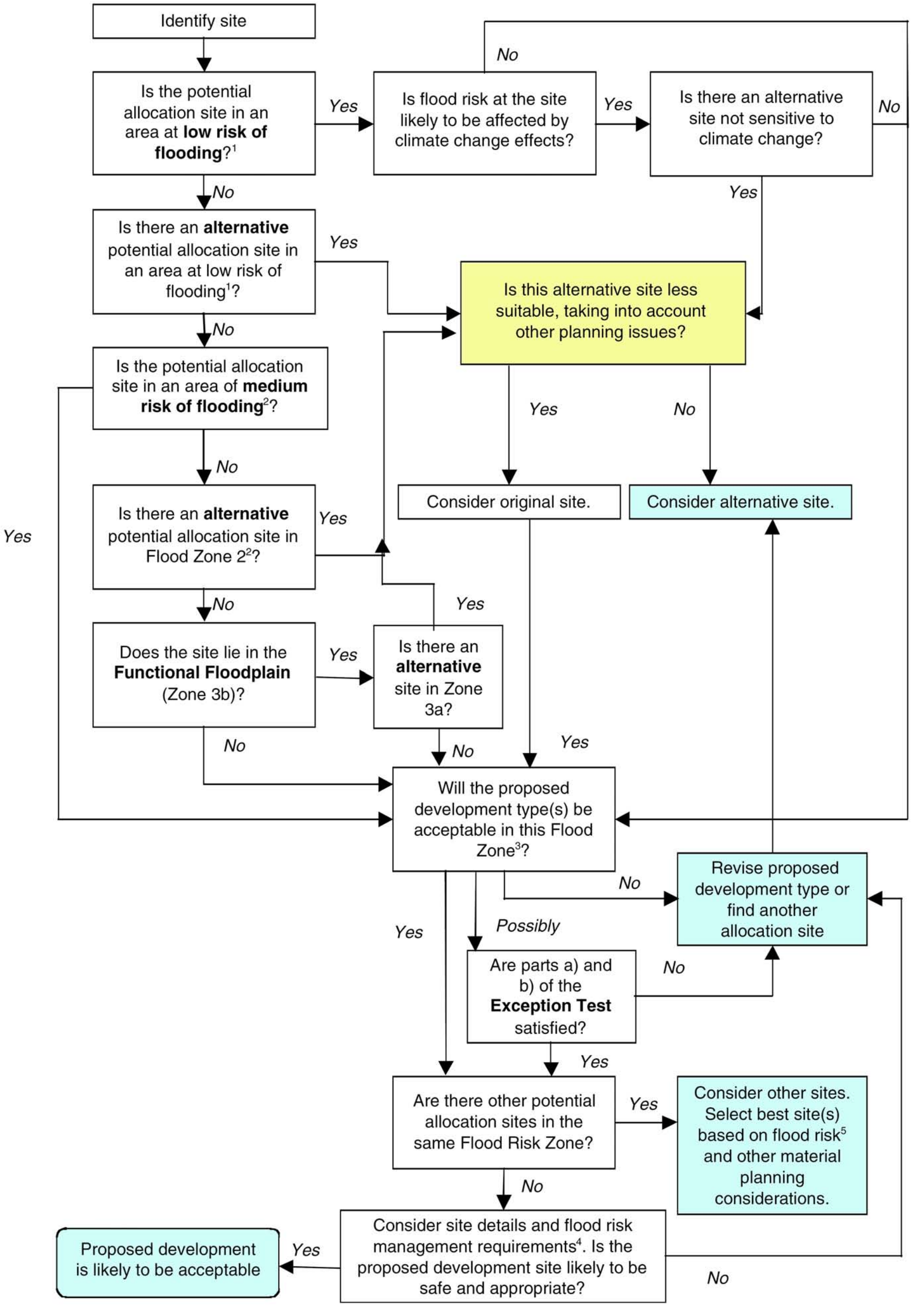
Miss Sarah Victor
Planning Liaison Officer

Direct dial 01543 404880
Direct fax 01543 444161
Direct e-mail sarah.victor@environment-agency.gov.uk

APPENDIX B

Appendix B

SEQUENTIAL TEST PROCESS



APPENDIX C

Appendix C

Details of the Environment Agency Flood Zones

Introduction

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

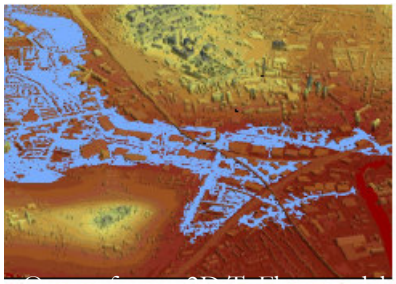
Environment Agency Fluvial Maps

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

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

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

Updates of the Environment Agency Flood Maps from Modelling



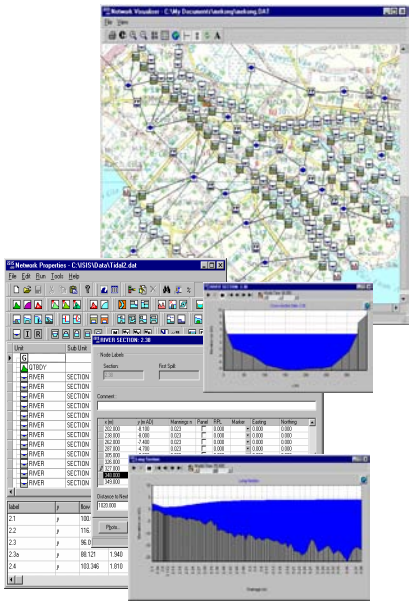
In many places the results of flood mapping studies have superseded the JFlow model. Generally these studies included high quality hydrological research, surveyed river cross sections, and more precise digital modelling such as ISIS, TuFlow and HecRas.

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

Updates of the Environment Agency Flood Maps from Recent Events

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

ISIS Software Graphic Interface



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

Non Main River flooding in the Environment Agency Flood Maps

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

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

Areas Benefiting from Defences

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

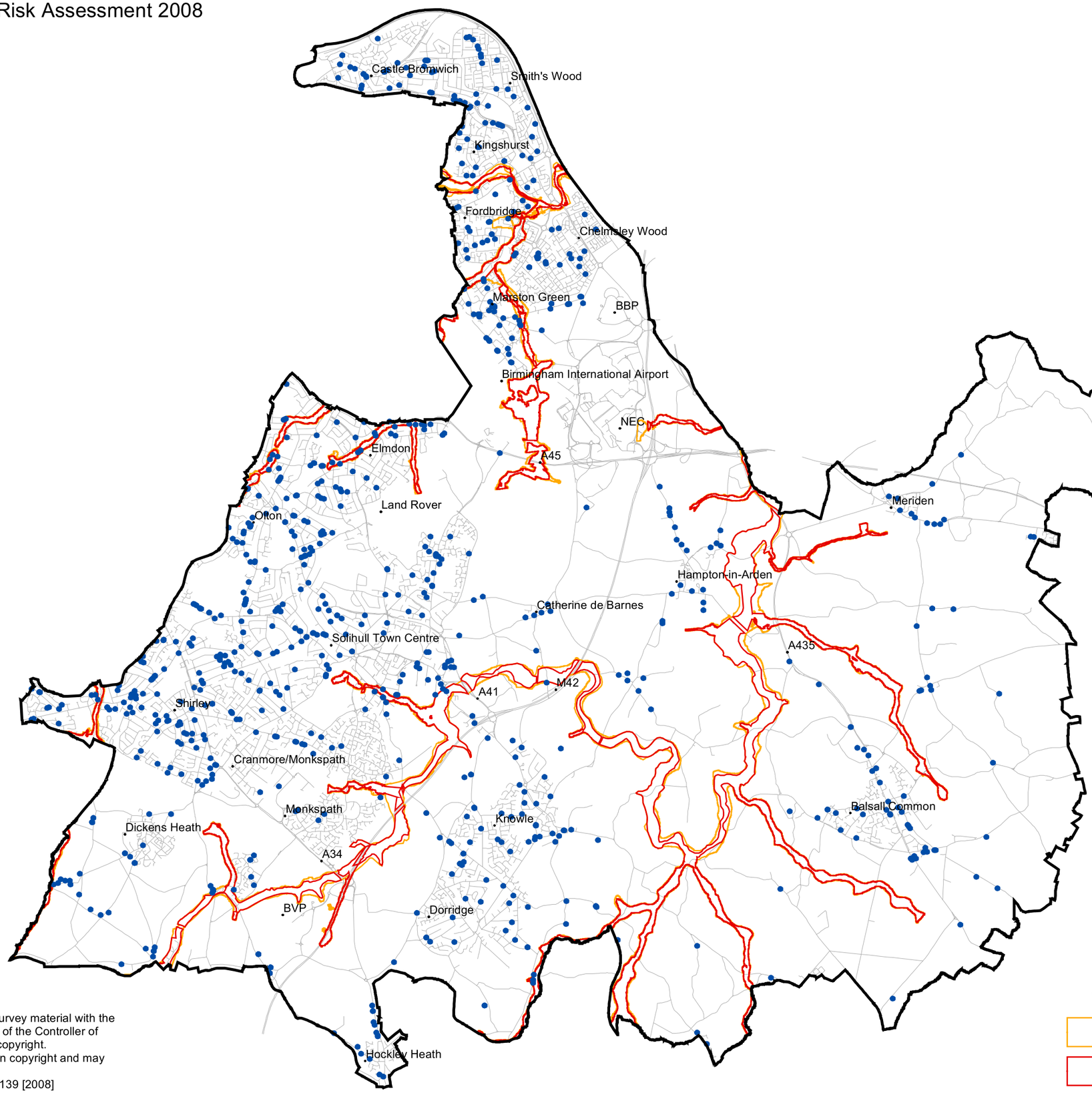
Climate Change Effect on Flood Zones

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

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

Solihull Strategic Flood Risk Assessment 2008

Solihull METROPOLITAN BOROUGH COUNCIL



Flooding From All Sources

FZ2

FZ3a & b