



The Black Country Strategic Flood Risk Assessment (SFRA)

February 2009 (Final)



EXECUTIVE SUMMARY

Introduction

1. The Black Country is situated to the north-west of Birmingham, and encapsulates the Boroughs of Wolverhampton, Wallsall, Sandwell and Dudley. The Sub region covers an area of approximately 36,000 hectares and has a population of approximately 1,100,000.
2. A number of rivers flow through the Black Country including the River Tame (including the Oldbury and Wolverhampton Arms), the River Stour, and the Smestow and Ford Brooks, however the area is characterised by a long history of development and industrialisation during which many of the local rivers and brooks were culverted. For this reason, there are few open watercourses flowing evident within the Sub region, and the risk of fluvial flooding is relatively low.
3. Notwithstanding this however, the heavily urbanised nature of the Sub region, and steep sided valleys, result in quite a high susceptibility to localised surface water flooding during periods of intense rainfall. Furthermore, whilst many of the culverts within the Sub region have a sizeable capacity, there always remains a potential risk of blockage, resulting in localised flooding.
4. It is imperative that the local planning authorities have a robust understanding of the potential risks posed by flooding within the Sub region. The SFRA process has identified considerable uncertainty surrounding the degree of risk posed by fluvial (river) flooding, and endeavours to address this uncertainty to ensure that spatial planning decisions (i.e. the allocation of land for future development) can be carried out in an informed manner in accordance with PPS25.
5. It is clear that flood risk from rivers is not a 'big' local issue within the Black Country at the current time, and only a relatively small proportion of the Sub region is at risk of flooding. Notwithstanding this, flooding caused by surface water runoff and/or culvert blockage may result in localised flooding without warning at any location, resulting in damage to property and severe disruption. It is essential to ensure that future planning decisions do not inadvertently increase the potential risk of localised flooding, and specific recommendations have been provided within the SFRA to guide the design of future development accordingly.

Why carry out a Strategic Flood Risk Assessment (SFRA)?

6. Flooding can result not only in costly damage to property, but can also pose a risk to life and livelihood. It is essential that future development is planned carefully, steering it away from areas that are most at risk from flooding, and ensuring that it does not exacerbate existing known flooding problems.
7. *Planning Policy Statement (PPS) 25: Development and Flood Risk* has been developed to underpin decisions relating to future development (including urban regeneration) within areas that are subject to flood risk. In simple terms, PPS25 requires local planning authorities to review the variation in flood risk across their district, and to steer vulnerable development (e.g. housing) towards areas of lowest risk. Where this cannot be achieved and development is to be permitted in areas that may be subject to some degree of flood risk, PPS25 requires the Council to demonstrate that there are sustainable mitigation solutions available that will ensure that the risk to property and life is minimised (throughout the lifetime of the development) should flooding occur.
8. The Strategic Flood Risk Assessment (SFRA) is the first step in this process, and it provides the building blocks upon which the Council's planning and development control decisions will be made.

What is a Strategic Flood Risk Assessment (SFRA)?

9. The Black Country Strategic Flood Risk Assessment (SFRA) has been carried out to meet the following key objectives:
- To collate all known sources of flooding, including river, surface water (local drainage), sewers and groundwater, that may affect existing and/or future development within the Black Country;
 - To delineate areas that have a 'low', 'medium' and 'high' probability of flooding within the Black Country, in accordance with Planning Policy Statement 25 (PPS25), and to map these:
 - Areas of 'high' probability of flooding are assessed as having a 1 in 100 or greater chance of river flooding (>1%) or 1 in 200 (>0.5%) chance of tidal flooding in any year, and are referred to as High Risk Zone 3;
 - Areas of 'medium' probability of flooding are assessed as having between a 1 in 100 and 1 in 1000 chance of river and/or tidal flooding (1% to 0.1%) in any year, and are referred to as Zone 2 Medium Probability;
 - Areas of 'low' probability of flooding are assessed as having a less than 1 in 1000 chance of flooding (<0.1%) in any year, and are referred to as Zone 1 Low Probability.
 - Within flood affected areas, to recommend appropriate land uses (in accordance with the PPS25 *Sequential Test*) that will not unduly place people or property at risk of flooding
 - Where flood risk has been identified as a potential constraint to future development, recommend possible flood mitigation solutions that may be integrated into the design (by the developer) to minimise the risk to property and life should a flood occur (in accordance with the PPS25 *Exception Test*).

The Sequential Test

10. The primary objective of PPS25 is to steer vulnerable development towards areas of lowest flood risk. PPS25 advocates a sequential approach that will guide the planning decision making process (i.e. the allocation of sites). In simple terms, this requires planners to seek to allocate sites for future development within areas of lowest flood risk in the initial instance. **Only if it can be demonstrated that there are no suitable sites within these areas should alternative sites (i.e. within areas that may potentially be at risk of flooding) be contemplated.** This is referred to as the Sequential Test.
11. As an integral part of the sequential approach, PPS25 stipulates permissible development types. This considers both the degree of flood risk posed to the site, and the likely vulnerability of the proposed development to damage (and indeed the risk to the lives of the site tenants) should a flood occur.
12. The PPS25 Sequential Test is depicted in Figure 3.1 of the Practice Guide Companion to PPS25 (Draft, February 2007) and Section 6.4.1 of this document.

The Exception Test

13. Many towns within England are situated adjacent to rivers, and are at risk of flooding. The future sustainability of these communities relies heavily upon their ability to grow and prosper. PPS25 recognises that, in some districts, including the Black Country, restricting residential development from areas designated as Zone 3a High Probability may heavily compromise the viability of existing communities within the respective Boroughs.

14. For this reason, PPS25 provides an Exception Test. Where a local planning authority has identified that there is a strong planning based argument for a flood risk vulnerable type development to proceed following the application of the Sequential Test, it will be necessary for the Council to demonstrate that the Exception Test can be satisfied.
15. For the Exception Test to be passed it must be demonstrated that:
 - *“...the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. If the DPD has reached the ‘submission’ stage, the benefits of the development should contribute to the Core Strategy’s Sustainability Appraisal;*
 - *the development should be on developable, previously developed land or if it is not on previously developed land, that there are no reasonable alternative sites on previously developed land; and*
 - *a FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and where possible, will reduce flood risk overall.”*

Outcomes of the Black Country SFRA

16. The Black Country has been delineated into zones of low, medium and high probability of flooding, based upon existing available information provided by the Environment Agency. Detailed flood risk mapping has been made available for the River Tame (including the Oldbury Arm), the River Stour and Smestow Brook. The Environment Agency Flood Zone Maps (March 2007) have been adopted as the basis for the SFRA for other watercourses.
17. A proportion of the Black Country is affected by flooding from the River Tame and Stour, and Smestow Brook. The spatial variation in flood risk across the Black Country has been delineated in the following manner:

Zone 3b (Functional Floodplain)

18. Areas subject to flooding up to (and including) once in every 20 years (5% annual exceedence probability (AEP)) on average have been delineated as ‘Zone 3b Functional Floodplain’. These are areas that are subject to relatively frequent flooding, and may be subject to fast flowing and/or deep water. Few areas within the Black Country fall within Zone 3b Functional Floodplain, however PPS25 recommends that these areas are afforded planning protection to preserve them for flood storage purposes in future years.

Zone 3a High Probability

19. Areas subject to flooding up to (and including) once in every 100 years (1% AEP) on average (i.e. Zone 3a High Probability) have been identified. Once again, relatively few areas within the Black Country fall within Zone 3a High Probability, and those areas at risk are generally situated immediately adjacent to the river corridors.
20. In a small number of locations, the capacity of the culverted watercourse is limited, and therefore in a 1 in 100 year design event a large proportion of the channel flow will travel overland. In the absence of a dedicated channel to convey the surplus flow, it is imperative that future development is not inadvertently placed at risk. For this reason, the overland flow path has been delineated as Zone 3a High Probability, emphasising the critical importance of careful planning decisions within these locations.

21. Following the satisfactory completion of the Sequential Test, should future development be permitted to occur within Zone 3a, residential development should be avoided wherever possible, restricting future land use to commercial and/or industrial (i.e. less vulnerable uses).
22. To meet the requirements of the Exception Test, it will be necessary for the Council to demonstrate that the development provides wider sustainability benefits to the community that outweigh flood risk. The Council must also demonstrate that the development is on developable, previously developed land or if it is not on previously developed land, that there are no reasonable alternative sites on previously developed land.
23. The SFRA has outlined specific development control conditions that should be placed upon development within Zone 3a High Probability to minimise both the damage to property, and the risk to life in case of flooding. It is essential that the developer carries out a detailed Flood Risk Assessment to consider the site-based constraints that flooding may place upon the proposed development.

Zone 2 Medium Probability

24. Areas subject to flooding in events exceeding the 100 year event (1% AEP), and up to (and including) once in every 1000 years (0.1% AEP) on average (i.e. Zone 2 Medium Probability) have been identified. Essential community services, including emergency services, should be avoided in these areas. There are generally no other land use planning restrictions placed upon future development in these areas, however it is important to ensure that the developer takes account of possible climate change impacts to avoid a possible increase in the risk of flooding in future years (achieved through completion of a simple Flood Risk Assessment) as well as residual risk and allowances for extreme events.

Zone 1 Low Probability

25. There are no restrictions placed on land use within Zone 1 Low Probability (i.e. all remaining areas of the Black Country). It is important to remember however that development within these areas, if not carefully managed, may exacerbate existing flooding and/or drainage problems downhill. It is necessary therefore to ensure that developers carry out a simple Flood Risk Assessment. This should demonstrate that the proposed drainage system design will mitigate any possible increase in runoff that may occur from the site as a result of the proposed development with an appropriate allowance made for climate change.

Localised Flooding Issues

26. In addition to fluvial (river) and tidal flooding, properties within The Black Country are also affected by a risk of flooding stemming from issues of a relatively localised nature. These include surcharging of the underground sewer system, the blockage of culverts and gullies resulting in overland flow, and surface water flooding. There is also a potential risk of groundwater flooding within the Black Country, particularly within the City of Wolverhampton, and the area along the boundary of the Sandwell and Dudley Boroughs.
27. Issues of this nature are unlikely to affect the allocation (or otherwise) of sites within the Black Country. It is absolutely imperative however that future development does not exacerbate localised flooding problems. The implementation of sustainable urban drainage systems must be ensured, and careful consideration to overland flow routes (e.g. avoiding obstructing these) as part of the site design should be encouraged.

The Way Forward

28. A proportion of the Black Country is at risk of flooding. The risk of flooding posed to properties within the respective Boroughs arises from a number of sources including river flooding, localised runoff, sewer and groundwater flooding.
29. A planning solution to flood risk management should be sought wherever possible, steering vulnerable development away from areas affected by flooding in accordance with the PPS25 Sequential Test. Specific planning recommendations have been provided for all urban centres within the Black Country.
30. Where other planning considerations must guide the allocation of sites and the Sequential Test cannot be satisfied, specific recommendations have been provided to assist the Council and the developer to meet the Exception Test. These should be applied as development control conditions for all future development. It is essential that these are applied, not only where there is a direct risk of flooding to the proposed development site, but elsewhere within the Black Country. It is important to recognise that all development may potentially have an adverse impact upon the existing flooding regime if not carefully mitigated. Again the sequential test must always be followed and satisfied but as part of that process, the exception test will need to be applied in some instances. Failure to apply the sequential approach may result in highly vulnerable development such as police stations and caravans being placed within Zone 3, which the Environment Agency can not support
31. Council policy is essential to ensure that the recommended development control conditions can be imposed consistently at the planning application stage. This is essential to achieve future sustainability within the Borough with respect to flood risk management. It is recommended that supplementary planning guidance is developed to build upon emerging Council policy, in light of the suggested development control conditions presented by the Black Country SFRA.
32. Emergency planning is imperative to minimise the risk to life posed by flooding within the Black Country. It is recommended that the Councils review their adopted flood risk response plan in light of the findings and recommendations of the SFRA.

A Living Document

33. The Black Country SFRA has been developed in accordance with PPS25. The SFRA has been developed building heavily upon existing knowledge with respect to flood risk within the Black Country. The Environment Agency regularly review and update their Flood Zone Maps (on a quarterly basis) and a rolling programme of detailed flood risk mapping within the Midlands Region is underway. This will improve the current knowledge of flood risk within the Black Country, and may marginally alter predicted flood extents within the respective Boroughs over time. This may therefore influence future development control decisions within these areas.
34. In summary, it is imperative that the SFRA is adopted as a 'living' document and is reviewed regularly in light of emerging policy directives and an improving understanding of flood risk within the Black Country. It is recommended that the SFRA is reviewed on a regular basis.

Table of Contents

Glossary.....	i
1 Introduction	1
1.1 Overview	1
2 SFRA Approach	2
3 Policy Framework	5
3.1 Introduction.....	5
3.2 National Policy.....	5
3.2.1 Planning Policy Statement 25: Development and Flood Risk.....	5
3.2.2 Consultation Planning Policy Statement: Planning and Climate Change	6
3.3 Regional Planning Policy	6
3.3.1 The West Midlands Regional Spatial Strategy	6
3.3.2 Sustainable Development - Checklist West Midlands	6
3.4 Local Planning Policy	7
3.4.1 The Black Country Unitary Development Plans	7
Walsall Borough Council.....	7
Wolverhampton City Council.....	7
Sandwell Borough Council.....	8
Dudley Borough Council	8
3.4.2 The Black Country Local Development Framework (LDF) – Core Strategy	8
4 Data Collection.....	9
4.1 Overview	9
4.2 Environment Agency Flood Zone Maps	9
4.3 Historical Flooding.....	9
4.4 Detailed Hydraulic Modelling.....	10
4.5 Flood Defences	10
4.6 Consultation	11
4.7 Topography	11
5 Flood Risk in the Black Country.....	13
5.1 Overview	13
5.2 Fluvial Flooding - Delineation of the PPS25 Flood Zones	13
5.2.1 Delineation of Zone 3b Functional Floodplain	14
5.2.2 Delineation of Zone 3a High Probability	15
5.2.3 Delineation of Zone 2 Medium Probability.....	15
5.2.4 Delineation of Zone 1 Low Probability	16
5.2.5 Delineation of ‘Overland Flow Paths’	16
5.3 Local Drainage Issues.....	16
5.4 Groundwater Flooding.....	17
5.5 Climate Change.....	17
5.6 Residual Risk of Flooding	18
6 Sustainable Management of Flood Risk.....	19
6.1 Overview	19
6.2 Responsibility for Flood Risk Management.....	19
6.3 Strategic Flood Risk Management - The Environment Agency	20
6.3.1 Overview.....	20
6.3.2 Catchment Flood Management Plan (CFMP) - Midlands Region	20
6.3.3 The Tame Strategy (TTD)	21
6.4 Planning & Development Control – The Black Country	22
6.4.1 Planning Solutions to Flood Risk Management	22
6.4.2 A Proactive Approach – Positive Reduction of Flood Risk through Development	24
6.4.3 Future Development within Zone 3b Functional Floodplain	24
6.4.4 Future Development within Zone 3a High Probability	24
6.4.5 Future Development within Zone 2 Medium Probability.....	25
6.4.6 Future Development within Zone 1 Low Probability	26
6.5 Overview of Flood Risk - Character Areas.....	26
6.5.1 Walsall Borough Council (Figure B-1).....	26
6.5.2 Wolverhampton City Council (Figure B-2).....	27
6.5.3 Sandwell Borough Council (Figure B-3)	28

6.5.4	Dudley Borough Council (Figure B-4)	28
6.6	Detailed Flood Risk Assessment (FRA) – The Developer	29
6.6.1	Scope of the Detailed Flood Risk Assessment	29
6.6.2	Raised Floor Levels & Basements (Freeboard)	31
6.6.3	Sustainable Drainage Systems (SUDS).....	31
6.7	Emergency Planning	33
6.8	Insurance.....	34
7	Conclusion & Recommendations.....	36

Glossary

AEP	Annual Exceedance Probability e.g. 1% AEP is equivalent to 1% probability of occurring in any one year (or, on average, once in every 100 years)
Core Strategy	The Development Plan Document within the Council's Local Development Framework, 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.
CLG	Community and Local Government
Defra	Department of Environment, Food and Rural Affairs
Development	The carrying out of building, engineering, mining or other operations, in, on, over or under land, or the making of any material change in the use of a building or other land.
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.
DPD	Development Planning Document
EA	Environment Agency
Flood Zone Map	Nationally consistent delineation of 'high' and 'medium' flood risk, published on a quarterly basis by the Environment Agency
Formal Flood Defence	A structure built and maintained specifically for flood defence purposes
Zone 3b Functional Floodplain	PPS25 Flood Zone, defined as areas at risk of flooding in the 5% AEP (1 in 20 chance) design event
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.
Zone 3a High Probability	PPS25 Flood Zone, defined as areas at risk of flooding in the 1% AEP (1 in 100) design event
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)
Local Development Framework (LDF)	Consists of a number of documents which together form the spatial strategy for development and the use of land
Zone 1 Low Probability	PPS25 Flood Zone, defined as areas outside of Zone 2 Medium Probability
Zone 2 Medium Probability	PPS25 Flood Zone, defined as areas at risk of flooding in events that are greater than the 1% AEP (1 in 100), and less than the 0.1% AEP (1 in 1000) design event

Planning Policy Guidance (PPG)	A series of notes issued by the Government, setting out policy guidance on different aspects of planning. They will be replaced by Planning Policy Statements.
Planning Policy Statement (PPS)	A series of statements issues by the Government, setting out policy guidance on different aspects of planning. They replace Planning Policy Guidance Notes
PPG25	Planning Policy Guidance 25: Development and Flood Risk Office of the Deputy Prime Minister (ODPM), 2001
PPS25	Planning Policy Statement 25: Development and Flood Risk Department of Community & Local Government, 2006
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.
Residual Risk	A measure of the outstanding flood risks and uncertainties that have not been explicitly quantified and/or accounted for as part of the review process
SEA	Strategic Environmental Assessment
SUDS	Sustainable Drainage System
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.
Sustainability Appraisal (SA)	Appraisal of plans, strategies and proposals to test them against broad sustainability objectives.
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).

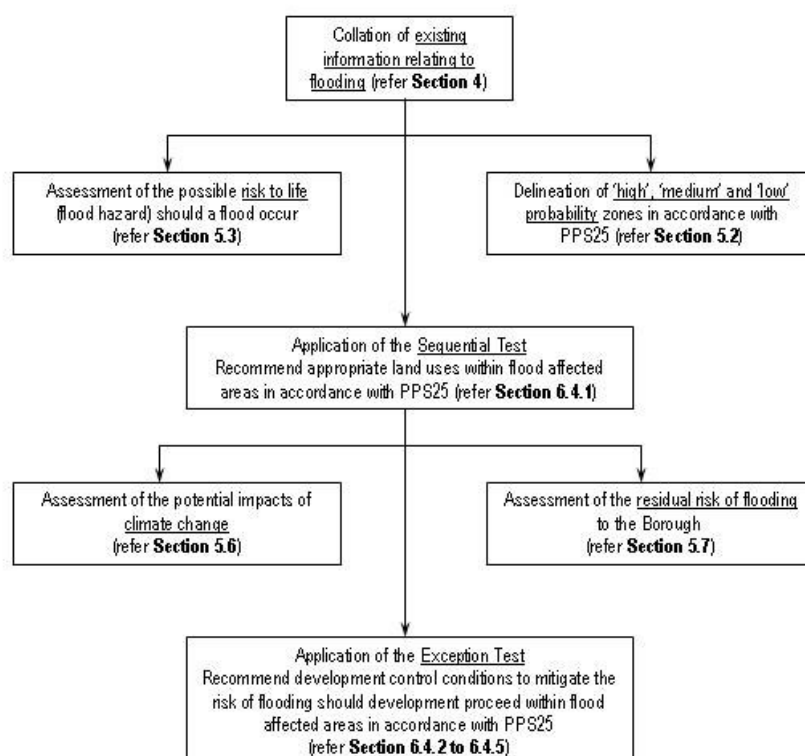
1 Introduction

1.1 Overview

35. The Black Country is situated to the north-west of Birmingham, and encapsulates the Boroughs of Wolverhampton, Wallsall, Sandwell and Dudley. The Sub region covers an area of approximately 36,000 hectares and has a population of approximately 1,100,000.
36. A number of rivers flow through the Black Country including the River Tame (including the Oldbury and Wolverhampton Arms), the River Stour, and the Smestow, Mousesweet and Ford Brooks, however the area is characterised by a long history of development and industrialisation during which many of the local rivers and brooks were culverted.
37. There are few open watercourses flowing evident within the Sub region, and the risk of fluvial flooding is relatively low. Notwithstanding this however, the heavily urbanised nature of the Sub region, and steep sided valleys, result in quite a high susceptibility to localised surface water flooding during periods of intense rainfall. Furthermore, whilst many of the culverts within the Sub region have a sizeable capacity, there always remains a potential risk of blockage, resulting in localised flooding.
38. It is imperative that the local planning authorities have a robust understanding of the potential risks posed by flooding within the Sub region. The SFRA process has identified considerable uncertainty surrounding the degree of risk posed by fluvial (river) flooding, and endeavours to address this uncertainty to ensure that spatial planning decisions (i.e. the allocation of land for future development) can be carried out in an informed manner in accordance with PPS25.
39. Planning Policy Statement (PPS) 25: Development and Flood Risk requires that local planning authorities prepare a Strategic Flood Risk Assessment (SFRA) in consultation with the Environment Agency. The primary purpose of the SFRA is to determine the variation in flood risk across the Black Country. Robust information on flood risk is essential to inform and support the Council's revised flooding policies in its emerging Local Development Framework (LDF).
40. Jacobs was commissioned to develop the Black Country Strategic Flood Risk Assessment (SFRA) in May 2007. The Black Country is currently reviewing its planning framework, and this SFRA supplements the evidence base that informs this review process. The SFRA is a technical document that will be submitted to the Secretary of State with the submission Core Strategy. This SFRA will be developed and refined over time and will feed into the Council's emerging 'preferred options' for site allocation.

2 SFRA Approach

41. The primary objective of the Black Country SFRA is to inform the revision of flooding policies, including the allocation of land for future development, within the emerging Local Development Framework (LDF). The SFRA has a broader purpose however, and in providing a robust depiction of flood risk across the Black Country, it can:
- Inform the development of the policy that will underpin decision making within the Black Country, particularly within areas that are affected by (and/or may adversely impact upon) flooding;
 - Assist the development control process by providing a more informed response to development proposals affected by flooding, influencing the design of future development within the Black Country;
 - Help to identify and implement strategic solutions to flood risk, providing the basis for possible future flood attenuation works;
 - Support and inform the Black Country Councils' emergency planning response to flooding.
42. The Government provides no specific methodology for the SFRA process. Therefore, to meet these broader objectives, the SFRA has been developed in a pragmatic manner in close consultation with both the Black Country Councils and the Environment Agency.
43. A considerable amount of knowledge exists with respect to flood risk within the Black Country, including information relating both to historical flooding, and the predicted extent of flooding under extreme weather conditions (i.e. as an outcome of detailed flood risk modelling carried out by the Environment Agency). The Black Country SFRA has built upon this existing knowledge, underpinning the delineation of the respective Boroughs into zones of 'high', 'medium' and 'low' probability of flooding, in accordance with PPS25. These zones have then been used to provide a robust and transparent evidence base for the development of flooding related policy, and the allocation of sites for future housing and employment uses.
44. A summary of the adopted SFRA process is provided in the figure below, outlining the specific tasks undertaken and the corresponding structure of the SFRA report.



45. Whilst locally the risk of flooding is relatively low, it is important to recognise that planning boundaries do not necessarily coincide with catchment boundaries. There are areas at risk of flooding downstream of the Black Country and future development within the Sub region could influence the risk of flooding posed to neighbouring areas if not carefully managed. It is imperative that all local authorities clearly understand the core issues that flood risk raises within their respective Boroughs, and adapt their decision making accordingly. They must be aware of the impact that careless planning may have, not only locally, but upon adjoining Boroughs.
46. A number of authorities across the Midlands are beginning to carry out similar strategic flood risk investigations. These will help provide the evidence base for the Core Strategies and Site Specific development allocations that will form part of the Local Development Frameworks that all local planning authorities must now produce.
47. Whilst the delivery teams and programmes underpinning these studies vary from one district to the next, all are being developed in close liaison with the Environment Agency. Consistency in the adopted approach and decision making with respect to the effective management of flood risk throughout the sub region is imperative. Regular discussions with the Environment Agency have been carried out throughout the SFRA process to this end, seeking clarity and consistency where needed.

3 Policy Framework

3.1 Introduction

48. This section provides a brief overview of planning policy relating to the Black Country in terms of flood risk. The SFRA is a key point of reference to the Black Country Councils in developing their flood risk policies, and this part of the document is designed to facilitate policy development.
49. The success of the SFRA is heavily dependent upon the Black Country Councils' ability to implement the recommendations put forward for future sustainable flood risk management, both with respect to planning decisions and development control conditions (refer Section 6.5). A framework of national and regional policy directive is in place, providing guidance and direction to local planning authorities. Ultimately however, it is the responsibility of the Councils to establish robust policies that will ensure future sustainability with respect to flood risk.

3.2 National Policy

3.2.1 Planning Policy Statement 25: Development and Flood Risk¹

50. Planning Policy Statement 25 (PPS25) was published in December 2006 and sets out the planning objectives for flood risk management. It states that all forms of flooding and their impacts are material planning considerations, which gives much weight to the issue of flooding. The aim of PPS25 is to ensure that flood risk is taken into account at all stages of the planning process in order to prevent inappropriate development in 'at risk' areas.
51. The key objectives for planning are appraising, managing and reducing flood risk. To *appraise* the risk it is stated that flood risk areas need to be identified, and that the level of risk needs to be identified. To facilitate this, PPS25 indicates that Regional Flood Risk Appraisals and Strategic Flood Risk Assessments should be prepared.
52. To *manage* the risk, Local Planning Authorities (LPAs) need to develop policies which "avoid flood risk to people and property where possible, and manage any residual risk, taking account of the impacts of climate change". LPAs should also only permit development in flood risk areas if there are no feasible alternatives located in areas of lower flood risk.
53. To *reduce* the risk, PPS25 indicates that land needed for current or future flood management should be safeguarded; new development should have an appropriate location, layout and design and incorporate sustainable drainage systems (SUDS); and new development should be seen as an opportunity to reduce the causes and impacts of flooding by measures such as provision of flood storage, use of SUDS, and re-creating the functional flood plain.
54. A partnership approach is stressed in PPS25 to ensure that LPAs work with partners such as the Environment Agency. The Environment Agency can provide both information and advice relating to flood risk, and should always be consulted when preparing policy or making decisions which will have an impact on flood risk.
55. The future impacts of climate change are highlighted in PPS25, as climate change will lead to increased flood risk in many places in the years ahead. When developing planning policy, LPAs need to consider if it is necessary to encourage the relocation of existing development to locations at less of a risk from flooding in order to prevent future impacts of flooding.

¹ Communities and Local Government (2006) Planning Policy Statement 25: Development and Flood Risk

56. PPS25 also gives specific advice for determining planning applications, which needs to be considered when developing policy. LPAs should ensure that flood risk assessments (FRAs) are submitted with planning applications where this is appropriate; they should apply the sequential approach (defined in the PPS) which ensures that lower risk areas are considered preferable to higher risk areas; priority should be given to the use of SUDS; and new development should be designed to be resilient to flooding as appropriate.
57. The Practice Guide Companion to PPS25 was released in draft form for consultation by Communities and Local Government in February 2007, providing additional guidance on the principles set out in PPS25.

3.2.2 Consultation Planning Policy Statement: Planning and Climate Change²

58. The proposed planning policy statement for climate change was published for consultation in December 2006. When finalised, it will supplement the existing PPS1: Delivering Sustainable Development. The document highlights the issue of climate change, and sets out ways planning should prepare for its effects, which includes managing flood risk. Little detail is given about flooding in this document as PPS25 already does this.

3.3 Regional Planning Policy

3.3.1 The West Midlands Regional Spatial Strategy³

59. The Regional Spatial Strategy for the West Midlands does not include any specific policies relevant to flood risk within the Black Country, however it does provide some key objectives regarding flood risk. These will underpin the establishment of local Core Strategy policy, and are summarised below:
 - **Climate Change** The RSS states that the potential effects of climate should be recognised within the Black Country, which specifically relates to the increase of extreme rainfall events, and therefore an increased risk of local flooding incidents.
 - **Sustainability Appraisal** This attempts to address the key principals of sustainability within the Black Country, and regarding flood risk management the RSS states that development within floodplains should be avoided and the use of Sustainable Drainage Systems promoted.
60. It is worth noting that the Secretary of State's proposed changes to the West Midlands RSS Phase One Revision has inserted under Policy UR1B (Housing and Employment Land) that "*within the Growth Corridors and the Employment Land Investment Corridors, local authorities through the Joint Core Strategy and LDDs will produce water cycle strategies to ensure the quantity and quality of surface and ground water produced by developments does not exceed the capacity of supply and treatment infrastructure.*"

3.3.2 Sustainable Development - Checklist West Midlands⁴

61. *"There is broad agreement that new developments need to contribute to the creation of sustainable communities. Tools such as Ecohomes / BREEAM / the Code for Sustainable Homes assess the sustainability of designs for individual new homes and buildings. This Checklist works at the next scale; helping developers, local authorities and other interested parties to assess how sustainable designs are for new housing and mixed use developments.*

² Communities and Local Government (2006) Consultation Planning Policy Statement: Planning and Climate Change: Supplement to Planning Policy Statement 1

³ West Midlands Regional Assembly (2005) Regional Spatial Strategy for the West Midlands – Draft Phase 1 Revision: The Black Country

⁴ www.checklistwestmidlands.co.uk

62. *The West Midlands Checklist is intended for use at the design and planning application stages of a new development. It focuses on the sustainability issues pertinent to spatial planning, although it does address those construction and “in-use” issues that can be anticipated or influenced at the design phase. The Checklist assumes that the sustainability of sites being brought forward for development in Local Plans has been subject to Sustainability Appraisal / Strategic Environmental Assessment and has been tested at Examination in Public. As a result there is less focus on the location of the site.*
63. *The West Midlands Checklist is a tool for decision makers; in itself it does not make decisions. Flexibility is built into the tool to allow for variations in sites and locations as issues pertinent in one area may be less significant in another.”* (extract from www.checklistwestmidlands.co.uk, February 2009).

3.4 Local Planning Policy

3.4.1 The Black Country Unitary Development Plans

Walsall Borough Council⁵

64. The Walsall Unitary Development Plan was adopted in March 2005 and has one specific policy relevant to flood risk, which is linked to PPG25 and the Environment Agency Flood Maps – ENV40.
65. Policy ENV40: Conservation, Protection and Use of Water Resources:
“When considering development proposals the Council will take account of flood risk according to the principles set out in PPG25: Development and Flood Risk. This will include the adoption of a sequential approach which, in priority order, favours locations which have little or no risk, then low to medium risk, before those with high risk, subject to other sustainable development objectives including promoting the use of previously-developed. The Council will also take account of any information on flood risk provided by the Environment Agency, including the most recently produced Flood Zone Maps”.

66. This policy also includes a justification which sets out the use of PPG25 guidance document and the Environment Agency Flood Maps when considering planning proposals that may present a risk of flooding.

Wolverhampton City Council⁶

67. The Wolverhampton Unitary Development Plan was adopted in June 2006. The UDP states two specific policies relevant to flood risk, which covers floodplain management and urban runoff – EP7 and EP9.
68. Policy EP7: Protection of Floodplains gives specific details to the Council’s policy regarding development on floodplains. It gives a clear distinction between the High Probability Flood Zones 3 and the Zone 2 Medium Probability. The policy is mainly focused on PPG25, and therefore does not consider the additional distinction between the Zone 3a High Probability and 3b (Functional Floodplain).
69. Policy EP9: Sustainable Drainage arrangements for development:
“All development proposals should be located and designed so as to minimise the quantity and maximise the quality of surface water run-off, by incorporating the maximum possible area of permeable ground surface and features which regulate surface water flows from impermeable surfaces.
Development will only be permitted where adequate provision is made for the drainage of foul and surface water. Where necessary infrastructure improvements can be carried out to the satisfaction of the statutory sewerage undertaker, planning permission will be subject to a condition and / or formal legal agreement specifying the improvements that must be carried out.”

⁵ Walsall Borough Council (2005) Unitary Development Plan

⁶ Wolverhampton City Council (2006) Unitary Development Plan

70. Policy EP9 also gives reference to Wolverhampton's sustainability policies regarding the specific design requirements for sustainable urban drainage.

Sandwell Borough Council⁷

71. The Sandwell Unitary Development Plan was adopted in April 2004 and has one specific policy relevant to flood risk (i.e. PC7), which covers the requirements of PPG25 amongst others.

72. Policy PC7: Surface Water:

“Ensure that new development constructed in areas susceptible to flooding should be protected to an appropriate standard to ensure that it is safe. Flood defences required as a result of development should be fully funded by developers as part of the development”.

73. This policy provides a series of sub-sections that cover the Council's objectives to protect river floodplains and prevent development occurring within the natural floodplains (i.e. functional floodplain). The Council also aims to promote Sustainable Drainage Systems within development proposals and the opening up of culverted watercourses.

Dudley Borough Council⁸

74. The Dudley Unitary Development Plan was adopted in March 2005 and has a few policies relating to watercourses, floodplain management and urban runoff, but does not specifically give a direct link to flood risk.

75. The UDP does give some specific objectives that indirectly link to flood risk, which include the promotion of Sustainable Drainage Systems, de-culverting of watercourses, and preventing development occurring in floodplains.

3.4.2 The Black Country Local Development Framework (LDF) – Core Strategy

76. It is understood that the Local Development Framework (LDF) is in its early stages. This provides the local authorities within the Black Country with the opportunity to ensure that adopted Core Strategy policy is in accordance with PPS25 from the start, giving due regard to national and regional policy guidance.

77. Among others, key points to include in emerging LDF policy are: the sequential test, the need for a detailed Flood Risk Assessment (FRA), and the use of SuDS as an integral part of the design process. Furthermore however, it is recommended that the policy is developed with due consideration to the specific recommendations for future development within flood affected areas as set out in Section 6.5 of this document.

78. These recommendations have been identified and agreed in close consultation with the Environment Agency and the Councils. They represent the minimum conditions that will be expected by the Environment Agency should development be permitted to proceed, and it is recommended that these are included in a supplementary planning document (SPD) to support the over-arching policies.

⁷ Sandwell Borough Council (2004) Unitary Development Plan

⁸ Dudley Borough Council (2005) Unitary Development Plan

4 Data Collection

4.1 Overview

79. A considerable amount of knowledge exists with respect to flood risk within the Black Country, including (but not limited to):
- Historical river flooding information;
 - Information relating to localised flooding issues (surface water, groundwater, sewer related and/or pluvial flooding), collated in consultation with the Council and the Environment Agency;
 - Detailed flood risk mapping;
 - Environment Agency Flood Zone Maps (March 2007);
 - Topography (LiDAR).
80. All of this data has been sourced from the Black Country Councils and the Environment Agency, forming the core dataset that has informed the SFRA process. The application of this data in the delineation of zones of 'high', 'medium' and 'low' probability of flooding, and the formulation of planning and development control recommendations, is explained in Section 5. An overview of the core datasets, including their source and their applicability to the SFRA process, is outlined below.

4.2 Environment Agency Flood Zone Maps

81. The Environment Agency's Flood Zone Map was adopted as the 'first pass' method of assessing fluvial flood risk within the Black Country as part of the SFRA development.
82. The Environment Agency's Flood Map shows the natural floodplain, ignoring the presence of defences, and therefore areas potentially at risk of flooding from rivers or the sea. The Flood Map shows the area that is susceptible to a 1 in 100 (1% annual exceedance probability (AEP)) chance of flooding from rivers, and a 1 in 200 (0.5% AEP) chance of tidal flooding, in any one year. It also indicates the area that has a 1 in 1000 (0.1% AEP) chance of flooding from rivers and/or the sea in any given year. This is also known as the Extreme Flood Outline.
83. The Flood Map outlines have been produced from a combination of a national generalised computer model and some historic flood event outlines. The Environment Agency's knowledge of the floodplain is continuously being improved by a variety of studies, detailed models, data from river flow and level monitoring stations, and actual flooding information. The Agency has an ongoing programme of improvement, and updates are made on a quarterly basis.

4.3 Historical Flooding

84. Detailed discussions have been held with the respective Councils to identify those areas within the Black Country that are known to have been exposed to flooding in recent years. These have been highlighted in the adjoining flood risk maps (see Appendix 3). The maps also provide brief explanations on the cause (and affected area) of each incident.
85. It is important to highlight that, within the study area, very few (if any) incidents of historical flooding from rivers have been identified in recent memory. For this reason, many of the observed flooding incidents listed are events in which properties (and key infrastructure) have been affected not only by flooding from local watercourses, but also from surcharging of the underground sewer system, blockage of culverts and gullies, and/or surface water runoff.
86. This is an important reminder that the risk of flooding must always be carefully considered when planning future development, irrespective of the site's proximity to a local river or watercourse. Development control decisions must consider all forms of potential flooding to the site. They must also be made with due consideration to the potential impact that future development may have upon known existing flooding problems if not carefully managed.

4.4 Detailed Hydraulic Modelling

87. A number of detailed flooding investigations have been carried out by the Environment Agency across the upper reaches of the River Tame, including the Oldbury Arm, within the Sandwell and Walsall Boroughs. The bulk of these studies have generally incorporated the development of a detailed hydraulic model for these reaches, providing a more robust understanding of the localised fluvial flooding regime.
88. The River Stour in Dudley and Smestow Brook in Wolverhampton have also been modelled as part of a study conducted by the Environment Agency, which was developed in line with Section 105 (2) of the Water Resources Act.
89. The flood extents derived from detailed hydraulic models are generally considered to be more refined and accurate than the existing Flood Zone Map in the study area. For this reason, the extents derived from the detailed hydraulic models (where available) have been used to underpin the delineation of flood risk (Zone 3a and Zone 3b) in this Strategic Flood Risk Assessment.
90. It should be noted that the detailed hydraulic models developed on behalf of the Environment Agency assume 'typical' conditions within the respective river systems that are being analysed. The predicted water levels may change if the operating regimes of the rivers involved are altered (e.g. engineering works which may be implemented in the future), culverts are permitted to block, or the condition of the river channel is allowed to deteriorate.

4.5 Flood Defences

91. Flood defences are typically raised structures that alter natural flow patterns and prevent floodwater from entering property in times of flooding. They are generally categorised as either 'formal' or 'informal' defences. A 'formal' flood defence is a structure that was built specifically for the purpose of flood defence, and is maintained by its respective owner, which could be the Environment Agency, Local Authority, or an individual. An 'informal' flood defence is a structure that has not been specifically built to retain floodwater, and is not maintained for this specific purpose, but may afford some protection against flooding. The structural integrity and design standard is unknown for these type of defences, and their existence can not always be guaranteed for the lifetime of a proposed development. These defences can include boundary walls, industrial buildings, railway embankments and road embankments situated immediately adjacent to rivers.
92. Formal flood defences within the Black Country have been identified in consultation with the Environment Agency and through site walkovers. The defences identified are located mainly on the River Tame (including the Oldbury and Wolverhampton Arms), as indicated on the adjoining maps. These defence are mainly regarded as 'maintained river channel', although at some locations there do exist some raised banks and/or floodwalls. These defences are generally less than 1m in height and therefore provide only a limited increase in the standard of protection to adjoining properties and do not pose a risk to life.
93. Although these defences may be formally maintained, it is important to reiterate that the risk of flooding can never be fully removed. There will always be a residual risk of flooding, due to (for example) a more extreme event, changing climatic conditions, a structural failure of the constructed flood defence system or flooding behind the defences due to local runoff or groundwater. It is incumbent on both the Council and developers to ensure that the level and integrity of defence provided within developing areas can be assured for the lifetime of the development.
94. No informal raised flood defences providing protection from flooding have been specifically identified in The Black Country as part of the SFRA process although some may exist.

4.6 Consultation

95. Consultation has formed a key part of the data collation phase for the Black Country SFRA. The following key stakeholders have been comprehensively consulted to inform the current investigation:

The Black Country Councils

Planning: Consulted to identify areas under pressure from development and/or regeneration

Street Planning and Public Protection: Consulted to identify areas potentially at risk from river flooding and/or urban drainage

Emergency Planning: Consulted to discuss the Borough's existing emergency response to flooding

Environment Agency

The Environment Agency has been consulted to source specific flood risk information to inform the development of the SFRA. In addition, the Environment Agency is a statutory consultee under PPS25 and therefore must be satisfied with the findings and recommendations for sustainable flood risk management into the future. For this reason, the Environment Agency has been consulted during the development of the SFRA to discuss potential flood risk mitigation measures and planning recommendations.

Severn Trent Water

Severn Trent Water is responsible for the management of urban drainage (surface water) and sewerage within the Black Country. Severn Trent Water was consulted to discuss the risk of localised flooding associated with the existing drainage/sewer system. Severn Trent Water have provided a copy of the DG5 register for the Black Country. This provides a summary of properties (within a postcode area) that have been subject to flooding to some degree from the sewer system in years past. It is important to highlight that this is not a measure of risk, and sewer failure may occur at any point within the underground system

It is highlighted that issues associated with failures of the underground drainage/sewer systems are often relatively localised, and should not preclude development. Notwithstanding this however, specific problems have been highlighted by the SFRA process (refer Section 6.5), and careful consideration should be given to the potential impact of future intensification and/or redevelopment. **It is essential to ensure that future development does not exacerbate known existing problems.** Planning decisions should be made with due consideration to potential drainage and sewer capacity problems (to be advised by Severn Trent Water as part of the statutory LDF consultation process), and conditions should be placed upon future development to ensure that these capacity issues are rectified before development is permitted to proceed.

4.7 Topography

96. In some instances, detailed flood risk mapping has been carried out, providing a robust means of delineating zones of 'high' probability (i.e. 1% annual exceedence probability (AEP)). In other areas however, dependence must be placed upon the Environment Agency Flood Zone Map, providing a relatively coarse depiction of flood risk. A 'sensitivity' check has been carried out for those events in which detailed modelling is currently not available. The primary purpose of this check is to ensure that the adopted Environment Agency Flood Zone Map is generally representative of anticipated flooding conditions.

97. In addition to reviewing the capacity of the culverted watercourses (refer Section 5), indeed it is also important to ensure that the Environment Agency Flood Zone Map reflects the fact that water flows downhill, and that water levels across the river (i.e. on either bank of the river at the same location) are equal. The Environment Agency LiDAR and IfSAR data has been used to reflect the topography of the study area in this instance.

5 Flood Risk in the Black Country

5.1 Overview

98. Within the Black Country, the principal watercourses that pose a potential risk of flooding to properties include the River Tame (including the Oldbury and Wolverhampton Arms), Ford Brook, Smestow Brook and the River Stour.
99. Although the majority of the River Tames' floodplain is currently green belt area, some isolated properties appear to be at risk from flooding, particularly from the 1 in 1000 year flood event (0.1% AEP). The entire stretch of the River Tame, including the Oldbury Arm, is classified as 'maintained channel' by the Environment Agency and recent hydraulic modelling suggests that, apart from some isolated locations, most flooding events are largely contained by the river channel.
100. The Wolverhampton Arm of the River Tame has been re-routed through the construction of the Tame Tunnel, which now provides some sort of flood defence for some areas within the Walsall Borough (see also Section 6.5). Although, the 'old' course of the river channel is still indicated by the presence of the current Environment Agency Flood Zone maps (see Figure 3.1), it is expected that the considerable size of this culvert puts the immediate surrounding area at risk from only the extreme 1 in 1000 year flood event (0.1% AEP).
101. Recent modelling for Smestow Brook in Wolverhampton, Ford Brook in Walsall and the River Stour in Dudley suggests that only a small number of properties are located within Zone 3a High Probability. Zone 2 Medium Probability does highlight significant urbanised areas, but these outlines have been produced through the less robust method for obtaining the National Flood Zone dataset (see Section 4) and it could therefore be that these outlines are in fact less extreme than currently indicated.
102. Beyond these principal watercourses, there also exist a considerable number of minor watercourses within the Black Country, such as Tipton Brook and the Boundary Brook River System in Sandwell, Sneyd Brook in Walsall, Merrhill Brook in Wolverhampton and Holbeche and Wordsley Brook in Dudley. These smaller watercourses and drains affect fewer properties within the Black Country than for example the River Tame, however they are far more susceptible to flash flooding resulting from localised intense rainfall. With changing climate patterns, it is expected that storms of this nature will become increasingly common. It is vitally important that planning decisions recognise the potential risk that these watercourses pose to property and plan development accordingly so that future sustainability can be assured.
103. There also exists a considerable amount of localised and incidental flood risk with the Black Country (see the adjoining Flood Risk Maps). This is perceived to be caused by localised flash flooding through heavy rainfall, blocked road gullies, river culverts and possibly sewer/urban drainage networks.

5.2 Fluvial Flooding - Delineation of the PPS25 Flood Zones

104. It is emphasised that the **risk** of an event (in this instance a flood event) is a function of both the **probability** that the flood will occur, and the **consequence** to the community as a direct result of the flood. PPS25 endeavours to assess the likelihood (or probability) of flooding, categorising the Borough into zones of low, medium and high probability. It then provides recommendations to assist the Council to manage the consequence of flooding in a sustainable manner, for example through the restriction of vulnerable development in areas of highest flood risk.
105. To this end, a key outcome of the SFRA process is the establishment of the Sequential Test in accordance with Appendix D (Table D1) of PPS25. To inform the planning process, it is necessary to review flood risk across the area, categorising the area in terms of the likelihood (or probability) that flooding will occur.

106. The Black Country has been delineated into the flood zones summarised below.

Zone 3b The Functional Floodplain

Areas of the region susceptible to flooding within which “*water has to flow or be stored in times of flood*” (PPS25).

Zone 3a High Probability

Land assessed as having a 1 in 100 or greater annual probability of flooding in any year (i.e. 1% AEP).

Zone 2 Medium Probability

Land assessed as having between a 1 in 100 (i.e. 1% AEP) and 1 in 1000 (i.e. 0.1% AEP) annual probability of river flooding in any year.

Zone 1 Low Probability

Land assessed as having a less than 1 in 1000 annual probability of river flooding in any year (i.e. 0.1% AEP).

107. The delineation of the PPS25 flood zones is discussed below, and presented in the adjoining Flood Risk Maps. It is important to note that along culverted river reaches there can still be a risk of flooding due to floodwaters using overland flow paths, for example during a blockage of the culvert system. This likelihood has also been highlighted on the adjoining maps, and is further discussed in Appendix C.

5.2.1 Delineation of Zone 3b Functional Floodplain

108. Zone 3b Functional Floodplain is defined as those areas in which “*water has to flow or be stored in times of flood*”. The definition of functional floodplain remains somewhat open to subjective interpretation. PPS25 states that “*SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes.*” For the purposes of the Black Country SFRA, Zone 3b has been defined in the following manner:

- land where the flow of flood water is not prevented by flood defences or by permanent buildings or other solid barriers from inundation during times of flood;
- land which provides a function of flood conveyance (i.e. free flow) or flood storage, either through natural processes, or by design (e.g. washlands and flood storage areas);
- land subject to flooding in the 5% AEP (20 year) flood event (i.e. relatively frequent inundation expected, on average once every 20 years).

109. Detailed modelled flood extents for the 1 in 20 year design event were adopted for the basis of Zone 3b Functional Floodplain delineation. Where detailed modelling of the 1 in 20 year design event has not been carried out to date by the Environment Agency, additional modelling was undertaken. A simple hydraulic model with river (floodplain) cross-sections based on Digital Elevation Data was established to provide a robust estimation of the 1 in 20 year (Zone 3b) flood extents. Modelled watercourses include the River Sneyd in Walsall.

110. Within The Black Country, this encompasses primarily those low-lying areas immediately adjoining the River Tame (including the Oldbury and Wolverhampton Arms), the River Stour, Ford Brook and Smestow Brook. Any development within these areas is likely to measurably impact upon the existing flooding regime, increasing the severity and frequency of flooding elsewhere.

111. Some existing urban areas along these watercourses are affected by flooding in the 5% AEP (20 year) flooding event. The recent release of the PPS25 Practice Companion Guide highlights the importance of considering existing land use when delineating areas that are to be treated as 'functional floodplain' for planning purposes. Due to the obstructions to overland flow paths posed by existing development within flood affected areas, existing buildings should generally not be considered as falling within the functional floodplain.
112. Notwithstanding this however, the land surrounding existing buildings is indeed Zone 3b Functional Floodplain, and planning decisions should be taken accordingly. It is important to recognise that these areas are subject to relatively frequent flooding – on average, flooding once in every 20 years. There are clear safety, sustainability and insurance implications associated with future development within these areas, and it is strongly recommended that these areas are offered planning protection to avoid future development.

5.2.2 Delineation of Zone 3a High Probability

113. Zone 3a High Probability is defined as those areas of the Black Country that are situated below (or within) the 1% AEP (100 year) fluvial flood extent.
114. The detailed modelling outputs developed by the Environment Agency, where available (refer Section 4), have been adopted for the delineation of Zone 3a High Probability, superseding the current EA flood zone map (March 2007). Only in those areas within which detailed flood mapping is not available and/or fit for purpose, the Environment Agency's Flood Zone Maps have been adopted to underpin the SFRA process.
115. At these locations, two thorough checks have been carried out to ensure that the adopted flood map provides a sensible depiction of Zone 3a High Probability:
 - The Environment Agency Flood Zone Map assumes that the 1 in 2 year design flood is carried within the river channel or culvert. The remaining flow (i.e. up to the 1 in 100 year design flood) is assumed to be conveyed overland, and the flood extents estimated accordingly. A check of this assumption has been made.

Where river channels have been culverted historically throughout the Black Country, an estimation of the culvert capacity has been established, and this has been compared with the estimated peak design flow regime for the contributing catchment area. Where it is clear that the capacity of the culvert far exceeds the 1 in 100 year design flood flow, the predicted extents of the Environment Agency's Flood Zone Map are reviewed (and in many cases removed) to reflect the substantial capacity of the culvert system.

It is highlighted that, should the culvert become blocked, the current Environment Agency Flood Zone Map provides a reasonable depiction of the overland flow routes that may be at risk. For this reason, these have been retained for planning purposes (see below).

- Detailed topography has been used to carry out a 'sensitivity check' of the flood zone maps. This check has sought to ensure that the predicted floodplain extents are sensible in light of surrounding ground levels (e.g. the peak design water level is equivalent on the left and right banks).

5.2.3 Delineation of Zone 2 Medium Probability

116. Zone 2 Medium Probability is defined as those areas of the Black Country that are situated between the 0.1% AEP (1 in 1000 year) and the 1% AEP (1 in 100 year) flood extents. In this instance, Zone 2 Medium Probability is defined in accordance with the Environment Agency Flood Zone Map.

5.2.4 Delineation of Zone 1 Low Probability

117. Zone 1 Low Probability is defined as those areas of the Black Country that are situated above (or outside of) the 0.1% AEP (1000 year) flood extent. For SFRA purposes, this incorporates all land that is outside of the shaded Zone 2 and Zone 3 flood risk areas (as defined above).

5.2.5 Delineation of 'Overland Flow Paths'

118. As explained in Section 5.2.2 above, a detailed review of the current Environment Agency Flood Zone Map has been carried out. Many watercourses within the Black Country have been culverted over time, and in many instances the capacity of the culvert is sufficient to cater for the full 1 in 100 year peak design flow. The broad scale modelling carried out to establish the national Flood Zone Map assumes that only the 1 in 2 year flow is carried underground, and everything over and above this is conveyed overland. Consequently, where indeed the culvert capacity is sufficient, the predicted flood outline is clearly conservative.
119. Through agreement with the Environment Agency therefore, where the SFRA review has confirmed that a 1 in 100 year capacity is available within the culvert, Zone 3a High Probability has been adjusted accordingly. It is important to recognise however that, should a blockage of the culvert occur, water will spill overland and follow the natural topography in a downhill direction.
120. For this reason, an 'overland flow path' has been retained and depicted in the adjoining flood maps. It is important that a proactive maintenance regime is retained to reduce the risk of potential blockage, and consequently overland flooding.

5.3 Local Drainage Issues

121. As discussed in Section 4.6, consultations have been carried out with the Environment Agency and the Black Country Councils to identify known and/or perceived problem areas. These drainage problems may be attributed to inundation due to poor maintenance, associated with (for example) culvert blockages, and/or increased overland flow due to development during heavy rainfall. Issues of this nature are often relatively localised, affecting generally a small number of properties.
122. A substantial number of known localised problems have been identified throughout the Black Country, highlighted as an outcome of flooding experienced by local residents or businesses (see adjoining Flood Zone maps). It is important to note that a number have subsequently been addressed through subsequent maintenance to rectify the problem (e.g. removal of localised blockages).
123. However, due to the Environment Agency en-maining procedure (i.e. the transferral of minor watercourses to Main River status) some of the maintenance regimes have been transferred to the Environment Agency's responsibility (most notably within the Dudley Borough). The absence of local knowledge within the Agency and sometimes staffing problems, are perceived to put pressure on keeping some culverted watercourses clear from blockages, potentially causing localised flooding incidents to (re-)occur.
124. It is therefore imperative that a strict maintenance regime is in place, especially for known 'problem' watercourses, and within Sandwell these regimes are currently being sub-contracted back to the Borough Council. Given the number of road inundation incidents throughout the Black Country, it is also important to ensure that the regularly cleaning of road gullies is incorporated.
125. Within the urban centres of the Black Country, it is also inevitable that localised flooding problems arising from under capacity drainage and/or sewer systems will occur, particularly given the mounting pressure placed upon ageing systems as a result of climate change. Input has been sought from Severn Trent Water to pinpoint known and/or perceived problem areas, which was received through Severn Trent Water's DG5 register; key risk areas have subsequently been highlighted on the adjoining Flood Risk Maps.

126. Once again however, it should be noted that drainage issues are generally localised, and can be addressed as part of the design process. They therefore will generally not influence the decision as to whether or not land will be allocated for future development. It is essential however to ensure that future development does not exacerbate existing flooding problems. Strict planning conditions should be placed upon developers to ensure that best practice measures are implemented to mitigate any potential increase in loading upon existing drainage system(s).
127. The Environment Agency strongly advocates the use of Sustainable Drainage Systems (SUDS). A wide variety of SUDS techniques are available (refer Section 6.6.3), potentially providing both water quality and water quantity improvement benefits on a site by site basis throughout the Black Country. Wherever possible within brownfield areas, the developer should seek to reduce the rate of runoff from the site to greenfield runoff rates (i.e. the rate of runoff generated from the site assuming an open grassed area). Collectively, the effective application of SUDS as part of all future development will assist in reducing the risk of flooding to the respective Boroughs within the Black Country.

5.4 Groundwater Flooding

128. The risk of groundwater flooding is typically highly variable and heavily dependent upon local conditions at any particular time, nevertheless the risk of groundwater flooding in this instance is considered to be relatively low throughout the Black Country. However, following the termination of several (industrial) abstraction licenses, some local groundwater flooding incidents have occurred within Wolverhampton (most notably in local areas in the northeast and southeast of Wolverhampton; see the adjoining maps). Also the Council borders between Sandwell and Dudley has experienced some high water tables in the past.
129. In accordance with PPS25, future development will require an appropriate Flood Risk Assessment (FRA) at the planning application stage, commensurate with the level of flood risk posed to the site. The FRA should incorporate a site based assessment of the potential risk of groundwater flooding to the site, confirming (or otherwise) the likelihood and/or severity of this source of flood risk.

5.5 Climate Change

130. A considerable amount of research is being carried out worldwide in an endeavour to quantify the impacts that climate change is likely to have on flooding in future years. Climate change is perceived to represent an increasing risk to low lying areas of England, and it is anticipated that the frequency and severity of flooding will change measurably within our lifetime. PPS25 (Appendix B) states that a 10% increase in the 1% AEP (100 year) river flow can be expected within the next 20 years, increasing to 20% within the next 50 to 100 years.
131. It is essential that developers consider the possible change in flood risk over the lifetime of the development as a result of climate change. The likely increase in flow and/or tide level over the lifetime of the development should be assessed proportionally to the guidance provided by the EA as outlined above.
132. Detailed modelling of the impact of climate change throughout the Black Country is not readily available. The topography of the Sub region is relatively well defined, with steep sided valleys and narrow waterway corridors, and therefore the likely impact of an increase in the peak design flow is unlikely to affect vast areas currently not at risk. Localised intense storms are likely to occur more frequently however, and therefore the culverted watercourses may be subject to more regular surcharging, resulting in localised flooding.

133. In the absence of a definitive flood outline, in simple terms the anticipated extent of the 1% AEP (100 year) flood affected area in 2106 can be approximated by the current 0.1% AEP (1000 year) flood outline, i.e. Zone 2 Medium Probability. This indicates a relatively large increase in the number of properties at risk of flooding, and although this is considered a particularly conservative estimate, in planning terms it is essential that the Black Country Councils acknowledge the potential impact that climate change may have upon their District.
134. **Adopting the pragmatic comparison between Zone 3a and Zone 2 above, and with due consideration to the relatively well defined topography of the area, it is clear that climate change will not markedly increase the extent of river flooding.** For this reason, few areas that are currently situated outside of Zone 3 High Probability will be at risk of flooding in future years. This is an important conclusion from a spatial planning perspective. Notwithstanding this however, **those properties (and areas) that are currently at risk of flooding may be susceptible to more frequent, more severe flooding in future years.** It is essential therefore that the development control process (influencing the design of future development within the Sub region) carefully mitigates against the potential impact that climate change may have upon the risk of flooding to the property.
135. For this reason, all of the development control recommendations set out in Section 6.4 below require all floor levels, access routes, drainage systems and flood mitigation measures to be designed with an allowance for climate change. This provides a robust and sustainable approach to the potential impacts that climate change may have upon the Sub region over the next 100 years, ensuring that future development is considered in light of the possible increases in flood risk over time.
136. It is emphasised that the potential impacts of climate change will affect not only the risk of flooding posed to property as a result of river flooding, but it will also potentially increase the frequency and intensity of localised storms over the Sub region. This may exacerbate localised drainage problems. It is important therefore that the site based detailed Flood Risk Assessment (i.e. prepared by the developer at the planning application stage as outlined in Section 6) takes due consideration of climate change.

5.6 Residual Risk of Flooding

137. It is essential that the risk of flooding is minimised over the lifetime of the development in all instances. It is important to recognise however that flood risk can never be fully mitigated, and there will always be a residual risk of flooding.
138. This residual risk is associated with a number of potential risk factors including (but not limited to):
- a flooding event that exceeds that for which the flood risk management measures (for example, upstream storage) have been designed;
 - general uncertainties inherent in the prediction of flooding.
139. The SFRA process has carried out a review of flood risk within the Black Country in accordance with the PPS25 Sequential Test, identifying a number of areas that fall within Zone 3a High Probability. The modelling of flood flows and flood levels is not an exact science. There are limitations in the methodologies used for prediction, and the models developed are reliant upon observed flow data for calibration, much of which is often of questionable quality. For this reason, there are inherent uncertainties in the prediction of flood levels used in the assessment and management of flood risk.
140. It is difficult to quantify uncertainty. The adopted flood zones underpinning the Black Country SFRA are based upon the detailed flood mapping. Whilst these provide a robust depiction of flood risk for specific modelled conditions, all detailed modelling requires the making of core assumptions and the use of empirical estimations relating to (for example) rainfall distribution and catchment response.
141. It is incumbent on developers to carry out a detailed Flood Risk Assessment as part of the design process. A review of uncertainty should be undertaken as an integral outcome of this more detailed investigation.

6 Sustainable Management of Flood Risk

6.1 Overview

142. An ability to demonstrate 'sustainability' is a primary government objective for future development within the UK. The definition of 'sustainability' encompasses a number of important issues ranging broadly from the environment (i.e. minimising the impact upon the natural environment) to energy consumption (i.e. seeking alternative sources of energy to avoid the depletion of natural resources). Of particular importance however is sustainable development within flood affected areas.
143. The significant flood events that have occurred this summer have shown the devastating impacts that flooding can have on lives, homes and businesses. A considerable number of people live and work within areas that are susceptible to flooding, and ideally development should be moved away from these areas over time. It is recognised however that this is often not a practicable solution. For this reason, careful consideration must be taken of the measures that can be put into place to minimise the risk to property and life posed by flooding. These should address the flood risk not only in the short term, but throughout the lifetime of the proposed development. This is a requirement of PPS25.
144. The primary purpose of the SFRA is to inform decision making as part of the planning and development control process, taking due consideration of the scale and nature of flood risk affecting the Black Country. Responsibility for flood risk management resides with all tiers of government, and indeed individual landowners, as outlined below.

6.2 Responsibility for Flood Risk Management

145. There is no statutory requirement for the Government to protect property against the risk of flooding. Notwithstanding this however, the Government recognises the importance of safeguarding the wider community, and in doing so the economic and social well being of the nation. An overview of key responsibilities with respect to flood risk management is provided below.
146. The Regional Assembly should consider flood risk when reviewing strategic planning decisions including (for example) the provision of future housing and transport infrastructure.
147. The Environment Agency has a statutory responsibility for flood management and defence in England. It assists the planning and development control process through the provision of information and advice regarding flood risk and flooding related issues.
148. The Local Planning Authority is responsible for carrying out a Strategic Flood Risk Assessment. The SFRA should consider the risk of flooding throughout the sub region and should inform the allocation of land for future development, development control policies and sustainability appraisals. Local Planning Authorities have a responsibility to consult with the Environment Agency when making planning decisions.
149. Landowners & Developers⁹ have the primary responsibility for protecting their land against the risk of flooding. They are also responsible for managing the drainage of their land such that they do not adversely impact upon adjoining properties.

⁹ Referred to also as 'landowners' within PPS25

6.3 Strategic Flood Risk Management - The Environment Agency

6.3.1 Overview

150. With the progressive development of urban areas along river corridors, particularly during the industrial era, a reactive approach to flood risk management evolved. As flooding occurred, walls or embankments were built to prevent inundation to developing areas. Needless to say, construction of such walls should be carefully assessed so that it does not result in the redistribution of floodwater, inadvertently increasing the risk of flooding elsewhere.
151. The Environment Agency (EA) in more recent years has taken a strategic approach to flood risk management. The assessment and management of flood risk is carried out on a 'whole of catchment' basis. This enables the Environment Agency to review the impact that proposed defence works at a particular location may have upon flooding at other locations throughout the catchment.
152. A number of flood risk management strategies have been developed within the region, encompassing the large river systems that influence flood risk within the Black Country. A brief overview of these investigations is provided below.

6.3.2 Catchment Flood Management Plan (CFMP) - Midlands Region

153. *"One of the Environment Agency's main goals is to reduce flood risk from rivers and the sea to people, property and the natural environment by supporting and implementing government policies.*
154. *Flooding is a natural process – we can never stop it happening altogether. So tackling flooding is more than just defending against floods. It means understanding the complex causes of flooding and taking co-ordinated action on every front in partnership with others to reduce flood risk by:*
 - *Understanding current and future flood risk;*
 - *Planning for the likely impacts of climate change;*
 - *Preventing inappropriate development in flood risk areas;*
 - *Delivering more sustainable measures to reduce flood risk;*
 - *Exploring the wider opportunities to reduce the sources of flood risk, including changes in land use and land management practices and the use of sustainable drainage systems.*
155. *Catchment Flood Management Plans (CFMPs) are a planning tool through which the Agency aims to work in partnership with other key decision-makers within a river catchment to explore and define long term sustainable policies for flood risk management. CFMPs are a learning process to support an integrated approach to land use planning and management, and also River Basin Management Plans under the Water Framework Directive."¹⁰*
156. CFMPs are being developed for the River Trent catchment (including the River Tame) and the River Severn catchment (including the River Stour).

¹⁰ Catchment Flood Management Plans – Volume 1 (Guidance), Version 1.0, July 2004

157. The key actions in relation to the Stour Catchment (and relevant to mainly Dudley and parts of Wolverhampton) include;

Short Term Policy (0 – 10 years):	Do minimum
Long Term Policy (11 – 50 years):	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

158. In order to achieve these policies, the CFMP states the following responses;

- Changes to agricultural land management to reduce surface water run-off.
- Afforestation, though the areas required to be converted to woodland would be significant for a modest return in flood risk reduction.
- Construction of localised flood defences.
- Improvements to or extension of the existing flood warning scheme.

159. Although still in its scoping stage, the Trent CFMP has identified a set of key CFMP objectives in relation to the Trent catchment, which can be categorised in three key areas; Environmental, Social and Economical. Objectives that are most relevant to the Black Country SFRA include;

- Support and encourage land management and land use that will reduce run-off rates from upland areas.
- Reduce the number of people at risk from deep and fast flowing flood waters.
- Maintain an acceptable level of flood risk to people, property and infrastructure despite future increase pressure resulting from climate change, sea level rise and land use change.
- Reduce the disruption caused by flooding to transport and infrastructure.
- Reduce the cost of flood risk management and implement more sustainable methods of flood risk management.
- Prevent unacceptable increase in the cost of flood damages, taking into account future pressures which may increase flood risk.

6.3.3 The Tame Strategy (TTD)

160. The Environment Agency is currently developing a strategic plan for managing flood risk in the Tame Catchment. It covers the entire River Tame catchment up until its confluence with the River Trent.

161. The Tame Strategy has developed some key strategic aims and objectives for the catchment, which include;
- Ensure that identified flood management measures are technically, environmentally and economically appropriate and that a full range of options is considered and tested for feasibility
 - Develop hydraulic models for the Tame that are suitable and sufficiently adaptable to permit testing of a full range of options and scenarios
 - Protect and, where possible, enhance existing sites with special environmental designations or having nature conservation value
 - Actively pursue flood management solutions that will provide maximum opportunities for naturalisation of the channel and other environmental restoration/enhancement (provided that these are technically and economically justifiable)
 - Ensure compatibility with relevant plans and policies at national, regional and local levels
 - Actively pursue partnership initiatives which may lead to flood management benefits and to improvements in water quality, biodiversity and amenity.

6.4 Planning & Development Control – The Black Country

6.4.1 Planning Solutions to Flood Risk Management

The Sequential Test

162. Historically urbanisation has evolved along river corridors, the rivers providing a critical source of water, food and energy. This leaves many areas of England with a legacy of key urban centres that, due largely to their close proximity to rivers, are at risk of flooding.
163. The ideal solution to effective and sustainable flood risk management is a planning led one, i.e. steer urban development away from areas that are susceptible to flooding. PPS25 advocates a sequential approach that will guide the planning decision making process (i.e. the allocation of sites). In simple terms, this requires planners to seek to allocate sites for future development within areas of lowest flood risk in the initial instance. Only if it can be demonstrated that there are no suitable sites within these areas should alternative sites (i.e. within areas that may potentially be at risk of flooding) be contemplated. This sequential approach is referred to as **The Sequential Test**. This is summarised in in Figure 3.1 of the PPS25 Practice Companion Guide (A Living Draft, February 2007).
164. **It is absolutely imperative to highlight that the SFRA does not attempt, and indeed cannot, fully address the requirements of the PPS25 Sequential Test.** As highlighted in Section 6.4.1 and Figure 3.1 of the Practice Guide, it is necessary for the Council to demonstrate that sites for future development have been sought within the lowest flood risk zone (i.e. Zone 1 Low Probability). Only if it can be shown that suitable sites are not available within this zone can alternative sites be considered within the areas that are at greater risk of possible flooding (i.e. Zone 2, and finally Zone 3).
165. Wherever possible, the Council should restrict development to the permissible land uses summarised in PPS25 Appendix D (Table D2). This may involve seeking opportunities to 'swap' more vulnerable allocations at risk of flooding with areas of lesser vulnerability that are situated on higher ground. This is discussed further in Sections 6.4.2 to 6.4.6 below.

166. It is important to recognise that the principles of the sequential approach are applicable throughout the planning cycle, and refer equally to the forward planning process (delivered by Council as part of the LDF) as they do to the assessment of windfall sites. Where windfall sites come forward for consideration, it is essential that the developer to consider the planning 'need' for the proposed site (adopting a sequential approach in accordance with PPS25). The Council will assist where possible with supporting information. The detailed FRA will be required to demonstrate the careful and measured consideration of whether indeed there is an alternative site available within an area of lesser flood risk, in accordance with the PPS25 Sequential Test.

The Exception Test

167. It is recognised that only a relatively small proportion of the Black Country is situated within Zone 3a High Probability. Prohibiting future residential development in these areas is unlikely to have a detrimental impact upon the economic and social welfare of the existing community, however there may be pressing planning 'needs' that may warrant further consideration of these areas. Should this be the case, the Council and potential future developers are required to work through the **Exception Test** (PPS25 Appendix D) where applicable. For the Exception Test to be passed:
- *"It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. If the DPD has reached the 'submission' stage, the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal;*
 - *the development should be on developable, previously development land or if it is not on previously developed land, that there are no reasonable alternative sites on previously development land; and*
 - *a FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and where possible, will reduce flood risk overall."*
168. The first two points set out in the Exception Test are planning considerations that must be adequately addressed. A planning solution to removing flood risk must be sought at each specific location in the initial instance, seeking to relocate the proposed allocation to an area of lower flood risk (i.e. Zone 1 Low Probability or Zone 2 Medium Probability) wherever feasible.
169. The SFRA has been developed in liaison with the respective Councils and the Environment Agency to work through the requirements of the Sequential Test (and, where necessary, the Exception Test) within the Black Country. It will be the responsibility of the developer (in all instances within Zone 3a High Probability) to develop a detailed Flood Risk Assessment that can demonstrate that the Sequential Test has been applied, and (where appropriate) that the risk of flooding has been adequately addressed in accordance with PPS25.
170. The management of flood risk throughout the Black Country must be assured should development be permitted to proceed, and the SFRA has provided specific recommendations that ultimately should be adopted as planning conditions for all future development. It is the responsibility of the prospective developer to build upon these recommendations as part of a detailed Flood Risk Assessment to ensure that the specific requirements of PPS25 can be met.
171. Specific planning and development control recommendations for future development within the Black Country are presented below. A 'user guide' to assist in the application of the SFRA recommendations is provided in Appendix A.
172. An overview of flood risk throughout the Black Country has been provided in Section 6.5 and adjoining Figures 3.1 to 3.6. **Future planning decisions should consider the spatial variation in flood risk across the Black Country, as defined by the delineated flood zone that applies at the specified site location, and apply the recommendations provided below accordingly.** Once again, it is reiterated that PPS25 applies equally to both allocated sites identified within the emerging LDF and future windfall sites. The application of the Sequential Test should be guided by Figure 3.1 of the PPS25 Practice Guide.

6.4.2 A Proactive Approach – Positive Reduction of Flood Risk through Development

173. It is crucial to reiterate that PPS25 considers not only the risk of flooding posed to new development. It also seeks to positively reduce the risk of flooding posed to existing properties within the Black Country. It is strongly recommended that this principle be adopted as the underlying 'goal' for developers and Council development control teams within the area and specifically those areas highlighted as having a historical flood risk.
174. Developers should be encouraged to demonstrate that their proposal will deliver a positive reduction in flood risk to the area, whether that be by reducing the frequency or severity of flooding (for example, through the introduction of SuDS), or by reducing the impact that flooding may have on the community (for example, through a reduction in the number of people within the site that may be at risk). This should not be seen as an onerous requirement, and indeed if integrated into the design at the conceptual stage, will place no added demands upon the development and/or planning application process.
175. Possible risk reduction measures for consideration may include the following:
 - The integration of SuDS to reduce the runoff rate from the site;
 - A change in land use to reduce the vulnerability of the proposed development;
 - A reduction in the building platform area;
 - The raising of internal floor levels and flood proofing (within existing buildings) to reduce potential flood damage;
 - The rearrangement of buildings within the site to remove obstructions to overland flow paths;
 - The placement of buildings to higher areas within the site to limit the risk of flood damage

6.4.3 Future Development within Zone 3b Functional Floodplain

Planning Recommendations – Allocation of Land for Future Development

Areas of Functional Floodplain should be protected for flood storage purposes. Future development should be restricted to water-compatible uses and essential infrastructure that has to be there (in accordance with PPS25). Careful consideration should be given to the respective Council's emergency response in times of flood to ensure that public safety is not compromised.

Development Control Recommendations – Minimum Requirements

Future development, with the exception of water compatible uses and essential infrastructure, should not be permitted. The frequency and severity of flooding within these areas are such that no engineered mitigation measures could be implemented to safely and effectively minimise the risk to life and property over the lifetime of the development.

6.4.4 Future Development within Zone 3a High Probability

Planning Recommendations – Allocation of Land for Future Development

1. Future development within Zone 3a High Probability should be restricted to 'less vulnerable' land uses, in accordance with PPS25 (Appendix D) Table D2. 'More vulnerable' land uses, including residential development, should be steered towards zones of lower flood risk (i.e. Zone 2 Medium Probability or Zone 1 Low Probability) within which suitable land may be available in adjoining character areas.
2. Where non-flood risk related planning matters dictate that 'more vulnerable' (residential) development should be considered further, it will be necessary to ensure that the requirements of the Exception Test are satisfied. In planning terms, it must be

demonstrated that “the development provides wider sustainability benefits to the community that outweigh flood risk”, and that “the development is on developable previously developed land, or that there are no reasonable alternative sites on previously developed land”.

3. To satisfy the remaining criteria of the Exception Test, all development within Zone 3a High Probability should be conditioned in accordance with the development control recommendations below

Development Control Recommendations – Minimum Requirements

1. All proposed future development within Zone 3a High Probability will require a detailed Flood Risk Assessment (FRA);
2. Floor levels must be situated above the 1% AEP (100 year) predicted maximum flood level plus climate change, incorporating an allowance for freeboard;
3. Dry access is to be provided (above flood level) to enable the safe evacuation of residents and/or employees in case of flooding. In exceptional circumstances where this is not achievable, and for non-residential uses, safe access must be provided at all locations, defined in accordance with the emerging Defra research as outlined in “Flood Risks to People” (FD2320 and FD2321). It is essential to ensure that the nominated evacuation route does not divert evacuees onto a ‘dry island’ upon which essential supplies (i.e. food, shelter and medical treatment) will not be available for the duration of the flood event;
4. Basements are not to be utilised for habitable purposes. All basements must provide a safe evacuation route in time of flood, providing an access point that is situated above the 1% AEP (100year) peak design plus climate change flood level;
5. Implement SUDS to ensure that runoff from the site (post redevelopment) does not exceed greenfield runoff rates. Any SUDS design must take due account of groundwater and geological conditions;
6. Ensure that the proposed development does not result in an increase in maximum flood levels within adjoining properties. This may be achieved by ensuring (for example) that the existing building footprint is not increased and/or compensatory flood storage is provided within the site (or upstream)¹¹;
7. A minimum 8m buffer zone must be provided to ‘top of bank’ within sites immediately adjoining the river corridor. This requirement may be negotiated with the EA in heavily constrained locations

6.4.5 Future Development within Zone 2 Medium Probability

Planning Recommendations – Allocation of Land for Future Development

1. In accordance with PPS25, land use within Zone 2 Medium Probability should be restricted to the ‘water-compatible’, ‘less vulnerable’ and ‘more vulnerable’ category (including residential development), or essential infrastructure, to satisfy the requirements of the Sequential Test
2. Where non-flood risk related planning matters dictate that ‘highly vulnerable’ development should be considered further, it will be necessary to ensure that the requirements of the Exception Test are satisfied. In planning terms, it must be demonstrated that “the development provides wider sustainability benefits to the community that outweigh flood risk”, and that “the development is on developable previously developed land, or that there are no reasonable alternative sites on previously developed land”.
3. To satisfy the remaining criteria of the Exception Test, all development within Zone 2 Medium Probability should be conditioned in accordance with the development control recommendations below.

¹¹ Compensatory flood storage should be located as close as practically possible to the proposed development. The Environment Agency can provide further advice in this regard

Development Control Recommendations – Minimum Requirements

1. All proposed future development within Zone 2 Medium Probability will require a Flood Risk Assessment (FRA) that is commensurate with the risk posed to the proposed development;
2. Floor levels must be situated above the 1% AEP (100 year) predicted maximum flood level plus climate change, incorporating an allowance for freeboard;
3. Dry access is to be provided (above flood level) to enable the safe evacuation of residents and/or employees in case of flooding. In exceptional circumstances where this is not achievable, and for non-residential uses, safe access must be provided at all locations, defined in accordance with the emerging Defra research as outlined in “Flood Risks to People” (FD2320 and FD2321). It is essential to ensure that the nominated evacuation route does not divert evacuees onto a ‘dry island’ upon which essential supplies (i.e. food, shelter and medical treatment) will not be available for the duration of the flood event;
4. Implement SUDS wherever practicable, to ensure that runoff from the site (post redevelopment) does not exceed greenfield runoff rates. Any SUDS design must take due account of groundwater and geological conditions (refer Section 6.6.3)

6.4.6 Future Development within Zone 1 Low Probability

Planning Recommendations – Allocation of Land for Future Development

There are generally no flood risk related constraints placed upon land use within Zone 1 Low Probability (in accordance with PPS25), however it is important to recognise that future development within this zone may adversely impact upon the existing flooding regime if not carefully managed. Flooding related issues of a localised nature may also occur within Zone 1 Low Probability. For this reason, all development should be carried out in accordance with the development control recommendation below.

Development Control Recommendations – Minimum Requirements

A simple Flood Risk Assessment will be required in compliance with PPS25 and current guidance and policy. This will involve the introduction of SUDS techniques to ensure that runoff from the site (post redevelopment) does not exceed greenfield runoff rates. Any SUDS design must take due account of groundwater and geological conditions.

6.5 Overview of Flood Risk - Character Areas

176. To provide meaningful recommendations, and for ease of reference, the flood risk within the Black Country has been considered on the basis of each Borough or City Council. Maps are provided in Appendix B at the back of this report.

6.5.1 Walsall Borough Council (Figure B-1)

The Walsall Borough Council area incorporates some key watercourses such as Ford Brook and the River Tame (including the Wolverhampton Arm), which generate the main fluvial flood risk for the area. The areas that are currently affected by the Zone 3a High Probability include parts of Bloxwich, Walsall Town centre (Sneyd Brook and Ford Brook), Willenhall and Darlaston (River Tame - (Wolverhampton Arm)).

Ford Brook incorporates a major culvert that runs underneath the centre of Walsall, which is understood to provide some level of protection to the area. However culvert capacity is limited to a 5-year return period flood event (i.e. 20% AEP), this indicates potential flood risk during storm events of greater than 1 in 5 year magnitude (see the culvert assessment explanation provided in Appendix C).

The above culvert capacity, and resulting potential flood risk, for Walsall town centre / the Ford Brook was identified as a serious issue for Walsall Council. On the basis of its experience and analyses supporting planning applications in the area, the Council is concerned the work completed for this level 1 SFRA might overstate the degree of flood risk. Consequently a further, more detailed level 2 assessment has been commissioned by Walsall Council in conjunction with the Environment Agency. The results of this work are due to be published in March / April 2009 and will supersede any culvert capacity and flood zone data for this particular stretch of watercourse contained within this level 1 SFRA document.

The Tame tunnel however, provides a significant level of flood protection to the Willenhall area, which is assessed to be much higher than that provided by the Ford Brook culvert. Provided that the tunnel is free from debris or other blockages, it is expected that the Zone 3a High Probability is contained by the tunnel.

Within the Walsall Borough, the open channel section of the River Tame (including the Wolverhampton Arm) is a 'maintained watercourse', which means that the river channel is regularly inspected and maintained by the Environment Agency regarding bank erosion and vegetation overgrowth issues.

Key areas that are currently located within the Zone 3b Functional Floodplain include various urban areas along the Sneyd Brook. The Functional Floodplain connected to the River Tame tends to not cover any significant urbanised areas within Walsall, only sporadically some isolated properties (e.g. the Walsall FC Club House).

Walsall's road infrastructure is known to provide an escape route for the M6 Motorway traffic, putting significant pressure on the infrastructure during peak rush hour. Although the infrastructure is currently undergoing major improvements to ease this pressure, it is anticipated that during major flooding events, some areas could become gridlocked and therefore potentially preventing rescue services to reach flooding affected areas.

In recent history, apart from some garden flooding in November 2000, the Walsall Borough has not experienced any significant fluvial flooding. However, some isolated incidents have occurred in the past, which tend to be generated through excessive runoff during heavy rainfall, culvert blockage or overland flow routes. *(Note that post event data from the summer 2007 event(s) has not been incorporated in this study)*

6.5.2 Wolverhampton City Council (Figure B-2)

The majority of the river network within Wolverhampton City Council is culverted and therefore the main flood risk posed to properties tends to be generated by localised flood incidents, mainly due to blocked road gullies and extreme surface water runoff. However, data for the Smestow Brook in the Western part of Wolverhampton does indicate some isolated properties at risk from fluvial flooding, mainly concentrated within the Compton area. The Graisle Brook and Oxley Brook flood maps also contain further properties located within the Zone 3a High Probability.

The culverted river network generally consist of large sized culverts, suggesting that for some locations (e.g. the upper reaches of Smestow Brook) the true extent of the current Zone 3a High Probability is debatable (see also Appendix).

Flood risk generated by groundwater appears to be a much more significant issue within the Wolverhampton City Council area compared to the other Black Country Councils. This reflects general rising water tables within the Black Country region, due to the significant reduction in industrial groundwater extraction over the last 20 years. Historically, several groundwater flooding issues have been reported, most notably within the North-eastern (Newholds, Scotlands and Wood Heyes) and South-western areas (Merry Hill, Bradmore and Blakenhall) of Wolverhampton.

Regarding major flood events that have hit the UK in recent times not much has been reported within Wolverhampton City Council, with the exception of some local incidental occurrences connected to minor watercourses (e.g. low lying areas along Woodfield Avnue). *(Note that post event data from the summer 2007 event(s) has not been incorporated in this study)*

6.5.3 Sandwell Borough Council (Figure B-3)

The Sandwell Borough is mostly at risk from flooding from the Main River Tame and the Oldbury Arm of the River Tame. These river reaches have been thoroughly modelled by the Environment Agency, which therefore give a comprehensive overview of the High Probability Flood Zones 3a and 3b.

The (Main) River Tame floodplain mainly uses the green corridors within the Borough, although the Zone 2 Medium Probability does indicate some properties at risk from flooding in West Bromwich (e.g. the Yew Tree and Hamstead suburbs).

The Oldbury Arm of the River Tame however, places a number of properties within the Zone 3b Functional Floodplain near Horseley Heath in Tipton, which indicates that these properties would quite regularly flood. Additionally, the Medium Probability Flood Zone indicates a significant number of properties at risk from flooding, which tend to mainly be concentrated in Wednesbury, Tipton and Oldbury.

The River Tame and the Oldbury Arm are represented by the Environment Agency as 'maintained river channels', which means that these river reaches are regularly inspected for erosion and/or vegetation problems. Further site walkovers also indicated that flood defence structures along watercourses within the Dudley Borough generally consists of improved river banks or minor embankments, which suggests that significant defence failure is unlikely to occur within the Borough.

The majority of minor watercourses within Sandwell are culverted. Preliminary investigations on the size of these culverts have indicated that for some it is expected that the 100-year return period flow is contained by the culvert, therefore potentially eliminating the current Zone 3a High Probability (see Appendix). Most notable watercourses include Tipton and Swan Brook in Tipton and the Hockley Brook river system in Smethwick.

The Sandwell Borough also tends to be subjected to regular road flooding due to extreme heavy rainfall or blocked road gullies. This could pose some pressure on emergency planning, but it is understood that principal risk locations have been represented in the current Emergency Plan for the Borough.

Historically, most significant (fluvial) flood events date back to the 1980's and 1990's, which affected several properties within the Borough. Following increased culvert (grid) maintenance and some flood defence schemes, no major flooding has occurred in recent years.

However, it was noted during the consultations with the local Drainage Officer that the severe flooding problem connected to the motorway culvert in Titford, Blackheath still exists. The recent construction of an additional storm culvert has not been able to resolve this problem, and this particular location is therefore still under investigation.

6.5.4 Dudley Borough Council (Figure B-4)

Unlike the other Black Country Councils, the Dudley Borough generally includes mostly open channel watercourses. These watercourses mainly contain the headwaters of the River Stour and, to some extent, the River Tame, catchment, and therefore tend to have a narrow, well-defined floodplain. Subsequently, only a small number of properties are affected by fluvial flooding within the Borough.

Some river stretches however, are (almost entirely) culverted, of which Swan Brook to the Northeast is most notable. This particular culverted stretch appears to be of significant size,

therefore potentially reducing, if not eliminating the current Zone 3a High Probability at this location. Through consultations with the local Drainage Officer it was also highlighted that an unknown tributary of the River Stour to the Southeast of Dudley is almost entirely culverted. However, the culvert dimensions were not made available for this project and therefore the (possible) overland flow route indicated by the National Flood Zone Maps has been adopted as a true representation of flood risk.

Historically, the Borough has been affected by various localised flooding incidents, ranging from excessive surface water runoff to culvert blockage. There also exists some concern regarding the maintenance of culverts along the Main Rivers (e.g. the River Stour, Illey Brook etc) within the Borough. These maintenance programmes are now the responsibility of the Environment Agency, and current staffing issues within the Agency could potentially increase the number of localised flooding incidents regarding culvert blockages.

During the summer of this year some locations along the upper reach of the Stour and Illey Brook experienced significant flooding, although it is understood that these incidents were caused by a combination of high river levels and culvert capacity problems (see Appendix).

6.6 Detailed Flood Risk Assessment (FRA) – The Developer

6.6.1 Scope of the Detailed Flood Risk Assessment

177. As highlighted in Section 2, the SFRA is a strategic document that provides an overview of flood risk throughout the area. It is imperative that a site-based Flood Risk Assessment (FRA) is carried out by the developer for all proposed developments within Zones 2 and 3, and for sites greater than 1ha within Zone 1. This should be submitted as an integral part of the planning application.
178. The FRA should be commensurate with the risk of flooding to the proposed development. For example, where the risk of flooding to the site is negligible (e.g. Zone 1 Low Probability), there is little benefit to be gained in assessing the potential risk to life and/or property as a result of flooding. Rather, emphasis should be placed on ensuring that runoff from the site does not exacerbate flooding lower in the catchment. The particular requirements for FRAs within each delineated flood zone are outlined below.

It is highlighted that the description of flood risk provided in the Character Area discussions above place emphasis upon the primary source of flood risk (i.e. river flooding). In all areas, a localised risk of flooding may also occur, typically associated with local catchment runoff following intense rainfall passing directly over the Borough. This localised risk of flooding must also be considered as an integral part of the detailed Flood Risk Assessment.

179. Proposed Development within Zone 3a High Probability

All FRAs supporting proposed development within Zone 3a High Probability should 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.
- 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;
- Details of proposed sustainable drainage systems (SuDS) that will be implemented. Any SuDS design must take due account of groundwater and geological conditions (refer Section 6.6.3);
- The developer must provide a clear and concise statement summarising how the proposed (re)development has contributed to a positive reduction in flood risk within the Black Country

180. Proposed Development within Zone 2 Medium Probability

- For all sites within Zone 2 Medium Probability, a high level FRA commensurate with the level of risk posed to the site should be prepared based upon readily available existing flooding information, sourced from the EA. It will be necessary to demonstrate that the residual risk of flooding to the property is effectively managed through, for example, the provision of raised floor levels and the provision of a planned evacuation route.
- The risk of alternative sources of flooding (e.g. urban drainage and/or groundwater) must be considered, and sustainable urban drainage techniques must be employed to ensure no worsening to existing flooding problems elsewhere within the area.
- As part of the high level FRA, the developer must provide a clear and concise statement summarising how the proposed (re)development has contributed to a positive reduction in flood risk within the Black Country.
- Details of proposed sustainable drainage systems (SuDS) that will be implemented. Any SuDS design must take due account of groundwater and geological conditions.

181. Proposed Development within Zone 1 Low Probability

For all sites greater than 1ha in area, a simple Flood Risk Assessment must be prepared. The risk of alternative sources of flooding (e.g. urban drainage and/or groundwater) must be considered. Details must be provided of proposed sustainable drainage systems (SUDS) that will be implemented. Any SUDS design must take due account of groundwater and geological conditions.

182. 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.

183. Liaison with the Environment Agency

To assist local planning authorities, the Environment Agency has produced standing advice to inform on their requirements regarding the consultation process for planning applications on flood risk matters. Full details of their Flood Risk Standing Advice can be found on the website: www.pipernetworking.com.

184. The Environment Agency is an excellent source of information to inform the development of the detailed FRA. The external relations team should be contacted as early as possible to source information relating to (for example) historical flooding, hydraulic modelling and topography (LiDAR). It is emphasised that the information provided within the SFRA is the best available at the time of writing. More up to date information may be available, and contact should always be made with the EA at an early stage to ensure that the detailed site based FRA is using the most current datasets, avoiding unnecessary re-work..

6.6.2 Raised Floor Levels & Basements (Freeboard)

185. The raising of floor levels above the 1% AEP (100 year) fluvial 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% AEP (100 year) predicted flood level assuming a 20% increase in flow over the next 100 years.

186. Wherever possible, floor levels should be situated a minimum of 600mm above the 1% AEP (100 year) plus climate change flood level, determined as an outcome of the site based FRA. The height that the floor level is raised above flood level is referred to as the 'freeboard', and is determined as a measure of the residual risks.

187. The use of basements within flood affected areas should be discouraged. Where basement uses are permitted however, it is necessary to ensure that the basement access points are situated 300mm above the 1% AEP (100 year) flood level plus climate change. The basement must be of a waterproof construction to avoid seepage during flooding conditions. Habitable uses of basements within flood affected areas should not be permitted.

6.6.3 Sustainable Drainage Systems (SUDS)

188. 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. The integration of sustainable drainage systems into a site design can also provide broader benefits, including an improvement in the quality of runoff discharged from the site, the capture and re-use of site runoff for irrigation and/or non potable uses, and the provision of greenspace areas offering recreation and/or aesthetic benefits.

189. SUDS may improve the sustainable management of water for a site by¹²:
- reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;
 - reducing volumes and the frequency of water flowing directly to watercourses or sewers from developed sites;
 - improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
 - reducing potable water demand through rainwater harvesting;
 - improving amenity through the provision of public open space and wildlife habitat;
 - replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.
190. In catchment terms, any reduction in the amount of water that originates from any given site is likely to be small. But if applied across the catchment in a consistent way, the cumulative affect of a number of sites could be significant.
191. There are numerous different ways that SUDS can be incorporated into a development and the most commonly found components of a SUDS system are described in the following table¹³. The appropriate application of a SUDS scheme to a specific development is heavily dependent upon the topography and geology of the site (and its surrounds). For example, areas overlaying clay geology are likely to be unsuitable for infiltration techniques including soakaways. Similarly, steep slopes are generally unsuitable for SUDS techniques that rely upon flow storage, e.g. ponds and wetlands. Careful consideration of the site characteristics must be assured to ensure the future sustainability of the adopted drainage system.

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.
Filter drain	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 only be considered where other SUDS techniques are not practicable).

¹² Interim Code of Practice for Sustainable Drainage Systems National SUDS Working Group, 2004

¹³ Interim Code of Practice for Sustainable Drainage Systems National SUDS Working Group, 2004

192. For more guidance on SUDS, the following documents and websites are recommended as a starting point:
- Interim Code of Practice for Sustainable Drainage Systems, National SUDS Working Group, 2004
 - Adopted Planning Policy Statement 25, Annex F, Office of the Deputy Prime Minister, 2005
 - www.ciria.org.uk/SUDS/

6.7 Emergency Planning

193. Emergency planning is a critical element of any sustainable flood risk management solution. Liaison with both the Environment Agency and emergency services is imperative.
194. The Council is designated as a Category 1 Responder under the Civil Contingencies Act 2004. As such, the Council has defined responsibilities to assess risk, and respond appropriately in case of an emergency, including (for example) a major flooding event. The Council's primary responsibilities are¹⁴:
- a. *from time to time assess the risk of an emergency occurring;*
 - b. *from time to time assess the risk of an emergency making it necessary or expedient for the person or body to perform any of his or its functions;*
 - c. *maintain plans for the purpose of ensuring, so far as is reasonably practicable, that if an emergency occurs the person or body is able to continue to perform his or its functions;*
 - d. *maintain plans for the purpose of ensuring that if an emergency occurs or is likely to occur the person or body is able to perform his or its functions so far as necessary or desirable for the purpose of:*
 - i. *preventing the emergency,*
 - ii. *reducing, controlling or mitigating its effects, or*
 - iii. *taking other action in connection with it*
195. The Environment Agency monitors river levels within the main rivers affecting the Black Country, including the River Tame and the Oldbury Arm of the Tame, the River Stour and Smestow Brook. Based upon a sophisticated in-house forecasting computer model, the Agency makes an assessment of the anticipated maximum water level that is likely to be reached within the proceeding hours (and/or days).
196. Where these predicted water levels are expected to result in the inundation of populated areas¹⁵, the Environment Agency will issue a series of flood warnings to both the public and professional partners within defined flood warning areas, encouraging residents to take action to avoid damage to property in the first instance. Within the Tame catchment, the onset of flooding can be very rapid with little warning, sometimes less than 3 hours, particularly in the upper reaches (e.g. the Oldbury Arm). A recent review of the Flood Warning services within the Black Country has been undertaken as part of the Upper Trent Flood Warning Management Plan.

¹⁴ Civil Contingencies Act 2004

¹⁵ Restricted to those urban areas situated within Environment Agency flood warning zones

197. As water levels rise and begin to pose a risk to life and/or livelihood, it is the responsibility of the Council to coordinate the evacuation of residents. This evacuation will be supported and facilitated by the emergency services. It is essential that a robust plan is in place that clearly sets out (as a minimum):
- roles and responsibilities;
 - paths of communication;
 - evacuation routes;
 - community centres to house evacuated residents;
 - contingency plans in case of loss of power and/or communication.
198. 'Dry' access (i.e. above flood level) should be sought wherever possible to ensure that all residents can be safely evacuated in times of flood. As part of their long term strategy for road maintenance and improvement, the Council progressively should seek to raise critical evacuation routes above the greater of the 1% AEP + 20% flow (i.e. climate change) flood level. As an absolute minimum, 'safe' access must be assured during the 1% AEP (100 year) fluvial flood level, defined with due consideration to the emerging Defra research presented in "Flood Risk to People" (FD2320 and FD2321). It is highlighted that road raising must not have a detrimental impact upon flow routes and/or the effectiveness of floodplain storage.
199. Coordination with the emergency services and the Environment Agency is imperative to ensure the safety of residents in time of flood. Few areas within the Black Country are at risk of river flooding (as indicated by the shaded PPS25 flood risk zones in the adjoining maps). These areas are typically susceptible to relatively long duration rainfall events, and considerable forewarning will generally be provided to encourage preparation in an effort to minimise property damage and risk to life
200. In contrast, areas suffering from localised flooding issues will tend to be at greater risk. These areas are susceptible to 'flash' flooding, associated with storm cells that pass over the sub region resulting in high intensity, often relatively localised, rainfall. It is anticipated that events of this nature will occur more often as a result of possible climate change over the coming decades. Events of this nature are difficult to predict accurately, and the rapid runoff that follows will often result in flooding that cannot be sensibly forewarned.
201. All urbanised areas are potentially at some degree risk of localised flooding due to heavy rainfall. The blockage of gullies and culverts as a result of litter and/or leaves is commonplace, and this will inevitably lead to localised problems that can only realistically be addressed by reactive maintenance.
202. It is recommended that the Council's Emergency Response Plan is reviewed in light of the findings and recommendations of the SFRA to ensure that safe access can be provided during a major flooding event.

6.8 Insurance

203. Many residents and business owners perceive insurance to be a final safeguard should damages be sustained as a result of a natural disaster such as flooding. Considerable media interest followed the widespread flooding of 2000 when it became clear that the insurance industry were rigorously reviewing their approach to providing insurance protection to homes and businesses situated within flood affected areas. Not surprisingly, the recent widespread flooding of July 2007 has further exacerbated the discussion surrounding the future of insurance for householders and business owners situated within flood affected areas.

204. The following quotations are an extract from the Association of British Insurers (ABI) website, dated August 2007:

“The UK is unique in offering flood cover as a standard feature of household and most business policies. Unlike much of Europe and worldwide, cover is widely available to the UK’s 23.5 million householders.

In the long term, this situation could worsen, unless we take action to reduce flood risk to people and property. Climate change will increase winter rainfall, the frequency of heavy rainfall, and sea levels and storm surge heights. With no change in Government policies or spending, climate change could increase the number of properties at risk of flooding to 3.5 million. Furthermore, continued pressure on land could mean even more new developments being situated in floodplains.

By spreading the risk across policy holders, insurance enables householders and businesses to minimize the financial cost of damage from flooding. In the modern competitive insurance market, premiums reflect the risks that customers face. This enables insurance to be offered at very competitive prices to customers living in low flood risk areas.

In 2003 ABI members agreed to extend their commitment to provide flood insurance to the vast majority of UK customers. The result of discussions between Government and insurers was a [Statement of Principles](#), which aims to provide reassurance to the overwhelming majority of insurance customers living in the floodplain about the continued availability of insurance in future.

Individual property owners can do much to increase the resistance and resilience of their properties to flood damage - [further information is available](#). ABI has issued a [factsheet for property owners](#) on a range of measures that could be taken by a homeowner to improve the resilience of their property to flood damage.”

205. In summary, for the time being, residents and business owners can be assured that insurance will be available to assist in recovery following a flood event. It would appear fair to say however that the future availability of flood insurance within the UK will be heavily dependant upon commitment from the government to reduce the risk of flooding over time, particularly given the anticipated impacts of climate change. Investment is required in flood defence and improving the capacity of sewage and drainage infrastructure, however it is also essential to ensure that spatial planning decisions do not place property within areas at risk of flooding.

7 Conclusion & Recommendations

206. A reasonable number of properties within the Black Country are at risk of flooding from rivers, however the heavily urbanised area, and steep topography, introduces a relatively high susceptibility to localised flooding. The risk of flooding posed to properties within the respective Boroughs arises from a number of sources including river flooding, localised runoff and sewer flooding.
207. Planning policy needs to be informed about the risk posed by flooding. A collation of potential sources of flood risk has been carried out in accordance with PPS25, developed in close consultation with both the Black Country Councils and the Environment Agency. The Black Country has been broken down into zones of 'high', 'medium' and 'low' probability of flooding in accordance with PPS25, providing the basis for the application of the PPS25 Sequential Test.
208. A planning solution to flood risk management should be sought wherever possible, steering vulnerable development away from areas affected by flooding in accordance with the PPS25 Sequential Test. Specific planning recommendations have been provided for all urban centres within the Black Country (refer Section 6.4).
209. Where other planning considerations must guide the allocation of sites and the Sequential Test cannot be satisfied, specific recommendations have been provided to assist the Council and the developer to meet the Exception Test. These should be applied as development control conditions for all future development (refer Section 6.5).
210. Council policy is essential to ensure that the recommended development control conditions can be imposed consistently at the planning application stage. This is essential to achieve future sustainability within the Black Country with respect to flood risk management. It is recommended that supplementary planning guidance is developed to build upon emerging Council policy, in light of the suggested development control conditions presented by the Black Country SFRA (refer Section 6.5).
211. Emergency planning is imperative to minimise the risk to life posed by flooding within the Borough. It is recommended that the Black Country Councils review their adopted flood risk response plan in light of the findings and recommendations of the SFRA.
212. The core data used to underpin the development of the SFRA will be superseded over time as the Environment Agency provides further investment in detailed modelling of the watercourses within the Black Country, reviewing its Flood Zone Maps on a quarterly basis. It is recommended that the Environment Agency Flood Zone Maps are retained as the 'first pass' filter at the development application stage, triggering (or otherwise) the need for a more detailed site-based investigation.
213. The SFRA should be retained as a 'living' document, reviewed on a regular basis in light of better flood risk information and emerging policy guidance.

APPENDIX A

The Black Country SFRA User Guide

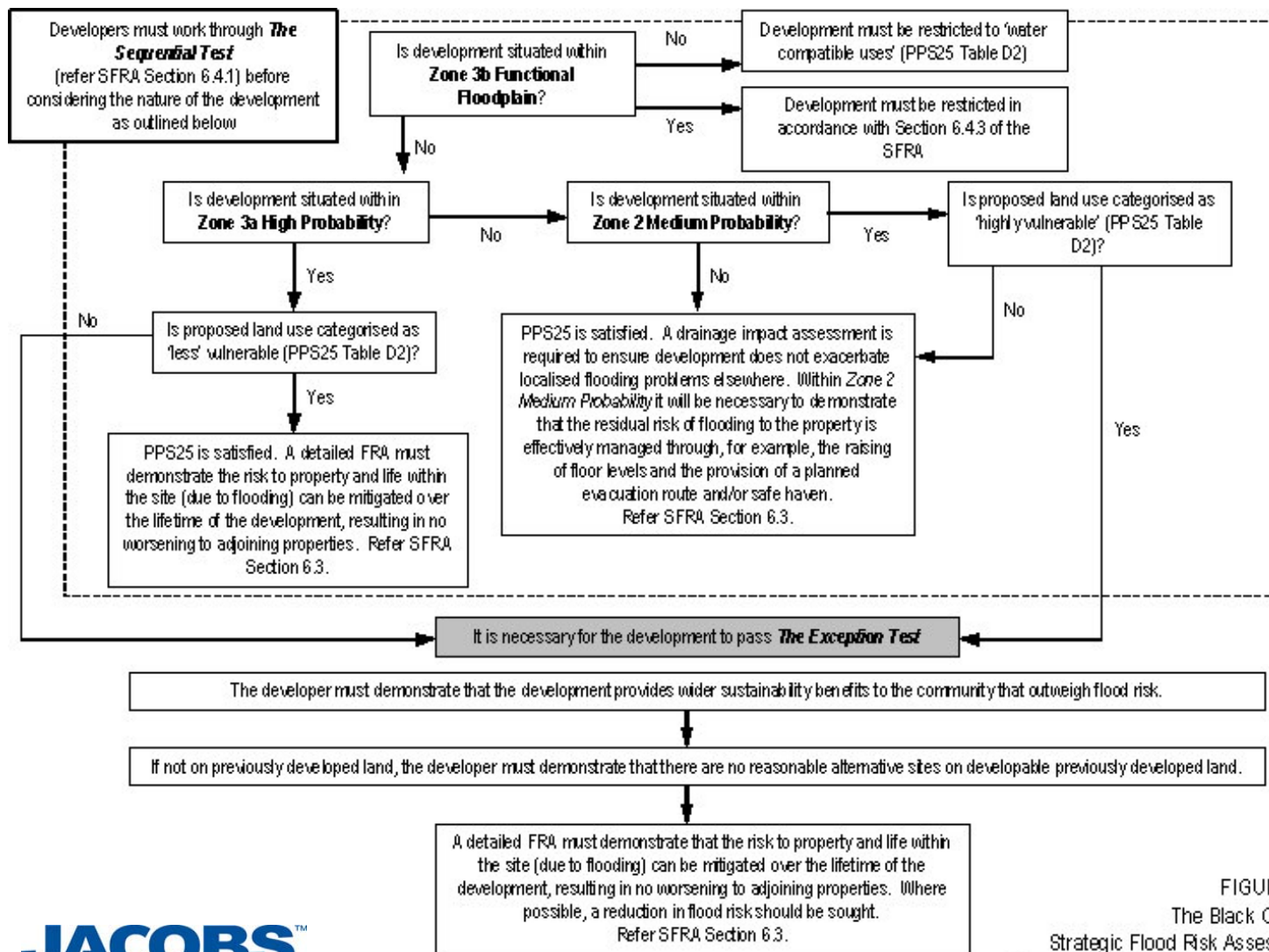


FIGURE A-2
The Black Country
Strategic Flood Risk Assessment
User Guide (Development Control)

APPENDIX B

The Black Country SFRA PPS25 Flood Risk Maps

APPENDIX C

Culvert Capacity Checks

Culvert Capacity Checks

Introduction

Much of the available flood extent data for the Black Country area is restricted to the Environment Agency national dataset. Where no modelled data is available, the Environment Agency Flood Zone Maps fall back onto the J-flow methodology (Developed by JBA Consultants for the Environment Agency). J-flow is a very straightforward way of establishing peak water levels along river channels, using the National DTM (Digital Terrain Model) with peak flow levels at regular intervals. Due to limitations in the DTM resolution the J-Flow methodology is forced to make some basic assumptions:

- At river bankfull capacity is the median flow (i.e. The 1 in 2 year flood event).
- Culverts along the watercourse also have a maximum capacity of the median flow.

Where conduit dimension data is known the latter assumption can be challenged, and the validity of specific flood envelopes can be assessed.

Data Availability

The available culvert cross sectional dimensions and invert levels were obtained from local authority records, for all Black Country watercourses within The EA Flood Zone 2. This allowed analysis of 21 culverts across the Black Country study area (see Figure C-1 below).

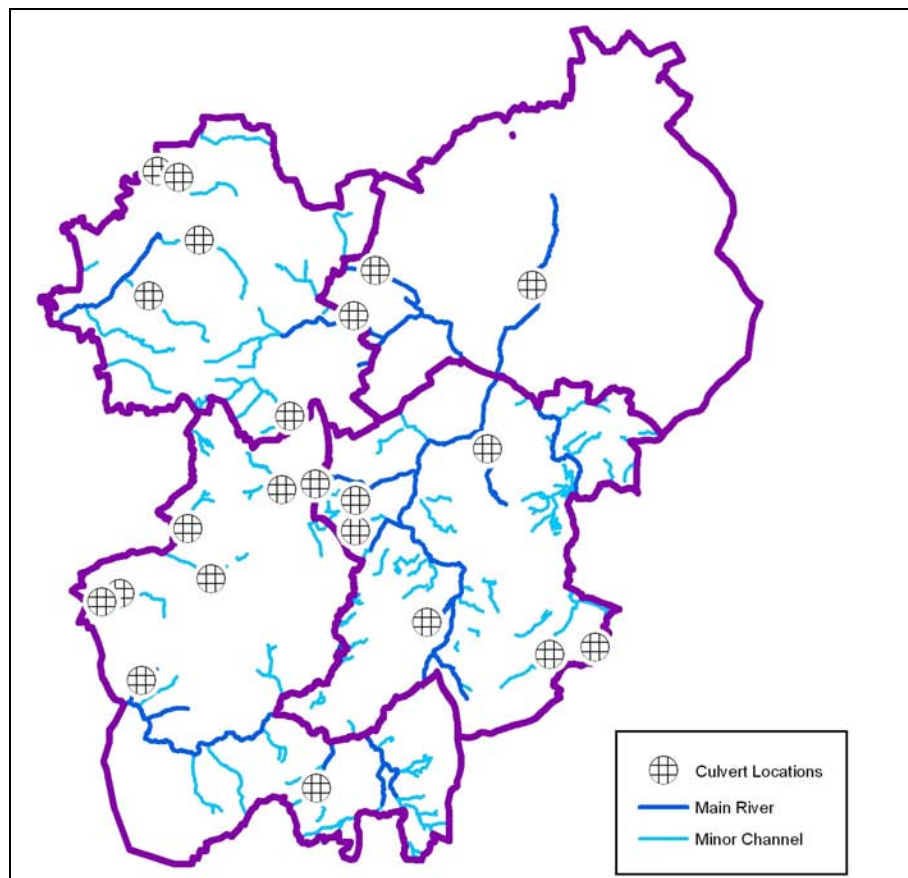


Figure C-1 – Culvert Capacity test locations Within the Black Country Area.

Methodology

Catchment parameters were determined from culvert outlet locations using the Flood Estimation Handbook (FEH) CD-ROM [version 2.0] (NERC CEH 2006).

For each culvert the statistical pooling group method using the FEH WINFAP V1.1 software (NERC CEH Wallingford 2005) was employed. This produced a suite of peak flows for return periods ranging from the 1 in 2 year event to the 1 in 500 year event.

Maximum Flow capacity of culvert sections was calculated using Manning's Equation:

$$Q_{\max} = \frac{AR^{2/3} s^{1/2}}{n}$$

A = Cross sectional area of flow
R = Culvert hydraulic radius
P = culvert wetted perimeter
s = slope of the culvert barrel
n = Manning's n value for the culvert

CIRIA (1997) **Culvert Design Guide**

The Minimum cross sectional area available for each culvert was utilised to represent constrictions to flow. Mannings roughness values were maintained at 0.02 which is thought to be the most suitable value for a wide range of culvert interior surfaces (c.f. Van Te Chow. (1959) Open channel Hydraulics McGraw Hill Publishers). Where invert levels were not available for culvert sections, channel slope was estimated from the difference between culvert inlet and outlet elevations taken from LiDAR (Laser altimetry) elevation data.

Calculated maximum flow capacities were referenced against the flows obtained from the FEH statistical method; this showed the greatest return period flood event that may be contained within each culvert.

Results

Within the Black Country 21 culverts were analysed, the J-Flow assumption was considered valid for 9 culverts, see Table C-1. Where the national flood zone maps encompass culverts with a capacity significantly greater than the median flow fluvial the flood risk is considered to be debatable. It is thought that these flood zones may only represent overland flow routes, which can be potentially used during the event of culvert failure or blockage. However if these culverts have a flood event capacity of less than 100 years some fluvial flooding is anticipated and the J-Flow assumption cannot be confidently challenged (and in this instance, the Environment Agency Flood Zone Maps have been maintained as an accurate representation of flood risk for the 1% and (0.1%) AEP flood event(s)).

Table C-1 – Culvert Capacity Results

Watercourse Name	Council	Maximum Flow (Cumeecs)	Flood Event Capacity (Return Period)	J-Flow Assumption Valid?
Tipton Brook	Sandwell	3.08	2	YES
Hobnail Brook	Sandwell	0.29	2	YES
Dudley Port Brook	Sandwell	0.06	2	YES
White Heath Brook	Sandwell	0.28	2	YES
Thimble Mill Brook	Sandwell	5.74	500	NO
Boundary Brook	Sandwell	7.79	500	NO
Swan Brook - Woodsetton	Dudley	7.69	500	NO
Swan Brook - Bean Rd	Dudley	6.31	500	NO

Watercourse Name	Council	Maximum Flow (Cumecs)	Flood Event Capacity (Return Period)	J-Flow Assumption Valid?
Lutely Gutter	Dudley	0.53	2	YES
Wordsley Brook	Dudley	12.93	500	NO
Dawley Brook - Dawley Road	Dudley	1.14	5	YES*
Dawley Brook Mayfair	Dudley	1.65	50	YES*
Holbeche Brook	Dudley	2.37	500	NO
Bobs Brook	Dudley	6.86	500	NO
Graisley Brook	Wolverhampton	5.61	500	NO
Bilston Brook	Wolverhampton	13.16	500	NO
Smestow Brook	Wolverhampton	20.86	500	NO
Pendeford Brook	Wolverhampton	5.2	10	YES*
Oxley Brook	Wolverhampton	2.13	2	YES
Ford Brook Tunnel	Walsall	9.35	5	YES*
Bentley Canal Tunnel	Walsall	20.38	500	NO
River Tame Tunnel	Walsall	36.29	200	NO

* Indicates flood envelopes which cannot be reclassified but where the areal extents of National Floodzone maps are of questionable accuracy.

As a result 11 flood zone envelopes were reclassified as potential overland flow routes (see the adjoining Flood Zone Maps in Appendix B).

APPENDIX D

Hydraulic Modelling of Additional Functional Floodplain

Hydraulic modelling of additional Functional Floodplain (Flood Zone 3b) areas

Introduction

The Environment Agency National flood zones do not contain functional floodplain coverage. This information is highly pertinent to land development (see section 3.2.2 Planning Policy Statement 25: Development and Flood Risk). It was therefore decided that a basic hydraulic modelling methodology should be utilised to provide this data where no existing detailed modelling is available.

Due to the proximity to potential development areas, in the interim, two water courses were identified as priority sites for provision of additional functional floodplain zones (see Figure D-1 below):

- Sneyd Brook – Walsall
- Waterhead Brook – Wolverhampton

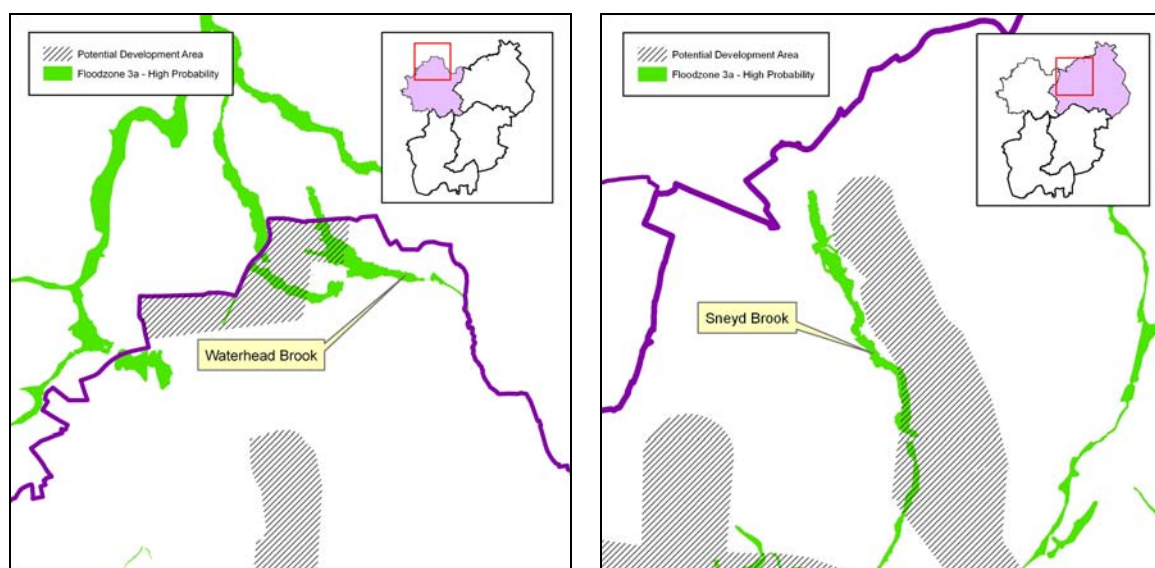


Figure D-1 – Additional functional floodplain model locations.

Methodology

River catchment hydrology was analysed using a statistical pooling group method (FEH WINFAP V1.1 software, NERC CEH Wallingford 2005), this provided peak catchment runoff for the 25 year and 2 year (median flow) flood events.

The Isis hydrodynamic modelling software (HR Wallingford LTD) was used to perform a direct, steady state simulation of maximum channel stage within each watercourse. This method involves a full solution of the St Venant Equations for water flow including mass conservation calculation.

The assumptions made in order to derive this form of the equations are:

1. The flow is one dimensional - a single velocity and elevation can be used to describe the state of the water body in a cross-section.
2. The streamline curvature is small and vertical accelerations negligible; hence the pressure is hydrostatic.
3. The effects of boundary friction and turbulence can be accounted for by representations of channel conveyance derived for steady state flow.
4. The average channel bed slope is small enough such that the small angle approximation can be used.
5. All the functions and variables are continuous and differentiable (which precludes the proper modeling of bores or hydraulic jumps).

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Model input flows utilise the same assumptions as the J-Flow methodology of EA national flood zone dataset. That is that river channel bankfull capacity and culvert maximum flow is equivalent to the median catchment runoff (i.e. a 1 in 2 year event). Consequently the FEH 2 year event flows were subtracted from the 25 year event flows and the product was input into the model as a peak flow / time boundary.

Valley cross sections tangential to river flowpaths were extracted from SAR (Synthetic Aperture Radar) elevation data at 100 meter intervals data using ESRI ArcView (3.2) 3d Analyst software. Sections were cropped to single basins and converted to Isis river node format using Microsoft Excel. Manning's roughness parameters were set to 0.045, this is considered to be a suitable general value for surface runoff in urban environments (c.f. Van Te Chow. (1959) Open channel Hydraulics McGraw Hill Publishers). Relative path lengths between sections were set to unity.

A Critical Depth Boundary downstream boundary was utilised. This automatically generates a flow-head relationship based on preceding river section data. As modeled Froude numbers are equal to unity, conditions are satisfied for application of this method.

Model Outputs were mapped using ESRI ArcView (3.2) 3d Analyst by interpolating the maximum stage elevation contours of sequential river model sections.

Results

Function floodplain extents were mapped for the two watercourses as detailed in Figure D-2 below (see also Figures B-1 and B-2 in Appendix B):

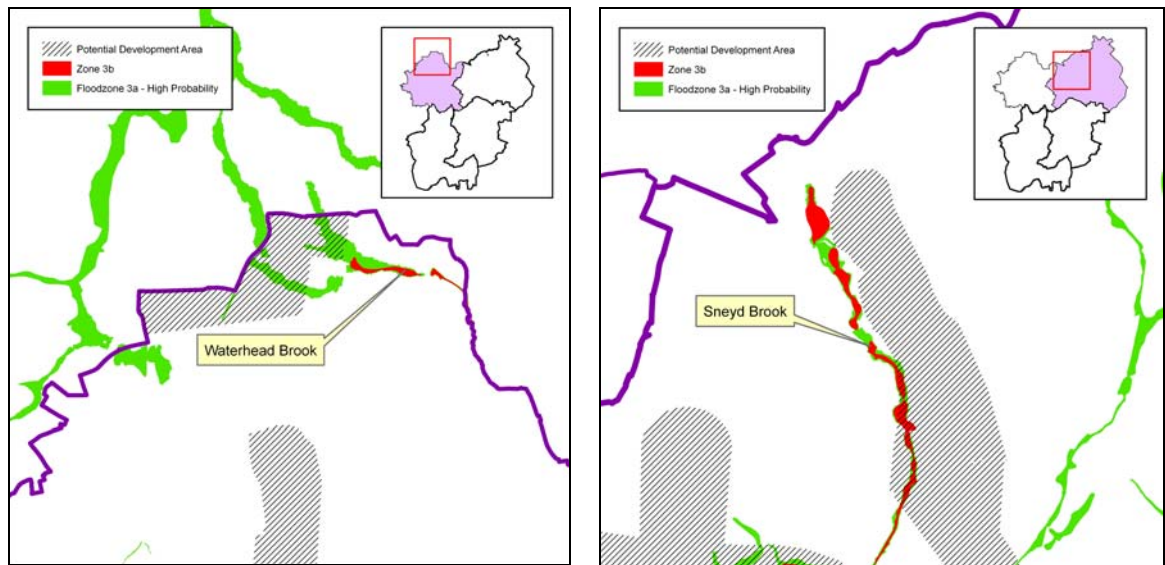


Figure D-2 – Modelled Functional Floodplain extents for Sneyd Brook Walsall and Waterhead Brook Wolverhampton.