Sheffield City Council
Strategic Flood Risk Assessment (SFRA)
Level 1

July 2008 (Final)

Sheffield City Council
Town Hall,
Sheffield,
S1 2HH

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EXECUTIVE SUMMARY

Introduction

1. The district of Sheffield is situated to the east of the Peak District in southern Yorkshire, extending from Mosborough in the south east to Stocksbridge in the north west. The population centres of the district are dispersed throughout the region, ranging in size from small rural hamlets to densely populated city areas. Much of the future growth within the region is focussed upon the regeneration of key employment and industry zones surrounding the city centre, encouraging housing growth around these centres through the provision of strategic transportation links. Development pressure continues steadily, securing the region as a vibrant area of growth within the north east.

2. It is important to recognise that some of those areas that are under pressure from future development are at risk of flooding from rivers within Sheffield. It is essential therefore that the Council are in a position to take informed decisions, providing a careful balance between the risk of flooding and other unrelated planning constraints that may place pressure upon 'at risk' areas. The Sheffield SFRA endeavours to provide specific advice to assist the Council in this regard.

3. **This report (and the supporting mapping) represents the Level 1 SFRA, and should be used by the Council to inform the application of the Sequential Test.** Following the application of the Sequential Test, it may be necessary to develop a Level 2 SFRA should it be shown that proposed allocations fall within a flood affected area of Sheffield. The Level 2 SFRA should consider the risk of flooding in greater detail within a local context to ensure that the site can be developed in a safe and sustainable manner.

Outcomes of the Sheffield District SFRA (Fluvial Flooding)

4. The Sheffield district has been delineated into zones of low, medium and high probability of fluvial flooding, based upon existing available information provided by the Environment Agency. Detailed flood risk mapping has been made available for the River Don, River Sheaf and Porter Brook, and the Environment Agency Flood Zone Maps (April 2008) have been adopted as the basis for the SFRA for other watercourses. Additional detailed modelling has been carried out to review the hazard posed by flooding in city centre areas adjoining the River Don encompassing Nursery Road, Kelham Island, and The Wicker.

5. The spatial variation in fluvial (river) flood risk across Sheffield has been delineated in the following manner:

Zone 3b (Functional Floodplain)

6. Areas subject to flooding up to (and including) once in every 20 years on average have been delineated. These areas have subsequently been sub-delineated on the basis of current land use such that:

   - Areas of existing open space have been defined as *Zone 3b Functional Floodplain;*
   - Areas that are 'previously developed' have been defined as *Zone 3a(i).*

7. Within the context of the SFRA **'previously developed' areas, delineated as Zone 3a(i) for planning purposes, relate to sites within which there are existing buildings that are considered to be impermeable to floodwaters.** It is important to recognise that the land surrounding these buildings are critical flow paths and/or flood storage areas, and must be retained. This sub-delineation is in accordance with the recommendations of the PPS25 Practice Guide, recognising the impact that existing barriers have upon the flooding regime.

8. It is important to recognise that all areas within Zone 3b and Zone 3a(i) are areas that are subject to relatively frequent flooding, and may be subject to fast flowing and/or deep water. Very careful consideration must be given to future sustainability and safety issues within this area, and development may only be considered following application of the Sequential Test.

9. No development is permissible in Zone 3b apart from water compatible uses and essential infrastructure, and only then if the Exception Test can be passed. Specific planning responses have been developed for both Zone 3b and Zone 3a(i), and these are set out in Section 7.4.

Zone 3a High Probability

10. Areas subject to flooding in the 1% probability of occurring in any one year (1 in 100) design event have been delineated as Zone 3a High Probability. Development within these areas may only be considered following application of the Sequential Test and Exception Test and 'More Vulnerable' development should be avoided wherever possible.

11. The SFRA has outlined specific development control recommendations that should be placed upon development within Zone 3a High Probability to minimise the damage to property, the risk to life in case of flooding, and the need for sustainable drainage systems (SUDS). 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.

12. Re-development provides an opportunity to reduce the causes and impacts of flooding for example by incorporating SUDS and resilient building design, creating flood storage, re-creating functional floodplain and setting back defences.

Zone 2 Medium Probability

13. Areas subject to flooding in events exceeding the 1% (1 in 100) event, and up to (and including) the 0.1% (1 in 1000) event have been delineated as Zone 2 Medium Probability. Development within these areas may only be considered following application of the Sequential Test. 'Highly Vulnerable Development', for example emergency services, should be avoided in these areas and is only permissible if it has passed the Exception Test.

14. There are generally no other restrictions placed upon land use 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).

Zone 1 Low Probability

15. All areas outside of Zones 2 and 3 have been delineated as Zone 1 Low Probability. There are no restrictions placed on land use within Zone 1 Low Probability (i.e. all remaining areas of Sheffield) by PPS25. It is essential however that consideration is given to the potential risk of flooding from other sources (outlined in 'Localised Flooding Issues' below), ensuring that future development is not inadvertently placed at risk. It is also essential to ensure that future development does not exacerbate the current risk posed to existing homes and businesses.

Localised Flooding Issues

16. Properties and infrastructure within Sheffield district are also at risk of flooding from other sources. These include surface water flooding, the surcharging of the underground sewer system, and the blockage of culverts and gullies (which results in overland flow). Evidence of localised flooding of this nature has been captured through consultation with the Council, Yorkshire Water and the Environment Agency and is presented in the flood maps (refer Appendix A).

17. PPS25 does not address issues of this nature within its delineation of flood zones and what development is acceptable within them. Incidents of this nature can be often be addressed through the design process, and therefore will not generally affect decision making with respect the allocation (or otherwise) of sites within Sheffield. The recent flooding in June 2007 highlights the importance of considering localised flooding as an integral part of the planning process however. Whilst this was (statistically) a relatively rare event[1], this did provide a timely reminder that uncontrolled flooding as a result of particularly heavy rains can create significant damage and disruption.

18. The PPS25 Practice Guide (June 2008) advocates the application of a sequential approach, taking into consideration *all* sources of flooding, and it is absolutely essential not to overlook the potential risk of localised flooding during the design process. A proactive approach to risk reduction through design can mitigate the potential for damage, both to the development itself and elsewhere. Specific development control recommendations have been provided accordingly (refer Section 7.4).

19. As a minimum, the implementation of sustainable drainage systems (SUDS) must be ensured, and careful consideration given to avoiding the obstruction of overland flow routes with buildings and/or landscaping.

A Proactive Approach – Reduction in Flood Risk

20. It is crucial to recognise that PPS25 considers not only the risk of flooding posed to new development, but that it also seeks to positively reduce the risk of flooding posed to existing properties within Sheffield. It is strongly recommended that this principle be adopted as the underlying 'goal' for developers and Council development control teams within Sheffield.

21. Developers should be encouraged to demonstrate that their proposal will deliver a positive reduction in flood risk to Sheffield, 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 be reflected through the inclusion of a positive statement within the detailed FRA that clearly and concisely summarised how this reduction in flood risk will be delivered.

[1] Estimated to be equivalent to approximately a 0.25% (1 in 400) design event

The Way Forward

22. 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 Sheffield City Council and the Environment Agency. Sheffield 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.

23. A planning solution to flood risk management should be sought wherever possible. Vulnerable development should be steered away from areas affected by flooding (in accordance with the PPS25 Sequential Test). Specific planning recommendations have been provided for all urban centres within Sheffield district (refer Section 7.4).

24. If after having undertaken the Sequential Test it has been identified that there are no reasonably available sites in areas not at risk of flooding, specific recommendations have been provided to assist the Council and the developer apply the Exception Test (refer Section 7.4). These should be considered when writing new policies as part of the Local Development Framework, as well as in the determination of planning applications.

25. Council policy is essential to ensure that the suggested development control recommendations can be imposed consistently at the planning application stage. This is essential to achieve flood risk reduction and future sustainability within Sheffield.

26. Emergency planning is crucial for the minimisation to the risk to life posed by flooding within Sheffield. It is recommended that the Council advises the local Resilience Forum of the risks raised in light of the Sheffield SFRA, ensuring that the planning for future emergency response can be reviewed accordingly.

A Living Document

27. The Sheffield SFRA has been developed building heavily upon existing knowledge with respect to flood risk within Sheffield. A rolling programme of detailed flood risk management investigations within the North East region is underway. This, in addition to observed flooding that may occur throughout a year, will improve the current knowledge of flood risk and may alter predicted flood extents within Sheffield. Furthermore, Communities and Local Government (CLG) are working to provide further detailed advice with respect to the application of PPS25. Given that this is the case, a periodic review of the Sheffield SFRA is imperative.

28. It is recommended that the Sheffield SFRA is reviewed on a regular basis. A series of key questions to be challenged as part of the SFRA review process are set out in Section 8 of this document, providing the basis by which the need for a detailed review of the document should be triggered. It is recommended that a review of these triggers is carried out once every 2 years.

Disclaimer

It is important to recognise that the information provided within the Level 1 SFRA is the best available data at the time of writing. The mapping of flood risk is not an exact science, and there may be some uncertainties in the information presented. The Level 1 SFRA is a strategic document that is intended to support the spatial planning process. It will trigger a more detailed site-based Flood Risk Assessment where future development is being considered (following application of the Sequential Test), and it is expected that the FRA will improve the level of accuracy in the flood extents from a localised perspective.

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Overview

1. The district of Sheffield is situated to the east of the Peak District in southern Yorkshire, extending from Mosborough in the south east to Stocksbridge in the north west. The population centres of the district are dispersed throughout the region, ranging in size from small rural hamlets to densely populated city areas. Much of the future growth within the region is focussed upon the regeneration of key employment and industry zones surrounding the city centre, encouraging housing growth around these centres through the provision of strategic transportation links. Development pressure continues steadily, securing the region as a vibrant area of growth within the north east. An overview map of the district is provided in Figure A.

2. 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 district. Robust information on flood risk is essential to inform and support the Council's revised flooding policies in its emerging Local Development Framework (LDF).

3. Jacobs was commissioned to carry out a detailed review of the Sheffield City Council Strategic Flood Risk Assessment (SFRA)[2] in January 2008. Sheffield City Council 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 of the Site Allocations Development Plan Document (DPD). This SFRA will be developed and refined over time and will inform the allocation of sites for future development.

4. This report (and the supporting mapping) represents the Level 1 SFRA, and should be used by the Council to inform the application of the Sequential Test. Following the application of the Sequential Test, a Level 2 SFRA will be developed to further review the proposed allocations that fall within a flood affected area of Sheffield. The Level 2 SFRA will consider the risk of flooding in greater detail within a local context to ensure that the site can be developed in a safe and sustainable manner.

[2] First published in December 2006

2 SFRA Approach

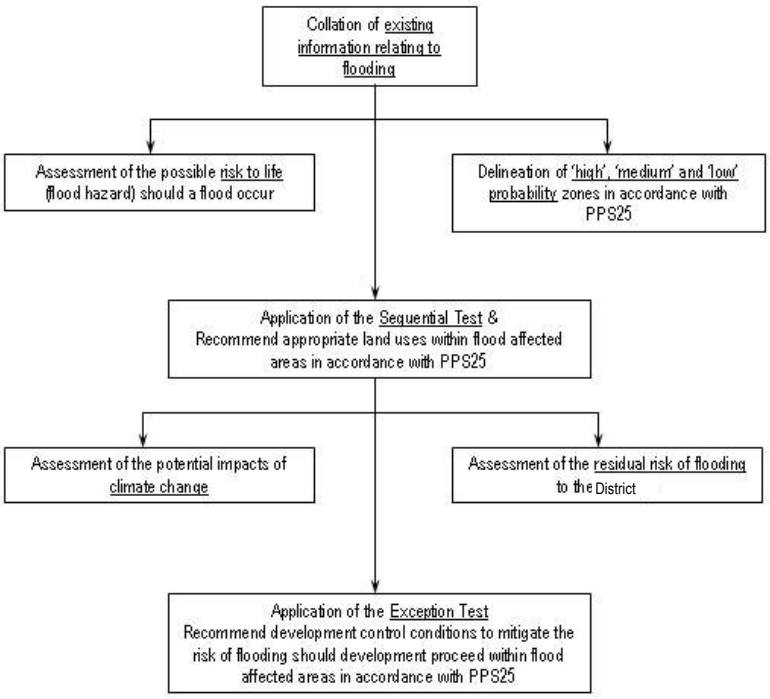
5. The primary objective of the Sheffield SFRA is to inform the allocation of sites and to allow the sequential test to be applied (if required). The SFRA will also inform the revision of flooding policies within the emerging Local Development Framework (LDF). The SFRA also has a broader purpose and, in providing a robust depiction of flood risk across Sheffield, it can:

   - Inform the development of the policy that will underpin decision making within Sheffield, 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 Sheffield;
   - Help to identify and implement strategic solutions to flood risk, providing the basis for possible future flood attenuation works;
   - Support and inform Sheffield City Council's emergency planning response to flooding.

6. 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 through consultation with Sheffield City Council and the Environment Agency based upon PPS25 (December 2006) and the Practice Guide Companion (revised draft released June 2008).

7. A considerable amount of knowledge exists with respect to flood risk within parts of Sheffield, with a comprehensive program of flood risk mapping and strategic flood risk management investigations carried out by the Environment Agency. The Sheffield SFRA has built upon this existing knowledge, delineating the district into zones of 'high', 'medium' and 'low' probability of fluvial flooding, in accordance with PPS25. These zones have then been used to provide a reliable evidence base for the development of flooding-related policy, as well as the allocation of sites for future housing and employment uses. A review of flooding from other sources has also been carried out.

8. A summary of the adopted SFRA process is provided in the figure below, outlining the specific tasks undertaken.



Cross-boundary Issues

9. It is important to recognise that planning boundaries do not necessarily coincide with catchment boundaries. There are areas at risk of flooding downstream of Sheffield, including (for example) Doncaster, and future development within the city could influence the risk of flooding posed to neighbouring areas if it is not carefully managed. All local authorities clearly need to understand the core issues that flood risk raises within their respective areas and they must adapt their decision making accordingly. They must also be aware of the impact that planning decisions may have, not only locally, but upon adjoining Districts and Boroughs.

10. Other authorities across the North East Region are carrying 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.

11. Whilst the delivery teams and programmes supporting these studies vary from one authority to the next, all should be 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 vital. Discussions with the Environment Agency have been carried out throughout the SFRA process to this end, seeking clarity and consistency where needed.

A Living Document

12. The SFRA has been informed by existing knowledge with respect to flood risk within Sheffield. It is based upon emerging and existing policy guidance, including PPS25 (December 2006) and the supporting Practice Guide Companion to PPS25 (June 2008).

13. The Environment Agency regularly review and update their Flood Zone maps and a rolling programme of flood risk management investigations is underway within the North East region. This will improve the current knowledge of flood risk within Sheffield, and may alter predicted flood extents over time. It is important that the SFRA is adopted as a living document and is reviewed regularly in light of emerging policy directives and improving understanding of flood risk within the district. Given that this is the case, a periodic review of the Sheffield SFRA is imperative.

14. It is recommended that Sheffield SFRA is reviewed on a regular basis. A series of key questions to be challenged as part of the SFRA review process are set out in Section 8 of this document, providing the basis by which the need for a detailed review of the document should be triggered.

3 Policy Framework

3.1 Introduction

15. This section provides a brief overview of the strategy and policy context relevant to flood risk in Sheffield.

16. The success of the SFRA is heavily dependent upon the Council's ability to implement the recommendations put forward for future sustainable flood risk management, both with respect to planning decisions and development control conditions (see Section 7.4). A framework of national and regional policy provides guidance and direction to local planning authorities in formulating robust local planning policies. This in turn will ensure a sound sustainability approach to flood risk and development.

3.2 National Planning Policy

3.2.1 Overview

17. National planning policy is set out in a number of Planning Policy Statements (PPSs) and Planning Policy Guidance Notes (PPGs). The Government is currently reviewing all PPGs with revised advice being set out in equivalent PPSs and, where necessary, accompanying best practice guidance.

18. PPSs and PPGs cover a full range of planning issues drawing on the central issue of sustainable development. Central themes include the re-use of 'deliverable' previously developed land, promoting economic growth, and the intention to steer inappropriate development away from areas at risk of flooding. Under paragraph 4.31 of 'PPS12: Local Spatial Planning' it is a requirement of Regional Assemblies and Local Authorities to ensure their Regional Spatial Strategies (RSSs) or Local Development Frameworks (LDFs) are in conformity with the guidance in PPSs and PPGs. The regional and local policy context for SFRAs is set out in the next section.

3.2.2 Planning Policy Statement (PPS) 1: Delivering Sustainable Development

19. Planning Policy Statement 1 (PPS1) sets out the Government's overarching planning policies on the delivery of sustainable development through the planning system. The following extract provides a succinct summary of the principles set out by PPS1.

Planning shapes the places where people live and work and the country we live in. Good planning ensures that we get the right development, in the right place and at the right time. It makes a positive difference to people's lives and helps to deliver homes, jobs, and better opportunities for all, whilst protecting and enhancing the natural and historic environment, and conserving the countryside and open spaces that are vital resources for everyone. But poor planning can result in a legacy for current and future generations of run-down town centres, unsafe and dilapidated housing, crime and disorder, and the loss of our finest countryside to development.

Good planning is a positive and proactive process, operating in the public interest through a system of plan preparation and control over the development and use of land.

Sustainable development is the core principle underpinning planning. At the heart of sustainable development is the simple idea of ensuring a better quality of life for everyone, now and for future generations.

The Government set out four aims for sustainable development, namely:

- *social progress which recognises the needs of everyone;*
- *effective protection of the environment;*
- *the prudent use of natural resources; and,*
- *the maintenance of high and stable levels of economic growth and employment.*

These aims should be pursued in an integrated way through a sustainable, innovative and productive economy that delivers high levels of employment and a just society that promotes social inclusion, sustainable communities and personal well being, in ways that protect and enhance the physical environment and optimise resource and energy use.

3.2.3 Planning Policy Statement (PPS) 25: Development and Flood Risk

20. Planning Policy Statement 25 (PPS25) was published in December 2006, and underpins the process by which local planning authorities are to account for flood risk as an integral part of the planning process. The overarching principles set out by PPS25 for the management of flood risk at a planning authority level are encapsulated in Paragraph 6 of the document:

21. "Regional planning bodies (RPBs) and local planning authorities (LPAs) should prepare and implement planning strategies that help to deliver sustainable development by:

Appraising risk

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

Managing risk

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

Reducing risk

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

A partnership approach

- working effectively with the Environment Agency, other operating authorities and other stakeholders to ensure that best use is made of their expertise and information so that plans are effective and decisions on planning applications can be delivered expeditiously; and
- ensuring spatial planning supports flood risk management policies and plans, River Basin Management Plans and emergency planning."[3]

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

23. The guidance in PPS25 also indicates that Sustainability Appraisals should be informed by the SFRA for their area. Under the Town and Country Planning (Local Development) (England) Regulations 2004, a Sustainability Appraisal (SA) is required for all Local Development Documents (LDDs) which form part of Local Development Frameworks (LDFs). The purpose of SA is to promote sustainable development through better integration of sustainability considerations in the preparation and adoption of plans. The Regulations stipulate that SAs of LDFs should meet the requirements of the Strategic Environmental Assessment (SEA) Directive.

24. It is important to reiterate that PPS25 is not applied in isolation as part of the planning process. The formulation of Council policy and the allocation of land for future development must also meet the requirements of other planning policy statements, including (for example) PPS3: Housing.

25. The SFRA aims to assist in this process through the provision of a clear and robust evidence base upon which informed decisions can be made.

3.2.4 Development and Flood Risk: Practice Guide Companion to PPS25

26. In February 2007 the companion guide to PPS25 was published as a consultation paper[4]. This document provides additional guidance on the principles set out in PPS25, which should be considered by Sheffield City Council when preparing its LDF. The final Practice Guide was released in June 2008. The guide provides a helpful indication of the ways in which the principles of PPS25 might be applied in practice.

3.2.5 Planning Policy Statement: Planning and Climate Change[5]

27. The proposed planning policy statement on climate change was published for consultation in December 2006. Now it is published, it supplements the existing PPS1: Delivering Sustainable Development and the guidance in Annex B of PPS12. The document highlights the issue of climate change, and sets out ways planning should prepare for its effect, which includes managing flood risk. However, little detail is given about flooding in this document as PPS25 already covers this topic.

[3] Communities and Local Government (2006), pg 2, Para 6, PPS25: Development and Flood Risk, HMSO

[4] Communities and Local Government (2007) Development and Flood Risk: A Practice Guide Companion to PPS25 'Living Draft' A Consultation Paper

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

3.3 Regional Planning Policy

3.3.1 Overview

"Government legislation in 2004 saw Regional Planning Guidance - the framework for local authority development plans which oversee development and land use applications - replaced by a Regional Spatial Strategy (RSS). In this region, this is called the Yorkshire and Humber Plan.

Once completed, the RSS, titled the Yorkshire and Humber Plan, will set the framework to guide and direct where and how development and investment takes place across the region. Under new planning law, it will form part of the "development plan'' for each local authority and be taken into account in determining planning applications.

The draft RSS includes a broad strategy to shape the future development of cities, towns and villages across the region; regional priorities in terms of location and scale of development for economic development; housing; transport and communications; the environment ; tourism and leisure and urban and rural regeneration. It will also include a regional transport strategy."

3.3.2 The Yorkshire and Humber Plan (RSS 12)

28. This RSS was published in December 2005 and adopted in May 2008. However, it is still relevant when considering the regional policies. The plan guides development up to 2021, and beyond. The plan identifies that the South Yorkshire (Rotherham) Region is forecast to experience significant economic growth and is likely to remain a significant economic driver of the Regions economy

29. The Yorkshire and Humber Plan recognises that climate changes will increase the risk of flooding and Policy YH2 requires Local Authorities to, "*Plan for the successful adaptation of the predicted impacts of climate change by minimising threats from and impact of coastal erosion, increased flood risk, increased storminess, habitat disturbance, increased pressure on water resources supply and drainage systems*."

30. Policy ENV1 Floods and flood risk states that *"development in high flood risk areas will be avoided, where possible, and flood management will be undertaken proactively".* The purpose of this policy is to inform development on the basis of strategic flood risk assessments and ensure flood management reflects regional spatial and economic priorities, as well as environmental objectives, thereby helping to maintain protection of the major conurbations and communities. Paragraph 15.8 states that:

    "Local Authorities should undertake strategic flood risk assessments in line with regional Supplementary Planning Guidance and then adopt a risk-based sequential approach to planning for flood risk in line with PPG25; consider specifying higher standards of resilience to flooding for new development in high flood risk areas (e.g. minimum ground floor levels, suitable ground floor uses, height of two storeys); determine the balance between blight and flood risk, especially in regeneration areas".

31. The Examination in Public into the draft Regional Spatial Strategy (RSS) concluded in October 2006, and the Report of the Panel was released in March 2007. Chapter 6 (Volume 1), Section C of the Panel Report relates specifically to Flood Risk and Water Resources. The Panel Report raises concern that, whilst it is recognised that the draft RSS precedes the final release of PPS25 in December 2006, Policy ENV1 *"does not take adequate account of the need to consider the implications of development in areas of flood risk."* Furthermore, the Panel Report considers *"the Plan did not give enough prominence to flood risk in relation to strategic patterns of development."* For this reason, specific amendments to Policy ENV1 have been recommended in line with Environment Agency suggested changes[6].

32. Finally, paragraph 15.7 states that *"The Environment Agency, landowners, developers, local authorities, internal drainage boards, Yorkshire Forward and other bodies all have important roles and differing levels of funding. These include to lead a strategic, integrated, pro-active approach to catchment management; prioritise flood risk management and ensure protection in line with policy and catchment flood management plans."*

3.4 Local Planning Policy

3.4.1 Sheffield Unitary Development Plan (UDP)

33. The Unitary Development Plan (UDP) is the statutory development plan for Sheffield, adopted in March 1998. The UDP sets out a number of policies that are directly relevant to the findings and recommendations of the Sheffield SFRA. These policies are outlined below.

34. Policy GE17 'Rivers and Streams' states:

> *As part of the development of the Green Network, all rivers and streams will be protected and enhanced for the benefit of wildlife and, where appropriate, for public access and recreation. This will be done by:*
>
> *a. not permitting the culverting of any river or stream unless absolutely necessary and encouraging the re-opening of culverted water courses where opportunities arise; and*
> *b. requiring that any development involving alterations to the channels of rivers and streams be designed in a way which is sympathetic to nature conservation and archaeological interests; and*
> *c. expecting the setting back of new development to an appropriate distance from the banks of major rivers and streams to allow for landscaping; and*
> d. *encouraging the creation of a continuous public footpath along one bank of major rivers and streams, except where this would conflict with important nature conservation interests or public safety*

35. Policy GE20 'Flood Defence' states:

> *Development will not be permitted where flooding risks to it or to existing development would not be overcome by suitable on-site protective measures. Where necessary, off-site flood prevention measures will be required before a new development takes place.*

[6] Please be aware that, at the time of writing, specific details regarding the suggested EA changes to RSS policy were not available for inclusion in the SFRA

36. Policy GE21 'Protection of Washlands' states:

> *Development will be permitted in washlands only where:*
> *a) it would not significantly affect the ability of the washland to store floodwater; and*
> *b) there would be no serious risk to the development from flooding or pollution*

37. Following consultation with the Council, from September 2007 the Secretary of State directed the saving of all policies in the UDP except for:

GE26	Water Quality of Waterways
IB4	Land for Industry and Business
IB10	Visitor Accommodation in Industry and Business Areas
H1	Land Needed for New Housing
CF5	Community Benefits
MW1	Mineral Working
MW2	Conservation of Mineral Reserves

3.4.2 Sheffield Development Framework (SDF)

38. Under the new arrangements for the planning system, a local development framework is being created which will be a portfolio of local development documents. These documents collectively deliver the spatial planning strategy for the Sheffield area.

39. In Sheffield, the *Sheffield Development Framework (SDF)* will be the City's portfolio of local development documents, collectively covering the whole of the Sheffield District except for the area in the Peak Park. Once adopted, the SDF will replace the Unitary Development Plan (UDP).

40. The Core Strategy was submitted in September 2007 following a mandatory consultation period, and the Examination in Public commenced in April 2008. It is expected that the Core Strategy will be formally adopted in early 2009.

41. The City Policies and City Sites were consulted upon during 2007, and submission of the documents for examination in public is expected in March 2009. Adoption of the City policies and site proposals is anticipated in the summer of 2010.

4 Data Collection

4.1 Overview

42. A considerable amount of data has been collated to inform the analysis (and delineation) of flood risk throughout Sheffield, including:

- Topographic and geological information;
- Historical river flooding information;
- Information relating to localised flooding issues, which was collated in consultation with the Council and the Environment Agency;
- Detailed flood risk mapping;
- Environment Agency Flood Zone Maps (April 2008);

43. This data has been sourced from Sheffield City Council and the Environment Agency. It has formed 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, along with the formulation of planning and development control recommendations, is explained in Section 7. An overview of the core datasets, including their source and their applicability to the SFRA process, is outlined below.

4.2 Consultation

44. Consultation has formed a key part of the data collation phase for the Sheffield SFRA. The following key stakeholders have been consulted during the current study to inform the investigation:

Sheffield City Council

- *Planning:* Consulted to identify areas under pressure from development and/or regeneration
- *Drainage:* Consulted to identify areas potentially at risk from river flooding, and surface water problems
- *Development Control:* Consulted to discuss the implementation of the SFRA from a development control perspective

The Environment Agency

45. 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.

Yorkshire Water

46. Yorkshire Water is responsible for the management of urban drainage (surface water) and sewerage within Sheffield. Yorkshire Water was consulted to discuss the risk and number of incidences of localised flooding associated with the existing drainage/sewer system. Unfortunately, for the purpose of the SFRA, Yorkshire Water was unable to release any location-specific information regarding known incidents of flooding connected to their urban drainage and sewerage network. This is due to data confidentiality.

47. For this reason, it is not possible to pinpoint known flooding problems relating specifically to the failure of the sewer system. Discussions were held with Council drainage engineers that have considerable familiarity with problems faced within the local area however, and they have highlighted locations that are known to suffer regular issues associated with 'failure' of the underground drainage system.

4.3 Environment Agency Flood Zone Maps

48. The Environment Agency's Flood Zone Map (April 2008) was adopted as the 'first pass' method of assessing fluvial flood risk within Sheffield as part of the SFRA development.

49. The Environment Agency's Flood Map shows the natural floodplain (which ignores the presence of existing defences, because these can be breached, overtopped and may not be in existence for the lifetime of the development) and areas potentially at risk of flooding from rivers or the sea. The Flood Map shows the area that is susceptible to a 1% (1 in 100) chance of flooding from rivers in any one year. It also indicates the area that has a 0.1% (1 in 1000) chance of flooding from rivers and/or the sea in any given year. This is also known as the Extreme Flood Outline. Sheffield has no tidal flood risk.

50. The Flood Map outlines have been produced from a combination of a national generalised computer model, detailed modelling, 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 Environment Agency has an ongoing programme of improvement and updates are made on a quarterly basis.

51. The Environment Agency's own definition of the flood map is defined in their policy 541_05. An excerpt from it reads:

'Flood Zones are required to identify the extents over which flooding could occur, from rivers and the sea, ignoring the presence of flood defences. The way in which different types of flood defences are considered is explained below:

- *[The Environment Agency] interpret PPS25 to mean that flooding is not constrained by formal raised flood defences. Therefore, the Flood Zones ignore the effect of defences in reducing the probability of flooding but do not underestimate the extents of flooding where defences increase the area potentially at risk.*
- *The definition of Flood Zone 3b (Functional Floodplain) in PPS25 includes land which 'is designed to flood in an extreme (0.1%) flood'. This means that [the Environment Agency's] mapped extent of a flood with an annual probability of 1% (1 in 100) fluvial / 0.5% (1 in 200) tidal will include areas that are designed to flood due to the operation of flood storage areas.*
- *Other types of flood defences or infrastructure (whether or not their primary purpose is flood alleviation) such as engineered river channels, bypass channels, culverts and bridges are considered as existing infrastructure for the purpose of Flood Zones. In principle this means they are included when modelling and mapping Flood Zones. This principle also applies to embankments that are not flood defences, although any pathways through the embankment should be taken into account'.*

4.4 Historical Flooding

52. Flooding from the River Don and its tributaries has affected homes and businesses in Sheffield on a number of occasions in living memory, most recently in the autumn of 2000 and the summer of 2007. The June 2007 flooding was particularly severe in South Yorkshire, resulting in the loss of life and widespread damage and disruption to the region. Historical flood extents have been provided by the Environment Agency for the Porter Brook corridor, spanning the period 1958 to 1991. This is provided in Figure B.

53. It is important to highlight that the flooding that occurred in 2007 has been attributed, at least in part, to sources other than rivers. Some flood incidences were the result of surface water flooding, particularly in nearby Hull, offering a timely reminder of the importance of considering flooding from other (non fluvial) sources.

54. A map providing an overview of areas that were affected in June 2007 is provided as Figure C. This information is based on evidence gathered at the time of the event. A boundary of the affected area is not included as the evidence is still being validated in certain areas. However, the Zone 2 outline shown on the maps in Appendix A does take account of the Environment Agency's surveys, and the Environment Agency may be contacted directly for further information. It should be borne in mind that the event has only affected the Zone 1/Zone 2 boundary, and none of the other Flood Zone boundaries. Whilst important, the boundary between Zones 1 and 2 is less of an issue in planning terms than the extent of higher probability Flood Zones.

55. The source and impact of historical flooding (where available) within the study area is described in Section 6 below.

4.5 Detailed Hydraulic Modelling

56. Detailed flooding investigations have been carried out by the Environment Agency, which have been supplied to Jacobs for the purpose of this study. The modelled reaches within Sheffield include the River Don, the River Sheaf, Blackburn Brook and Porter Brook. Additional two dimensional modelling of the River Don corridor between Kelham Island and The Wicker has also been carried out as part of this investigation, examining the potential risk to life posed by flooding when the river (and it tributaries) overtop their banks.

57. 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 support the delineation of flood risk (Zone 3a and Zone 3b) in this Strategic Flood Risk Assessment.

58. 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, the condition of the river channel is allowed to deteriorate, or, simply, the climatic inputs to the watercourse vary over space and time.

4.6 Flood Defences

59. 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 'de facto' 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, a Local Authority, or an individual riparian (river side) owner. A 'de facto' 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. These can include impermeable boundary walls, railway and road embankments and/or large buildings.

60. Formal and de facto flood defences within Sheffield have been identified in consultation with the Environment Agency (see SFRA flood maps in Appendix A). Road and rail embankments that may alter the flow of water across the floodplain are also evident in some areas of Sheffield. It is not feasible to identify all 'de facto defences' as part of the SFRA. It is important however that the detailed site based FRA considers the presence, and potential impact, of local structures that may alter the flow of water during flooding conditions.

4.7 Flood Warning Areas

61. Areas benefiting from the Environment Agency's Flood Warnings Direct Service can also be seen in Figure D. The Environment Agency's Flood Warnings Direct Service provides flood warnings direct to customers by telephone, mobile, fax or pager. Customers can also get practical advice on preparing for a flood and what to do if one happens. The areas that are within the flood warning zone include properties within the River Don corridor between Hillsborough and the M1, properties adjoining the River Sheaf between Bannerdale Road and the River Don, and properties adjoining the Porter Brook corridor between Endcliffe Park and its confluence with the River Sheaf (in the city centre).

62. It is important to recognise that flood warning in England is currently provided as an 'opt in' service. For this reason, only those property owners that actively register with the service will receive a flood warning. This is a cause for concern, and is an issue of national debate at the time of writing. It is understood that the Environment Agency is keen to establish an 'opt out' system for flood warning, within which property owners would have to actively elect *not* to receive warnings of a possible flooding event. Until this time, raising community awareness with respect to the inherent risks posed by flooding within Sheffield is of critical importance.

4.8 Topography & Geology

63. Topographic information has been provided by Sheffield City Council and the Environment Agency.

- LiDAR has been provided by the Environment Agency, restricted purely to the river corridors. LiDAR is a detailed Digital Elevation Model (DEM) that, in simple terms, offers a three dimensional representation of the local topography. Whilst the vertical accuracy of LiDAR data is generally very good (within ±250mm in many cases), the heavily urbanised nature of the river valleys within the city centre may adversely affect this in this instance. It is estimated that the vertical accuracy of the LiDAR data within Sheffield (for SFRA purposes) is approximately ±1m.

- Contour information has been provided by Sheffield City Council for the whole district. This data has been converted into a DEM (using ArcGIS) to enable the assessment of potential overland flow routes. The source of the contour information is not readily known, however it is understood that the vertical accuracy of this data is relatively poor (up to ±10m in steep areas). Caution should be used in the application of this data therefore.

64. Geological information has been retrieved from the British Geological Society (BGS), providing an overview of soils and substrate.

65. The topographic and geological characteristics of Sheffield are discussed in Section 5.5 below.

5 Data Interpretation

66. The data captured from key sources to inform the development of the Sheffield SFRA is outlined in Section 4, above. This section provides an overview of how this data has been interpreted to meet the requirements of PPS25. The findings of these analyses are presented in Section 6.

5.1 Delineation of the PPS25 Flood Zones (Fluvial Flood Risk)

67. 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 consequences of the flooding. PPS25 endeavours to assess the likelihood (or probability) of flooding, categorising the district 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.

68. To this end, a key outcome of the SFRA process is the establishment of flood maps that will inform the application of the Sequential Test in accordance with Appendix D (Table D1) of PPS25. To inform the planning process, it is necessary to delineate the area into zones that depict the likelihood (or probability) that flooding will occur.

69. The district has been delineated into the flood zones summarised below:

Zone 3b 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% (1 in 100) or greater annual probability of river flooding in any year.

Zone 2 Medium Probability

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

Zone 1 Low Probability

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

5.1.1 Delineation of Zone 3b Functional Floodplain

70. 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[7] 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 Sheffield SFRA, Zone 3b has been defined in the following manner:

- land subject to flooding in the 5% AEP (20 year) flood event;
- 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 where the flow of flood water is not prevented by flood defences or by permanent buildings or other solid barriers during times of flood;

71. Detailed modelled flood extents for the 5% (1 in 20 year) design event were adopted for the River Don, River Sheaf, Blackburn Brook and Porter Brook for the basis of Zone 3b Functional Floodplain delineation.

5.1.2 Existing Development Affected by the 5% (1 in 20) Design Event - Zone 3a(i)

72. In some areas of Sheffield, it is evident that existing properties may be affected by flooding in the 5% AEP (20 year) flooding event. The PPS25 Practice Guide highlights the importance of considering existing land use when delineating areas that are to be treated as 'functional floodplain' for planning purposes.

73. Discussions with the Environment Agency have confirmed that, due to the obstructions to overland flow paths posed by existing development within flood affected areas, existing buildings (that are considered impermeable to floodwater) should *not* be considered as falling within the functional floodplain. For this reason, **these areas have been delineated as Zone 3a(i) for planning purposes**, and a suite of recommended planning responses have been established accordingly. It is important to highlight that the land surrounding existing buildings form important flow paths and flood storage areas however, and these must be protected.

74. It is important to recognise that all areas within Zone 3a(i) 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 informed planning decisions must be taken with particular care.

5.1.3 Delineation of Zone 3a High Probability

75. Zone 3a High Probability is defined as those areas of Sheffield that are situated within the 1% (1 in 100) flood extent.

[7] Table D1, Appendix D, PPS25

76. The Environment Agency Flood Zone Map (April 2008) has been adopted for the delineation of Zone 3a High Probability. Whilst detailed modelling of the River Don, River Sheaf and Porter Brook is available, it is important to recognise that Zone 3a is delineated *without* the presence of formal and/or informal defences. The detailed modelling of the rivers depicts the physical characteristics of the existing system, including raised walls where these exist. These are therefore not suitable for the assessment of Zone 3a High Probability from a planning perspective.

5.1.4 Delineation of Zone 2 Medium Probability

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

5.1.5 Delineation of Zone 1 Low Probability

78. Zone 1 Low Probability is defined as those areas of Sheffield that are situated outside of the 0.1% AEP (1 in 1000) 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 Assessment of Risk (Flood Hazard)

79. The assessment of flood risk has thus far considered the maximum extent to which flooding will occur during a particular flood event. This provides the basis for assessing broadly the areas potentially impacted by flooding. Of equal importance however is the speed with which (and depth) flooding occurs as water levels rise. The inundation of floodwaters into low lying areas can pose a considerable risk to life.

80. Substantial research has been carried out internationally into the risk posed to pedestrians during flash flooding. This research has concluded that the likelihood of a person being knocked over by floodwaters is related directly to the depth of flow, and the speed with which the water is flowing.

81. To ensure that the risk posed by floodwaters is assessed consistently, Defra (in collaboration with the Environment Agency) has produced a guidance document entitled FD2321 Flood Risks to People. Table 3.2 of the guidance provides criteria for determining the degree of danger that is posed to life, assessed as a product of flood depth and flow velocity (i.e. depth x (velocity + 0.5%)). The guidance states that if this product is below 0.75, then caution should be exercised due to *"shallow flowing water or deep standing water"*. In contrast, if the product exceeds 2.5 then the hazard posed to life is extreme with *"deep fast flowing water",* representing a danger to all.

82. **This guidance should be used as part of the design process for all site based Flood Risk Assessments to ensure that the proposed development is safe under all flooding conditions.** The delineation of flood hazard should also be used to inform a sequential approach to the siting of development within an area, guiding vulnerable uses away from areas most at risk.

83. The Level 1 SFRA has broadly considered the risks associated with river flooding throughout the district, and the possibility of failure of water storage facilities, as described in Section 6 below.

5.3 Assessment of Localised Flood Risk

84. The risk of flooding from other (non fluvial) sources is an important consideration. The recent flooding that affected England, and particularly South Yorkshire, in the summer of 2007 highlighted the potential risk that groundwater, surface water runoff and sewer flooding can have upon an area. Newbury (West Berkshire) and Hull both suffered severe flooding from non-fluvial sources. Whilst the rivers were certainly the primary source of the flooding suffered in Sheffield during this event, surface water flooding is understood to have played a contributing factor in some locations. Discussions with the Council drainage team indicate that approximately 5% of the damages sustained within Sheffield in June 2007 were as a result of surface water flooding alone.

85. Within Sheffield, relatively limited information is available relating to anecdotal observations of localised flood risk problems. These are generally as a result of blocked culverts and gullies, surface water runoff, and failures of the underground sewer system during particularly intense rainfall. It is important to highlight that this information only relates to localised problems *once they have occurred*. PPS25 strongly advocates the prediction (where possible) of potential flood risk, seeking an avoidance strategy that guides development away from these areas wherever possible. It is very difficult to sensibly predict the potential risk of localised flooding, particularly given that many of these incidents will be as a result of (for example) the collection of leaves over a gully during a rainfall event.

86. The topography and geology of the district provides a means of broadly identifying those areas within which surface water runoff is likely to cause the most disruption and potentially damage to property. Areas in which the soils are highly impermeable (reducing the capacity of infiltration into the ground during periods of wet weather) and localised 'sags' in the topography (where ponding is likely to occur) can be considered locations within which the potential risk of localised flooding should be taken into account as part of the design process. An overview of the geology and topography of the district is provided in Figure E.

87. More generally, though, development can fundamentally alter drainage patterns, obstructing overland flow routes, and altering the volume and speed of runoff. The SFRA has therefore captured all readily available information relating to localised flooding in an effort to inform future detailed Flood Risk Assessments (FRAs). It is essential to highlight that this should not be considered a comprehensive representation of all localised flood risks as indeed not all observed incidents may have been reported (and the blockage of culverts and gullies can happen anywhere).

5.4 Potential Impacts of Climate Change upon Flood Risk

88. 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 rivers 1% AEP (1 in 100) flood flow can be expected within the next 20 years, increasing to 20% within the next 100 years.

89. It is essential that Sheffield City Council and 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 over the lifetime of the development should be assessed proportionally to the guidance provided above.

Fluvial Flooding

90. As highlighted in Section 4.5 above, the detailed modelling of watercourses within the study area has included the presence of existing raised formal and informal flood defences. As the planning process must consider the risk of flooding over the lifetime of development (up to 100 years), it is important to assume that existing structures may not be retained in the longer term, and/or may fail unexpectedly. For this reason, the detailed models are not relevant for planning purposes.

91. In accordance with current best practice therefore, the Environment Agency's Flood Zone Maps have formed the basis for the assessment of flood risk in these river valleys. In the absence of detailed modelling, the Environment Agency advocate using the current 0.1% AEP (1 in 1000) flood outline, i.e. Zone 2 Medium Probability, as a conservative estimation of the anticipated extent of the 1% AEP (1 in 100) flood affected area in 100 years (i.e. as a result of climate change).

Localised Flooding

92. It is important to remember 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 district. This may exacerbate localised drainage problems, and it is essential therefore that the detailed FRA considers the potential impacts of climate change upon localised flood risks, as well as the risks of fluvial flooding. The predicted increase in rainfall intensity as a result of climate change (for design purposes) is provided in Table B2, Appendix B of PPS25.

5.5 Topography, Overland Flow Paths & Geology

Topography & Overland Flow Paths

93. The topography of Sheffield is dominated by the steep slopes of the Peak District to the west, falling towards the characteristically undulating nature of the River Don catchment to the east.

94. To the west of Sheffield city centre, a relatively large proportion of the district is situated on relatively steep sided valleys, and the rivers valleys are well contained. Relatively few properties are at risk of flooding from rivers in these upper reaches, however there is likely to be a relatively high risk of flash flooding following intense rainfall as water runs rapidly off the valley sides.

95. To the east of the city centre, the district flattens and the river valleys widen. Runoff from the steep upper reaches arrives quickly, resulting in the overtopping of the rivers into flatter floodplain areas (including, for example, Meadowhall). Within these flatter areas, the drainage system relies heavily upon an ability to drain freely into the rivers. When river levels are high, the drainage systems are unable to discharge, resulting in surface water flooding that exacerbates problems within lowlying areas.

96. The topography of Sheffield has been used to model indicative overland flow paths. This is done using an automated function within ArcGIS. It uses the topographic model and simply looks at where slopes and valleys exist and predicts that water flowing on the surface of the land would follow these pathways. An overview of the district topography is provided in Appendix B, along with maps of the indicative overland flow paths (Appendix C).

97. It must be remembered that the modelled flow paths are indicative. Overland flow path modelling cannot take into account local factors, such as the layout of roads, buildings, walls and fences, which would influence flow greatly at a local level. Therefore, the overland flow path modelling is intended to provide simply a strategic overview of areas that may be at risk.

Geology

98. The solid geology in Sheffield is characterised by Namurian (Millstone Grit) to the west, and Lower Westphalian to the east. The soils are typically alluvium along the river corridors, with relatively large areas of peat within the uppermost reaches of the River Don catchment.

99. The presence of peat is an important characteristic when considering the response of a catchment to rainfall. The soil is very absorbent, however once saturated will rapidly release a relatively high volume of water which could contribute to localised flash flooding.

100. An overview of Sheffield's geology is provided in Figure E.

6 Flood Risk in Sheffield

6.1 Overview

101. The watercourses in Sheffield[8] that pose significant flood risk to buildings and infrastructure include the River Don, the River Sheaf, the River Loxley, Porter Brook and Blackburn Brook. Other smaller watercourses worth mentioning include the River Loxley and Kelham Goit, both of which are tributaries of the River Don (to the north of the city centre) that have contributed to property flooding in the past.

6.2 Historical Fluvial (River) Flooding

102. Areas that were affected by flooding from Porter Brook between 1958 and 1999 have been provided by the Environment Agency, and these are presented in Figure B. Many other areas of the district have also been subject to flooding however with a long history of anecdotal evidence of events affecting properties along the River Don and Blackburn Brook corridors.

103. The most severe flood event in recent years was in June 2007 when the River Don and its tributaries burst their banks. Appendix D provides an overview of the impact of the flooding, and graphic television footage of areas immediately to the north of the River Don emphasised the sheer depth and velocity of overland flooding that occurred in the height of the floods. Areas that were particularly badly affected (from the River Don) include Kelham Island, Nursery Street and The Wicker. The demountable defences constructed in recent years to protect the Meadowhall Shopping Centre were overtopped in 2007.

104. Flooding to property also occurred from tributaries of the River Don including Blackburn Brook, the Little Don, the Loxley, and Ecclesfield and Whitley Brooks. It is understood that this was exacerbated to some extent by the partial blockage of structures by debris washing downstream. As a result, floodwaters ponded behind blocked culverts, result in the overtopping of river banks.

105. It is estimated that the summer 2007 flood represented between a 0.67% (1 in 150) and a 0.5% (1 in 200) design event. The Environment Agency has amended their Flood Map to include areas that flooded beyond the previous Flood Zone 2 outline.

6.3 Fluvial (River) Flood Risk

106. An overview of flooding from rivers within Sheffield is presented in the adjoining flood maps, which have been developed in accordance with PPS25 (as explained in Section 5 above). The primary risk of fluvial (river) flooding within Sheffield is from the River Don and its tributaries including the River Sheaf, Porter Brook and Blackburn Brook. In most instances, the river valleys are relatively well defined and the floodplain areas are not extensive. Urbanisation has occurred right up to the river frontages however, and in the case of Porter Brook, the river has been culverted beneath the city centre to make way for development. This has resulted in the constriction of the natural river system, and during following particularly intense rainfall, river levels rise resulting in flooding to overbank areas.

[8] Watercourses with main river designation within Sheffield include the River Don, River Sheaf, River Loxley, Blackburn Brook and Porter Brook

107. The frequency of flooding varies throughout Sheffield. A large proportion of the areas at risk have a 1% (1 in 100) chance of being flooded in any year. Some lower lying areas, including for example industrial areas adjoining Blackburn Brook and city centre areas surrounding Sheffield Station are at increased risk, with a 5% (1 in 20) chance of flooding in any year.

108. The events of June 2007 did highlight the problems that can be caused by culvert blockage. The lower reaches of Porter Brook are culverted, and are therefore susceptible to blockage, which will increase the risk of flooding. Culvert crossings (roads) along both Porter Brook and Blackburn Brook are also particularly susceptible to sudden blockage as a result of debris washing downstream during a flood event.

109. With climate change, potential blockage and ultimately structural degradation of culverts over time, the capacity of these systems will deteriorate. This is not a major consideration in planning terms today, but future reviews of the SFRA process should assess any possible changes that may have occurred. More importantly, a rigorous regime of monitoring and maintenance of the existing system of culverts should be assured to avoid deterioration of the system.

110. It is highlighted that both the Council and the Environment Agency actively encourage the re-naturalisation of culverted reaches of waterways within the district, as set out in Council's UDP Policy GE17. Opportunities to open culverts and restore natural waterways should be actively sought as part of future development initiatives, contributing not only a potential long term reduction in flood risk, but also enhancing the natural environment.

6.4 Localised Flood Risk

111. As discussed in Section 4.2, consultations have been carried out with the Environment Agency, Sheffield City Council and Yorkshire Water to identify known and/or perceived areas that may be susceptible to localised flooding. This includes (for example) surface water flooding that may occur as a result of blockage and/or surcharging of the underground drainage system.

112. A summary of localised flooding incidents within the district has been provided by Sheffield City Council, categorised in terms of issued that arose as a result of insufficient culvert capacity, and issues that occurred due to culvert blockage. This is provided in the SFRA flood maps in Appendix A. Specific information relating to the June 2007 event has been captured through discussions with the Council, and this is provided in Appendix D.

113. Yorkshire Water collates a summary of properties affected by flooding as a result of the failure (or surcharging) of the sewer system, referred to as the 'DG5 register'. This register is a collation of the addresses of all incidents of sewer related flooding over time, and it is worth noting that properties are only removed from the list when improvements are made to the system to rectify the problem. Due to issues of confidentiality, the information that could be made available for publishing within a public document is very general in nature, and relatively little knowledge can be drawn. Yorkshire Water is obliged to provide this data upon request however, and detailed site based investigations should approach the organisation to seek information relating to historical incidents of sewer system related flooding.

114. PPS25 advocates a sequential approach when considering the risk of flooding from non river (or localised) sources. As discussed in Section 7.4, issues of a localised nature can generally be addressed safely and sustainably through the design process, and will typically not restrict development. Within a site however, development should be configured (and designed) to minimise the potential risks associated with localised flooding.

115. It is important to ensure not only that the site itself is not placed at risk of localised flooding, but also that the likelihood (and severity) of localised flooding to adjacent sites is not inadvertently worsened. Sustainable Drainage Systems (SUDS) should be an integral part of all drainage systems within the district to achieve this aim wherever site conditions permit, and these are discussed further in Section 7.6.3.

116. The indicative overland flow paths (see Appendix C) show natural undulations in the local topography, and therefore where surface water caused by heavy rainfall or surcharging drainage systems may gather and flow[9]. Whilst the design capacity of the existing drainage system within the district of Sheffield is likely to be somewhat variable, typically it can be assumed that a local storm event that exceeds a 20% (1 in 5) design event will exceed the capacity of the local drainage system in older areas of the district, resulting in overland flow. It is important to recognise however that intense rainfall will typically result in debris being washed overland, resulting in the blockage of gullies and culverts. This too will cause the drainage system to surcharge.

117. As explained in Section 5.5, these flow paths would be influenced greatly at a local level by buildings and infrastructure. However, they give a picture of the terrain in Sheffield that could generate overland flow, and where it would arrive.

118. The areas at the foot of the overland flow paths are receiving areas, which are referred to as 'receptors' (i.e. areas that are potentially at risk of ponding following heavy rainfall in the area). More important than the receptors though are the 'pathways', i.e. the route which the overland flowpath takes between the source (where it originates) and the receptor. Future development, especially in terms of building layout, must be mindful of the pathway of the overland flow paths. Obstructions should be removed to avoid the ponding of water behind buildings, walls and fences as this could cause localised flooding. Also, any drainage system that is situated near the receptor of the overland flow path should be mindful of the fact that the site may need to provide storage and conveyance for surface water quantities greater than the site alone would generate.

6.5 Groundwater Flooding

119. The risk of groundwater flooding is typically variable and heavily dependent upon local geological, topographical and weather conditions, as well as local abstraction regimes. Groundwater flooding is hard to predict and challenging to mitigate. Even with a carefully monitored network of boreholes, it can be difficult to tell when and where groundwater flooding will occur.

120. There are no known incidents of groundwater flooding in Sheffield, and it is considered reasonable to assume that the potential risk of groundwater flooding is extremely low. Notwithstanding this, it is recommended that a local site-based assessment of potential groundwater risks is carried out as part of a detailed Flood Risk Assessment, ensuring that the proposed design caters for any localised risk that may exist.

[9] It is important to highlight that the overland flow paths delineated in the maps are based purely upon a strategic interrogation of the district topography. Localised flow routes are likely to occur in other locations (i.e. not indicated in the maps) as a result of, for example, sewer surcharges following heavy rain. The detailed site-based FRA must consider the risk of localised surface water flooding at all locations, and should not be constrained by the indicative routes identified in these high level maps.

121. Typically groundwater flooding will not preclude development, unless there is a demonstrated history of relatively frequent and problematic flooding on site. Where a potential risk of groundwater is identified however, it may be appropriate to (for example) incorporate flood proofing measures and/or the raising of entry thresholds to mitigate possible damages. The adopted design will need to ensure that it does not result in any worsening to the risk posed to adjoining properties, for example, through the displacement of available groundwater storage capacity as a result of basement construction. Groundwater flooding can also last for extended periods (up to 6 months, in some cases) and access should be an important consideration, as should the maintenance of utility services, particularly foul water services.

122. Another consideration with respect to groundwater is the effectiveness (or otherwise) of SUDS. The design of proposed developments should carefully consider the impact that raised groundwater levels may have upon the operation of SUDS during periods of heavy rainfall. As described in Section 7.6.3, infiltration techniques will be compromised in areas in which the water table is elevated.

6.6 Risk to Life from Flooding (Flood Hazard)

Flood hazard due to overbank flooding

123. As outlined in Section 5.2 above, the speed and depth with which the River Don and its tributaries flood into developed areas of the district is an important consideration. Deep, fast flowing water may potentially pose risk to life. This must be considered when planning future development.

124. As indicated in the section above, footage from the June 2007 event highlighted the propensity of areas within Sheffield to suffer from deep, fast flowing water. For this reason, a detailed two dimensional model of areas adjoining the River Don (including The Wicker, Kelham Goit and Nursery Street) has been developed. This enables an examination of the depth and velocity of the floodwaters as water breaks out of the river and flows overland

125. To assess the risk that the floodwaters pose to life, a flood hazard map has been prepared as an outcome of the 2D modelling, and this is presented in the detailed Level 2 SFRA assessments prepared for Kelham Island and the Nursery St precinct respectively (July 2008). The 'hazard' posed by flooding is determined as a product of the depth and the speed of the flow[10], and assessed in accordance with Defra guidance 'Flood Risk to People (FD2321). The hazard categories adopted for SFRA purposes are outlined below:

d x (v + 0.5)	Degree of Flood Hazard	Description
<0.75	Low	Caution *"Flood zone with shallow flowing water or deep standing water"*
0.75 - 1.25	Moderate	Dangerous for some (i.e. children) *"Danger: Flood zone with deep or fast flowing water"*
1.25 - 2.5	Significant	Dangerous for most people *"Danger: flood zone with deep fast flowing water"*
>2.5	Extreme	Dangerous for all *"Extreme danger: flood zone with deep fast flowing water"*

Ref: FD2321/TR1 Table 3.2

[10] Hazard = Depth x (Velocity + 0.5)

126. It is highlighted that those areas that were affected by deep, fast flowing floodwaters from the River Don in June 2007 are generally protected to some degree against more frequent flooding by either relatively high river banks, or raised walls (de facto defences). Whilst the 2007 event was relatively extreme, this does reinforce the very real risk that flooding can pose to property and life. It is very important that the design process carefully considers not only the likelihood of flooding, but also incorporates design measures to ensure that tenants are safe when flooding occurs. Further discussion regarding the hazard posed by fluvial flooding within the Don corridor is provided in the Level 2 SFRA assessments for Kelham Island and Nursery Street (July 2008).

Flood hazard due to reservoir failure

127. Sheffield is characterised to a large degree by the relatively large number of water supply reservoirs that are situated in the upper reaches of the River Don catchment, perched to the west of the city in the hills of the Peak District. A large proportion of these reservoirs are owned and operated by Yorkshire Water, and fall under the auspice of the Reservoirs Act.

128. Whilst it is probably fair to state that the probability of a catastrophic dam failure is relatively low, the consequence of such an event can be particularly severe. The 'Sheffield Great Flood' of 1864 was a direct result of dam failure on the River Loxley. It is estimated that up to 800 homes were lost in the Hillsborough area, and over 270 killed as a result of the dam collapse. In June 2007, a slip failure occurred in the earthen face of the Ulley Reservoir dam wall in the adjacent Borough of Rotherham. Emergency works prevented the complete structural collapse of the dam, but during the height of the emergency the M1 was closed for an extended period, and a sewage treatment works, an electricity substation and a high pressure gas pipeline were all at immediate risk. Furthermore, hundreds of homes that may have been at risk should a failure have occurred were evacuated, emphasising the potential risk to life and livelihood.

129. Large reservoirs within England that are either greater than 25,000m^3 in capacity, or may pose an immediate risk to life as a result of failure, are managed and maintained in accordance with current UK legislation (i.e. Reservoirs Act 1975). The Water Act 2003 amended the Reservoirs Act 1975, requiring the preparation of dedicated Flood Plans for reservoirs by the reservoir owners. A Flood Plan is a set of documents that describe the arrangements to be put into operation in response to a sudden large release of water from a reservoir that could pose a threat to property and life downstream. A Flood Plan will include an assessment of the impacts of dam failure, a review of the measures that can be taken by the reservoir operator to prevent the catastrophic failure, and an assessment of the emergency response mechanism required to minimise risk to life and property should a failure occur.

130. Currently these Flood Plans are considered sensitive information, largely as a result of fears of a potential security breach. It is widely recognised how invaluable this information is in terms of both spatial planning and preparedness for an emergency. The recent Pitt Review (June 2008) has recommended that this information is released to the Environment Agency and Local Authorities for informed use in the planning process. Pitt has also recommended that the threshold for registering dams under the Reservoirs Act (currently based on the storage capacity of the facility) be reviewed, and smaller dams that may pose a direct risk to life should also be captured.

131. It is worth highlighting that there is currently no requirement under PPS25 to restrict development downstream of reservoirs, the residual risk of failure relating to any engineered structure remains. The Council may therefore consider it appropriate to steer development away from these areas.

Flood hazard due to flood defence failure

132. A relatively small number of formal flood defences have been identified within Sheffield, however a number of de facto defences exist in the form of river walls along the River Don within the city centre corridor (refer Appendix A). Once again, during June 2007 it is understood that a wall collapse did occur along this reach of the River Don, resulting in the inundation of areas behind the river walls (although the précised location of the collapse could not be confirmed). The demountable defences constructed to protect the Meadowhall Shopping Centre were also overtopped.

133. Currently the likelihood that members of the general public will be situated immediately behind a raised formal and/or informal defence along the River Don in Sheffield is relatively low. The area is currently largely old industrial areas and disused space. These are key regeneration sites for the city however, and therefore this is likely to change in future years. For this reason, the potential risk to life as a result of a sudden structural collapse of a raised flood wall may increase with time (simply by virtue of people being nearby). It is imperative that a detailed site based flood risk assessment considers the potential impact of the overtopping and/or breach of a formal and/or de facto flood defence, and ensures that future tenants of the site will not be placed at immediate risk during flooding conditions.

134. Finally, as highlighted earlier, road and/or railway embankments may form a de facto flood defence function, altering the path of floodwaters as they flow overland. These will often be generally substantial engineered embankments that are unlikely to suffer catastrophic failure as a result of flooding. These will not have been designed to withhold a depth of water putting pressure upon the structure however, and therefore careful consideration of the safety of such embankments should therefore be taken at the detailed FRA stage.

6.7 Impacts of Climate Change upon Flood Risk

135. 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.

136. 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 effects over the lifetime of the development should be assessed proportionally to the guidance provided in Annex B of PPS25. For design purposes, the Environment Agency recommends that the ‘lifetime of development’ be adopted as 100 years for residential development, and 60 years for commercial development.

Fluvial Flooding

137. Detailed modelling of the potential impacts of climate change has been carried out for the River Don and its tributaries. As highlighted in Section 4.5 above however, this modelling has assumed existing catchment conditions, i.e. including the presence of raised defences. This is not appropriate information from a planning perspective therefore. Instead, in accordance with current best practice, it is recommended that the Council consider Zone 2 Medium Probability to be a reasonable estimation of the likely impacts that climate change will have upon the 1% (1 in 100) event over the next 100 years.

138. Making reference to the SFRA flood maps therefore, due to the steep sided nature of the river valleys it is clear that climate change will not dramatically increase the extent of river flooding in Sheffield. 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.

139. Notwithstanding this, those properties (and areas) that are currently at risk of flooding may be susceptible to more frequent, more severe flooding in future years. Therefore, it is essential that the development control process (which should influence the design of future development within the district) carefully mitigates against the potential impact that climate change may have upon the risk of flooding to property.

Localised Flooding

140. Localised intense storms are likely to occur more frequently and, therefore, surface water flooding is predicted to occur more often. Because of this, it is important that site-specific, detailed Flood Risk Assessments (i.e. prepared by the developer at the planning application stage as outlined in Section 0) are carried out and that they take due consideration of climate change.

Planning Recommendations

141. The development control recommendations set out in Section 7.4 (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 district over the next 100 years. It aims to ensure that future development is considered in light of the possible increases in flood risk over time.

142. *It is highlighted that, for planning purposes within the context of the current review of the emerging Local Development Framework, Zone 3a High Probability is defined on the basis of existing (i.e. 2008) flood level predictions.*

6.8 Residual Risk of Flooding

143. It is essential that the risk of flooding is minimised over the lifetime of the development in all instances. It is important to recognise that flood risk can never be fully mitigated, and there will always be a residual risk of flooding.

144. 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 local drainage system has been designed;
- the residual danger posed to property and life as a result of flood defence failure through structural collapse. Overtopping of a defence may also pose a residual danger to property and life.
- general uncertainties inherent in the prediction of flooding;

145. The modelling of flood flows and flood levels is not an exact science. Therefore, there are inherent uncertainties in the prediction of flood levels used in the assessment of flood risk. The adopted flood zones underpinning Sheffield are largely based upon historical flood outlines and detailed flood modelling within the area. Whilst these provide a good 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.

146. Taking a conservative approach for planning purposes, the Environment Agency advises that finished floor levels are raised to a minimum of 300mm above the peak design flood level (including climate change) when advising developers. This advice is reflected in the development control recommendations discussed in Sections 7.4 and 7.6.2 below.

7 Sustainable Management of Flood Risk

7.1 Overview

147. 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 is sustainable development within flood affected areas.

148. The significant flood events that have occurred in England in the summer of 2007 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. However, it is recognised that this is not always 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.

149. 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 Sheffield. Responsibility for flood risk management resides with all tiers of government and, indeed, individual landowners, as outlined below.

7.2 Responsibility for Flood Risk Management

150. There is no statutory requirement for the Government to protect property against the risk of flooding. Aside from this fact, 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.

151. The Regional Assembly should consider flood risk when reviewing strategic planning decisions including (for example) the provision of future housing and transport infrastructure.

152. The Environment Agency has a statutory but permissive responsibility for flood management and defence in England. The EA is a statutory consultee body for the planning and development control process, providing information and advice regarding flood risk and flooding related issues.

153. The Local Planning Authority is responsible for carrying out a Strategic Flood Risk Assessment. The SFRA should consider the risk of flooding throughout the district 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.

154. Landowners & Developers[11] 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.

[11] Referred to also as 'landowners' within PPS25

155. The Environment Agency has developed a guide entitled “Living on the Edge” that provides specific advice regarding the rights and responsibilities of property owners, the Environment Agency and other bodies. The guide is targeted at owners of land situated alongside rivers or other watercourses, and is a useful reference point outlining who is responsible for flood defence, and what this means in practical terms. It also discusses how stakeholders can work collaboratively to protect and enhance the natural environment of our rivers and streams. This guide can be found on the Environment Agency’s website at *www.environment-agency.gov.uk*

7.3 Strategic Flood Risk Management - The Environment Agency

7.3.1 Overview

156. 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 can result in the redistribution of floodwater, inadvertently increasing the risk of flooding elsewhere. Therefore, this approach to flood risk management in the modern era should only follow a thorough assessment of the risks that could be created elsewhere in the catchment and are considered acceptable.

157. The Environment Agency, 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.

7.3.2 Catchment Flood Management Plan (CFMP) – Don & Rother

158. *“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.”*

159. *“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 coordinated 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.”*

160. *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.”*[12]

[12] Catchment Flood Management Plans – Volume 1 (Guidance), Version 1.0, July 2004

161. A CFMP has been developed for the River Don catchment (encompassing the River Rother). A consultation summary document was published in June 2008 outlining the main messages from the CFMP.

162. The district of Sheffield is encompassed within two of the defined CFMP policy units – 'Sheffield' and 'Upper Don'. Specific messages have been developed for both areas of the Don catchment, and these are summarised below.

'Sheffield' Policy Unit

Strategic Vision

> *"Sheffield is characterised by flooding from a number of differing sources. An integrated approach to managing flooding is required. This will require considered application of development plans and regeneration aspiration to ensure that they are implemented in accordance with Government Guidance PPS25 and do contribute to existing flooding issues. These actions need to be linked to effective development control within the area at flood risk, and where possible take positive steps to reduce flooding through improvement to surface water and sewage infrastructure."*

Key Messages

- Work with local businesses to advise them of flood risk and flooding risk management issues (e.g. resilience measures) so that they may reduce or mitigate the impacts of flooding;
- Encourage a balanced approach to floodplain redevelopment and typically support the removal of culverts and improved waterfront access;
- Improve access to the river channel for maintenance;
- Expand and improve our flood warning service where appropriate, improve service uptake by the public and local businesses, and increase public awareness of flood issues;
- Work with emergency services and other organisations to improve emergency action plans.

'Upper Don' Policy Unit

Key Messages

- Promote land management in the upper Don and Dearne to reduce surface runoff;
- Promote blocking of moorland grips.

7.3.3 River Don Catchment Flood Risk Management Strategy (FRMS)

163. The River Don Flood Risk Management Strategy (FRMS) is currently underway. The FRMS will take the overarching policy recommendations of the CFMP, and consider these in a more localised context to establish a clear and tangible 'way forward' for flood risk management within the catchment.

164. It is important to reiterate that the construction of flood defence structures is not always the answer, and serious questions must be asked about the long term viability of such a strategy. For this reason, the engagement and cooperation of stakeholders within the catchment (including, for example, Sheffield City Council and local landowners) to collectively contribute to a reduction in flood risk in the future is absolutely vital. This is a key element of the FRMS.

165. Consultation on the Don Catchment FRMS is expected to commence in August 2008, and the strategy is currently programmed for completion by March 2009.

7.3.4 Opportunities for Flood Risk Management within Sheffield

166. In addition to the over-arching catchment wide studies discussed above, a number of more localised feasibility studies are underway in an endeavour to identify potential opportunities for flood risk management within Sheffield. These are focussed heavily upon the tributaries of the River Don, including Porter Brook, Blackburn Brook and the River Sheaf.

167. A number of possible opportunities for flood risk reduction have been identified, and these will be reviewed in further detail (in liaison with the local authority) in due course. It is important that the planning process supports wherever possible initiatives that will contribute to a reduction in flood risk over the long term. This may achieved through, for example, the protection of sites for flood storage purposes.

7.4 Application of PPS25 within Sheffield

7.4.1 Planning Solutions to Flood Risk Management

The Sequential Test

168. Historically, urbanisation has evolved along river corridors due to the rivers providing a critical source of water, food and energy. This leaves many areas of England with a legacy of urban centres that, because of their close proximity to rivers, are at risk of flooding.

169. 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, and is summarised in Figure 4.1 of the PPS25 Practice Guide (June 2008).

> **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 Figure 4.1 of the PPS25 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).

170. It is important to remember that 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. The Council must 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.

171. It is important to recognise that the principles of the sequential approach are applicable throughout the planning and development 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. 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[13].

The Exception Test

172. Only a relatively small proportion of Sheffield is situated within Zone 3a High Probability. However, Zone 3a affects many existing urban and retail areas (including Sheffield city centre, for example) and prohibiting future development within these areas may have a detrimental impact upon the economic and social welfare of the existing community. It is essential that a sequential approach is taken to underpin all planning decisions as stipulated above. It may be however that pressing planning arguments (that outweigh flood risk) remain, putting into place a requirement to investigate further the possibility of regeneration and/or future development within areas at risk of flooding.

173. Should this be the case, the Council and potential future developers are required to work through the **Exception Test** (PPS25 Appendix D) where applicable. It is important to remember that the Sequential Test should always be carried out prior to the Exception Test. 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 Development Plan Document'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 developed land; and*

174. The first two points set out in the Exception Test are planning considerations. 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.

175. The Sheffield SFRA has been developed to inform the Sequential Test. It will be the responsibility of the Council to carry out the Sequential Test on the basis of this information, allocating potential sites for future development accordingly. Equally developers proposing sites in Zone 3 or Zone 2 will be required to demonstrate within the detailed Flood Risk Assessment that the Sequential Test has been applied, and (where appropriate) that the risk of flooding has been adequately addressed in accordance with PPS25.

176. The management of flood risk throughout the district must be assured should development be permitted to proceed, addressing the third critical element of the Exception Test. The SFRA has provided specific recommendations that ultimately should be adopted as design features, with evidence provided of how they will be fulfilled prior to permission being granted 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.

[13] It is strongly recommended that developers agree the application of the Sequential Test with the Council **before** embarking upon a detailed site based FRA, thereby ensuring that the site can be taken forward on planning grounds prior to considering potential design solutions

177. An overview of flood risk throughout the district has been provided in Section 6. **Future planning decisions should consider the spatial variation in flood risk across the district, as defined by the delineated flood zone that applies at the specified site location, and apply the recommendations provided below accordingly.** It is reiterated that PPS25 applies to allocated sites identified within the emerging LDF and to future windfall sites.

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

178. 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 district. It is strongly recommended that this principle be adopted as the underlying 'goal' for developers and Council development control teams within Sheffield.

179. Developers should be encouraged to demonstrate that their proposal will deliver a positive reduction in flood risk to Sheffield, 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.

180. 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 and intensity of use. This is to prevent intensification through the addition of storeys (or other conversion) within the same footprint;
- Incorporating flood resilience into building design, for example, 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. This is to ensure that water does not pond and cause localised flooding;
- Apply the sequential approach at a site level to minimise risk by directing the most vulnerable development to areas of lowest flood risk, matching vulnerability of land use to flood risk (as stated in PPS25);
- Risk reduction should also be linked to the specific messages and objectives that have emerged from the Don & Rother CFMP.

181. A clear statement will be required within each detailed FRA that concisely summarises how a reduction in flood risk has been achieved within the proposed (re)development. This may be specified as (for example) a reduction in flow from the site, a reduction in water levels within (or adjacent to) the site, or a reduction in the consequences of flooding.

7.4.3 Localised Flood Risk within the Planning Process

182. The PPS25 Practice Guide advocates the application of a sequential approach when allocating land, taking into consideration *all* sources of flooding. The local drainage related problems identified within Sheffield are generally localised, and relate to historical incidents, the source of which is often somewhat uncertain. It is important to recognise that these are not a measure of 'risk', but rather problems that have occurred due to a particular set of local circumstances in the past (for example, the blockage of a local gully inlet). These may or may not reoccur in future years.

183. From a spatial planning perspective, it is considered unreasonable to restrict future development within areas that may have suffered a localised flooding incident in years past. It is essential, though, not to overlook the potential risk of localised flooding during the design process. Whilst the incidents that have been identified will typically not result in widespread damage or disruption, a proactive approach to risk reduction through design can mitigate the potential for damage, both to the development itself and elsewhere. Advice from the Environment Agency says it is for the site-specific FRA to demonstrate whether a site is acceptable or not within a localised flood area. Specific development control recommendations have been provided accordingly.

7.4.4 Spatial Planning & Development Control Recommendations

PPS25 Requirement	PPS25 Flood Zone					
	Zone 3a (i)	Zone 3b Functional Floodplain	Zone 3a High Probability		Zone 2 Medium Probability	Zone 1 Low Probability
			Undefended Areas	Defended Areas		
SPATIAL PLANNING RECOMMENDATIONS						
Important Considerations	It is important to recognise that Zone 3a(i) relates solely to existing buildings that are impermeable to flood water. The land surrounding these buildings are important flow paths and/or flood storage areas that must be retained. Developers must seek to proactively reduce the risk of flooding within Zone 3a(i) by reducing the building footprint and increasing the resilience of buildings to flooding. It should be recognised that property situated within this zone will be subject to frequent flooding, on average, no less than once in every 20 years. There are clear sustainability implications to be considered in this regard, and it is highly questionable whether insurance against flooding related damages will be available in the longer term.		Future development within Zone 3a High Probability can only be considered following the undertaking, and passing, of the Sequential Test		Future development within Zone 2 Medium Probability can only be considered following undertaking, and passing, of the Sequential Test	It is important to recognise that sites within Zone 1 may be susceptible to flooding from other sources. Development may contribute to an increase in flood risk elsewhere if not carefully mitigated
Land Use (refer Table D2 of PPS25)	Proactively seek a reduction in risk by reducing the vulnerability of the existing land use. More Vulnerable development should not be permitted in these areas.	Water Compatible Development	Land use should be restricted to Water Compatible or Less Vulnerable development. More Vulnerable development may only be considered if Exception Test can be passed		Land use should be restricted to Water Compatible, Less Vulnerable or More Vulnerable development. Highly Vulnerable development may only be considered if Exception Test can be passed	No restrictions
Permitted Development & Property Subdivision	There should be a presumption against all building extensions (including out-buildings). Property subdivision may increase the popultation at risk, and should not be permitted	N/A	Building extensions (including out-buildings) should be discouraged to avoid raising flood levels elsewhere. Property subdivision may increase the intensity of development, and the population at risk, and should be discouraged		N/A	N/A
DEVELOPMENT CONTROL RECOMMENDATIONS						
Detailed Flood Risk Assessment (FRA)	Required	Required	Required	Required	Required	Required for all sites greater than 1ha in area. Recommend that all sites carry out an assessment of localised flood risks (including surface water (flash) flooding)
Floor Level	To be situated a minimum of 300mm above the 1 in 100 year river flood level, including climate change					No minimum level stipulated by PPS25
Site Access & Egress	For residential property, dry access is to be provided in the 1 in 100 year river flood. For commercial property, access must be 'safe' in accordance with Defra "Flood Risk to People" (FD2320 & FD2321)	N/A	To ensure the safety of residents and employees during a flood, access and egress routes must be designed to meet Environment Agency defined criteria, as set out in Appendix A. 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.			No minimum level stipulated by PPS25
Basements	Not permitted	N/A	No habitable uses permitted at basement level. All basements must have an access point that is above the 1 in 100 year river flood level, including climate change		No restrictions	No restrictions
Site Runoff	Implement SuDS to ensure that runoff from the site (post redevelopment) does not exceed greenfield runoff rates, where this is achieveable. Any SuDS design must take due account of groundwater and geological conditions (refer Section 7.6.3)					
Buffer Zone	A minimum 8m buffer zone must be provided to 'top of bank' within sites immediately adjoining a river corridor. This relates to both open waterways and culverted waterway corridors. Reference should be made to the Environment Agency's "Living on the Edge" guide (www.environment-agency.gov.uk) that discusses any development situated in, over, under or adjacent to rivers and/or streams.					
Other	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, that overland flow routes are not truncated by buildings and/or infrastructure, or hydraulically linked compensatory flood storage is provided within the site (or upstream) Potential overland flow routes have been identified in Appendix C. These are areas that may be susceptible to surface water flooding when the drainage system is exceeded. Developers should carefully consider the risk of surface water flooding as part of all detailed site-based Flood Risk Assessments. Developers should avoid placing obstructions over natural overland flow routes to reduce the risk of surface water flooding both within the site, and to adjoining areas. As an integral part of the government's "Making Space for Water" agenda, the Environment Agency is actively seeking the renaturalisation of culverted watercourses as part of any future development. Realistic opportunities to reinstate the natural open waterway within existing culverted reaches of the river(s) should be promoted. This is captured in Council's UDP Policy GE17					

7.4.5 Building Extensions

184. Concern is mounting throughout England that valuable floodplain areas are being progressively lost to extensions and/or outbuildings that are below a specified size. These are 'permitted' developments that can take place without specific planning approval. Whilst each individual extension may not result in a measurable impact upon localised flood levels, the cumulative impact of building extensions has the potential to be considerable.

185. It is recognised that permitted development rights heavily limits the ability of a local authority to restrict some developments. Article 4 of the Town and Country Planning General Permitted Development Order 1995 (GPDO 1995) provides a possible vehicle for removal of these rights in exceptional circumstances. However, this measure has implications for property rights. As such, it may be open to compensation claims from affected landowners.

186. The Planning White Paper: *Planning for a Sustainable Future* (May 2007) recognises the shortfalls of the existing Article 4 procedure and mentions that measures to remove such barriers are being considered. These were consulted on through the *Changes to Permitted Development: Permitted Development Rights for Householders* consultation paper between May and August 2007 and raised a number of proposals. The proposals seek to enable greater local planning authority flexibility in issuing Article 4 directions by removing the need for the Secretary of State's consent and by amending existing compensation arrangements.

187. The *Changes to Permitted Development: Permitted Development Rights for Householders* consultation paper does not exclusively refer to flood reduction measures nor do the proposals suggest any changes to the existing GPDO 1995 that will tighten the limit on the size of land within the curtilage of a dwelling permitted for householder development. Therefore the cumulative impact of such development upon localised flood levels will remain and intensify with time.

188. Local Development Orders (LDOs) enable local planning authorities to apply permitted development rights to certain types of development which would otherwise require planning permission. LDOs are considered to be appropriate for minor development that is common and invariably gains planning permission with little objection or to assist the development of an area where significant change is anticipated. LDOs are not an appropriate mechanism in trying to restrict development outright. They can be tailored, however, to direct that permitted development rights do not apply to development in specific areas such a higher flood risk areas, for example.

189. Notwithstanding this, the importance of a long term sustainable view on the loss of floodplain to building extensions is widely accepted.

7.5 Overview of Flood Risk & SFRA Interpretation

7.5.1 SFRA Interpretation

190. The spatial variation in flood risk across the district is depicted in the adjoining maps, and described in Section 6. **The Sheffield SFRA (Level 1) should be used by both the Council and prospective developers to assist them to meet their obligations under PPS25 throughout the planning cycle**, including the delivery of a detailed site-based Flood Risk Assessment**.** Instructions for use are provided below:

Sheffield City Council (Forward Planning)

191. The SFRA flood maps in Appendix A provide an overview of the spatial variation in *fluvial* flood risk throughout the district (i.e. the risk of flooding from rivers), based upon current climate predictions. It is necessary to adopt a sequential approach when considering where land should be allocated for future development, and this is described in Section 7.4. These figures should be used to inform this sequential approach. Furthermore, PPS25 provides clear guidance on permissible land use within areas potentially at risk from flooding, and this too is discussed in Section 7.4.

192. Whilst there is no particular constraint placed upon land use within areas of Zone 1 Low Probability within Sheffield, it is strongly recommended that the Council takes due consideration of flooding from other sources (i.e. non fluvial):

- Overland flow routes are evident in the local topography (see Appendix C), and development should be oriented to avoid blocking these in any way;
- Observed incidents of localised flooding are provided in Appendix A, and these should be used to inform design to ensure that future development does not exacerbate these existing problems.

193. Many of these localised sources of flooding within Sheffield can be effectively managed through the design process (see Section 7.4.4). However, it is recommended that advice is taken from the Environment Agency to ensure that the severity of the local issue that may affect (or be exacerbated by) the proposed allocation is fully appreciated.

194. It is noted that consultation is currently being carried out by Defra with respect to surface water flooding, and in due course it is expected that a *Surface Water Management Plan (SWMP)* will be a mandatory requirement within areas that are known to be at risk from 'other' (non fluvial) sources of flooding. The SWMP will consider the potential risk of surface water and groundwater flooding in greater detail, and will establish a recommended mitigation plan to manage this risk effectively over time. It is anticipated that the development of the SWMP will be led by the Council, however input from stakeholders including the Environment Agency and Yorkshire Water will be essential.

Sheffield City Council (Development Control) & Developers

195. All development applications should consider the need for a further, more detailed assessment, of flood risk. All sites situated within Zone 2 or Zone 3, and sites greater than 1ha within Zone 1, require a detailed Flood Risk Assessment, in accordance with Section 7.6.1 of this report. The SFRA flood maps provided in Appendix A summarise the extent of flooding (from rivers) across the site, highlighting the zone within which the proposed development site will fall. These should be used to trigger a more detailed assessment of flood risk related issues within the site, as described in Section 7.4 and Section 0.

196. The assessment of flooding related issues is imperative for all proposed development, irrespective of its location and/or scale within the district, and the SFRA provides some helpful tools to assist in this regard. **It is imperative that the information outlined below is used with careful reference to the discussion and guidance provided in Sections 5 and 6 of this report.**

- The **risk of flooding to the site from rivers** is described in Section 6, and summarised in the SFRA flood maps in Appendix A. Recorded accounts of historical flooding from Porter Brook are provided in Figure B, and the flooding that occurred during June 2007 is described in Figure C and Appendix D. The locality of **formal flood defences** is presented in Appendix A, and available **flood warning services** throughout the district are indicated in Figure D.

- Appendix B offers a broad indication of the **topography of Sheffield**, including a measure of ground slope[14]. Appendix C provides the route that overland flow can be expected to take during an intense storm event that exceeds the capacity of the existing drainage system (i.e. **overland flow paths**) [15]. The blockage of these routes by buildings may result in localised flooding and, consequently, this should be avoided wherever possible. Areas that may be susceptible to localised ponding are also evident.
- The SFRA flood maps in Appendix A provide a summary of **locations that have been susceptible to localised flooding historically**. This is not a comprehensive record of flooding, and relies upon community reports of flooding made to the Council(s). It is a good indication of areas that may be susceptible to localised flooding however, and reiterates the importance of considering flood risk related issues in areas that are outside of the designated PPS25 flood zones.
- Within all areas of Sheffield, groundwater levels and soil permeability should be assessed on site at an early stage, and this should be used to inform the design of buildings and sustainable drainage systems (SUDS). An overview of the **geology of the district** is provided in Figure E.
- Appendix F provides the current Interim National Guidance for developers for Rainfall Runoff Management. This guidance has been provided by the Environment Agency (June 2008) and will **assist developers to design the drainage system for their site.**
- Appendix E provides clear guidance for developers to ensure that **safe access and egress** can be provided to/from the site to address the residual risk of flooding.

[14] The size of the vector is directly proportional to the steepness of the slope. In simple terms, the larger the vector, the steeper the gradient
[15] It is important to highlight that the overland flow paths delineated in the maps are based purely upon a strategic interrogation of the district topography. Localised flow routes are likely to occur in other locations (i.e. not indicated in the maps) as a result of, for example, sewer surcharges following heavy rain. The detailed site-based FRA must consider the risk of localised surface water flooding at all locations, and should not be constrained by the indicative routes identified in these high level maps.

7.6 Detailed Flood Risk Assessment (FRA) – The Developer

7.6.1 Scope of the Detailed Flood Risk Assessment

197. The SFRA is a strategic document that provides an overview of flood risk throughout the district. Once the Sequential Test has been applied in accordance with Section 7.4 and the table within Section 7.4.4 to determine the allocation of sites for future development, it is imperative that a site-based Flood Risk Assessment (FRA) is carried out by the developer for all proposed developments. This should be submitted as an integral part of the planning application. **It is emphasised that, for windfall sites, it will be necessary for the developer to demonstrate that the Sequential Test has been applied (in accordance with PPS25) within the detailed FRA.**

198. 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.

> ***The detailed FRA should utilise the background information provided within this Level 1 SFRA, as explained in Section 7.5.1.*** *It is important to reiterate that the SFRA provides the best available information at the time of writing. As highlighted below, the Environment Agency is an excellent source of information to inform the development of the detailed FRA, and they should be contacted as early as possible to source additional (more recent) information as appropriate.*

Proposed Development within Zone 3a High Probability, Zone 3a(i) & Zone 3b Functional Floodplain

199. All FRAs supporting proposed development within Zone 3b Functional Floodplain and 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) as well as from river flooding. In addition to the use of information provided within the SFRA, this will involve discussion with the Council and the Environment Agency to confirm whether a localised risk of flooding exists at the proposed site. Specific guidance is provided in Section 6 for the assessment of flood risk from other sources.
- The vulnerability of the development to flooding over the lifetime of the development (including the potential impacts of climate change) **for all sources of flooding**, 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 (with respect to fluvial flooding) 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 propensity of culverted systems to block, increasing the risk of flooding, should be considered.
- The presence of both formal and de-facto (including, for example, local road and/or rail embankments) flood defences within the proximity of the site must be considered. Flood defences may alter the risk of flooding within the site, and it is imperative that any change in the flooding regime as a result of a flood defence is thoroughly understood. The integrity of the defence must be assessed to ensure that the defence will be structurally sound throughout the lifetime of the proposed development. The potential impact of a defence failure must be considered.

- 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. It is emphasised that the detailed assessment of potential impacts elsewhere should not be limited (in a geographical sense) to Sheffield. Future development within the district may adversely affect sites within adjoining Boroughs, and it is essential that this is mitigated.
- 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, provision for escape/evacuation (refer Appendix E), 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 to ensure that runoff from the site (post redevelopment) does not exceed greenfield runoff rates and volumes. Any SUDS design must take due account of topographical, groundwater and geological conditions (refer Section 7.6.3);
- 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 district;

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 (refer Section 7.6.2) and the provision of a planned evacuation route and/or safe haven (refer Appendix I).
- The risk of alternative sources of flooding (e.g. urban drainage and/or groundwater) must be considered, and sustainable drainage techniques must be employed to ensure no worsening to existing flooding problems elsewhere within the area. Once again, it is reiterated that future development within the district may adversely affect sites within adjoining Boroughs, and it is essential that this is mitigated. Specific guidance is provided in Section 6 for the assessment of flood risk from other sources.
- 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 district.
- Details of proposed sustainable drainage systems (SUDS) that will be implemented to ensure that runoff from the site (post redevelopment) does not exceed greenfield runoff rates and volumes. Any SUDS design must take due account of topographical, groundwater and geological conditions (refer Section 7.6.3).

Proposed Development within Zone 1 Low Probability

200. For all sites greater than 1 hectare 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, and sustainable drainage techniques must be employed to ensure no worsening to existing flooding problems elsewhere within the area. Once again, it is reiterated that future development within the district may adversely affect sites within adjoining Boroughs, and it is essential that this is mitigated. Specific guidance is provided in Section 6 for the assessment of localised flood risk.
- 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 district.
- Details of proposed sustainable drainage systems (SUDS) that will be implemented to ensure that runoff from the site (post redevelopment) does not exceed greenfield runoff rates and volumes. Any SUDS design must take due account of topographical, groundwater and geological conditions (refer Section 7.6.3).

Liaison with the Environment Agency

201. 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*. This will be moved to the Environment Agency website (*www.environment-agency.gov.uk)* after October 2008.

202. 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.

203. It is strongly recommended that a draft of the detailed FRA is provided to the EA for review and comment before submitted with the Planning Application, thereby reducing potentially costly delays to the planning process.

7.6.2 Raised Floor Levels & Basements (Freeboard)

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

205. Wherever possible, floor levels should be situated a minimum of 300mm above the 1% AEP (1 in 100) plus climate change flood level, determined as an outcome of the site based FRA. A minimum of 600mm above the 1% AEP (1 in 100) flood level should be adopted if no climate change data is available. 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.

206. The use of basements within flood affected areas should be discouraged. Where basement uses are permitted, it is necessary to ensure that the basement access points are situated 300mm above the 1% AEP (1 in 100) 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. It must be demonstrated that any below ground construction does not adversely increase the risk of groundwater flooding to adjoining properties.

7.6.3 Sustainable Drainage Systems (SUDS)

207. SUDS are the various approaches that can be used to manage surface water drainage in a way that mimics the natural environment. The management of rainfall (and then surface water) is considered an essential element of reducing future flood risk to both the site and its surroundings. Indeed, reducing the rate and volume of discharge from urban sites to greenfield conditions is one of the most effective ways of reducing and managing flood risk within an area. The integration of SUDS into a site design can also provide broader benefits, including an improvement in the water 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 green space areas offering recreation and/or aesthetic benefits.

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

- reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;
- reducing volumes 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.

209. In catchment terms, the cumulative affect of applying SUDS to a number of sites can have a significant affect in reducing the volume of water entering a watercourse.

210. 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 table[16]. The SUDS techniques may be introduced simply to slow discharge from impermeable surfaces, or to capture and store rainfall on site for non-potable uses (i.e. rainwater harvesting).

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.

[16] Interim Code of Practice for Sustainable Drainage Systems National SUDS Working Group, 2004

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

211. The appropriate application of a SUDS scheme to a specific development is heavily dependent upon the **geology of the site** (and its surrounds) as well as the local groundwater regime. For example, infiltration techniques are generally most suitable in areas of permeable soils and geology. The geology of the district is summarised in Figure E.

212. The **topography of the site** is also an essential consideration for the selection of an appropriate SUDS system. For example, areas of steeply sloping ground are generally unsuitable for techniques that rely on the storage and/or infiltration of runoff upon the surface. An overview of the topography of Sheffield is included in Appendix B to assist in this regard. A graphical depiction of ground slope has been provided in vector form, with the larger vectors representing a steeper gradient.

213. It is important to highlight that a shallow water table will compromise the operation of an infiltration system, and it is essential that **groundwater levels** (in addition to soil permeability) are assessed on site as an integral part of the design process.

214. The **adoption and future maintenance of sustainable drainage systems** is a crucial consideration when implementing SUDS. Two possible options available to ensure that the SUDS are properly implemented and maintained, and the arrangement to be adopted will be dictated by Sheffield City Council. These include an agreement under Section 106 of the Town and Country Planning Act, or by a condition to planning permission. Further information relating to the adoption and maintenance of SUDS within Sheffield should be sought from the Council.

215. .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
- Planning Policy Statement 25, Annex F, CLG, December 2006
- The SUDS Manual (C697), CIRIA, 2007
- The Building Regulations, Approved Document H - Drainage and Waste Disposal (2002)
- www.ciria.org.uk/SUDS/
- Sheffield City Council website at http://www.sheffield.gov.uk/in-your-area/housing-services/environmental-sustainability/sustainable-housing/suds

216. Developers should also utilise the guidance within the document **'Rainfall Runoff Management for Developments - Interim National Procedure'**, which can be seen in Appendix F of this report.

217.

	SUDS technique	Flood Reduction	Water Quality Improvement	Landscape & Wildlife Benefit
Most Sustainable	Living roofs	✔	✔	✔
	Basins and ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✔	✔	✔
	Filter strips and swales	✔	✔	✔
	Infiltration devices - soakaways - infiltration trenches and basins	✔	✔	✔
	Permeable surfaces and filter drains - gravelled areas - solid paving blocks - porous paving	✔	✔	
Least Sustainable	Tanked systems - over-sized pipes/tanks - storms cells	✔		

7.7 Local Community Actions to Reduce Flood Damage

218. There will always be a residual risk of flooding, whether that be (for example) from an event that is more extreme than that considered, or whether as a result of a flood defence system that fails unexpectedly. Flood resistance and flood resilience may need to be incorporated into the design of buildings for this reason.

219. In all areas at risk of flooding, a basic level of flood resistance and resilience will be achieved by following good building practice and complying with the requirements of the Building Regulations 2000[17]. The difference between 'resilience' and 'resistance' is explained below:

- *Flood resistance,* or 'dry proofing', where flood water is prevented from entering the building. For example using flood barriers across doorways and airbricks, or raising floor levels.

- *Flood resilience,* or 'wet proofing', accepts that flood water will enter the building and allows for this situation through careful internal design for example raising electrical sockets and fitting tiled floors. The finishes and services are such that the building can quickly be returned to use after the flood.

220. Examples of both flood-resistant and flood resilient design are given in Improving the Flood Performance of New Buildings (Flood Resilient Construction), CLG (2007).

221. A number of properties within Sheffield are potentially at risk of flooding. It is essential therefore to ensure a broad awareness with respect to flood risk, providing the community with the knowledge (and tools) that will enable them to help themselves should a flood event occur.

222. The Civil Contingencies Act 2004 (CCA) places a legal duty on responders to undertake risk assessments and maintain them in a Community Risk Register, and publish this register. The Community Risk Register should be approved by the Local Resilience Forum (LRF). The LRF usually consists of Category One responders; these are the Police, Fire, Ambulance, Environment Agency and Health Authorities. Their role is to ensure that there is integrated emergency management for major incidents. The Community Risk Register is the first step in the emergency planning process

[17] Office of Deputy Prime Minister (ODPM) – now Communities & Local Government (CLG)

223. The following 'community based measures' are cost effective solutions that local communities may introduce to minimise the damage sustained to their own homes in the case of flooding. Further guidance is provided by the EA, Defra and CLG[18] (refer the National Flood Forum (*www. floodforum.gov.uk*)).

224. It is recommended that the Local Authority seek to proactively raise awareness within the community with respect to flooding (and indeed 'self help' flood risk reduction opportunities) through, for example, the circulation of a targeted newsletter to affected residents to coincide with the release of the Rotherham SFRA.

7.7.1 Flood Proofing

225. The 'flood proofing' of a property may take a variety of forms:

For new homes and/or during redevelopment

- Raising of floor levels

  The raising of floor levels above the anticipated maximum flood level ensures that the interior of the property is not directly affected by flooding, avoiding damage to furnishings, wiring and interior walls. It is highlighted that plumbing may still be impacted as a result of mains sewer failure.

- Raising of electrical wiring

  The raising of electrical wiring and sockets within flood affected buildings reduces the risks to health and safety, and reduces the time required after a flood to rectify the damage.

For existing homes

- Flood boards

  The placement of a temporary watertight seal across doors, windows and air bricks to avoid inundation of the building interior. This may be suitable for relatively short periods of flooding, however the porosity of brickwork may result in damage being sustained should water levels remain elevated for an extended period of time. This may lessen the effectiveness of flood proofing to existing properties affected by flooding from larger river systems such as the Don.

[18] Improving the Flood Performance of New Buildings – Flood Resilient Construction (May 2007)

7.8 Emergency Planning

226. 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 are[19]:

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

227. All Category 1 responders have the same duties under the Civil Contingencies Act. The duties of the Act fall on each Category 1 responder individually. As all these duties fall equally on each Category 1 responder, they should use the Local Resilience Forum to agree how to share this work out amongst the member organisations to avoid duplication of effort. An example of this is where different agencies will take the lead and co-ordinate the risk assessment for particular hazards or co-ordinate the arrangements for warning and informing the public.

228. The Environment Agency monitors river levels on the River Don, the River Sheaf and Porter Brook. The Environment Agency uses this data in conjunction with weather forecasts to monitor and forecast the expected response of the rivers to a rainfall event. Where these predicted water levels are expected to result in the water level rising above the river bank[20], the Environment Agency will issue a series of flood warnings within defined flood warning areas, encouraging residents to take action to avoid damage to property in the first instance.

229. 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.

230. Category 1 responders work together to coordinate flood response. The Environment Agency provide Flood Warnings and forecast information to the public. Category 1 and Category 2 responders and the Local Authorities and the Emergency Services use this information to try to ensure the safety of residents in time of flood. Some areas within Sheffield are at risk of river flooding (as indicated by the shaded PPS25 Flood Zones in the adjoining maps) that occurs after 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.

[19] Civil Contingencies Act 2004
[20] Restricted to those urban areas situated within Environment Agency flood warning zones

231. 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 district 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.

232. 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.

233. It is recommended that the Council advises the local Resilience Forum of the risks raised in light of the Sheffield SFRA, ensuring that the planning for future emergency response can be reviewed accordingly.

7.9 Insurance

234. 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 summer 2007 has further exacerbated the discussion surrounding the future of insurance for householders and business owners situated within flood affected areas.

235. 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 fact sheet 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."

236. 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. However, it would appear fair to say 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. It is also essential to ensure that spatial planning decisions do not place property within areas at risk of flooding.

8 Conclusion & Recommendations

237. The risk of flooding within Sheffield arises from a number of sources, including rivers and surface water flooding. The River Don, the River Sheaf, Blackburn Brook and Porter Brook (in addition to smaller tributaries in particularly extreme events) all pose a potential risk of flooding to homes and businesses within Sheffield. A risk of surface water flooding also exists, both as a result of the steep sided valleys upon which the district is situated, and the inability of the drainage system to discharge freely into the rivers during periods of high water level. Areas have also experienced flooding as a result of culvert blockage that occurs when debris is washed downstream.

SFRA Recommendations

238. 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 Sheffield City Council and the Environment Agency. Sheffield 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.

239. 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 Sheffield (refer Section 7.4).

240. Local Authorities (and, indeed, developers) are encouraged to aim for a positive reduction in flood risk through future development and regeneration. This process strives to ensure that decisions taken not only avoid the creation of a future legacy of new development at risk of flooding, but also progressively reduce the risk of flooding to existing development. This is a key objective of PPS25.

241. If after having undertaken the Sequential Test it has been identified that there are no reasonably available sites in areas at risk of flooding, specific recommendations have been provided to assist the Council and the developer apply the Exception Test (refer Section 7.4). These should be considered when writing new policies as part of the Local Development Framework, as well as in the determination of planning applications.

242. Council policy is essential to ensure that the suggested development control recommendations can be imposed consistently at the planning application stage. This is essential to achieve flood risk reduction and future sustainability within Sheffield.

243. Emergency planning is crucial for the minimisation to the risk to life posed by flooding within the district. It is recommended that the Council advises the local Resilience Forum of the risks raised in light of the Sheffield SFRA, ensuring that the planning for future emergency response can be reviewed accordingly.

A Living Document

244. The SFRA has been developed building heavily upon existing knowledge with respect to flood risk within the district. A rolling programme of detailed flood risk management investigations within the North East Region is underway. This, in addition to observed flooding that may occur throughout a year, will improve the current knowledge of flood risk within the district and may alter predicted flood extents within Sheffield. Furthermore, Communities and Local Government (CLG) are working to provide further detailed advice with respect to the application of PPS25 and future amendments to the PPS25 Practice Guide are anticipated. Given that this is the case, a periodic review of the Sheffield SFRA is imperative.

245. It is recommended that the Sheffield SFRA is reviewed on a regular basis. A series of key questions to be challenged as part of the SFRA review process are set out in below, providing the basis by which the need for a detailed review of the document should be triggered. It is recommended that a review of these triggers is carried out once every 2 years:

Question 1

Has any flooding been observed within the district since the previous review? If so, the following information should be captured as an addendum to the SFRA:

- What was the mapped extent of the flooding?
- On what date did the flooding occur?
- What was the perceived cause of the flooding?
- If possible, what was the indicative statistical probability of the observed flooding event? (i.e. how often, on average, would an event of that magnitude be observed within the district?)
- If the flooding was caused by overtopping of the riverbanks, are the observed flood extents situated outside of the current Zone 3a? If it is estimated that the frequency of flooding does not exceed, on average, once in every 100 years then the flooded areas (from the river) should be incorporated into Zone 3a to inform future planning decision making.

Question 2

Have any amendments to PPS25 or the Practice Guide been released since the previous review? If so, the following key questions should be tested:

- Does the revision to the policy guidance alter the definition of the PPS25 Flood Zones presented within the SFRA? (refer to Section 5.1)
- Does the revision to the policy guidance alter the decision making process required to satisfy the Sequential Test? (refer to Section 7.4.1)
- Does the revision to the policy guidance alter the application of the Exception Test? (refer to Section 7.4.1)
- Does the revision to the policy guidance alter the categorisation of land use vulnerability, presented within Table D2 of PPS25 (December 2006)?

If the answer to any of these core questions is ‘yes’ then a review of the SFRA recommendations in light of the identified policy change should be carried out.

Question 3

Has the Environment Agency issued any amendments to their flood risk mapping and/or standing guidance since the previous policy review? If so:

- Has any further detailed flood risk mapping been completed within the district, resulting in a change to the 20 year, 100 year or 1000 year flood outline? If yes, then the Zone 3b and Zone 3a flood outlines should be updated accordingly.
- Has the assessment of the impacts that climate change may have upon rainfall and/or river flows over time altered? If yes, then a review of the impacts that climate change may have upon the district is required.
- Do the development control recommendations provided in Section 7.4 of the SFRA in any way contradict emerging EA advice with respect to (for example) the provision of emergency access, the setting of floor levels and the integration of sustainable drainage techniques? If yes, then a discussion with the EA is required to ensure an agreed suite of development control requirements are in place.

The Environment Agency reviews the Flood Zone Map on a quarterly basis. If it has been revised within the district, the updated Flood Zones will be automatically forwarded to the Council for their reference. *It is recommended that only those areas that have been amended by the Environment Agency since the previous SFRA review are reflected in Zone 3 and Zone 2 of the SFRA flood maps.* This ensures that the more rigorous analyses carried out as part of the SFRA process are not inadvertently lost by a simple global replacement of the SFRA flood maps with the Flood Zone Maps.

Question 4

Has the implementation of the SFRA within the spatial planning and/or development control functions of the Council raised any particular issues or concerns that need to be reviewed as part of the SFRA process?

Disclaimer

It is important to recognise that the information provided within the Level 1 SFRA is the best available data at the time of writing. The mapping of flood risk is not an exact science, and there may be some uncertainties in the information presented. The Level 1 SFRA is a strategic document that is intended to support the spatial planning process. It will trigger a more detailed site-based Flood Risk Assessment where future development is being considered (following application of the Sequential Test), and it is expected that the FRA will improve the level of accuracy in the flood extents from a localised perspective.

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Glossary

AEP	Annual Exceedance Probability, or the probability of flooding in any one year, for example: ➢ 5% (1 in 20 years) ➢ 3.33% (1 in 30 years) ➢ 1% (1 in 100 years) ➢ 0.1% (1 in 1000 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	Communities and Local Government. CLG sets UK policy on local government, housing, urban regeneration, planning and fire and rescue. It has responsibility for building regulations, fire safety and some housing issues in England and Wales.
Defacto Flood Defences	Structures, such as railway embankments, that provide an element of flood defence but have not been specifically designed or identified for such purpose.
Defra	Department of Environment, Food and Rural Affairs. Defra has overall policy responsibility for flood and coastal erosion risk in England. Defra funds most of the Environment Agency's flood management activities in England and provides grant aid on a project by project basis to the other flood and coastal defence operating authorities (local authorities and internal drainage boards).
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.
EA	Environment Agency
Flood Zone Map	Nationally consistent delineation of 'high' and 'medium' flood risk, published on a quarterly basis by the Environment Agency
Fluvial	Pertaining to rivers or streams and their action
Formal Flood Defence	A structure built and maintained specifically for flood defence purposes
Groundwater Emergence Maps (GEMs)	The GEMs were created by Jacobs as part of a groundwater flooding scoping study, which was commissioned by Defra and set out to provide information on the scale, distribution and nature of groundwater flooding in England. The maps define broad areas of susceptibility based on geology and topography.
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.

Local Development Framework (LDF)	Consists of a number of documents which together form the spatial strategy for development and the use of land
Main River	A watercourse designated on a statutory map of Main Rivers, maintained by Defra, on which the Environment Agency has permissive powers to construct and maintain flood defences.
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	The risks remaining after applying the sequential approach and taking mitigating actions
SEA	Strategic Environmental Assessment. Authorities that prepare and/or adopt a plan or programme which is likely to have significant effects on the environment must prepare a SEA. The SEA will assess the environmental effects of the plan or programme, and consult environmental authorities and the public. The SEA will take the results of the consultation into account during the preparation process and before the plan or programme is adopted.
SUDS	Sustainable Drainage Systems aim to decrease the amount of surface runoff, decrease the velocity of surface runoff, or divert it for other useful purposes, thereby reducing the contribution it makes to sewer discharge and flooding.
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).
Zone 3b Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Defined as areas at risk of flooding in the 5% AEP (1 in 20 chance) design event

Zone 3a High Probability	This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
Zone 2 Medium Probability	This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year.
Zone 1 Low Probability	This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).

Appendix A

SFRA Flood Maps (PPS25 Zones)

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Appendix B

Topography

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Appendix C

Overland Flow Routes[21]

[21] It is important to highlight that the overland flow paths delineated in the maps are based purely upon a strategic interrogation of the district topography. Localised flow routes are likely to occur in other locations (i.e. not indicated in the maps) as a result of, for example, sewer surcharges following heavy rain. The detailed site-based FRA must consider the risk of localised surface water flooding at all locations, and should not be constrained by the indicative routes identified in these high level maps

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Appendix D

June 2007 Flood Event

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Appendix E

Environment Agency Safe Access and Egress Design Recommendations

'Safe' access and egress is to be designed to meet the following strict criteria:

Developments within Zone 3a High Probability and Zone 2 Medium Probability that **ARE NOT** offered protection from flood defences:

- Dry escape, above the 100 year flood level taking into account climate change, should be provided for all 'more vulnerable' (including residential) and 'highly vulnerable' development;
- 'Safe' should preferably be dry[22] for all other uses such as educational establishments, hotels and 'less vulnerable' land use classifications.

Developments within Zone 3a High Probability and Zone 2 Medium Probability that **ARE** offered protection from flood defences:

- 'Safe' access should preferably be dry for 'highly vulnerable' uses;
- 'Safe' access should incorporate the ability to escape to levels above the breach water level[23].

In all instances, it will be necessary to ensure that Sheffield City Council Emergency Planning Team and the emergency services (consulted via the Emergency Planning Team) accept the proposals.

For *major 'highly vulnerable' development*, 'safety' will also need to be ensured through the development of a robust evacuation plan. This should clearly define routes to dry (i.e. 'unflooded') land. This may include routes through flood waters, providing the depth and speed of flow across the evacuation route are below the risk defined by the *"some"* threshold in 'Flood Risk to People' (Defra, FD2321)[24].

For *infrastructure development*, 'safety' will also need to be ensured through the development of a robust evacuation plan. This should clearly define dry escape routes (above the 100 year plus climate change flood level) to dry (i.e. 'unflooded') land.

In exceptional circumstances, dry access (above the 100 year plus climate change flood level) for 'more vulnerable' and/or 'highly vulnerable' development may not be achievable. In these exceptional circumstances, liaison must be sought with the Environment Agency and Sheffield City Council's Emergency Planning Team to ensure that the safety of site tenants can be satisfactorily resolved.

[22] Above the 100 year, plus climate change, flood level

[23] Defined assuming the full hydrostatic loading of the flood defence upon collapse (as a worst case scenario)

[24] Defra Research Paper FD2321 'Flood Risks to People'

Appendix F

Rainfall Runoff Management for Developments - Interim National Procedure

RAINFALL RUNOFF MANAGEMENT FOR DEVELOPMENTS
INTERIM NATIONAL PROCEDURE

1. **Procedure status.** This procedure is an interim method, which is expected to be revised as improved tools are developed. It utilises well recognised existing methods, but revision is anticipated to provide a more consistent approach as and when FEH procedures can be extended to catchments at development scale.

2. **Compliance to national guidance.** The objective of this procedure is to assist developers and their designers to conform to PPS25.

3. **Application of the procedure.** This procedure applies to both greenfield and brownfield sites. In the case of brownfield sites, drainage proposals will be measured against the existing performance of the site (although it is preferable for solutions to provide runoff characteristics which are similar to greenfield behaviour). Therefore where greenfield performance is referred to in this document, this should be considered as meaning the existing site conditions for brownfield redevelopment sites. Sites with polluted land will have particular consent requirements and affect the drainage techniques that can be used.

4. **Use of infiltration.** Part H of the Building Regulations requires that the first choice of surface water disposal should be to discharge to infiltration systems where practicable. Infiltration techniques should therefore be applied wherever they are appropriate.

5. **Sewers for Adoption.** Drainage calculations and criteria, where appropriate, should comply with the 6th edition of Sewers for Adoption.

6. **Need for this procedure.** It is recognised that the impact of urban development on greenfield areas increases both the rate of run-off and the volume of run-off in response to rainfall and that the water quality impact on the receiving watercourse is likely to be detrimental.

7. **Procedure philosophy.** The objectives of this procedure are to:

- stormwater runoff discharged from urban developments to replicate or achieve a reduction from the greenfield response of the site over an extended range of storm probabilities (return periods)
- manage runoff on site for extreme events.

This requires:

- the **peak rate** of stormwater run-off to be controlled
- the **volume** of run-off to be reduced
- the **pollution** load to receiving waters from stormwater runoff to be minimised
- the assessment of **overland flows and temporary flood storage** across the site.

8. **Discharge rate criteria.** The Environment Agency will normally require that, for the range of annual flow rate probabilities, up to and including the 1% annual probability (1 in 100 year event) the developed rate of runoff into a watercourse should be no greater than the undeveloped rate of runoff for the same event. Exceptions only apply where it is not practical to achieve this due to either constraints on the size of the hydraulic control unit (see point 17), or excessive storage volumes. The purpose of this is to retain a natural flow regime in the receiving watercourse and not increase peak rates of flow for events of an annual probability greater than 1%. Three annual probabilities merit specific consideration; 100%, 3.33% and 1%. (Note that in many places elsewhere in this Guide return periods are used instead of annual probabilities, as much historic nomenclature and many formulae use return periods).

8.1 *The 100% annual probability* (1 in 1 year event) is the highest probability event to be specifically considered to ensure that flows to the watercourse are tightly controlled for these more frequent events.

8.2 *The 3.33% annual probability* (1 in 30 years event) is of importance because of its linkage with the level of service requirement of Sewers for Adoption 6th edition (SfA6). SfA6 requires that surface water sewers should be capable of carrying the 3.33% annual probability event within the system without causing flooding to any part of the site.

8.3 *The 1% annual probability* (1 in 100 years event) has been selected since it represents the boundary between high and medium risks of fluvial flooding defined by PPS25 and also recognises it is not practicable to fully limit flows for the most extreme events. Also SfA6 recognises that, during extreme wet weather, the capacity of surface water sewers may be inadequate. SfA6 requires that the site layout should be such that internal property flooding does not result, by demonstrating safe above ground flow paths. The return period for this analysis is not specified, but it is recommended that 1% annual probability event (i.e. an event with a return period of 100 years) is used.

8.4 *Flood flows.* up to the 1% annual probability event should preferably be contained within the site at designated temporary storage locations unless it can be shown to have no material impact in terms of nuisance or damage, or increase river flows during periods of river flooding. Analysis for overland flood flows within the site will need to use short high intensity rainfall events of between 15 minutes and 1 hour duration.

9. **The calculation of greenfield runoff rate.** The calculation of peak rates of runoff from a greenfield site is related to its size. The values derived should be regarded as indicative due to the limitations of the existing tools. Table 9.1 summarises the techniques to be used.

Table 9.1 Tools to be used for calculation of greenfield run-off criteria

Development size	Method
0 – 50 ha	The Institute of Hydrology Report 124 Flood Estimation for Small Catchments (1994) is to be used to determine peak green field runoff rates. Where developments are smaller than 50 ha, the analysis for determining the peak greenfield discharge rate should use 50 ha in the formula and linearly interpolate the flow rate value based on the ratio of the development to 50 ha. FSSR 2 and 14 regional growth curve factors are to be used to calculate the greenfield peak flow rates for 1, 30 and 100 year return periods.
50 ha – 200 ha	IH Report 124 will be used to calculate greenfield peak flow rates. Regional growth factors to be applied.
Above 200 ha	IH Report 124 can be used for catchments that are much larger than 200 ha. However, for schemes of this size it is recommended that the Flood Estimation Handbook (FEH) should be applied. Both the statistical approach and the unit hydrograph approach should be used to calculate peak flow rates. The unit hydrograph method will also provide the volume of greenfield run-off. However, where FEH is not considered appropriate for the calculation of greenfield run-off for the development site, for whatever reasons, IH 124 should be used.

10. **Volumetric criteria.** The stormwater runoff volume from a site should be limited to the greenfield runoff volume wherever possible. The additional runoff volume caused by urbanisation should be controlled using two criteria.

10.1 *Interception***.** Where possible, infiltration or other techniques are to be used to ensure minimal discharge to receiving waters for rainfall depths up to 5mm.

10.2 *Additional runoff due to development***.** The difference in runoff volume pre and post-development for the 100 year 6 hour event, (the additional runoff generated) should be disposed of by way of infiltration, or if this is not feasible due to soil type, discharged from the site at flow rates below 2l/s/ha.

10.3 Where compliance to 100 year volumetric criterion, as defined in section 10.2, is not provided, the limiting discharge for the 30 and 100 year return periods will be constrained to the mean annual peak rate of runoff for the greenfield site (Referred to as QBAR in IH Report 124).

11. **Percentage runoff from greenfield sites.** The percentage runoff of the rainfall on a greenfield site can be assumed to be approximately equal to the SPR value of the soil type of the site. The SPR value can be used from either the Flood Studies Report (FSR) or the Flood Estimation Handbook (FEH).

12. **Percentage runoff from developments.** Calculation of the run-off volume from the developed site for preliminary assessment and design of drainage facilities will assume 100% run-off from paved areas and 0% run-off from pervious areas. Runoff from impermeable surfaces served by effective infiltration systems can be assumed to contribute no runoff for storage volumes assessment.

13. **Detailed design of stormwater runoff.** All network design for stormwater runoff and proof of compliance in meeting peak flow rate discharge criteria, using computer simulation, should use the standard Wallingford Procedure variable UK runoff model using appropriate parameters.

14. **SUDS for water quality.** SUDS units should be used to achieve water quality improvements and amenity benefits as well as achieving compliance to these hydraulic criteria. Best practice in achieving water quality protection should be used.

15. **Reliability of SUDS.** At present certain SUDS units are considered to have some degree of risk of medium term hydraulic failure, due to either maintenance or possible change of status. In these situations, to ensure compliance with pipe capacity criteria, they will be deemed not to be effective when calculating pipe sizes and storage requirements. For pipe sizing the current view of the Water Undertakers should apply (see the National SUDS Framework document). For storage sizing of all structures which are not to be adopted by Water Undertakers, the view of the Environment Agency should normally apply.

16 **Climate change factor.** Climate change will be taken into account in hydrological regions by increasing the rainfall depth by the recommended allowances in PPS25 for computing storage volumes. No allowance for climate change should be applied to calculated greenfield peak rates of runoff from the site for any hydrological region. It should be recognised that although climate change is acknowledged as taking place, certainty regarding the hydrological changes, particularly of extreme short duration events, is very low.

17. **Minimum limit of discharge rate.** A practicable minimum limit on the discharge rate from a flow attenuation device is often a compromise between attenuating to a satisfactorily low flow rate while keeping the risk of blockage to an acceptable level. It is suggested that this is 5 litres per second, using an appropriate vortex flow control device or other technically acceptable flow control device. The minimum size of pipe discharging from a flow attenuation device should be 150mm laid at a gradient not flatter than 1 in 150, which meets the requirements of Sewers for Adoption 6th Edition.

18. **Catchment Flood Management Plans.** CFMPs (Catchment Flood Management Plans), consider the impact of development on flood risk in the catchment based on existing land use plans contained in the local plan published by the Local Planning Authority and projections of development beyond the periods covered by the land use plans. Strategy Plans identified in the CFMPs each cover part of the catchment and may consider the local impact of these

developments in more detail. Where these exist for an area proposed for development, their findings must be taken into account in the development proposal.

Further information can be found in the books:

Preliminary rainfall runoff management for developments (R & D Technical Report W5-074/A Revision D (Environment Agency and Kellagher R, 2004 - Free download from the Environment Agency web site www.environment-agency.gov.uk).

CIRIA C697 The SUDS manual ***(Woods Ballard B; Kellagher R et al, 2007 – available from CIRIA bookshop www.ciria.org)***

Interim code of practice for sustainable drainage (National SUDS Working Group, 2004) - Free download from CIRIA web site www.ciria.org or Environment Agency web site www.environment-agency.gov.uk)