Nottinghamshire and Nottingham

Level 1 Strategic Flood Risk Assessment

Minerals and Waste

Final Living Document
April 2011




Prepared for

Nottinghamshire County Council

Nottingham City Council

www.urs-scottwilson.com

Revision Schedule

Level 1 Minerals and Waste Strategic Flood Risk Assessment
April 2011

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Glossary

Term	Definition
Attenuation	In the context of this report - the storing of water to reduce peak discharge of water.
Aquifer	A source of groundwater comprising water-bearing rock, sand or gravel capable of yielding significant quantities of water.
Catchment Flood Management Plan	A high-level planning strategy through which the EA works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Culvert	A channel or pipe that carries water below the level of the ground.
Drift Geology	Sediments deposited by the action of ice and glacial processes
EA Flood Zone 1	Low probability of fluvial flooding. Probability of fluvial flooding is < 0.1%
EA Flood Zone 2	Medium probability of fluvial flooding. Probability of fluvial flooding is 0.1 – 1%. Probability of tidal flooding is 0.1 – 0.5 %
EA Flood Zone 3a	High probability of fluvial flooding. Probability of fluvial flooding is 1% (1 in 100 years) or greater. Probability of tidal flooding is 0.5%(1 in 200 years)
EA Flood Zone 3b	Functional floodplain. High probability of fluvial flooding. Probability of fluvial flooding is >5%
Exception Test	The exception test should be applied following the application of the Sequential Test. Conditions need to be met before the exception test can be applied.
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood plain	Area adjacent to river, coast or estuary that is naturally susceptible to flooding.
Flood Resilience	Measures that minimise water ingress and promotes fast drying and easy cleaning, to prevent any permanent damage.
Flood Resistant	Measures to prevent flood water entering a building or damaging its fabric. This has the same meaning as flood proof.
Flood Risk	The level of flood risk is the product of the frequency or likelihood of the flood events and their consequences (such as loss, damage, harm, distress and disruption)
Flood Risk Assessment	A FRA is required for any planning application at a potential risk of flooding to ensure the proposed development is not at an unacceptable risk of flooding and does not increase the risk of flooding elsewhere.
Flood storage	A temporary area that stores excess runoff or river flow often ponds or reservoirs.
Flood Zone	Flood Zones show the probability of river and sea flooding, ignoring the presence of existing defences (PPS25)
Fluvial	Relating to the actions, processes and behaviour of a water course (river or stream)
Fluvial flooding	Flooding by a river or a watercourse.
Freeboard	Height of flood defence crest level (or building level) above designed water level
Functional Floodplain	Land where water has to flow or be stored in times of flood.
Groundwater	Water that is in the ground, this is usually referring to water in the saturated zone below the water table.
Inundation	Flooding.

Term	Definition
Local Development Framework (LDF)	The core of the updated planning system (introduced by the Planning and Compulsory Purchase Act 2004). The LDF comprises the Local Development Documents, including the development plan documents that expand on policies and provide greater detail. The development plan includes a core strategy, site allocations and a proposals map.
Local Planning Authority	Body that is responsible for controlling planning and development through the planning system.
Main River	Watercourse defined on a 'Main River Map' designated by DEFRA. The EA has permissive powers to carry out flood defence works, maintenance and operational activities for Main Rivers only.
Mitigation measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere.
Overland Flow	Flooding caused when intense rainfall exceeds the capacity of the drainage systems or when, during prolonged periods of wet weather, the soil is so saturated such that it cannot accept any more water.
Residual Flood Risk	The remaining flood risk after risk reduction measures have been taken into account.
Return Period	The average time period between rainfall or flood events with the same intensity and effect.
Risk	Risk is a combination of the probability of an event occurring and the potential consequences of the flood event
River Catchment	The areas drained by a river.
SAR	Synthetic Aperture Radar - a high resolution ground mapping technique, which uses reflected radar pulses.
Sequential Test	Aims to steer vulnerable development to areas of lowest flood risk.
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
Solid Geology	Solid rock that underlies loose material and superficial deposits on the earth's surface.
Source Protection Zone	Defined areas in which certain types of development are restricted to ensure that groundwater sources remain free from contaminants.
Sustainability	To preserve /maintain a state or process for future generations
Sustainable drainage system	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques, aiming to mimic the natural drainage patterns of a developed site
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations meeting their own needs.
Topographic survey	A survey of ground levels.
Tributary	A body of water, flowing into a larger body of water, such as a smaller stream joining a larger stream.
Watercourse	All rivers, streams, drainage ditches (i.e. ditches with outfalls and capacity to convey flow), drains, cuts, culverts and dykes that carry water.
1 in 100 year event	Event that on average will occur once every 100 years. Also expressed as an event, which has a 1% probability of occurring in any one year.
1 in 100 year design standard	Flood defence that is designed for an event, which has an annual probability of 1%. In events more severe than this the defence would be expected to fail or to allow flooding. Also applies to the design of new development in the floodplain.

Strategic Flood Risk Assessment Pro Forma

The following table has been reproduced from the Level 1 SFRA Outputs outlined in the Practice Guide to Planning Policy Statement (PPS) 25 (December 2009) (para 3.55, pg 54-55). It is presented here to demonstrate that the objectives of the Level 1 SFRA under PPS25 have been met and to provide those who review this SFRA a ready reference to where responses to the questions raised below can be found within this document.

Topic Area and Question	Location in Document
Plans showing the LPA area, Main rivers, ordinary watercourses and Flood Zones, including Functional Floodplain (if appropriate), across the local authority area, as well as all previously allocated development sites (or sites to be considered in the future).	Appendices A-E
An assessment of the implications of climate change for flood risk at allocated development sites over an appropriate time period.	Section 6.6 and Section 7.10
Plans to show areas at risk from other sources of flooding such as surface water and groundwater flooding.	Appendices A, C and D
Flood risk management measures, including location and standard of infrastructure and the location of flood warning systems.	Appendices A, B and L, Section 7.8 and Section 7.9
Locations where additional development may significantly increase flood risk elsewhere through the impact on existing sources of flooding, or by the generation of increased surface water runoff, where a surface water management plan may be needed.	Section 5 and Section 7.11
Guidance on the preparation of FRAs for allocated development sites.	Section 9
Guidance on the likely applicability of Sustainable Drainage Systems (SUDS) for managing surface water run-off at key development sites.	Section 8.4 and Section 9.9

Executive Summary

Scott Wilson Ltd was commissioned in January 2010 to undertake a Level 1 Minerals and Waste Strategic Flood Risk Assessment (SFRA) for Nottinghamshire County Council (NCC) and Nottingham City Council (NCiC) Unitary Authority. It is intended that the SFRA will be used as a tool by NCC and NCiC to support their emerging Core Strategy by providing information that will be used as part of the evidence base by both authorities to support an emerging Joint Waste Development Framework, and by NCC in producing its Minerals Development Framework.

Locations of potential future mineral extraction site allocations within Nottinghamshire were provided by NCC to assess as part of this SFRA. General discussion of potential waste sites has been provided until they emerge at a later stage to be reviewed as potential allocations.

Flood related planning policy at national, regional and district levels has been reviewed to highlight flood risk requirements at all stages of planning. This process has also helped to demonstrate how the SFRA will feed into the individual Councils' Local Development Framework (LDF) process. PPS25 requires that, as part of any SFRA, all sources of flooding are identified and reviewed against potential site allocations to allow them to be Sequentially Tested by the Council to ensure that the highest risk development is located in areas at lowest risk of flooding.

In order to assess the risk of flooding, the EA and other key stakeholders have been consulted including NCC, NCiC, Severn Trent Water Ltd. (STW), Anglian Water Services Ltd. (AWS), Ashfield District Council (ADC), Bassetlaw District Council (BDC), Broxtowe Borough Council (BBC), Gedling Borough Council (GBC), Mansfield District Council (MDC), Newark and Sherwood District Council (NSDC), Rushcliffe Borough Council (RBC), Internal Drainage Boards (IDBs) and British Waterways (BW). Data provided has been split into five main sources of flood risk being: flooding from rivers and watercourses (fluvial), sewer flooding, surface water/overland flooding (pluvial), groundwater flooding and flooding from man made and artificial sources.

Relevant GIS layers provided by stakeholders have been used in the preparation of the SFRA maps listed in the table below.

SFRA Mapping Contents

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	EA Flood Zones (Undefended)	A-2
	Internal Drainage Board Areas	A-3
	BGS Bedrock/Superficial Drift Geology	A-4
	Groundwater Source Protection Zones & Vulnerability	A-5
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	Flood Warning Areas	A-7
1:50,000 Scale County Insets	Fluvial (River Flooding)	B1 to B13
	Pluvial (Surface Water Flooding)	C1 to C13
	Other Potential Sources of Flooding & Historical Flooding	D1 to D13
	Detailed Modelled Flood Outlines (Defended)	E1 to E13.(excl. E5 and E7 where no data available)

For the purposes of this study, 'Nottinghamshire' is defined as the combined administrative areas of ADC, BDC, BBC, GBC, MDC, NSDC, RBC and NCiC. The predominant risk of flooding within Nottinghamshire is due to flooding from rivers and watercourses. Nottinghamshire falls within one major river catchment,

the River Trent. Major tributaries include the River Soar, River Erewash, River Leen, River Devon and the River Idle.

The EA provided a digital copy of their Historical Flood Map (Appendix D) and confirmed that the River Trent is tidally influenced downstream from Cromwell Lock in the NSDC area and its tidal dominance is downstream of Gainsborough, which includes the left bank within the BDC area. The EA have provided details of flood defence structures (raised defences and major assets) throughout the Study Area which provide a varied standard of protection (SoP) (Appendices B and E).

A number of IDBs provided digital copies of their watercourses (Appendix B), board areas (Figure A-3 at Appendix A) and relevant structures. BW provided a digital copy of their canals (Appendices A-E), raised embankments (Appendix D) and structures within Nottinghamshire and details of water control measures.

All SFRA Flood Zones are based on information provided by the EA and prescribed methodologies in PPS25. In order to present the best available flood risk information, maps illustrating the EA's Flood Zone Maps (Flood Zone 2 (0.1% Annual Exceedence Probability (AEP), 1 in 1000 year flood event) and Flood Zone 3 (1% AEP, 1 in 100 year flood event) have been produced as part of this SFRA (Figure A-2 at Appendix A and Appendix B). Where available, defended flood outlines derived from a number of detailed hydraulic modelling studies previously undertaken for watercourses within Nottinghamshire have also been mapped in this SFRA (Appendix E).

Climate change over the next 25 to 100 years is expected to result in wetter and warmer winters, causing an increase in large fluvial flood events in the Study Area. Secondly, extreme rainfall events are likely to become more frequent leading to a greater storm intensity and duration. This is likely to lead to a great deal more runoff causing surface water flooding and overwhelming of the urban sewer networks in particular.
Until such time when more detailed hydraulic modelling is undertaken providing complete coverage for Nottinghamshire, where modelled information is not available, the Flood Zone 2 outline has been adopted as a proxy for fluvial Flood Zone 3 inclusive of an additional 20% allowance on peak flows resulting from climate change. The Flood Zone 3 outline has also been adopted as a proxy for fluvial Flood Zone 3b (5% AEP, 1 in 20 year Functional Floodplain). These are considered to be conservative proxy flood outlines.

The EA's Flood Maps for Surface Water Flooding (Appendix C) and Areas Susceptible to Groundwater Flooding (Figure A-6 at Appendix A) have been included to address the risks of surface water and groundwater flooding. Historical sewer flooding records for the last 10 years were provided from the STW DG5 register detailing the total number of internal and external sewer flooding events occurring as a result of hydraulic overloading (Appendix D), not blockages or other causes.

To attempt to counteract the increase in runoff due to climate change and the increase in new development in local areas, the use of Sustainable Drainage Systems (SuDS) is becoming more important. In addition to the more usual attenuation and infiltration systems, the provision of more 'green' spaces within the urban environment can also help to reduce runoff and also increase wildlife habitat. BGS derived solid Bedrock and Superficial deposits maps, EA Groundwater Vulnerability (GWV) data and Groundwater Source Protection Zone data was collected and mapped as part of this study in order to identify areas suitable for each SuDS technique (Figures A-4 and A-5 at Appendix A).

This SFRA was completed using the current PPS25 climate change recommendations; however during the lifetime of this document it is quite likely that climate change recommendations may alter. As a result future site-specific FRAs may have to adapt to these changes in line with current guidance in response to continuing research into climate change.

The SFRA has been developed by building heavily upon existing knowledge with respect to flood risk within the study area. These documents have an intended lifespan of 6-10 years. Therefore it should be noted that although up-to-date at the time of production, the SFRA has a finite lifespan and should potentially be upgraded or revised as required by NCC. As a result, it is recommended that the SFRA be

adopted as a 'Living Document' and should be reviewed regularly and, if necessary, updated with new flood risk or planning policy data.

1 Introduction

1.1 Commission

1.1.1 Scott Wilson Ltd was commissioned in January 2010 to undertake a Level 1 Minerals and Waste Strategic Flood Risk Assessment (SFRA) for Nottinghamshire County Council (NCC) and Nottingham City Council (NCiC) Unitary Authority. It is intended that the SFRA will be used as a tool by NCC and NCiC to support their emerging Core Strategy by providing information that will be used as part of the evidence base by both authorities to support an emerging Joint Waste Development Framework, and by NCC in producing its Minerals Development Framework.

1.2 Background

1.2.1 The Minerals Development Framework and Joint Waste Development Framework will consist of policies and proposals to guide future minerals and waste planning decisions and will replace the adopted Minerals and Waste Local Plans (2005 and 2002 respectively) (see Section 3.5).

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

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

1.2.4 PPG25 was superseded by Planning Policy Statement 25: Development and Flood Risk (PPS25) in December 2006 and was again revised in March 2010[1]. PPS25 re-emphasises the active role LPAs should have in ensuring flood risk is considered in strategic land use planning. PPS25 encourages LPAs to undertake SFRAs as part of their evidence base for the LDF process and to use their findings to inform strategic and use planning. The PPS25 Practice Guide (originally published June 2008 as a 'Living Draft') was updated in December 2009[2]. The approach to SFRAs as suggested in this document has been used.

1.2.5 To assist LPAs in their strategic land use planning, SFRAs should present sufficient information to enable the LPAs to apply the Sequential Test (detailed in PPS25 and Chapter 4 of this report) to their proposed development sites.

> "*Decision-makers should use the SFRA to inform their knowledge of flooding, refine the information on the flood map and determine the variations in flood risk from all sources of flooding across and from their area. These should form the basis for preparing appropriate policies for flood risk management for these areas.*" (DCLG, March 2010)

[1] Department for Communities and Local Government. March 2010. Planning Policy Statement 25: Development and Flood Risk (PPS25). http://www.communities.gov.uk/documents/planningandbuilding/pdf/planningpolicystatement25.pdf
[2] Department for Communities and Local Government. December 2009. Planning Policy Statement 25: Development and Flood Risk Practice Guide. http://www.communities.gov.uk/documents/planningandbuilding/pdf/pps25guideupdate.pdf

1.2.6 In addition, where development sites cannot be located in accordance with the Sequential Test as set out in PPS25 (i.e. to steer development to low risk sites): there is a need to apply the Exception Test. In which case;

> *"…the scope of the SFRA will be widened to consider the impact of the flood risk management infrastructure..."* (DCLG, March 2010)

1.2.7 In addition to forming a tool for use in strategic land use planning, an SFRA should also be accessible, and provide guidance to aid in the general planning process of a LPA.

1.2.8 Individual District Council SFRAs have been completed by Ashfield District Council (ADC), Bassetlaw District Council (BDC), Mansfield District Council (MDC) and Newark and Sherwood District Council (NSDC). The Greater Nottingham SFRA was also completed for Broxtowe Borough Council (BBC), Gedling Borough Council (GBC), NCiC, Rushcliffe Borough Council (RBC) and Erewash Borough Council (EBC). NCiC have also produced a River Leen SFRA (2008).Together, these assessed the flood risk posed to potential housing, employment and industrial sites across the whole of Nottinghamshire. This Level 1 SFRA utilises the data collected as part of these studies to assess the flood risk posed to potential Minerals and Waste sites. It is recommended that these reports are read in conjunction with this SFRA.

1.3 SFRA Structure

1.3.1 The PPS25 Practice Guide (DCLG, December 2009) recommends that SFRAs are completed in two consecutive stages. This follows the iterative approach encouraged by PPS25 and provides LPAs with tools throughout the LDF process sufficient to inform and update decisions regarding development sites. The two stages are:

- Level 1 SFRA – Study Area Flood Source & Data Review to enable application of the Sequential Test by the LPA;
- Level 2 SFRA – Increases scope of SFRA to include development site assessments for Exception Testing (where required).

Level 1 SFRA

1.3.2 The Level 1 SFRA report will present sufficient information to enable NCC to apply the Sequential Test to potential major waste and mineral sites to inform the scope of the Sustainability Appraisal (SA) and to assist NCC in identifying whether the application of the Exception Test will be necessary.

1.3.3 The objective of the Level 1 SFRA, is to collate and review available information on flood risk in the Study Area. Information has been sought from a variety of stakeholders including the EA, NCC, ST, AW, BW and the British Geological Survey (BGS).

1.3.4 The information presented in a Level 1 SFRA should not be considered as an exhaustive list of all available flood-related data for the study area. The Level 1 SFRA report is a presentation of flood sources and risk, which is based on data collected following consultation with and input from the partner LPA and relevant agencies, within the available timeframe. The Level 2 SFRA will enable the contacts and relationships with key stakeholders developed in Level 1 to continue to assist in providing data and information for the SFRA.

1.3.5 The Level 1 SFRA should be used by the LPA, together with other evidential documents and the draft SA, to undertake the Sequential Test. This will help to identify where sites can be located in Flood Zone 1 or where they may require further investigation through a Level 2 SFRA.

Level 2 SFRA

1.3.6 A second stage (Level 2 SFRA) may be carried out following the undertaking of the Level 1 SFRA if, following application of the Sequential Test, potential sites are still located in areas at risk of flooding. A Level 2 SFRA therefore facilitates the application of the Exception Test where required.

1.3.7 The Sequential and Exception Tests are discussed in more detail in Sections 4 and 5.

1.4 SFRA Aims and Objectives

1.4.1 URS/Scott Wilson has built on local flooding information provided by key Stakeholders (Section 6.3). This report follows the layout recommended by PPS25 (DCLG, March 2010) and the accompanying Practice Guide (DCLG, December 2009) to ensure that the SFRA is sound and undertaken in accordance with current guidance.

1.4.2 The aim of the Nottinghamshire and Nottingham Waste and Minerals SFRA is to assess and map the different levels and types of flood risk in the study area to inform the MDF and JWDF site allocation process.

1.4.3 The aim of the SFRA will be met through the following objectives:

- To provide an assessment of the impact of all potential sources of flooding in accordance with PPS25 using the information available, including an assessment of any future impacts associated with climate change;
- Enable planning policies to be identified to minimise and manage local flooding issues;
- Provide information required to apply the Sequential Test for identification of land suitable for development in line with the principles of PPS25;
- To provide baseline data to inform the Sustainability Appraisal (SA) of the Development Plan Documents (DPDs) with regard to catchment-wide flooding issues which affect the Study Area;
- To provide sufficient information to allow the Councils to assess flood risk for specific development proposal sites to include minerals and waste sites, thereby setting out the requirements for site specific Flood Risk Assessments (FRAs);
- Enable the Councils to use the SFRA as a basis for decision making at the planning application stage;

1.4.4 The identification of sites and areas for future development must consider the current and future risks of flooding from a number of sources, including fluvial (flooding from rivers), surface water flooding (storm water), flooding from sewers, flooding from manmade/artificial sources and groundwater flooding. It is therefore vitally important that flood risk is considered at a strategic scale to inform land allocations and future developments proposed by the emerging LDFs.

1.4.5 The SFRA will also include an appraisal of potential minerals sites across the County in relation to flood risk to inform the spatial distribution of NCC's MDF site allocations.

2 Study Area

2.1 General Overview

2.1.1 The SFRA Study Area illustrated in Figure 2-1 overleaf and Figure A-1 at Appendix A comprises the administrative area of Nottinghamshire County and Nottingham City covering approximately 2,155 km^2. The County is situated within the East Midlands bordering South Yorkshire to the north, Lincolnshire to the east, Derbyshire to the west and Leicestershire to the south.

2.1.2 For the purposes of this study, 'Nottinghamshire' is defined as the combined administrative areas of ADC, BDC, BBC, GBC, MDC, NSDC, RBC and NCiC. Table 2-1 shows their approximate areas.

Table 2-1 Approximate areas for the individual LPAs within Nottinghamshire

District/Borough	Approximate Area (km²)
Ashfield	109
Bassetlaw	637
Broxtowe	80
Gedling	120
Mansfield	77
Newark and Sherwood	650
Rushcliffe	408
Nottingham City	74

2.1.3 The predominant land use comprises arable farming and grazing, and urban land use. Nottingham is the only city within the County of Nottinghamshire. Major towns include Mansfield and Newark. Other towns include Retford, Worksop, Southwell, Sutton in Ashfield, Kirkby in Ashfield, Hucknall, Eastwood, Stapleford, Beeston and West Bridgford..

2.1.4 Nottinghamshire is in the rainfall shadow of the Pennines to the west, so receives relatively low rainfall at 500–750 mm annually (average over period 1971 - 2000)[3]

[3] Met Office. Regional Mapped Climate Averages 1971-2000, Annual Rainfall - Midlands. 2011. http://www.metoffice.gov.uk/climate/uk/averages/regmapavge.html#midlands

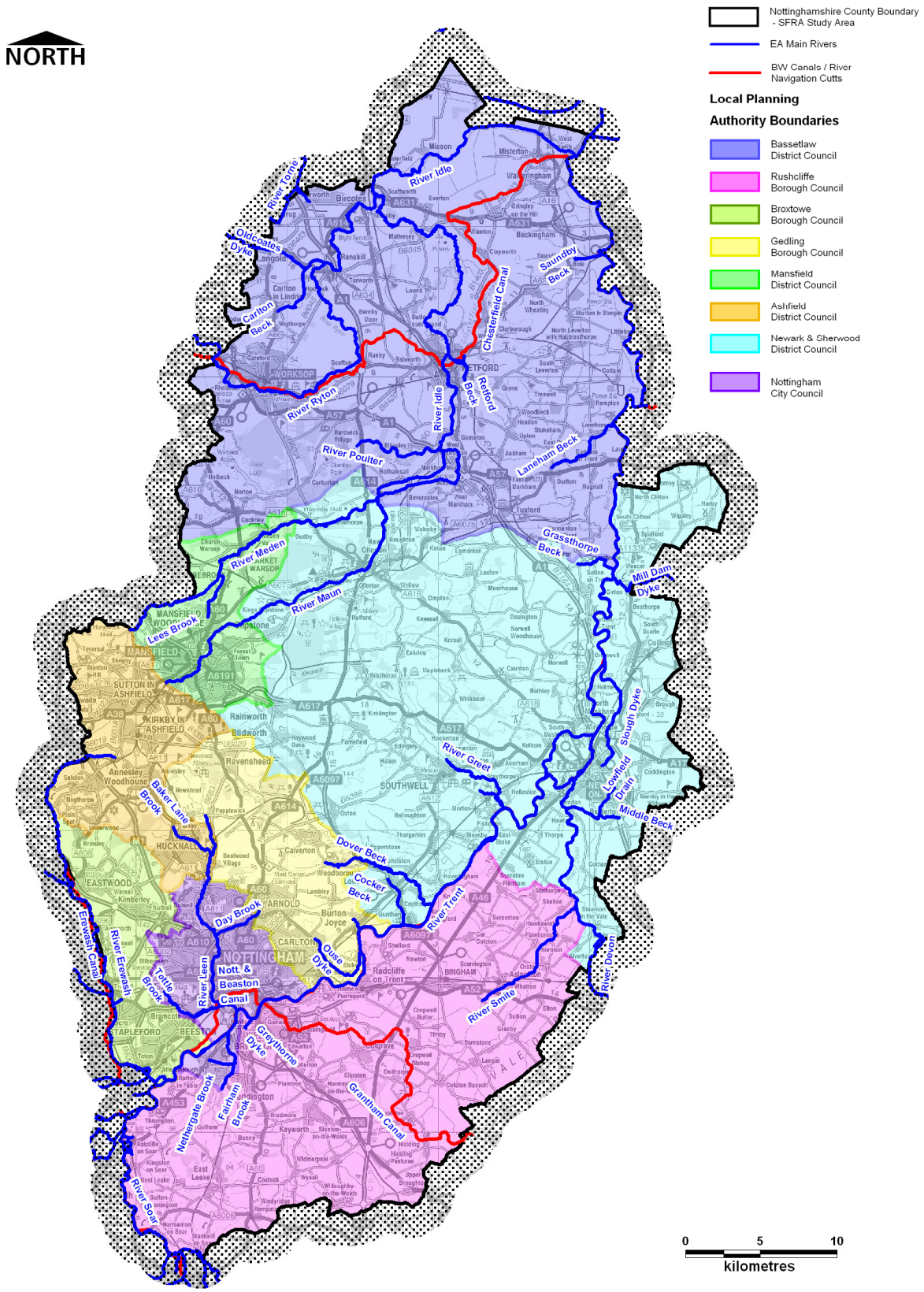

Figure 2-1: SFRA Study Area and Main Watercourses

2.2 Geology

2.2.1 Clays, sandstone and limestone form the predominant solid bedrock types within Nottinghamshire. Unconsolidated Superficial deposits mainly consist of sands and gravel, alluvium and glacial till. Contained within the solid and unconsolidated material is a mix of mineral resources, which have enabled the county to become one of the largest mineral producers in Great Britain.

2.2.2 The exposed bedrocks range from Upper Carboniferous to Lower Jurassic in age. The main structural trend is a shallow east-south-east dip which means that the oldest rocks are found in the west with the overlying younger rocks being progressively exposed to the east.

2.2.3 Upper Carboniferous Coal Measures (mudstones, coals and sandstones) occur on the western border of Nottinghamshire in the Erewash. The overlying Permian age Magnesian Limestone, forms a shallow escarpment running north from Nottingham through Mansfield and intermittently up to Oldcotes[4].

2.2.4 Triassic sandstones of the Sherwood Sandstone Group outcrop through central and eastern Nottinghamshire. The porous nature of the Sherwood Sandstone gives rise to free-draining soils this outcrop area, which includes Sherwood Forest. Much of the central and eastern part of Nottinghamshire is dominated by mudstones of the Triassic Mercia Mudstone Group. This is marked by an escarpment along the boundary with the Sherwood Sandstone which to the east gives rise to the relatively flat, undulating landscape through which the River Trent has cut its wide floodplain[4]. Between Nottingham and Newark the Trent forms a very distinct trench. This is believed to have been created during the ice ages when the river's route to the Wash via the Ancaster gap was blocked by stagnant ice in the Vale of Belvoir forcing it northwards.

2.2.5 The eastern border of Nottinghamshire is marked by a change to the thick blue clays of the Lias of Lower Jurassic age. Areas of open water along the course of the Trent represent former workings for gravel, huge quantities of which were deposited by the meanderings of the river over the past 15,000 years[4]. In the far south of the County a thick blanket of boulder clay forms an undulating landscape known as the 'Wolds'

2.2.6 A geology map illustrating the underlying Solid Bedrock and Superficial deposits derived from BGS 1:50,000 scale mapping is presented in Figure A-4 at Appendix A.

2.3 Current Minerals Extraction Situation

2.3.1 According to the Nottinghamshire Minerals Local Plan (December 2005) (see Section 3.5), Nottinghamshire (excluding Nottingham City in this case) is rich in mineral resources which serve both local and wider needs. Nottinghamshire is the largest producer of sand and gravel in the East Midlands and one of the largest in Great Britain. Sand and gravel is worked from alluvial material found in the Trent and Idle Valleys. In Nottinghamshire gypsum and opencast coal are relatively scarce. In contrast there are large resources of sand and gravel, Sherwood Sandstone and Clay.

4 Natural England. 2011. Nottinghamshire (including City of Nottingham).
http://www.naturalengland.org.uk/ourwork/conservation/geodiversity/englands/counties/area_ID26.aspx

Sand and Gravel

2.3.2 Nottinghamshire's sand and gravel production has generally mirrored national trends with production peaking at 3.6 million tonnes in 1988 however production trends began to fall to an average of 2.7 million tonnes between 1997 and 2001. This trend is believed to reflect a decline in construction/road activity, a greater use of secondary aggregates and a long-term national trend that has shifted from sand and gravel to crushed rock. Since the Plan was adopted sand and gravel production recovered due to the recent boom only to fall to record lows as the current recession took hold.

2.3.3 Approximately one third of the sand and gravel produced in Nottinghamshire is used within the County. The rest is mainly used in Yorkshire and Humberside and some is exported to other East Midland counties.

2.3.4 As predicted in the previous Minerals Plan the Idle Valley is likely to be providing only a very small contribution of sand and gravel by 2014. The Trent Valley will therefore be required to meet nearly all the County's requirements in the medium to long term. Although resource depletion will not be a problem, finding sufficient environmentally acceptable sites to continue production at current levels much beyond the plan period is likely to be a fundamental issue for the future. This can only reinforce the need for significant long-term reductions in dependence on sand and gravel for meeting demand for aggregates.

Sherwood Sandstone

2.3.5 In Nottinghamshire production of Sherwood Sandstone (covering nearly a quarter of the County) reached a peak of 1.15 million tonnes in 1992; the recent average is now similar to that of the late 1990s at approximately 0.7 million tonnes but has fallen significantly due to the current recession.

2.3.6 Nottinghamshire currently consumes only half the current production and exports the rest mainly to Derbyshire and Leicestershire. Future sales of Sherwood Sandstone are noted in the Local Plan as unlikely to follow a uniform trend.

Limestone

2.3.7 Limestone is the only 'hard rock' of any economic interest to be found in the County, and Nottinghamshire's output is very low compared to the regional production which is very large. Today production of aggregate limestone is limited to one quarry at Nether Langwith which has been mothballed since 2007 due to the recession. Small quantities of building stone are also produced at a quarry near Linby. This works a local variation of the Magnesian Limestone known as the Bulwell Stone

Brick Clay

2.3.8 Nottinghamshire's production of brick clay is estimated to be around 350 - 400,000 tonnes per annum. This is extracted at two brick pits that support an associated modern brickworks that manufacture high quality facing bricks. Together these make a significant contribution towards regional brick production.

2.3.9 There is no national demand forecast for clay but it is reasonable to assume that demand will remain broadly similar to recent levels.

Gypsum

2.3.10 Nottinghamshire is one of the UK's largest gypsum producing areas. High quality mineral is extracted from a quarry at Balderton near Newark and Mill and cement grade mineral is won from a drift mine at East Leake. These supply associated plasterboard and plaster works. Reserves of both resource are believed to be high.

Coal

2.3.11 The exposed coalfield in the Erewash Valley has been worked extensively mined by opencast methods but no opencast coal mining has occurred since 1999. Significant resources are known to remain and proposals to exploit this mineral in the future are likely to occur especially if energy prices remain high. The County's deep mined coal industry has collapsed over the last 30 years from 29 collieries in 1980 to just one active colliery at Thorseby today. Another colliery (Harworth) is currently mothballed. Most former collieries including the spoil heaps may have been reclaimed although some tips have and are being washed to recover coal.

Hydrocarbons – Oil and Gas

2.3.12 Nottinghamshire has been producing oil on a small since the Second World War. Today there are 9 active fields. In 2010 planning permission was given to explore for coal bed methane but no drilling has yet commenced.

2.4 Current Waste Management Situation

2.4.1 According to the recent consultation paper on 'Further Issues and Options' relating to the proposed new Waste Core Strategy (published September 2010), Nottinghamshire produces approximately 4 million tonnes of municipal, commercial, industrial, construction and demolition waste each year. Other major sources include power station ash, agricultural waste and sewage sludge.

2.4.2 Waste management is going through a major and rapid transformation in response to statutory UK and EU targets and the impact of escalating landfill taxes. The aim is to reduce dependence on landfill in favour of more sustainable options such as recycling, composting, anaerobic digestion and energy recovery. To achieve this, a significant number of new waste management facilities will be required nationally and locally. In Nottinghamshire (including Nottingham City in this case), the situation is arguably more urgent because waste disposal capacity is becoming very limited and options for finding suitable new landfill sites are few.

2.4.3 In 2009/10, 42% of municipal waste was recycled whilst a further 21% was sent for energy recovery at the Eastcroft Incinerator in Nottingham City which has been operating since the early 1970s. Landfill accounted for 38% and in 2010 only 3 sites were accepting this waste in the County with some being exported.

2.4.4 The latest national estimates published in 2011 suggest that around 52-58% of commercial and industrial waste is being recycled. However, local information on the management of commercial and industrial waste is very limited and often unreliable so it is not possible to confirm if this figure is a reasonable estimate for Nottinghamshire. Recycling commercial and industrial waste is likely to have increased significantly from recent historic levels, but unlike municipal waste, there are no major dedicated commercial and industrial waste energy recovery plants and it is doubtful if much, if any, of this waste is composted. Nearly all construction and demolition waste

is now being recycled or used for other purposes. Only a small proportion, perhaps as little as 10% is land-filled based on national estimates.

2.4.5 The emerging Waste Core Strategy will set out how much and what types of waste management capacity is needed and in broad terms where it will be needed. Although no decisions have yet been reached it is likely that any new large plant will be located in the Nottingham, and Mansfield or Ashfield as this is where most waste is produced.

2.5 Watercourses

2.5.1 EA Main Rivers within the SFRA Study Area are illustrated in Figure 2-1 and in Figure A-1 at Appendix A. Nottinghamshire falls within one major river catchment, the River Trent. Major tributaries include the River Soar, River Erewash, River Leen, River Devon and the River Idle.

2.5.2 Section 7.3 provides further details on the major watercourses in Nottinghamshire.

3 Policy Context

3.1 Planning Policy Overview

3.1.1 The planning policy review collates and summarises policy and guidance relevant to planning for flood risk in Nottinghamshire and comments on the extent to which the existing European, National, Regional and Local policy framework reflects the aspirations of Planning Policy Statement 25 (PPS25).

3.1.2 The scale of the data and guidance used is appropriate to the scale of the local authorities covered and is able to present a useful and useable overview to flood risk and planning issues. By bringing together the planning and flood risk reviews, a strategic overview of flood risk was completed. This highlights the main conflicts between flood risk and planning policy within the local authorities.

3.1.3 Figure 3-1 overleaf illustrates the structure of the current planning system, however, in light of new a Government, this is currently being reformed and is likely to change in the near future.

3.1.4 In satisfying the minerals allocations and waste targets set by the Regional Spatial Strategy (RSS), the NCC and NCiC MDF must consider many planning policies (of which those relating to flooding cover a relatively limited number) to ensure future minerals and waste sites are sustainable. This chapter sets out the national, regional and local policies in place relating to minerals, waste and flooding and/or flood risk management within the study area.

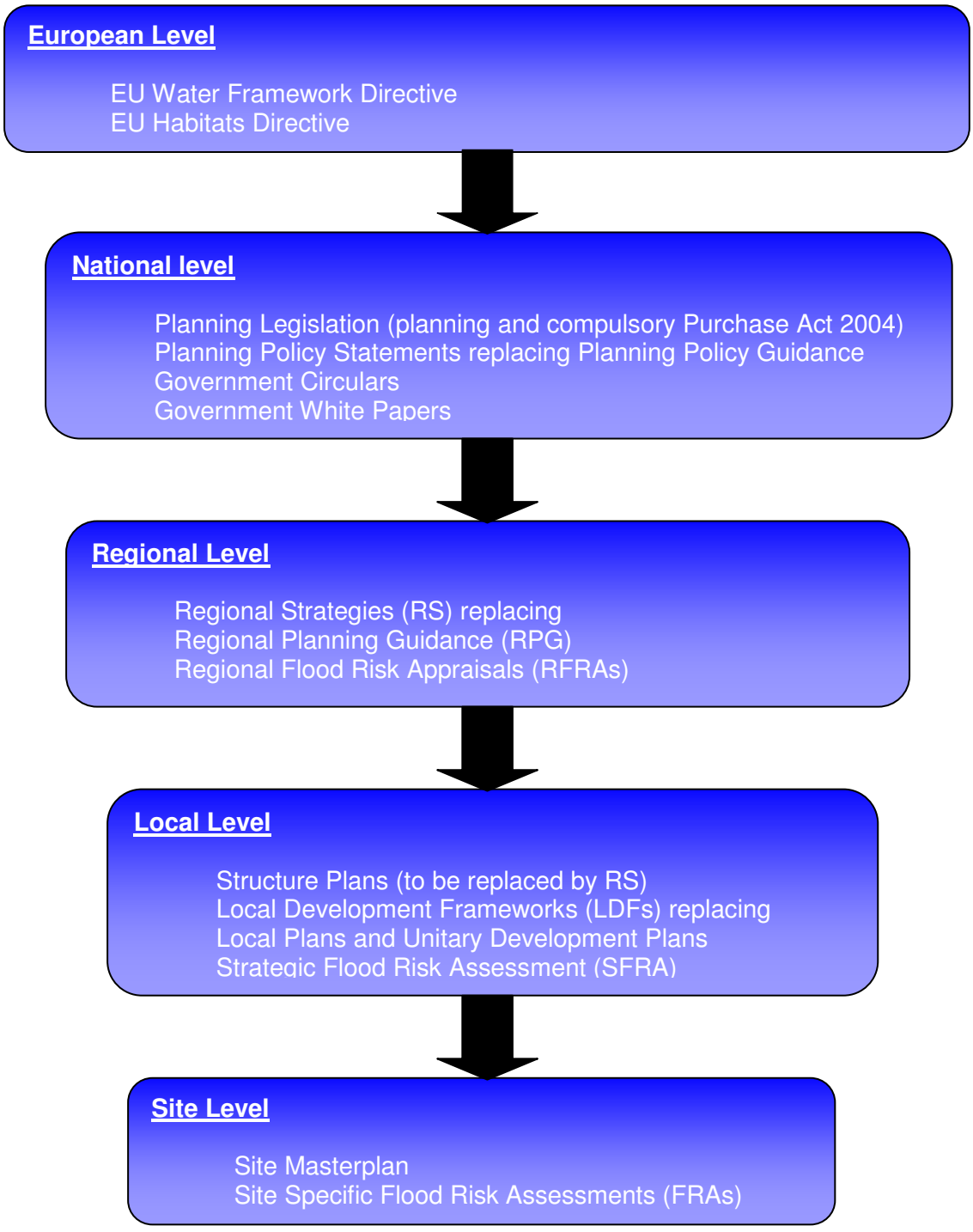

Figure 3-1: Flow Chart Illustrating Structure of the Current Planning System in Relation to Flood Risk

3.2 European Policy

European Union (EU) Floods Directive (November 2007)

3.2.1 The EU Flood Directive (2007/60/EC) was proposed by the European Commission (EC) on 18th January 2006, and was finally published in the Official Journal on 6th November 2007.

3.2.2 Its aim is to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity. The Directive requires Member States to first carry out a Preliminary Flood Risk Assessment (PFRA) by 2011 to identify the river basins and associated coastal areas at risk of flooding. This is described in more detail in Section 3.3.

Water Framework Directive (December 2000)

3.2.3 The Water Framework Directive (WFD) is a substantial piece of EU legislation and the largest directive related to water to date. The directive came into force on 22nd December 2000, and establishes a new integrated approach to the protection, improvement and sustainable use of Europe's rivers, lakes, estuaries, coastal waters and groundwater. The directive requires that all member states manage their inland and coastal water bodies so that a 'good status' is achieved by 2015. This aims to provide substantial long term benefits for sustainable management of water.

3.2.4 The Directive introduces two key changes to the way the water environment must be managed across the European Community:

- Environmental and Ecological Objectives; and
- River Basin Management Plans (RBMPs).

3.2.5 The WFD provides for Protected Areas and Priority Substances to safeguard uses of the water environment from the effects of pollution and dangerous chemicals. In addition, important ecological goals are set out to protect, enhance and restore aquatic ecosystems.

3.2.6 RBMPs are the key mechanism to ensure that the integrated management of rivers, canals, lakes, reservoirs and groundwater is successful and sustainable. RBMPs aim to provide a framework in which costs and benefits can be properly taken into account when setting environmental and water management objectives.

3.2.7 Each RBMP must apply to a 'River Basin District' (RBD) (a geographical area which is defined based on hydrology – see Annex 1, DEFRA and WAG River Basin Planning Guidance (RBPG), August 2006). The main RBD that is relevant to the Nottinghamshire area is the Humber RBD (equivalent to the EA East Area Region and including several major river catchments).

3.2.8 The river basin planning process involves setting environmental objectives for all groundwater and surface water within the RBD, and designing steps and timetables to meet these objectives. The EA is responsible for implementing the WFD in England and Wales and completed the Humber RBMP covering Nottinghamshire in December 2009[5].

[5] Environment Agency and Defra. 2009. River Basin Management Plan Humber River Basin District http://www.environment-agency.gov.uk/research/planning/124803.aspx

3.2.9 According to the DEFRA and WAG River Basin Planning Guidance (August 2006), a RBMP should be a strategic plan that gives all stakeholders within a RBD some confidence about future water management in their district. It should also set the policy framework within which future regulatory decisions affecting the water environment will be made.

3.2.10 Although RBMPs specifically address sustainable water management issues, the WFD also requires that other environmental considerations and socio-economic issues are taken into account. This ensures that the policy priorities between different stakeholders are balanced to ensure that sustainable development within RBDs is achieved.

3.2.11 As a result of the strategic nature of RBMPs, they are inherently linked to and can both influence and be influenced by planning policy within their areas. The following sections are extracted from the DEFRA and WAG River Basin Planning Guidance (August 2006).

3.3 National Policies

PPS10 Planning for Sustainable Waste Management (DCLG, March 2011)

3.3.1 Planning Policy Statement 10 (PPS10)[6] sets out the government's policy to be taken into account by waste planning authorities. It outlines the overall objective of Government policy regarding waste management and the sustainable management of waste. The main aspect of PPS10 that relates to flood risk is within Annex E, Location Criteria. Part A of this section outlines the considerations required to adequately protect water resources. In particular, the suitability of locations subject to flooding will need particular care.

3.3.2 PPS10 states that in deciding which sites and areas to identify for waste management facilities, waste planning authorities should assess their suitability for development against:

- The physical and environmental constraints on development, including existing and proposed neighbouring land uses; and
- The cumulative effect of previous waste disposal facilities on the well-being of the local community, including any significant adverse impacts on environmental quality and social cohesion.

Planning Policy Statement 25: Development and Flood Risk (DCLG, 2010)

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

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

3.3.4 The core principles of PPS25 include:

- Allocate all sites in accordance with the Sequential Test (Section 4) and Exception Test (Section 5) to reduce the flood risk and ensure that the vulnerability classification of the proposed development is appropriate to the flood zone classification;

[6] Department for Communities and Local Government. Planning Policy Statement 10: Planning for Sustainable Waste Management. 2011. TSO. http://www.communities.gov.uk/publications/planningandbuilding/planningpolicystatement10

- FRAs should be undertaken for all developments within Flood Zones 2 and 3 and sites with identified flood sources to assess the risk of flooding to the development and identify options to mitigate the flood risk to the development, site users and surrounding area;
- FRAs are required for all major developments in Flood Zone 1. The Environment Agency are statutory consultees for all planning applications for operational development greater that 1 ha; and
- Flood risk to developments should be assessed for all forms of flooding.

3.3.5 PPS25 is supported by a Practice Guide (December 2009) and builds on the principles originally set out in PPG25 (July 2001). PPS25 seeks to guide the preparation of SFRAs and the location of development in order to avoid and manage flood and residual risk. PPS25 also aims to reduce flood risk to and from new development through policies on layout and design. PPS25 reaffirms that all forms of flooding and their impact on the natural and built environment are material planning considerations. Guidance for the minimum content of and best practice for the preparation of SFRAs is contained in Annex E.

3.3.6 PPS25 sets the following minimum requirements for the appraisal, management and reduction of flood risk:

- Identify land at risk from flooding and the degree of risk;
- Preparing Regional Flood Risk Assessments (RFRAs) or SFRAs as appropriate, either as part of the Sustainability Appraisal of their plans or as a freestanding assessment;
- Frame policies for the location of development which avoid flood risk to people and property, where possible and manage any residual risk, taking into account climate change;
- Reduce flood risk to and from new development through location, layout and design, including sustainable drainage approaches;
- Use opportunities offered by new development to reduce flood risk;
- Only permit development in areas of flood risk when there are no suitable alternative sites elsewhere and the benefits outweigh the risks from flooding. Work with the EA and other stakeholders to ensure that best use is made of their expertise and information in informing planning decisions; and
- Ensuring spatial planning supports flood risk management and emergency planning.

A Risk-based Approach

3.3.7 PPS25 presents a three-tier approach to flood risk assessment at the regional, strategic and site specific levels. At the regional level this will be in the form of a RFRAs and at the district site level, a SFRA. Policies and proposals should be established on the basis of the SFRA.

3.3.8 PPS25 indicates that the Regional Planning Body should take flood risk into consideration when determining strategic planning considerations in the RSS. The RSS, guided by the RFRA, should identify broad locations and establish locational criteria for development in the region. This in turn will inform SFRAs and consequently Local Development Documents at the local level.

Key Requirements for SFRAs

- SFRAs will refine information on the probability of flooding, taking into account all sources of flooding and the impacts of climate change. SFRAs should have regard to catchment-wide flooding issues that affect that area;
- The SFRA should provide the foundation from which to apply the Sequential and Exception Tests in the development allocation and development control process (see Flood Zones 1-3b). Where decision-makers have been unable to allocate all proposed development and infrastructure in accordance with the Sequential Test, taking account of the flood vulnerability category of the intended use, it will be necessary to increase the scope of the SFRA to provide the information necessary for application of the Exception Test. Guidance on the application of the Sequential and Exception Tests is contained in Annex D to the PPS;
- SFRAs should be prepared in consultation with the EA, emergency response and drainage authority functions of the LPA and where appropriate Internal Drainage Boards;
- Development should not add to flood risk and should, where possible, reduce it. SFRAs should identify the four key Flood Zones as follows:
    - ***Flood Zone 1***: Low Probability of Flooding - Land having a less than 1 in 1000 annual probability of river or sea flooding (<0.1%);
    - ***Flood Zone 2:*** Medium probability of Flooding - Land 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%);
    - ***Flood Zone 3a:*** High Probability of Flooding - Land having a greater than 1 in 100 annual probability of river flooding (>1%) or greater than a 1 in 200 annual probability of flooding from the sea (>0.5%); and
    - ***Flood Zone 3b***: Functional Floodplain - 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 agreed between the LPA and the EA.

3.3.9 Minimum requirements (set out in Annex E, PPS25) for site specific FRAs are that they should:

- Be proportionate to risk and appropriate to the scale, nature and location of the development;
- Consider risk of flooding to the development and risk arising from the development;
- Consider the impacts of climate change;
- Be undertaken early, by competent people;
- Consider adverse and beneficial effects of flood management infrastructure and consequences of failure;
- Consider vulnerability of those occupying the development, taking account of the Sequential and Exception Tests, the vulnerability classification and safe access arrangements;
- Ensure that assessments are fit for purpose by ensuring that different types of flooding are considered and quantified. Flooding should be considered from natural and human sources and joint cumulative effects should also be considered.
- Identify flood risk reduction measures. Emphasis should be given to reducing flood risk overall;

- The effects of flooding events (including extreme events) on people, property, the natural and historic environment and river and coastal processes should be considered;
- The remaining residual risk reduction measures should be included. It should be demonstrated that this is acceptable for the particular development/land use;
- The ability of water to soak into the ground may change with development and this should be considered, as should how the proposed layout of the development may affect drainage systems; and
- Assessments should be supported by appropriate data and information including historical data on previous events.

3.3.10 Annex E of PPS25 also identifies that there may be considerable benefits in LPAs within a catchment area of high development pressure or a designated development area, joining together to undertake a sub-regional SFRA. This will assist LPAs to consider the issues raised by flooding on the wider scale, and enable them to contribute to, and take account of, the WFD and RBMPs. Para 2.27 of the Practice Guide to PPS25, states that where sub-regional SFRAs are undertaken, these will provide more detailed information on the broad spatial distribution of flood risk and development and identify, within extensive areas of Flood Zone 3, where development is to be considered, and where it will be necessary to apply the Exception Test.

PPS25 in Context

3.3.11 PPS25 is clearly a key part of the Government's wider programme of responses to the challenge of climate change. If climate change is not stabilised (or mitigated) then it will have two impacts on flood risk. Projected sea level rises would suggest that the risk of flood defence levels being overtopped would increase. Secondly, climate change is likely to create higher rainfall in winter, and consequently increase the risk of flooding along river catchments. An increased frequency of intense rainfall events is also likely to increase the numbers of urban and flash floods, and could also mean increases in the extent of flooding from rising groundwater.

3.3.12 It is important to see PPS25 as part of a wider integrated approach to spatial planning. Flood risk should be considered alongside other spatial planning concerns such as the delivery of housing, economic growth, management of natural resources, regeneration and the management of other natural hazards. There are clear links to other Planning Policy Statements that may not be explicit in PPS25, but which are necessary to achieve its objectives. The most obvious link is with the supplement to PPS1 'Climate Change and Sustainable Development'[7].

3.3.13 Limited amendments were proposed to clarify how certain aspects of PPS25 are applied to ensure it works effectively. The proposed amendments affected tables D.1 (Flood Zones)[8] and D.2 (Flood Risk Vulnerability Classification)[9] in Annex D to PPS25. A consultation on these amendments was held between August and November 2009.

3.3.14 The revised version of PPS25, incorporating amendments covered by the consultation process was released late March 2010 and a summary of the amendments that affect Minerals and Waste Planning is provided in Table 3-1.

[7] Department for Communities and Local Government. 2007. Planning Policy Statement: Planning and Climate Change. Supplement to Planning Policy Statement 1. TSO. Accessed 2011 via http://www.communities.gov.uk/documents/planningandbuilding/pdf/ppsclimatechange.pdf
[8] Department for Communities and Local Government. March 2010. Planning Policy Statement 25: Development and Flood Risk (PPS25). Pg.28. http://www.communities.gov.uk/documents/planningandbuilding/pdf/planningpolicystatement25.pdf#page=28
[9] Department for Communities and Local Government. March 2010. Planning Policy Statement 25: Development and Flood Risk (PPS25). Pg. 31. http://www.communities.gov.uk/documents/planningandbuilding/pdf/planningpolicystatement25.pdf#page=31

Table 3-1: Previous and amended text within PPS25.

Location of Amended Text	Pre-March 2010 text within PPS25 (where available)	Amended Text released post-March 2010 within PPS25
Table D1: Flood Zones – Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (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).	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their SFRAs areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But 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, should provide a starting point for consideration and discussions to identify the functional floodplain.
Table D2: Flood Risk Vulnerability Classification – Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk, and strategic utility infrastructure, including electricity generating power stations and grid and primary substations.	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which has to be located in a flood risk area for critical operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. • Wind turbines.
Table D2: Flood Risk Vulnerability Classification – Highly Vulnerable	• Installations requiring hazardous substances consent.[10]	• Installations requiring hazardous substances consent.[4] (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure').[11]
Table D2: Flood Risk Vulnerability Classification – Less Vulnerable	n/a	• Police, ambulance and fire stations which are ***not*** required to be operational during flooding.

3.3.15 In terms of the definition of the Flood Zone 3b Functional Floodplain, this is unlikely to affect existing delineation undertaken by each individual LPA and contained within the SCC Level 1 SFRA mapping and associated GIS layers. This is because the Flood Zone 3b Functional Floodplain extent has been agreed between the LPA and Environment Agency during the production of the Level 1 SFRAs.

[10] DETR Circular 04/00. Planning Controls for Hazardous Substances, para 18.
http://www.communities.gov.uk/publications/planningandbuilding/circularplanningcontrols
[11] In considering any development proposal for such an installation, LPAs should have regard to Planning Policy Statement 23, 'Planning and Pollution Control'.

3.3.16 The revised definitions and explanations within the Flood Risk Vulnerability Classification may have implications for the JWDF related to installations requiring Hazardous Substances Consent and therefore should be taken into consideration for any waste sites requiring such consent.

3.3.17 The other revised definitions are not considered to have implications for the MDF or the JWDF.

The Flood and Water Management Act (2010)

3.3.18 Following the devastating national floods of 2007, one of the recommendations from Sir Michael Pitt's review[12] was that *"the role of local authorities should be enhanced so that they take on responsibility for leading the co-ordination of flood risk management in their areas"*.

3.3.19 The Flood and Water Management Act (2010)[13] brings in new roles and responsibilities for local authorities. In particular, the Act defines the role of Lead Local Flood Authority (LLFA), which will include Unitary Authorities or County Councils. The LLFA will be encouraged to bring together relevant bodies and stakeholders to effectively manage local flood risk. These Flood Risk Management Authorities may include County, City and District Councils, IDBs, highways authorities, water companies and the EA.

3.3.20 The new responsibilities that the Act assigns to LLFAs include:

- Coordinated management of flooding from surface water, ground water and ordinary watercourses;
- Development and maintenance and implementation of Flood Risk Management Strategies;
- Investigation and recording of local flood events; and
- Establishment and maintenance of a Flood Risk Asset Register.

3.3.21 The Act gives LLFAs the role of 'SuDS Approving Body' (SAB) which allows each Council to be responsible for adopting and maintaining SuDS. This will mean that planning applications which have drainage implications should be approved by the SAB before work can commence.

3.3.22 The Flood Risk Regulations (2009) (Section 3.3.26) transpose the EU Floods Directive into UK Law. One of the main impacts on Local Authorities in the UK is that they are required to complete PFRAs (Section 3.2.2), produce Flood Risk Maps showing the extents and hazards of flooding in their area and finally, produce Flood Risk Management Plans (see Figure 3-2).

3.3.23 NCC and NCiC are the LLFAs for Nottinghamshire and Nottingham City respectively, however the transfer of consenting powers has not been implemented and the date of this transfer is not yet known.

[12] Sir Michael Pitt. June 2008. The Pitt Review: Lessons learned from the 2007 floods. http://www.environment-agency.gov.uk/research/library/publications/33889.aspx
[13] The National Archives. HM Government. 2010. The Flood and Water Management Act. http://www.legislation.gov.uk/ukpga/2010/29/contents

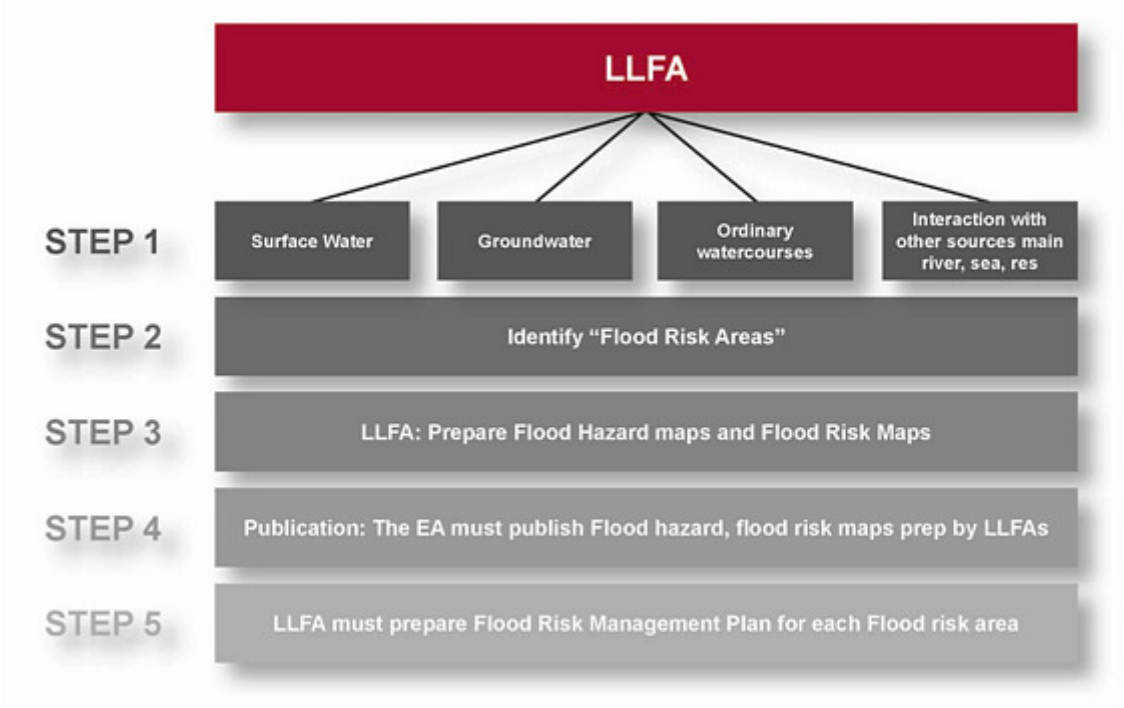

Figure 3-2: LLFA PFRAs

3.3.24 From 1st April 2011, NCC and NCiC became LLFAs which will include a requirement for consenting works on or near to Ordinary Watercourses (Non-Main Rivers) within their administrative areas currently consented by the EA (outside IDB authority areas).

PPS25: Development and Flood Risk Practice Guide (DCLG, December 2009)

3.3.25 The PPS25 Practice Guide expands on how flood risk should be taken into account when allocating land for mineral and waste development. The PPS25 Practice Guide provides guidance on the preparation of Minerals and Waste SFRAs. The PPS25 Practice Guide provides details of issues that LPAs need to consider in relation to flood risk, which include the following:

- Identify the location of mineral safeguarding areas and site allocations;
- Where appropriate restoration of minerals workings should reduce flood risk;
- Where possible the sequential approach to allocation of minerals sites; and
- The sequential approach to locating facilities at site level to minimise flood risk.

The Flood Risk Regulations (2009)

3.3.26 The Flood Risk Regulations[14] came into force on the 10th December 2009 and sets out duties for the Environment Agency and LLFAs in the preparation of a range of reports and mapping outputs.

3.3.27 LLFA (including NCC and NCiC) must prepare the following for publication by the Environment Agency before the 22nd December 2011:

- A PFRA report for flooding from sources other than that from the sea, main rivers and reservoirs; and
- Determine whether, in the opinion of the lead local authority, there is a significant flood risk in its area and identify the part of the area, if any, where this risk exists (for sources other than that from sea, main rivers and reservoirs).

3.3.28 Where LLFA identify a relevant flood risk area (as above), there is a requirement to prepare flood hazard and flood risk maps for these areas for publication by the Environment Agency before 22nd December 2013. In addition, for these areas, a flood risk management plan must be prepared for publication by the Environment Agency by 22nd December 2015.

3.3.29 Although the outputs of reports and mapping from the requirements of the Flood Risk Regulations 2009 will not be available for the purposes of this update of the minerals and waste evidence base, it is important to use the findings from these when updating the SFRA in the future. These should be available from the Environment Agency who has a duty to publish the required reports and mapping for river basin districts.

Future Water – The Government's Water Strategy for England (DEFRA, February 2008)

3.3.30 Future Water[15] sets out the Governments long term vision for water and the framework for water management in England. Future Water's vision for policy and management with regards to surface water drainage and river and coast flooding aims to have achieved the following goal by 2030 at the latest:

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

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

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

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

[14] The Flood Risk Regulations. 2009. http://www.legislation.gov.uk/uksi/2009/3042/contents/made
[15] HM Government. Future Water - The Government's water strategy for England. 2008. Defra Publications. http://www.defra.gov.uk/environment/quality/water/strategy/pdf/future-water.pdf

Mineral Policy Statement 1: Planning and Minerals (DCLG, November 2006)

3.3.34 Minerals Policy Statement 1 (MPS1)[16] and its Practice Guide[17] outline the government's key overarching policies and principles which apply to all minerals.

3.3.35 MPS1 states in paragraph 9 that the Government's objectives are to secure working practices which prevent or reduce as far as possible, impacts on the environment and human health arising from the extraction, processing, management or transportation of minerals.

3.3.36 Paragraph 15 adds that local authorities should identify sites and preferred areas having taken account of environmental considerations to provide greater certainty of where future sustainable mineral working will take place. In addition, its states that local authorities should consider the benefits, in terms of reduced environmental disturbance and more efficient use of mineral resources including full recovery of minerals, of extensions to existing mineral workings rather than new sites.

3.3.37 Paragraph 17 of MPS1 outlines the policies relating to environmental protection that local authorities should ensure and in particular, covers issues relating to flood risk as well as more generic water resources issues. In particular, it requires the following:

- In areas at risk of flooding, mineral extraction proposals should not have a significant adverse impact on flood flows or storage capacity; and
- Operators should not materially increase the risk of flooding at other properties and should increase the flood storage capacity.

Making Space for Water (DEFRA, March 2005)

3.3.38 The Government released Making Space for Water[18] in March 2005 after a consultation period. The purpose of the report is to introduce new strategies on the management of issues surrounding flood risk and coastal erosion for the next 20 years. The report recognises the requirement for a holistic approach between the various responsible bodies, including flood defence operating authorities, sewerage undertakers and highways authorities, to achieve sustainable development. Making Space for Water does not state specific policies but provides the Governments objectives on:

- Land use planning – it strongly encourages FRAs to be prepared at all levels of the planning process;
- Rural Issues – it promotes the environmental pillar of sustainable development through the use of wetlands and washlands, and managed realignment of coasts and rivers;
- The desire for national co-ordination of groundwater flood risk management within the overall flood and coastal erosion risk management framework;

[16] Department for Communities and Local Government. Mineral Policy Statement 1: Planning and Minerals. 2006. TSO. http://www.communities.gov.uk/publications/planningandbuilding/mineralspolicystatement5
[17] Department for Communities and Local Government. Planning and Minerals: Practice Guide. 2006. TSO. http://www.communities.gov.uk/publications/planningandbuilding/planningminerals
[18] DEFRA. Making Space for Water. 2005. Defra Publications. http://www.defra.gov.uk/environment/flooding/documents/policy/strategy/strategy-response1.pdf

- Integrated urban drainage management – it is committed to ensuring that SuDS techniques are incorporated in new developments;
- Coastal issues – it seeks to develop a more strategic and integrated approach to managing coastal flooding and erosion risks; and
- Living with flood risk – it identifies that there is a need to raise awareness and preparation in local communities for the changing flood and erosion risks resulting from climate change. The protection of the Functional Floodplain (introduced in Chapter 5) forms an integral aspiration of the strategy.

Minerals Planning Statement 2 - Controlling and Mitigating the Environmental Effects of Mineral Extraction in England (DCLG, March 2005)

3.3.39 Minerals Planning Statement 2 (MPnS2)[19] indicates that Development Plan Policies and proposals for minerals extraction and associated development should take into account the impacts of mineral working which includes dewatering and water pollution.

3.3.40 MPnS2 also suggests that developers should consult the EA prior to planning application submission to evaluate the hydrological, chemical and ecological impact of any workings on groundwater and surface water supplies.

Minerals Planning Guidance 2 – Applications, Permissions and Conditions (DCLG, July 1998)

3.3.41 Minerals Planning Guidance 2 (MPG2)[20] provides development control advice relating to minerals and on the preparation and determination of planning applications.

3.3.42 MPG2 Annex C provides a list of planning conditions that mineral planning applications should consider. In relation to flood risk planning conditions should consider the following:

Management of Waste – The way that waste is disposed of should always be attached to a planning permission. Conditions should aim prevent any interference with natural resources such as water supplies. Conditions can sometimes ensure that the disposal of waste has a positive use, such as reducing flood risk; and

Surface Water Drainage and Pollution Control – The disturbance of soil may lead to problems with land drainage, where as depositing waste material within the floodplain may give rise to flooding.

3.4 Regional Policies

East Midlands Regional Plan 2009 – 2026

3.4.1 The first East Midlands Regional Plan (EMRP)[21] comprising the RSS8 for the East Midlands was adopted in March 2009 setting out long term development strategy for the region up to 2026

[19] Department for Communities and Local Government. Minerals Planning Statement 2: Controlling and Mitigating the Environmental Effects of Mineral Extraction in England. 2005. TSO. http://www.communities.gov.uk/publications/planningandbuilding/mps2
[20] Department for Communities and Local Government. Minerals Planning Guidance 2: Applications, permissions and conditions. 1998. TSO. http://www.communities.gov.uk/publications/planningandbuilding/mineralsplanningguidance

under the provisions of the Planning and Compulsory Purchase Act 2004. The East Midlands Regional Assembly (EMRA) reviewed this plan in 2006 and was approved on 12th March 2009.

3.4.2 The following summarises the EMRP core policy objectives as they relate to flood risk and water management. The implications for the SFRA are also addressed below.

- Policy 1 'Regional Core Objectives' states that in order to secure sustainable development and meet regional core objectives within the East Midlands all strategies, plans and programmes having a spatial impact should reduce the impacts of climate change including the risk of damage to life and property from flooding and sea level change and decline in water quality and resources. This should be achieved through location design and construction of new development including providing sustainable drainage and managing flood water.

- Policy 2 'Promoting better design' states that layout, design and construction of new development should be continually improved including in terms of reduced carbon dioxide and providing resilience to climate change. This can be achieved by improving water efficiency, providing SuDS and by the management of flood water and reducing waste and pollution.

3.4.3 The extensive national flooding which occurred during the winter of 2000/1 and the summer 2007, and the potential impact of climate change have heightened the importance of flooding and land drainage as a fundamental spatial planning issue. This is particularly true for the East Midlands as 20% of the region is low lying and is safeguarded from fluvial and coastal flooding by drainage and flood defences and which includes vast areas of Lincolnshire coastline and extensive areas of both tidal and fluvial flood plains.

3.4.4 The regional approach to managing flood risk is described in Policy 35. The potential impact of climate change on flooding and drainage should be considered in the development of the Local Development Framework and strategies of relevant public bodies. In preparing Local Development Documents, and determining planning applications, local authorities should:

- Take into account the SFRA (including priority areas of Nottingham and Newark);

- Include policies which prevent inappropriate development in or where there would be an adverse impact on, the coastal and fluvial floodplain areas;

- Use the LDFs and relevant local strategies to deliver a programme of flood management schemes that also maximise biodiversity, provide townscape enhancement and other public benefits; and

- Require sustainable drainage in all new developments where practicable.

3.4.5 According to Policy 35 development should if, alone or in conjunction with other new development;

- Be at unacceptable risk from flooding or create such an unacceptable risk elsewhere;

- Inhibit the capacity of the floodplain to store water;

[21] Department for Communities and Local Government. East Midlands Regional Plan. 2009. TSO. http://www.gos.gov.uk/497296/docs/229865/East_Midlands_Regional_Plan2.pdf

- Impede the flow of floodwater in a way which would create an unacceptable risk elsewhere;
- Have a detrimental impact upon infiltration of rainfall to ground water storage;
- Otherwise unacceptably increase flood risk; and
- Interfere with coastal processes.

3.4.6 Developments may however be acceptable on the basis of conditions or agreements for adequate measures to mitigate the effects on the overall flooding regime, including provision for the maintenance and enhancement of biodiversity. Any such measures must accord with the flood management regime for that location.

3.4.7 The following policies relate to water management:

- Policy 30 refers to regional priorities for managing and increasing woodland cover. The introduction of new woodland should avoid negative consequences on water resources and contribute to flood alleviation and floodplain management;
- Policy 32 describes the regional approach to water resources and water quality describing how Local Authorities, developers, and water companies should work together to protect and improve water quality and reduce the risk of pollution, especially to vulnerable groundwater; and
- Policy 33 refers to the importance of protecting and enhancing the multi-functional importance of strategic river corridors (inclusive of the River Trent). Local Authorities, the Environment Agency and other relevant public bodies should work together to, amongst other objectives, manage flood risk.
- Policies 37 and 38 set out priorities for minerals and waste management respectively, however flood risk considerations are not discussed.

3.4.8 Nottinghamshire falls within the Northern Sub-Regional Strategy. Policy Northern SRS 4 'Enhancing Green Infrastructure through Development' highlights the importance of protecting the Sherwood Aquifer.

3.4.9 However, in July 2010, Regional Strategies were revoked under s79 (6) of the Local Democracy and Construction Act 2009 and were no longer to form part of the Development Plan. However, following a recent High Court judgment a letter from the Department for Communities and Local Government (DCLG) dated 10th November 2010 re-establishes Regional Strategies as part of the Development Plan. It remains the new Government's intention to revoke Regional Strategies, but they will continue to form part of the Development Plan and thus be considered in the decision making process until the Localism Bill is passed by Parliament.

East Midlands Regional Waste Strategy (January 2006)

3.4.10 The East Midlands Regional Waste Strategy (EMRWS)[22] was adopted in 2006 and provides a regional strategic framework which allows the region to rapidly progress towards a more sustainable way of producing, consuming and recycling waste. The EMWS identifies the current

[22] East Midlands Regional Assembly. East Midlands Regional Waste Strategy. 2006. http://www.emregionalstrategy.co.uk/write//Regional-Waste-Strategy-Jan06.pdf

regions capacity for waste management and sets out the future for the waste management infrastructure. Key principles and priorities for the EMRWS are as follows:

- To work towards zero growth in waste at the Regional level by 2016;
- To reduce the amount of waste land-filled in accordance with the EU Landfill Directive;
- To exceed Government targets for recycling and composting; and
- To take a flexible approach to other forms of waste recovery.

3.4.11 The type and amount of waste produced in Nottinghamshire in 2003 is shown in Table 3-2.

Table 3-2: Principal Waste Streams arising from Nottinghamshire

Type of Waste	Amount (Tonnes)
Municipal Solid Waste	618, 375
Commercial	580.500
Industrial	2, 596,950
Hazardous	50, 012
C & D Wastes	2, 371, 200
Agricultural	595, 920
Total Controlled Arisings	6, 217, 037
Total Arisings	6, 812, 957

3.4.12 The East Midlands had 60 million m³ of void space available for wastes in 2001. Assuming that waste management was to continue at the current rate it is estimated that the capacity for the East Midlands to accommodate waste would be exhausted in 8 years. For Nottinghamshire this is expected to be just 6 years. At present approximately 68% of waste produced in Nottinghamshire is disposed of in the region.

3.4.13 The EMWS states that in order for various statutory and non-statutory targets for waste management to be met then an extensive range of new waste management and related facilities will have to be delivered.

River Trent Catchment Flood Management Plan (CFMP) (December 2010)

3.4.14 A Catchment Flood Management Plans (CFMP) is a high-level strategic planning document that provides an overview of the main sources of flood risk and how these can be managed in a sustainable framework for the next 50 to 100 years. The Environment Agency engages stakeholders within the catchment to produce policies in terms of sustainable flood management solutions whilst also considering local land use changes and effects of climate change.

3.4.15 The River Trent CFMP[23] area has a long history of river, tidal and surface water flooding with earliest reports dating back to 530 A.D. The future approach to flood risk management in Nottinghamshire is outlined in the Trent CFMP which was published in December 2010. The Trent CFMP covers the entire River Trent catchment from its source above Stoke-on-Trent to the boundary with the shoreline management plan at Keadby Bridge.

[23] Environment Agency. 2010. River Trent Catchment Flood Management Plan. http://www.environment-agency.gov.uk/research/planning/114350.aspx

3.4.16 The EA's flood risk management approach in the Nottinghamshire area includes the following engineering schemes:

- Construction of new flood defences;
- Maintaining (and in some places enhancing) existing flood defences and structures;
- Maintaining river channels;
- Maintenance of drainage networks by Internal Drainage Boards (IDBs) and landowners; and
- Maintenance of road drainage and sewers.

3.4.17 The River Trent Catchment is divided into ten distinct sub areas (see Figure ES1.1.2 of the report) which have similar physical characteristics, sources of flooding and levels of risk. For each sub area one of the Environment Agency's six generic flood risk management policies has been assigned based on the assessment of how social, economic and environmental objectives are affected by flood risk management activities under each policy option.

3.4.18 Other flood risk management activities that are carried out in the catchment include:

- Using flood risk mapping to understand where flooding is likely;
- Providing flood forecasting and warning services;
- Working with Local Authorities to influence location, design and layout of redevelopment;
- Promoting and encouraging flood awareness to encourage flood preparation; and
- Promoting resilience and resistance for properties in the floodplain.

3.4.19 Nottinghamshire falls within six of these sub areas and so a variety of different flood risk management policies are applicable as shown in Table 3-3.

3.4.20 The River Trent CFMP is supported by an Action Plan, which includes specific reference to opportunities to work with aggregate extraction companies as described in Sections 8.2.5 to 8.2.8.

3.4.21 The CFMP should also inform and support planning policies, statutory land use plans and implementation of the WFD, so that future development in the catchment is sustainable in terms of flood risk. Awareness of the role of CFMPs among land-use planners is in its infancy as these plans, along with SFRAs, are a relatively new requirement.

Table 3-3: Flood Risk Management Policies for the six CFMP Sub-Areas with in Nottinghamshire.

Sub Area	Policy Unit Area	Policy Option	Definition
Rural Leicestershire	8	6	Areas of low to moderate flood risk where action will be taken with others to store water or manage runoff in locations that provide overall flood risk reduction or environmental benefits, locally or elsewhere in the catchment.
Burton, Derby and Nottingham	5	5	Areas of moderate to high flood risk where further action to reduce flood risk can be undertaken.
Upper Soar and Upper Anker	9	4	Areas of low, moderate or high flood risk where flood risk is already managed effectively but where more action is needed to keep pace with climate change. Take further action with others to store water or manage runoff in locations that provide overall flood risk reduction or environmental benefits, locally or elsewhere in the catchment.
Shelford to Gainsborough	4	4	Areas of low, moderate or high flood risk where flood risk is already managed effectively but where more action is needed to keep pace with climate change. Take further action with others to store water or manage runoff in locations that provide overall flood risk reduction or environmental benefits, locally or elsewhere in the catchment.
Sherwood	2	3	Areas of low to moderate flood risk where existing or alternative actions should be continued to manage flood risk at the current level.
Axholme & North West Lincolnshire	1	4	Areas of low, moderate or high flood risk where flood risk is already managed effectively but where more action is needed to keep pace with climate change. Take further action with others to store water or manage runoff in locations that provide overall flood risk reduction or environmental benefits, locally or elsewhere in the catchment.

Catchment Abstraction Management Strategies (CAMS)

3.4.22 The Environment Agency manages water resources at the local level and set out where water is available for abstraction through the use of Catchment Abstraction Management Strategy (CAMS).

3.4.23 Within the various CAMS, the Environment Agency's assessment of the availability of water resources is based on a classification system that gives a resource availability status and indicates the following:

- The relative balance between the environmental requirements for water and how much is licensed for abstraction;
- Whether water is available for further abstraction; and
- Areas where abstraction needs to be reduced.

3.4.24 The Catchment Abstraction Management Strategy Process is the national document, which supports the development of CAMS at a local level. It sets out the national policy and the regulatory framework within which CAMS operate, describes the process of developing CAMS and provides information on the structure and content of CAMS documents.

3.4.25 There are currently four CAMS which cover the Nottinghamshire study area and set out how water abstraction should be managed until 2012 and these are:

- Soar;
- Trent Corridor;
- Lower Trent and Erewash; and
- Idle and Torne.

Spatial Plans Influencing RBMPs

3.4.26 Emerging development plans will be an important source of information on future water management pressures that can inform the EA and refine its understanding of the current status of water bodies, and how this might change if no action was taken. The RBPG stresses the importance of taking into account the continuation of sustainable human development (including ports, recreational uses, water storage and flood risk management schemes) within RBDs and the setting of water management frameworks.

3.4.27 The EA's CFMPs and CAMSs are examples of such high-level planning tools that can inform development of RBMPs. Using CFMPs, the RFRA and SFRAs build upon existing flood risk and planning information to present current and potential future development within RBDs in relation to flood risk. In addition, policies that emerge from these studies (for example SuDS, Flood Risk Management procedures and mitigation options) have informed the development of the water management frameworks in RBMPs.

RBMPs Influencing Spatial Plans

3.4.28 As well as being informed by various spatial and catchment wide plans and strategies, RBMPs have produced strategic, regional policy information that is necessary to feed into the spatial planning process such as Local Development Frameworks. For example, where RBMPs have a direct affect on the use and development of land they will have to be material considerations in the preparation of statutory development plans for the areas they cover. It will also be necessary for planning authorities to consider WFD objectives at the detailed development control stage (not least to consider the requirements of Article 4(7) of the WFD in relation to new physical modifications).

3.4.29 To allow local authorities to incorporate WFD objectives into their various statutory development plans, the EA will provide local authorities with information such as CFMPs, CAMS and other catchment-wide guidance and strategies, to enable effective integration of the water management framework within statutory development plans. In order to address the fact that these plans have different planning cycles, and are at different stages in their development,

RBMP policies that affect the development and use of land must be considered in the monitoring and review of statutory spatial plans.

3.4.30 In addition, some of the measures necessary to achieve WFD objectives will be delivered through land use planning mechanisms. For example spatial planners can make major contributions to WFD objectives by including appropriate planning conditions and planning obligations in relevant planning permissions for new developments, or by restricting some forms of development. Delivery of these measures is more likely to take place if they are included in Local Development Frameworks / Plans by land use planners. LDFs being prepared by the individual authorities should already include policies and recommendations relating to flood risk management and development within catchments.

Draft Humber River Basin Management Plan (RBMP) (February 2009)

3.4.31 The Humber River Basin Management Plan has been completed and was published in December 2009. The following Actions from Annex C, Policy C-10 of the Humber RBMP (pgs 98-102) [24] are relevant to waste and minerals development:

> *"River side gravel pit operation to be modified wherever possible in collaboration with gravel companies and in agreement with local authorities to include river restoration as part of works. For example, the On Trent and Central Rivers Initiatives links wetlands through strategic restoration of sand and gravel quarries to establish a north -south corridor for species."*
>
> *"Implement a policy of linking gravel pits to rivers to create habitat lost through Land Drainage and Flood Defence schemes enhance fish stocks and create backwaters for other species, and using gravel pits to restore rivers."*

3.5 Adopted Local Plans

Nottinghamshire Minerals Local Plan (NCC, December 2005)

3.5.1 The Nottinghamshire Minerals Local Plan was adopted in December 2005 replacing the previous Minerals Local Plan adopted in 1997 and has a plan period which extends up to 2014. The Minerals Local Plan provides a detailed set of minerals policies which can be used to test the acceptability of all minerals planning proposals within the county.

3.5.2 Major reform to the planning system was introduced in September 2004. The Minerals Local Plan is subject to annual monitoring as part of the new development framework arrangements and will eventually be replaced by the new MDF. The current status of the Minerals Core Strategy is that there is to be a planned general public consultation on Issues and Options due to take place in summer 2011. Informal consultation with key stakeholders on a draft minerals safeguarding background paper took place in April 2009.

3.5.3 The Minerals Local Plan will be replaced by the Nottinghamshire MDF when adopted. Until the LDFs are adopted, most of the Minerals Local Plan policies have been saved by the Secretary of State. Those which are relevant to flood risk and the water environment in Nottinghamshire are summarised below:

[24] Environment Agency and Defra. 2009. River Basin Management Plan Humber River Basin District - Annex C: Actions to deliver objectives. http://www.environment-agency.gov.uk/research/planning/124803.aspx

- **Policy M3.9 'Flooding'** states that planning permission for minerals development will not be granted where there is an unacceptable impact on flood flows and flood storage capacity or on the integrity o function of flood defences and local land drainage systems unless conditions can be imposed to protect flood defences from both the temporary and permanent adverse effects of the development;

- **Policy M3.8 'Water Environment'** states that planning permission for minerals development will only be grated where (a) surface water flows are not detrimentally altered; (b) groundwater levels, where critical, are not affected; and (c) there are no risks of polluting ground or surface waters. Unless engineering measures and/ or operational management systems can adequately mitigate such risks; and

- **Policy M9.1 'Stockpiling of Dredgings'** - Proposals for the stocking of river dredgings prior to their use as aggregate will be permitted subject to measures to protect the integrity of the floodplain.

Nottinghamshire and Nottingham Waste Local Plan (NCC, January 2002)

3.5.4 The Nottinghamshire and Nottingham Waste Local Plan was adopted in January 2002 and forms part of the overall development framework for Nottinghamshire along with the Nottinghamshire and Nottingham Joint Structure Plan, District Local Plans and Nottingham City's Local Plan. The Waste Local Plan period lapsed at the end of 2004 but most policies have been saved by the Secretary of State and will remain in force until replaced by policies in the new Waste Core Strategy and other proposed waste development plan documents.

3.5.5 The Nottinghamshire and Nottingham Waste Local Plan provides a comprehensive set of policies which can be used to test the acceptability of all waste planning proposals within the county. Policy relevant to flood risk and the water environment is summarised below:

- **Policy W3 13** - Where planning permission for waste management facilities is be granted in areas where it has the potential to adversely affect floodplains, flood defences or the local drainage system conditions will be imposed to protect these systems. These conditions may include control over location of bunds, fixed plant or potential obstacles to flood flows, control on final restoration levels and or protection of existing drainage features.

3.6 Minerals and Waste Development Frameworks

3.6.1 The Nottinghamshire Minerals Development Framework (MDF) and Nottinghamshire and Nottingham Joint Waste Development Framework (JWDF) will form the structure for future minerals extraction and waste management for the next 10 - 15 years. They will comprise a range of new documents that contains policies setting out overall requirements for minerals and new waste management facilities; identifying sites where mineral extraction and waste management is acceptable in principle and general policies for protecting residential amenity, features of wildlife, heritage and landscape importance. These policies will form the main guidance for determining all minerals planning applications received by NCC and waste planning applications received by NCC and NCiC.

3.6.2 The new LDFs will emerge from a number of consultation stages which include 'Issues and Options' Consultation Papers for both minerals and waste sites and a study of sites that may have potential to accommodate a strategic waste treatment facility.

3.6.3 The primary purpose of LDDs is to make informed decisions with regards to identifying where minerals and waste sites should be located within Nottinghamshire. Current progress on document preparation is summarised below.

3.6.4 The Waste Core Strategy was open to general public consultation on Issues and Options in 2006. Following a number of changes to the planning system, consultation on further Issues and Options took place between September 2010 and November 2010.

3.6.5 Evidence gathering for the Mineral Core Strategy is currently underway and it is planned to commence general public consultation on issues and options in summer 2011. Informal consultation with key stakeholders on a draft minerals safeguarding background paper took place in April 2009.

3.6.6 Local operators, landowners and other interested parties have been invited to nominate sites that might be considered for future minerals extraction and waste management purposes. The potential minerals sites are shown and appraised in this study (see Section 6.4 and plans in Appendices A-E and table in Appendix K).

3.6.7 Potential waste sites are currently being identified by NCC from those nominated by operators and landowners relative to emerging potential future development sites.

Strategic Waste Treatment

3.6.8 The Minerals and Waste Development Framework is likely to need to make allocations for a number of strategic waste facilities, including sizeable waste treatment plant. The question therefore arises as to whether, for the purpose of this study, such a facility should be categorised as 'less vulnerable' development or whether it should be regarded as 'essential infrastructure', to which a different flood risk assessment approach would apply.

3.6.9 Essential infrastructure should be designed and constructed to remain operational and safe for users in times of flood.

4 The PPS25 Sequential Test

4.1 The Sequential Approach

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

4.1.2 The Sequential Test refers to the application of the sequential approach by LPAs. This allows the determination of site allocations based on flood risk and vulnerability (see Table 4-2 definition of Flood Zones, Table 4-3 Vulnerability). Development should be directed to Flood Zone 1 wherever possible, and then sequentially to Flood Zones 2 and 3. Additionally, within each Flood Zone development should be directed to the areas of least flood risk as identified within this SFRA.

4.1.3 PPS25 acknowledges that some areas will be at risk of flooding from flood sources other than fluvial or tidal systems. All sources of flooding must be considered when looking to locate new development. Other sources of flooding that require consideration when situating new development allocations include:

- Flooding from the Land - Surface Water;
- Flooding from Groundwater;
- Flooding from Sewers and Drains; and,
- Flooding from Manmade or Artificial Sources.

4.1.4 The LPA must demonstrate that it has considered a range of possible sites in conjunction with the Flood Zone information from the SFRA and the EA and has applied the Sequential Test in the site allocation process. Where necessary, the LPA may also need to demonstrate the acceptability of a site through the Exception Test based on location and proposed use and vulnerability (see Appendix D of PPS25).

4.1.5 LPAs are required to identify specific deliverable minerals and waste sites to meet their targets and ensure 15 years of delivery post adoption. Where this cannot be achieved broad areas for future use should be indicated. A windfall allowance should only be included where there is robust evidence of genuine local circumstances that prevent specific sites being identified.

4.1.6 Any windfall site proposed for use as a waste site will by definition differ to a site allocated in the LPAs development plan that has been sequentially tested. Therefore, the Sequential Test will need to be applied at the planning application stage and should be subject to the same consideration of flood risk as other potential sites.

4.1.7 A flow diagram for application of the Sequential Test from the Practice Guide to PPS25 is provided in Figure 4-1 overleaf.

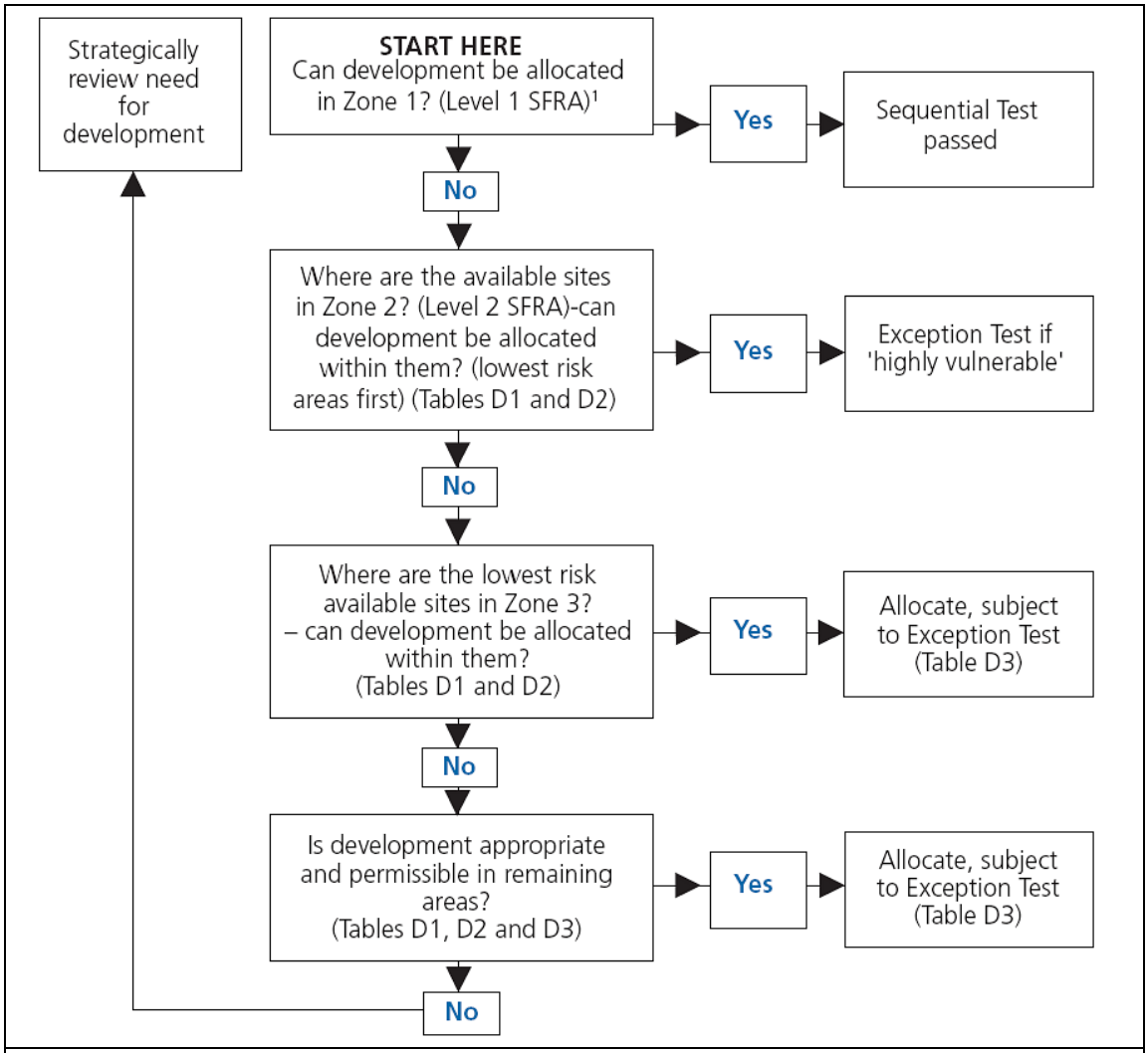

Figure 4-1: Flow diagram illustrating the application of the Sequential Test at the Local Level for LDD preparation (from PPS25 Practice Guide – December 2010 p88)

[1] Note: Other sources of flooding need to be considered in Flood Zone 1.

4.2 Using the SFRA to Apply the Sequential Test

4.2.1 The Sequential Test should be undertaken by the LPA and accurately documented to ensure decision processes are consistent and transparent. The Sequential Test should be carried out on potential development sites, with a view to balancing the flood probability and development vulnerability of sites throughout the LPA area.

4.2.2 The recommended steps required in undertaking the Sequential Test are detailed in Section 4.1. The recommendations are based on the Flood Zone and Flood Risk Vulnerability, summarised in Table 4-1 and Table 4-2 below:

Table 4-1: Flood Zones as defined in Table D1, Annex D of PPS25 (full description provided in Appendix D of PPS25).

Flood Zone	Definition		Probability of Flooding
	Fluvial	Tidal	
1	< 1 in 1000 year (< 0.1%)	< 1 in 1000 year (< 0.1%)	Low Probability
2	Between 1 in 1000 year (< 0.1%) and 1 in 100 year (1%)	Between 1 in 1000 year (< 0.1%) and 1 in 200 year (0.5%)	Medium Probability
3a	> 1 in 100 year (> 1%)	> 1 in 200 year (> 0.5%)	High Probability
3b	Either > 1 in 20 (5%) or as agreed by between the EA and LPA	Either > 1 in 20 (5%) or as agreed by between the EA and LPA	High - Functional Floodplain

Percentages refer to the probability if a flood event occurring in any one year

Table 4-2: Flood Risk Vulnerability and Flood Zone 'Compatibility' (PPS25, Appendix D, Table D.3)

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

4.2.3 The use of SFRA maps in the application of the Sequential Test is detailed in Sections 4.2 and 4.3 on the following pages, including Table 4-3 and Table 4-4 which seeks to highlight what development is appropriate in each Flood Zone.

Table 4-3: Flood Risk Vulnerability and Flood Zone Compatibility.

To be read in conjunction with Table 4-1 and Table 4-2 above.
Table seeks to highlight what development is appropriate in Flood Zones.

Use Category	Development	FLOOD ZONE			
		1	2	3a	3b
Essential Infra-structure	*Essential transport infrastructure (including mass evacuation routes), which has to cross the area at risk, and strategic utility infrastructure, including electricity generating power stations and grid, primary substations, wind turbines and water treatment works that need to remain operational in times of flood.	✓	S ⇩ ✓	S ⇩ E ⇩ ✓	S ⇩ E ⇩ ✓
Highly Vulnerable	*Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations required to be operational during flooding. *Emergency dispersal points. *Basement dwellings. *Caravans, mobile homes and park homes intended for permanent residential use. *Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure').	✓	S ⇩ E ⇩ ✓	×	×
More Vulnerable	*Hospitals. *Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. *Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels. *Non–residential uses for health services, nurseries and educational establishments. *Landfill and sites used for waste management facilities for hazardous waste. *Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.	✓	S ⇩ ✓	S ⇩ E ⇩ ✓	×
Less Vulnerable	* Police, ambulance and fire stations which are not required to be operational during flooding. *Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non–residential institutions not included in 'more vulnerable'; and assembly and leisure. *Land and buildings used for agriculture and forestry. *Waste treatment (except landfill and hazardous waste facilities). *Minerals working and processing (except for sand and gravel working). *Water treatment plants. *Sewage treatment plants (if adequate measures to control pollution and manage sewage during flooding events are in place).	✓	S ⇩ ✓	S ⇩ ✓	×
Water Compatible Development	*Flood control infrastructure. *Water transmission infrastructure and pumping stations. *Sewage transmission infrastructure and pumping stations. *Sand and gravel workings. *Docks, marinas and wharves. *Navigation facilities. *MOD defence installations. *Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. *Water-based recreation (excluding sleeping accommodation). *Lifeguard and coastguard stations. *Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. *Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.	✓	S ⇩ ✓	S ⇩ ✓	S ⇩ ✓

✓*: Appropriate use*
×*: Use should not be permitted*

S*: Use only appropriate if it passes the Sequential Test*
E*: Use only appropriate if it passes the exception test*
⇩*: If passed proceed*

Note: Even where development is found to be acceptable through the application of the Sequential and Exception Tests further flood resistance/resilience may be required in the design and construction of specific developments. Such a test should be based on the SFRA.

Sequential Test: Development should be steered first towards the lowest risk areas. Only where there are no reasonably available sites should development on suitable available sites in higher risk areas be considered taking into account flood risk vulnerability and applying the Exception Test where required.

Exception Test: Occasionally, development whose benefits outweigh the risk from flooding may be acceptable. For this test to be passed, the development should demonstrably provide wider sustainable benefits to the community, should be on previously-developed land (unless there are no reasonably available sites on previously-developed land), and should be demonstrably safe without increasing flood risk elsewhere and where possible reducing flood risk overall.

4.2.4 In accordance with PPS25, a sequential risk based approach should be used to ensure that the highest risk development is located in the area at lowest risk of flooding. The Sequential Test uses the EA and SFRA Flood Maps as a basis for measuring flood risk, this is discussed in more detail in Section 5.4.3. Table 4-4 below expands on Table 4-1 and Table 4-2 and displays the vulnerability classification for the different forms of minerals and waste developments that can be envisaged.

Table 4-4: Vulnerability Classification for Minerals and Waste Sites

Development Type	Vulnerability Classification	Acceptable Flood Zone
Installations requiring Hazardous Substances Consent	Highly Vulnerable	Flood Zone 1 and 2
Landfill and Hazardous Waste facilities	More Vulnerable	Flood Zone 1 and 2
Sewage Treatment Plants	Less Vulnerable	Flood Zones 1, 2 and 3a
Waste Treatment (except landfill and hazardous waste facilities)	Less Vulnerable	Flood Zones 1, 2 and 3a
Waste Recycling and Composting uses (except hazardous waste)	Less Vulnerable	Flood Zones 1, 2 and 3a
Minerals Working and Processing (excluding sand and gravel, including Sherwood Sandstone, Limestone, Clay and Gypsum).	Less Vulnerable	Flood Zones 1, 2 and 3a
Sand and Gravel	Water Compatible	Flood Zones 1, 2 and 3a and 3b
Secondary Aggregate Re-cycling	Less Vulnerable	Flood Zones 1, 2 and 3a
Concrete Block Manufacture	Less Vulnerable	Flood Zones 1, 2 and 3a
Concrete Batching Plant	Less Vulnerable	Flood Zones 1, 2 and 3a

4.2.5 Where the mineral or waste development type is 'highly vulnerable', 'more vulnerable', 'less vulnerable' or 'essential infrastructure' and a site is found to be impacted by a recurrent flood source (other than tidal or fluvial), the site and flood sources should be investigated further regardless of any requirement for the Exception Test. This should be discussed with the EA to

establish the appropriate time for the assessment to be undertaken, i.e. Exception Test through a Level 2 SFRA or assess through a site specific FRA.

4.2.6 The maps presented in Appendices A, B, C, D and E are designed to assist NCC in determining the flood risk classification for each site and in completing the Sequential Test. This will aid the determination of the most suitable type of land use at each site based on the vulnerability and flood risk. Certain sites have been identified as lying within Flood Zones 2 and 3 and, if suitable alternatives can not be found, in many cases it will be necessary to undertake the Exception Test (see Table 4-1).

4.2.7 The spatial strategy for minerals development is primarily driven by geology as minerals can only be worked where they naturally occur. This has implications when carrying out the Sequential Test in accordance with PPS25 (steering development to lowest flood risk) as reasonable alternative sites may not always be available. This is particularly the case with deposits of sand and gravel as many of the deposits are located within natural river floodplains which are often inundated during flood events, therefore not 'preferred' in accordance with the Sequential Test.

4.3 Using the SFRA Maps, Data and GIS Layers

4.3.1 Table 4-5 overleaf highlights which GIS layers and SFRA data should be used in carrying out the Sequential Test. The table poses some example questions that are not exhaustive, but should provide some guidance for a user of the SFRA.

Table 4-5: Sequential Test Key - A Guide to using the GIS Layers

Category	GIS Layer	Example Questions
Development Vulnerability	Not applicable refer to Table D2 in PPS25.	**Question 1** – Is the proposed land use defined as 'highly vulnerable' according to Table D2 in Planning Policy Statement 25?
		Question 2 - Is the proposed land use defined as 'more vulnerable' according to Table D2 in Planning Policy Statement 25?
		Question 3 - Is the proposed land use defined as 'less vulnerable' according to Table D2 in Planning Policy Statement 25?
		Question 4 - Is the proposed land use defined as 'essential infrastructure according to Table D2 in Planning Policy Statement 25?
		Question 5 - Is the proposed land use defined as 'water compatible development' according to Table D2 in Planning Policy Statement 25?
Flood Zone Classification	SFRA fluvial FZ2, FZ3a & FZ3b layers. Also examine historical floodplain and take into consideration climate change outlines.	**Question 6** – Through consultation of the EA's Flood Zone maps, is the site located in Flood Zone 1?
		Question 7 - Through consultation of the EA's Flood Zone maps, is the site located in Flood Zone 2?
		Question 8 - Through consultation of the EA's Flood Zone maps, is the site located in Flood Zone 3a?
		Question 9 - Through consultation of the EA's Flood Zone maps, is the site located in Flood Zone 3b?
		Question 10 - Can the proposed land use be located in Flood Zone 1?
		Question 11 - Can the proposed land use be located in Flood Zone 2?
		Question 12 - Can the proposed land use be located in Flood Zone 3a?
	EA main river maps.	**Question 13 -** Is the site located near a watercourse?

Table.4.5 (cont): Sequential Test Key - A Guide to using the GIS Layers (continued)

Category	GIS Layer	Example Questions
Other Flood Sources	SFRA fluvial FZ3 & FZ2 outlines plus climate change.	**Question 14 –** Is the site impacted by the effects of climate change
	Sewer Flood Layer & Historical Flood Outlines.	**Question 15** - Is the site in an area potentially at risk from sewer flooding?
	Historical Flood Outlines, Parish Council data, groundwater vulnerability maps.	**Question 16** - Is the site in an area potentially at risk from overland flow flooding?
		Question 17 - Is the site located in an area of rising groundwater levels?
		Question 18 - Does the site have a history of flooding from any other source?
Flood Risk Management	Flood Defence Layer (NFCDD), Flood Warning Layer, Areas Benefiting from Flood Defences Layer, Parish Council data.	**Question 19** - Does the site benefit from flood risk management measures?
		Question 20 - Can the proposed land use be relocated to an area benefiting from flood risk management measures or of lower flood risk?

4.3.2 As identified in Section 3, some watercourses in the study area do not have Flood Zones associated with them or do not have all Flood Zones defined. This is not to suggest these watercourses do not flood, moreover that modelled data is not currently available. Therefore, allocations adjacent to un-modelled watercourses or watercourses where all Flood Zones have not been defined cannot be assessed against all aspects of the Sequential Test using the existing data.

4.3.3 To overcome this deficiency in the data and to enable NCC/NCiC to proceed with application of the Sequential Test the following criteria should be considered:

- **No works should be located within 8m of any watercourse** - green corridors/buffer zones should be maintained along watercourses.
- **For watercourses where no Flood Zones have been defined –** If a site is within 50m of a watercourse and promoted for development further investigation should be undertaken to determine the suitability of the site for the proposed development. For application of the Sequential Test the site should be considered as lying within Flood Zone 3a until proven otherwise. If following further investigation the site is found to lie within Flood Zone 3b the development may not be appropriate against the policies presented in PPS25;
- **For watercourses where Flood Zone 3b (Functional Floodplain) has not been defined –** If a proposed development site is located in Flood Zone 3, there is a possibility it may also fall within Flood Zone 3b. Further investigation should be undertaken to define Flood Zone 3b for the local water course(s). According to the PPS25 Practice Guide when applying the Sequential Test the site should be considered as lying within Flood Zone 3b until proven otherwise. If following further investigation the site is found to lie within Flood Zone 3b the development may not be appropriate against the polices presented in PPS25; and
- **For watercourses where the effect of climate change on Flood Zones has not been defined –** For any development located in or adjacent to a Flood Zone boundary, there is a possibility that when considering the effects of climate change the site may be at greater flood risk. For example if a site is clearly identified to be in Flood Zone 3a (and not within 3b), when the effects of climate change are considered the site may be found to lie within Flood Zone 3b. For application of the Sequential Test, for sites located in Flood Zone 3 or at the boundary of Flood Zone 2 and 3, where the effects of climate change are not defined, the sites can be considered to lie within the higher risk Flood Zone, however the effects of climate change should be investigated further. If following further investigation the site is found to lie within a different Flood Zone the Sequential Test should be reapplied to determine if the proposed development is appropriate.

4.3.4 Adopting this approach will require LPAs to accept an element of risk when reviewing and allocating their development sites. For example, should the LPAs identify a site in Flood Zone 2 as acceptable for 'more vulnerable' development, the effects of climate change on Flood Zone definition may render the site within Flood Zone 3. In such a case, the site will therefore require application of the Exception Test. Similarly, the location of 'more vulnerable' development in Flood Zone 3a may be considered inappropriate if further work redefine those parts of Flood Zone 3a as Flood Zone 3b with consideration of climate change.

5 The Exception Test & Level 2 SFRAs

5.1 When is the Exception Test Required?

5.1.1 The application of the Sequential Test should ensure that 'more vulnerable' types of development, such as landfill sites or residential care homes (with reference to table D.2, of PPS25), are not allocated in areas at high risk of flooding.

5.1.2 For large development sites that lie within different Flood Zones, the sequential approach should be applied. If following the Sequential Test the site can be re-arranged so that flood risk and vulnerability classification of the development is deemed to be appropriate (in line with PPS25 guidelines), the Exception Test will not be required.

5.1.3 However, LPAs have to balance the requirements of PPS25 against other material considerations, which may lead to sites not being excluded from further consideration on the grounds of flood risk incompatibility alone. In these circumstances, it will be necessary for the planning authority to demonstrate that the site qualifies for development by passing all elements of the Exception Test.

5.1.4 It may be necessary to apply the Exception Test where the Sequential Test alone cannot deliver acceptable sites, and where some continuing development is necessary for wider sustainable development reasons, taking into account the need to avoid social or economic blight and the need for essential civil infrastructure to remain operational during floods.

5.1.5 Where the use of the Exception Test is required, decision makers should apply it at the earliest stage possible in the planning process to all the potential allocations for development and all planning applications other than for minor development.

5.2 The Exception Test Process

5.2.1 The Exception Test process is detailed in paragraph D9 of PPS25 and should only be applied following application of the Sequential Test. There are three stringent conditions (parts), all of which must be fulfilled before the Exception Test can be passed. These conditions are as follows:

a) *"It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk;*

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

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

5.2.2 Where the Level 1 SFRA demonstrates the potential need to apply the Exception Test, either due to current levels of flood risk or due to increases in flood risk resulting from climate change, further data collection and/or analysis may need to be carried out in a Level 2 SFRA to assist answering part c) of the Exception Test. Where a Level 2 SFRA has not been completed, a site specific FRA will be required to answer part c of the Exception Test.

5.3 What is a Level 2 SFRA?

5.3.1 Where decision makers have been unable to allocate all potential future minerals and waste sites and infrastructure in accordance with the Sequential Test using the Level 1 SFRA, it will be necessary to increase the scope of the SFRA to provide the information necessary for application of the Exception Test.

5.3.2 A Level 2 SFRA will assess the nature of the flood in more detail to include hazard and depth mapping including the presence of flood defence measures. This will allow a sequential approach to development within the flood zone, as areas with lower hazard and depth can be highlighted and developed ahead of areas at higher risk with regard to hazard and depth of water.

5.4 When is a Level 2 SFRA Required?

5.4.1 The more detailed Level 2 SFRA will be required in areas where there is high development pressure at medium or high flood risk and the Sequential Test has highlighted that there are no suitable alternative sites for the development.

5.4.2 The difference between a Level 2 SFRA and a site specific FRA is on the scale of the study, A Level 2 SFRA covers an *area* that potentially encompasses many sites or individual developments that require more refinement with regard to flood risk. Figure 5-1 below outlines the Hierarchical approach to flood risk assessment.

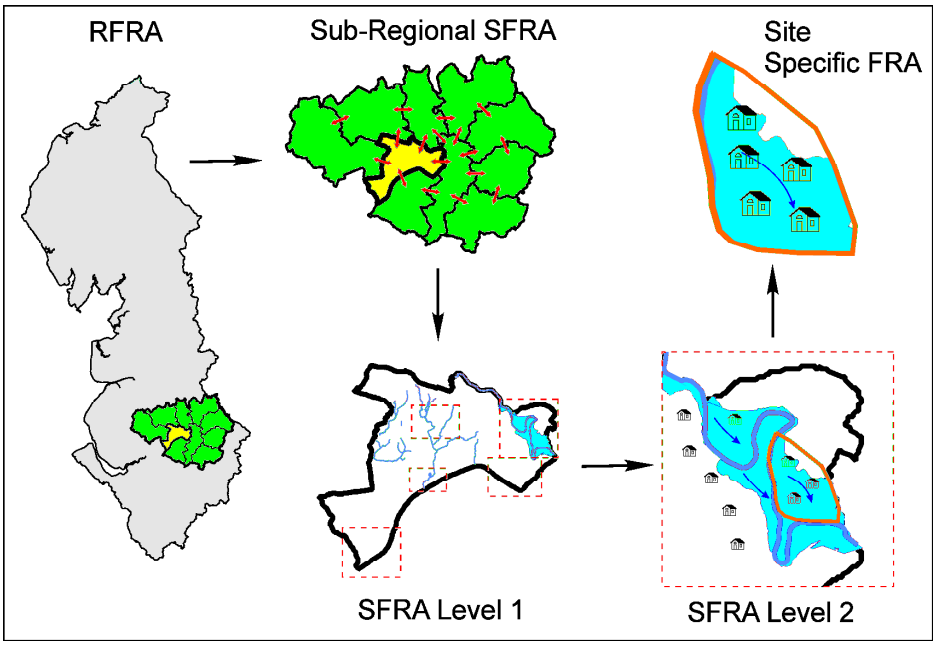

Figure 5-1: Hierarchical approach to Flood Risk Assessment.

5.4.3 Appendix M contains a framework for choosing where and when a Level 2 SFRA may be required and information and guidance on specifying Level 2 SFRAs. The requirement for

completion of the Exception Test and Level 2 SFRA is to be determined by NCC on completion of the Sequential Test.

6 Level 1 SFRA Methodology

6.1 Overview

6.1.1 As outlined in Section 1, the objective of the Level 1 SFRA is to collect, collate and review the existing available information relating to flooding in the Study Area.

6.1.2 The information is then presented in a format to enable NCC to apply the PPS25 Sequential Test to their potential minerals and waste sites by identifying sites located within Flood Zone 2 and Flood Zone 3, which, according to their vulnerability, may require the application of the Exception Test through a Level 2 SFRA.

6.1.3 Gaps in the data/information have also been identified in order to ascertain additional requirements needed to meet the objectives of a Level 2 SFRA where required.

6.1.4 A comprehensive record of all the data collected through the production of the Level 1 SFRA is presented in the document register included in Appendix F.

6.2 Tasks

6.2.1 The sequence of tasks undertaken in Stage 1 of the preparation of the Level 1 SFRA was, in chronological order:

- Inception meeting with NCC and the EA;
- Established the local Stakeholders;
- Contacted Stakeholders requesting data/information;
- Collated and reviewed data and populated data register;
- Presentation of available relevant information on flood sources and flood risk;
- Reviewed received data against the SFRA objectives; and
- Identified gaps in data.

6.2.2 The above tasks were completed between January 2010 and February 2011.

6.3 Stakeholder Consultation

6.3.1 In the preparation of this Level 1 SFRA the following stakeholders were contacted to provide data, advice and information with regards to flooding:

- Nottinghamshire County Council (NCC);
- Nottingham City Council (NCiC)
- Environment Agency (EA -Midlands Region);
- Ashfield District Council (ADC)
- Bassetlaw District Council (BDC)
- Mansfield District Council (MDC)

- Newark & Sherwood District Council (NSDC)
- Broxtowe Borough Council (BBC)
- Gedling Borough Council (GBC)
- Rushcliffe Borough Council (RBC)
- Severn Trent Water Ltd (STW);
- Anglian Water Services Ltd.(AWS);
- British Waterways (BW);
- Internal Drainage Boards (IDBs); and
- Natural England (NE) (website[25]);

6.3.2 The principal contacts and their associated details for these stakeholders are presented in Appendix G.

Nottinghamshire County Council

6.3.3 NCC were contacted to provide information, advice and data on flood risk and planning issues across its administrative area, and how its MDF and JWDF (with NCiC) programmes are emerging.

6.3.4 NCC's Highways Department were contacted as they are the responsible authority for many of the District's roads. The highways team are able to identify very detailed data such as specific gulley pots or pipes that need replacing. Much of this data is too detailed to be appropriate at the scale of a Level 1 SFRA and will be picked up at the more local level studies such as Level 2 SFRAs or site specific FRAs.

6.3.5 NCC and NCiC are currently preparing a Preliminary Flood Risk Assessment (PFRA) as required by the EU for Nottinghamshire and Nottingham City respectively (see Section 3.3) . As part of the data collection phase of this PFRA study, historical flooding records provided from a number of stakeholders throughout Nottinghamshire are being collated and digitised into GIS format. However, at the time of submission of this report they were not completed for publication. Once this has been completed, they should be included in any future updates to this SFRA (being a 'Living Document').

Environment Agency

6.3.6 The EA is the principal holder of flood risk data in the UK. The EA has discretionary powers under the Water Resource Act (1991) to manage flood risk and, as a result, are the holders of the majority of flood risk data available in the study area. Nottinghamshire falls within the Midlands region of the EA.

6.3.7 The EA attended the project inception meeting to determine what information could be made available for the SFRA and to discuss how to best use the data. A full list of the data provided by the EA can be found in Appendix F.

6.3.8 The EA have also assisted in the production of the SFRA by providing expert advice and comment.

[25] Natural England. 2010. GIS Digital Boundary Datasets. http://www.gis.naturalengland.org.uk/pubs/gis/GIS_register.asp

Local Planning Authorities

6.3.9 Individual District Council SFRAs were completed by ADC, BDC, MDC and NSDC. The Greater Nottingham SFRA was also completed for BBC, GBC, NCiC, RBC and Erewash Borough Council (Derbyshire administrative area). NCiC have also produced a River Leen SFRA (2008). Together, these assessed the flood risk posed to potential housing, employment and industrial sites across the whole of Nottinghamshire. This Level 1 SFRA utilises the data collected as part of these studies to assess the flood risk posed to potential minerals and waste sites.

6.3.10 ADC, BBC, BDC, GBC, MDC, NCiC, NSDC and RBC were contacted to provide copies of their SFRAs and GIS data to obtain information, advice and data on flood risk across their administrative area including any records of historical flooding issues.

Water Utilities

6.3.11 STW is the statutory water supply and sewerage provider for the majority of the Study Area. However, AWS provide potable water distribution for a small section along the north eastern boundary of the Study Area.

6.3.12 AWS confirmed that they held no records of sewer flooding within the Study Area. STW provided a register of flood events that have affected properties internally and externally as a result of hydraulic overloading (capacity exceedence). This information is provided to the regulatory body OFWAT (Office of Water Services) and is used to help define their capital programme. The register is also known as the DG5 register, and contains commercially sensitive information as well as information covered by the Data Protection Act (1998).

6.3.13 Sewer flooding information was also collected as part of the data provided by ADC from the 2007 Flood Survey.

6.3.14 Further detail regarding sewer flooding data is included in Section 7.6.

British Waterways

6.3.15 BW is responsible for maintaining the inland navigable waterway network across the UK including the Nottingham, Erewash, Beeston, Grantham and Chesterfield canals located in the Study Area. Consultation was undertaken to provide details of water level control measures, GIS layers of its structures and assets, and any historical flooding information.

6.3.16 This information has been summarised in Section 7.7.

Internal Drainage Boards

6.3.17 Nottinghamshire's administrative area includes watercourses that are administered by various Internal Drainage Boards (IDBs). IDBs are statutory bodies under the Land Drainage Act 1991.

6.3.18 The following IDBs were contacted for information:

- Newark Area IDB;
- Shire Group IDBs including;
  - Fairham Brook;

  - Hatfield Chase;
  - Finningley;
  - Laneham;
- Gaite Group IDBs including;
  - Everton;
  - Idle and Ryton;
  - Tickhill;
- Kingston Brook Internal Drainage Board;
- Upper Witham Internal Drainage Board; and

6.3.19 A request was made to each IDB for GIS data of their board area, centrelines of watercourses under their responsibility, catchment areas of these watercourses, hydraulic structural assets, any historical flooding information and information of any flood mitigation measures.

6.3.20 Further detail regarding flooding from IDB drains is included in Section 7.3.

Natural England

6.3.21 GIS layers were obtained from the Natural England website inclusive of Local Nature Reserves (LNR), Areas of Outstanding Natural Beauty (AONB), National Parks and Sites of Special Scientific Interest (SSSI) including those designated for wetland interest e.g. seasonally flooded grassland or wet woodland.

6.4 Data / Information Collected

6.4.1 Information and data requested from the identified stakeholders was integrated with Scott Wilson's GIS system, where possible, to facilitate review. The information collected from these stakeholders can be summarised as the following:

- Ordnance Survey (OS) background mapping;
- Administrative boundaries (County Council and District/Borough Councils);
- Hydrology e.g. EA Main Rivers, LPA ordinary watercourses, BW canals, IDB drains and watercourse catchment areas;
- EA Flood Zone Maps (February 2011);
- EA Areas Susceptible to Surface Water Flooding (AStSWF) (June 2010);
- EA Flood Maps for Surface Water (FMfSW) (February 2011);
- EA Areas Susceptible to Groundwater Flooding (AStGWF) (February 2011);
- Flood Storage Areas (February 2011);
- Detailed hydraulic model flood outlines;
- Locations and details of historical flood events (Historical Flood Map);
- Flood Warning Areas and procedures (December 2010)
- EA Catchment Flood Management Plans for the Trent;

- Hydrogeology e.g. Source Protection Zones and Vulnerability/Aquifer Designation Maps (July 2010);
- Flood defence assets e.g. raised defences (flood embankments or walls),and sluices;
- Areas benefiting from defences;
- IDB areas;
- Locations of structures e.g. culverts, pumping stations, BW raised canal embankments, aqueducts, sluices, weirs, cuttings, bridges and locks.
- Locations of Reservoirs Act (1975) reservoirs/water bodies within the study area;
- Local Authority information e.g. Local Minerals, Waste and Flood Response Plans;
- Geological mapping (derived from BGS 1:50,000 scale mapping);
- Sewer flooding problems (DG5 data); and
- Locations of potential minerals sites and information relating to the proposed land use, site size and potential reserves.

6.4.2 All data was registered and its accuracy and relevance reviewed to assess confidence levels for contribution to the SFRA. Details of all the data collected at the time of production, is presented in Appendix F.

6.5 Data Presentation – GIS Layers

6.5.1 Using the GIS layers collected, seven County overview maps and three sets of thirteen detailed 1:50, 000 scale map insets covering the entire County were produced as shown in Table 6-1 to visually assist NCC in their site allocation decision making process.

Table 6-1: SFRA Mapping Contents

	Contents	Appendix Figures
County Overviews	Study Area, Main Watercourses & Inset Index	A-1
	EA Flood Zones (Undefended)	A-2
	Internal Drainage Board Areas	A-3
	BGS Bedrock/Superficial Drift Geology	A-4
	Groundwater Source Protection Zones & Vulnerability	A-5
	Areas Susceptible to Groundwater Flooding	A-6
	Flood Warning Areas	A-7
1:50,000 Scale County Insets	Fluvial (River Flooding)	B1 to B13
	Pluvial (Surface Water Flooding)	C1 to C13
	Other Potential Sources of Flooding & Historical Flooding	D1 to D13
	Detailed Modelled Flood Outlines (Defended)	E1 to E13. *(excl. E5 and E7 where no data available)*

6.5.2 EA Main Rivers, BW canals, existing operational mineral sites and potential future mineral sites in Nottinghamshire are included in all maps.

6.5.3 Appendix H includes a detailed table highlighting the GIS layers that have been used and their limitations.

6.6 GIS Data Gaps and Assumptions

6.6.1 GIS layers of the County Council and the eight individual District/Borough Council boundaries were provided by NCiC for use in the SFRA mapping.

6.6.2 Some data that is necessary to satisfactorily complete an SFRA is either not available at all, or is not available in GIS format. In order to present the best available flood risk information for the Study Area, it has been necessary to make certain assumptions, in agreement with NCC and the EA, so that gaps in data could be filled; these assumptions have been outlined in the proceeding sections.

Fluvial Flooding Data

6.6.3 As fluvial (watercourse) flooding is a predominant source of flooding, existing GIS layers illustrating any potential sources, historical information and/or predictive extents of fluvial flooding from rivers, Ordinary Watercourses and drains in the Study Area have been mapped using data provided by the EA, IDBs and from individual LPAs as part of their local SFRAs. No additional hydraulic modelling has been undertaken as part of this study.

Data Sources and Requirements

6.6.4 As part of the Level 1 SFRA, PPS25 requires definition of the following fluvial Flood Zones across the Study Area are shown in Table 6-2.

6.6.5 Instances of historical fluvial flooding were also provided by ADC within their 2007 Flood Risk Survey GIS layer. Centrelines of LPA Ordinary Watercourses (from GBC and NSDC) and IDB drains/watercourses/culverts (GIS layers) were provided.

6.6.6 GIS layers of the EA's current (February 2011) undefended Flood Zone 2 (0.1% AEP, 1 in 1000 year event) and Flood Zone 3 (1% AEP, 1 in 100 year event) outlines were provided. GIS layers of the National Flood and Coastal Defence Database (NFCDD) raised/artificial defences and the EA's official Areas Benefiting from Defences (ABDs) were also provided (see Section 'Fluvial Flood Defences' later in this Chapter).

6.6.7 A number of detailed hydraulic modelling studies have been undertaken along watercourses within the Study Area as part of the LPA SFRAs (as mentioned in Section 6.3), EA Strategic Flood Risk Mapping (SFRM) studies or other local EA Flood Risk Mapping studies. Table 6-3 overleaf details the availability of modelled output provided by individual LPAs and the EA for the required PPS25 Flood Zones taking into account the presence of defences.

Table 6-2: PPS25 Flood Zones to be Mapped as Part of the SFRA

Flood Zone	Definition	Probability of Flooding
1	At risk from flood event greater than the 1 in 1000 year event (less than 0.1% annual probability of flooding each year).	**Low**
2	At risk from flood event between the 1 in 100 and 1 in 1000 year event (between 1% and 0.1% annual probability of flooding each year).	**Medium**
3+CC	At risk from flood event less than or equal to the 1 in 100 year event (greater than 1% annual probability of flooding each year) **plus an allowance for climate change** in accordance with PPS25 Table B.2 over the lifespan of a development. In the case of potential future minerals and waste sites, a 20% increase in peak river flows is expected up to the year 2111.	**High**
3a	At risk from flood event less than or equal to the 1 in 100 year event (greater than 1% annual probability of flooding each year).	**High**
3b	At risk from a flood event less than or equal to the 1 in 20 year event or otherwise agreed between the Local Planning Authority and the EA (greater than 5% AEP).	**High - Functional Floodplain**

Mapping

6.6.8 The EA's undefended Flood Zone 2 and Flood Zone 3 outlines, LPA Ordinary Watercourses and IDB drains/watercourses and culverts have been included in the map insets provided in Figures B1 to B13 at Appendix B to compare against potential minerals sites. GIS layers of the National Flood and Coastal Defence Database (NFCDD) raised/artificial defences and the EA's official Areas Benefiting from Defences (ABDs) have also been included (see Section 'Fluvial Flood Defences' overleaf).

Table 6-3: Detailed Modelled Flood Outlines provided for use in the SFRA

Displayed in Figures E-1 to E13 (excluding E5 and E7) at Appendix E

	Detailed Model Flood Outline Availability (Defended (D) or Undefended (UnD))							
	5% AEP (1 in 20/25 year) (FZ3b)		1% AEP (1 in 100 year) (FZ3a)		1% AEP+CC (1 in 100 year + 20% climate change) (FZ3+CC)		0.1% AEP (1 in 1000 year) (FZ2)	
Study	**UnD**	**D**	**UnD**	**D**	**UnD**	**D**	**UnD**	**D**
Greater Nottingham SFRA, Revised Oct 2010		✓		✓		✓		✓
Greater Nottingham SFRA, Black and Veatch, July 2008 (Superseded)		✓		✓		✓		✓
Tidal Trent Strategy, Black and Veatch July 2005)						✓		✓
Tidal Trent Flood Risk Management Study, Black and Veatch, April 2005				✓				
Trent Fluvial Strategy, Model 4, Black and Veatch, 2004		✓		✓		✓		
River Ryton, Bassetlaw SFRA July 2009		✓		✓		✓		✓
Retford Beck, Bassetlaw SFRA July 2009		✓		✓		✓		✓
River Idle, Bassetlaw SFRA July 2009		✓		✓		✓		✓
Baker Lane Brook, SFRM, March 2009	✓		✓		✓		✓	
River Leen and Day Brook SFRA, Black and Veatch, Sept 2008		✓	✓	✓		✓	✓	✓
Fairham and Nethergate Brook Flood Risk Mapping Study, EA, Sept 2008		✓	✓	✓		✓	✓	✓
Greythorne Dyke SFRM, Capita Symonds, October 2008		✓		✓		✓		
River Greet SFRM, Halcrow 2008	✓		✓		✓		✓	
River Meden Flood Risk Mapping Strategy, JBA, June 2008	✓		✓		✓		✓	
River Ryton SFRM, JBA, March 2008		✓	✓			✓ (SS)	✓	
River Maun Flood Risk Mapping, JBA, March 2007	✓		✓		✓		✓	
River Erewash SFRM, JBA, May 2005		✓	✓	✓				
River Idle Flood Risk Mapping, JBA, March 2005		✓	✓					

6.6.9 Figure A-3 at Appendix A illustrates where GIS layers were provided, the IDB areas of responsibility within Nottinghamshire in relation to the potential minerals sites. This indicates the relevant IDBs who are Statutory Consultees for any Level 2 SFRAs or site specific FRAs where required.

Data Assumptions and Limitations

6.6.10 The EA's Flood Zone Maps consist of a mixture of flood outlines derived through detailed numerical hydraulic modelling where available, and national broad-scale (more coarse) modelled flood outlines where detailed modelling has not as of yet been undertaken. The EA updates their Flood Map on a quarterly basis to include the results of new flood mapping studies undertaken to improved and refined the Flood Zones.

6.6.11 These Flood Zone Maps define the extent of flooding ignoring the presence of defences and the fact that their presence can not always be assured. The reason for this approach is to make an allowance for residual flood risk in the event of a failure or breach/overtopping of the flood defences. This conservative approach over time will reduce reliance on flood defences and raises the awareness of flood risk in defended areas to help ensure that it is managed appropriately as part of development proposals.

6.6.12 If a potential minerals site or emerging potential waste sites falls within an undefended EA Flood Zone 2 or Flood Zone 3, all available detailed modelled Flood Zones (GIS layers) should then be referred to.

6.6.13 The various defended and undefended detailed modelled outlines however provide an incomplete picture across the County for all the required PPS25 Flood Zones. It was therefore agreed with the EA that their latest **undefended Flood Zone 2 and Flood Zone 3** maps should be used to provide the first basis for assessing the risk of fluvial flooding against the potential minerals sites for the purposes of the Sequential Test. These are provided in Figure A-2 at Appendix A and in the Fluvial Flooding map insets provided in Figures B1 to B13 at Appendix B.

6.6.14 For information, the latest available **detailed modelled Flood Zones taking into account the presence of defences** are presented in Figures E-1 to E-13 (excl E-7) at Appendix E. Where only undefended scenarios have been run, this is because no formal/artificial raised defences exist alongside these watercourses e.g. the Rivers Maun, Meden and Greet, and Baker Lane Brook.

Functional Floodplain

6.6.15 **Where no detailed hydraulic modelled data is available for Flood Zone 3b, the Flood Zone 3a extent illustrated should be adopted as a conservative proxy for the functional floodplain** until such a time that more detailed information is available, such as completion of a Level 2 SFRA, an EA Strategic Flood Risk Mapping (SFRM) study or a site-specific FRA, as recommended by PPS25 guidance.

Climate Change

6.6.16 To ensure sustainable development now and in the future, PPS25 requires that the effects of climate change should be taken into account in an SFRA and that flood outlines delineating climate change should be presented. PPS25 outlines that when completing a SFRA, planning bodies will need to agree how to factor climate change and over what timeframe. With regard to this study in agreement with the EA, where available, detailed modelled fluvial outlines for Flood

Zone 3 including a 20% increase in peak flows allowing for the effects of climate change up to 2111 have been presented in Appendix E for the defended scenarios, and GIS layers for the undefended scenarios have been provided to NCC.

6.6.17 **In areas where no detailed hydraulic modelled data is available Flood Zone 3 plus climate change, it has been agreed with the EA that Flood Zone 2 should be adopted as a conservative proxy** until such time that more detailed information is available, such as completion of a Level 2 SFRA, an EA SFRM study or a site-specific FRA, as recommended by PPS25 guidance. This is not to say that the entire area used as a proxy is representative of Flood Zone 3 plus an allowance for climate change, but moreover that the boundary of Flood Zone 3 plus an allowance for climate change falls somewhere within that area.

6.6.18 The EA has confirmed that a new 1D/2D hybrid modelling study has been undertaken for the reach of the Trent Valley between the Ratcliffe Viaduct and Cromwell Weir. It has been confirmed that updated Flood Zones for this reach will not be available until at least the end of April 2011.

6.6.19 Sites illustrated alongside raised defences or within ABDs will require consideration of residual risk of flooding in the event of catastrophic failure of the defences (e.g. breach) as part of a Level 2 SFRA or a site specific FRA. The local SFRAs and EA should be consulted to confirm existing availability of any such modelling, which may already have performed breach analyses.

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Derivation of Flood Zones

Whilst every attempt has been made to use the most up-to-date, accurate and detailed modelled data, there were some instances where it was necessary to use proxy data where modelled data was not available.

Limitations & Uncertainties

Using proxy data to define Flood Zones presents a series of issues and limitations and uncertainties. This is especially true when Flood Zone 3a is used as a proxy for Flood Zone 3b. In urban areas, watercourses often flow in deep and canalised channels and through culverts or tunnels. However, broad-scale modelled outlines assume a 'bank-full' state prior to flooding and therefore, large areas are shown to be flooded at both Flood Zone 3 and Flood Zone 2.

The level of confidence assigned to each Flood Zone is a result of the level of assumptions and limitations in the modelling approach when deriving that Flood Zone. Until further modelling studies are complete, NCC and the EA have agreed to use the best available data and to consult when new data is available during the continuing LDF progress.

Fluvial Flood Defences

Data Sources and Requirements

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

6.6.24 Information on flood defences throughout the study area has been provided by the EA as a GIS layer of the NFCDD, listing details of major structures (such as a culvert or syphon) and raised flood defences. The NFCDD aims to provide the following information:

- The location, composition and condition of fluvial and tidal defences and watercourses referenced to identified risk areas,
- The types of asset (i.e. property, infrastructure, environmental) at risk within identified risk areas and including those protected by fluvial, tidal and coastal defences, and
- The extent of floods related to different flooding scenarios (e.g. different return periods and different types of flood event such as overtopping or embankment failure).

6.6.25 Raised defences may present a residual risk of flooding in the unlikely event of a major breach failure. The likelihood of this and potential locations where it could occur are dependent on the condition of the defences, maintenance regime and level of inspection/monitoring undertaken. The extent and impact of such an event is inevitably linked to the location at which the breach occurs and how long it is left to continue after the onset.

6.6.26 Defended Flood Zones (Figures E-1 to E13 (excluding E5 and E7 where no was available) at Appendix E) illustrated as being confined to the defences/channel highlight that the Standard of Protection (SoP) provided by the defences or natural channel banks exceeds the specified percentage AEP flood event. Flood Zones illustrated as being outside the defences/channel highlight that the percentage AEP flood event exceeds the SoP provided by the defences or natural channel banks e.g. a 1% AEP SoP defence would not constrain a 1% AEP+CC or a 0.1% AEP event and therefore during these scenarios, overtopping would ensue.

6.6.27 The EA have also provided a GIS layer of official Flood Storage Areas. There are none located within the county..

Mapping

6.6.28 The locations of NFCDD raised flood defences in the study area are presented in Figures B1-B13 included at Appendix B, and the selection of Figures at Appendix E.

6.6.29 The EA's official ABDs which include areas benefiting from defences providing a 1% AEP (1 in 100 year) SoP are included in the selection of Figures at Appendix E.

Climate Change

6.6.30 As climate change is expected to increase the frequency and intensity of peak rainfall, resulting in a subsequent increase in peak river flows, the current SoP offered by defences will reduce proportionally.

Flood Warnings

Data Sources and Requirements

6.6.31 The Civil Contingencies Bill requires that the EA *"maintain arrangements to warn the public of emergencies"*. As a Category 1 responder, the EA has a duty to maintain arrangements to warn, inform and advise the public in relation to particular emergencies.

6.6.32 The County Council also has a duty under the Civil Contingencies Act to warn and inform the public and that is done mainly through the Communications Unit.

6.6.33 The EA have provided a GIS layer of areas benefiting from the EA Flood Warning system which should be used by emergency planners in conjunction with the Flood Zone maps and flood defence information to assist in developing emergency plans for areas at risk of flooding with the study area.

Mapping

6.6.34 Figure A-7 at Appendix A illustrates coverage of the EA's Flood Warning Areas within Nottinghamshire. Appendix L details the individual flood warning codes and description of the areas covered.

Pluvial Flooding Data - Sewers

6.6.35 In urban areas, rainwater is frequently drained into surface water sewers or sewers containing both surface and waste water known as 'combined sewers'. Flooding can result when the sewer is overwhelmed by heavy rainfall, becomes blocked or is of inadequate capacity.

6.6.36 Due to the significance of sewer flooding in urbanised areas, the flood risk data that utility companies hold on their sewer network is classified as critical to contribute to addressing all sources of flood risk within the SFRA.

Data Sources and Requirements

6.6.37 Areas at risk from sewer flooding have been determined through review of records from DG5 registers provided by STW and AWS. In order to fulfil statutory commitments set by OFWAT, water companies must maintain verifiable records of sewer flooding, which is achieved through their DG5 registers. Water companies are required to record flooding arising from public foul, combined or surface water sewers and identify where properties have suffered internal or external flooding. The DG5 register does not however indicate areas or properties at risk of future flooding.

6.6.38 The data provided by STW is limited as it simply indicates areas reported to ST that have experienced flooding during the last 10 year period as a result of insufficient hydraulic capacity in the sewer network. It should be noted that the flood records provided could be misleading as they may not be a complete and accurate record of flood events in the study area over the last 10 years as some minor flooding incidents may go unreported, particularly if no property is affected by internal flooding.

6.6.39 AWS confirmed that they held no records of sewer flooding within the Study Area. Instances of STW sewer flooding were also provided by ADC within their 2007 Flood Risk Survey GIS layer.

6.6.40 It is important to note that maintenance work may have been undertaken by ST since the flooding incident(s) occurred. More detailed information should be requested from ST for site specific FRAs.

6.6.41 More detailed ST sewer flooding models provide a much more detailed and useful appreciation of the risk posed. However much of this work is not yet publicly available due to commercially sensitive issues or the Data Protection Act.

6.6.42 Until more detailed and suitable data becomes available, the Local Authorities, the EA and the utility companies should continue to liaise to determine how sewer flooding data can best be used to inform strategic planning.

Mapping

6.6.43 Detailed maps provided in Figures D1 to D13 at Appendix D illustrate incidents of internal and external surface water and foul water flooding for Nottinghamshire. Instances of sewer flooding provided by ADC included within their 2007 Flood Risk Survey have also been included in Figures D1 to D13 at Appendix D.

Climate Change

6.6.44 Climate change is estimated to result in milder, wetter winters and increased summer rainfall intensity. This combination will increase the pressure on existing sewer systems effectively reducing their design standard, leading to more frequent flooding.

6.6.45 The current data does not enable a robust assessment of the effects of climate change on sewer flooding to be undertaken. Therefore in the absence of accurate data, it can only be assumed that the effects of climate change will increase the probability of fluvial flooding.

Pluvial Flooding Data - Surface Water and Overland Flow

Data Sources and Requirements

6.6.46 An overview assessment of surface water/overland flow must be undertaken as part of the Level 1 SFRA and assessed as part of site specific FRAs.

6.6.47 Following the Pitt Review[12] it was recommended that the EA identified those areas that are a greatest risk from surface water flooding. The Environment Agency has since produced a national assessment of surface water flood risk in the form of two national mapping datasets that indicate broad areas likely to be at risk of surface water flooding.

6.6.48 The first generation national mapping, Areas Susceptible to Surface Water Flooding (AStSWF), contains three susceptibility bandings for a rainfall event with a 1 in 200 chance of occurring (less, intermediate and more). The map defines three bands of susceptibility to flooding as a result of surface water runoff from land: less, intermediate, and more. The 'more' band identifies those areas that have 'a natural vulnerability to: flood first; flood deepest; and/or, flood for relatively frequent, less extreme events (when compared to the 'intermediate' and 'less' bands).

6.6.49 The national methodology was updated in 2010 to produce the Flood Map for Surface Water (FMfSW), a revised model of two flood events (1 in 30 annual chance and 1 in 200 annual chance) taking into account the influence of both buildings and the sewer system to produce two depth bandings (greater than 0.1m and greater than 0.3m). The FMfSW picks out natural

drainage channels, rivers, low areas in floodplains, and flow paths between buildings. The maps only indicate flooding caused by local rainfall and do not show flooding that occurs from overflowing watercourses, drainage systems or public sewers caused by catchment-wide rainfall events or river flow.

6.6.50 ASTSWF maps and FMfSW covering Nottinghamshire were provided to NCC by the EA and made available for this Level 1 SFRA.

6.6.51 There are known limitations to both the ASTSWF and FMfSW datasets. Due to the simplistic modelling techniques used in deriving the maps, they are not suitable for identifying whether an individual property will flood. In locations where surface water flooding is strongly influenced by topography, the maps may be suitable for identifying where properties are in areas at risk of flooding.

6.6.52 Although the FMfSW is the most up-to-date dataset, there may be instances where the ASTSWF dataset is more appropriate:

- Local sewer capacity is able to drain less than 6mm/hr;
- Areas are very flat and longer storm durations are more likely to cause flooding than shorter durations.

6.6.53 For the purposes of this SFRA for Nottinghamshire, the FMfSW is considered the most appropriate dataset for quantifying flooding from the land.

6.6.54 The location of historical surface water flooding incidents has also been obtained as part of a review of historical information provided by ADC collected from their 2007 Flood Risk Survey.

Mapping

6.6.55 The FMfSW is illustrated in Figures C1 to C13 at Appendix C, highlighting areas at risk of surface water flooding in the future. The ADC 2007 Flood Risk Survey data is provided in Figures C1 to C13 at Appendix C.

Climate Change

6.6.56 The current data does not enable a robust assessment of the effects of climate change on sewer flooding to be undertaken. Therefore in the absence of accurate data and in combination with the increased the pressure on existing sewer systems effectively reducing their design standard, it can only be assumed that the effects of climate change will increase the probability of pluvial flooding.

Geology

Data Sources and Requirements

6.6.57 NCC provided GIS layers of Solid Bedrock and Superficial Drift deposit geological mapping originally derived from BGS 1:50,000 scale paper mapping covering Nottinghamshire to illustrate the primary choice of location for the potential minerals sites, also provided by NCC (see Section ‘Minerals and Waste Sites’ later in this chapter).

6.6.58 Groundwater protection is assisted by identifying different types of aquifer (underground layers of permeable, water-bearing rock or drift deposits from which groundwater can be extracted). From April 2010, the EA's Groundwater Protection Policy (GPP) will be using aquifer designations that are consistent with the WFD. These designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) but also their role in supporting surface water flows and wetland ecosystems.

6.6.59 The aquifer designation data is based on geological mapping provided by the BGS and is updated regularly to reflect their ongoing programme of improvements to these maps.

6.6.60 The maps are split into two different type of aquifer designation:

- **Superficial (Drift)** - permeable unconsolidated (loose) deposits (e.g. sands and gravels)
- **Bedrock** - solid permeable formations 9e.g. sandstone, chalk and limestone)

and display the following aquifer designations:

Principal Aquifers - These are layers of rock or drift deposits that have high inter-granular and/or fracture permeability, usually providing a high level of water storage and may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as 'major aquifer'.

Secondary Aquifers - These include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage. Secondary Aquifers are subdivided into two types:

- **Secondary A** - permeable layers capable of supporting water supplies at a local rather than strategic scale, sometimes forming an important source of base flow to rivers. These are generally aquifers formerly classified as 'minor aquifers';
- **Secondary B** - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers;
- **Secondary Undifferentiated** - assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both 'minor' and 'non-aquifer' in different locations due to the variable characteristics of the rock type

Mapping

6.6.61 The BGS derived Solid Bedrock and Superficial Drift deposits maps have been thematically mapped in Figure A-4 at Appendix A. The EA's Aquifer Designation Maps can be found on the EA's website[26].

[26] Environment Agency. 2011. Aquifers. http://www.environment-agency.gov.uk/homeandleisure/117020.aspx

Groundwater Vulnerability

Data Sources and Requirements

6.6.62 The EA have provided their Groundwater Vulnerability (GWV) Maps for Nottinghamshire in digital GIS format to assist with this SFRA.

6.6.63 Groundwater is an important strategic resource with three-quarters of all the groundwater pumped from boreholes or taken from springs is used for mains water supply. It directly supplies nearly a third of the drinking water in England and Wales. In some areas it is the only available drinking water resource. It also supplies nearly all those who do not have mains water.

6.6.64 Groundwater is not just for private domestic use: many hospitals, bottling and food processing plants also rely on their own groundwater supplies, as do major manufacturing and other industries. There are advantages in using groundwater for both public and private supplies: compared to surface water, it is of relatively high quality and usually requires less treatment prior to use, even for drinking and other potable purposes.

6.6.65 The widespread presence of groundwater means that any material spilt on or applied to the ground has the potential to reach the water table. Whether it will or not depends on the material involved and the ground conditions at that site. Pollutants introduced by people can overwhelm the natural capacity of the ground to deal with them.

6.6.66 If human activities do pollute groundwater, it is very difficult to return it to its original condition. Processes that take days or weeks in surface water systems may take decades to centuries in groundwater. This is because of the relatively slow rates of groundwater flow and the reduced microbiological activity below the soil zone (due to the general lack of oxygen and nutrients).

6.6.67 Protecting groundwater is therefore essential. The subsurface environment is inaccessible and complex and groundwater pollution can be very difficult to detect and may not become evident until a water supply or spring is affected. Pollutants may take months or years to migrate from the source to a receptor or to a point where they can be detected.

6.6.68 Groundwater vulnerability relates to the potential for contamination to groundwater and thus is a useful tool to determine the suitability of sustainable drainage (SuDS) techniques to manage runoff of surface water from any impermeable paved areas or buildings. The use of infiltration techniques will be dependant on the ground and groundwater conditions. However, other SuDS techniques may be suitable even if groundwater conditions preclude infiltration.

GWV Aquifer Type and Vulnerability Classification

6.6.69 The GWV Maps classify the underlying geology in terms of the aquifer type (permeability), soil leaching potential and vulnerability. The combination of all three produces the full vulnerability classification.

6.6.70 There are three aquifer types shown on GWV Maps:

- **Major Aquifer:** Highly productive and used for potable supply on a regional scale.
- **Minor Aquifer**: Variably permeable and potentially important for local water supplies.
- **Non – Aquifer**: Negligibly permeable, containing insignificant quantities of groundwater.

6.6.71 As well as an aquifer type, a vulnerability classification is assigned to each area on the map. Vulnerability is classed as **High, Intermediate** and **Low** and refers to the contaminant leaching potential through the soil and into the rock.

6.6.72 Factors that will influence the vulnerability of an aquifer to contamination include whether the aquifer is classed as confined or unconfined; the depth of the aquifer; whether the Major Aquifer is overlain by a Minor Aquifer that is in hydraulic continuity with; and the soil vulnerability.

6.6.73 Some strata have a high leaching potential and have very little ability to slow or halt the progress of contaminants and transmit them readily to the underlying aquifer. Other strata have a low leaching potential and are thus either impermeable or have a number of natural factors that can slow or stop the leaching of contaminants. Major Aquifers with a high vulnerability tend to be those with a more permeable surface geology.

GWV Soil Classification

6.6.74 There are two main types of soil classification used in conjunction with the aquifer and vulnerability ratings in the GWV maps. These include **Soils of High Leaching Potential** and **Soils of Low Leaching Potential**.

6.6.75 **"Soils of high leaching potential"** – these soils have little ability to attenuate diffuse source pollutants and in which non-adsorbed diffuse source pollutants and liquid discharges have the potential to move rapidly to underlying strata or to shallow groundwater. They are further classified into the following three sub-classes:

(1) Soils which readily transmit liquid discharges because they are either shallow, or susceptible to rapid flow directly to rock, gravel or groundwater.

(2) Deep, permeable, coarse textured soils which readily transmit a wide range of pollutants because of their rapid drainage and low attenuation potential.

(3) Coarse textured or moderately shallow soils which readily transmit non-adsorbed pollutants and liquid discharges but which have some ability to attenuate adsorbed pollutants because of their clay or organic matter contents.

6.6.76 Soil information for urban areas and restored mineral workings is based on fewer observations than elsewhere. A worst case vulnerability classification (high / H) is therefore assumed for these areas and for current mineral workings. All are given a designation HU until proved otherwise.

6.6.77 **"Soils of low leaching potential"** – soils in which pollutants are unlikely to penetrate the soil layer because either water movement is largely horizontal, or they have the ability to attenuate diffuse pollutants. Lateral flow from these soils may contribute to groundwater recharge elsewhere in the catchment. They generally have high clay or organic matter contents.

GWV Dataset Limitations

6.6.78 As with the BGS data, it is important to understand the main limitations associated with the GWV dataset. These include:

- The maps use existing geological and soil maps and databases held by the BGS and the National Soil Research Institute (NSRI) and designed to be used at a scale of

1:100,000. They are therefore suitable for strategic planning purposes but not for site-specific assessment.

- More specific vulnerability information can always be determined following more detailed site investigation.
- There are many areas, especially across restored mineral workings and urban areas, where the data is scarce and therefore it must be assumed that a worst case vulnerability exists.
- Slope and surface topography is not taken into account when assessing the vulnerability of near surface deposits.

Mapping

6.6.79 However, the EA's GWV Maps have been presented as thematic maps in Figure A-5 at Appendix A to highlight areas that overlie aquifers with a high vulnerability. The classifications provided in the GIS layer are described overleaf in Table 6-4.

Table 6-4: EA Groundwater Vulnerability Map Attribute Classifications[27]

Text	Text Description
MINOR	Variably permeable groundwater
MAJOR	Highly permeable groundwater
MINOR_L	Variably permeable groundwater with low leaching potential
MINOR_I	Variably permeable groundwater with intermediate leaching potential
MINOR_H	Variably permeable groundwater high leaching potential
MAJOR_I	Highly permeable groundwater with intermediate leaching potential
MAJOR_H	Highly permeable groundwater with high leaching potential
MAJOR_L	Highly permeable groundwater with low leaching potential
*H1	Soils which readily transmit liquid discharges because they are shallow or susceptible to rapid flow directly to rock, gravel or groundwater
*H2	Deep, permeable, coarse textured soils which readily transmit a wide range of pollutants because of their rapid drainage and low attenuation potential
*H3	Coarse textured or moderately shallow soils which readily transmit non-adsorbed pollutants and liquid discharges but have some ability to attenuate adsorbed pollutants because of their clay or organic matter content
*I1	Soils which can possibly transmit a wide range of pollutants
*I2	Soils which can possibly transmit non – or weakly adsorbed pollutants and liquid discharges but are unlikely to transmit adsorbed pollutants
*U	Soil information for urban areas and restored mineral workings

Groundwater Source Protection Zones

6.6.80 The EA have also provided their Groundwater Source Protection Zones (GWSPZs) for Nottinghamshire to assist with this SFRA. The GWSPZs[28] are defined for 2000 groundwater

[27] Environment Agency. 2005. **Groundwater Vulnerability Maps - National Dataset Field Attributes** Version 1.1.2.

sources such as wells, boreholes and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area. Generally, the closer the contaminating activity, the greater the risk posed to the aquifer. The maps show three main zones (inner, outer and total catchment).

6.6.81 The zones are used in conjunction with the EA's GPP to set up pollution prevention measures in areas which are at a higher risk, and to monitor the activities of potential polluters nearby. The shape and size of a zone depends on the condition of the ground, how the groundwater is removed, and other environmental factors. Groundwater source catchments are divided into three zones as follows:

- **SPZ1 – Inner Protection Zone** - Defined as a 50 day travel time from any point below the water table to the source. This zone has a minimum radius of 50 metres.

- **SPZ2 – Outer protection zone -** Defined by a 400 day travel time from a point below the water table. This zone has a minimum radius of 250m or 500m around the source, depending on the size of the abstraction.

- **SPZ3 – Source Catchment Protection Zone -** Defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source. For heavily exploited aquifers, the final Source Catchment Protection Zone can be defined as the whole aquifer recharge area where the ratio of groundwater abstraction to aquifer recharge (average recharge multiplied by outcrop area) is >0.75. There is still the need to define individual source protection areas to assist operators in catchment management.

Mapping

6.6.82 The EA's GWSPZs have been presented as a thematic map in Figure A-5 at Appendix A.

Groundwater Flooding

Data Sources and Requirements

6.6.83 PPS25 states that an assessment of the risk of groundwater flooding needs to be considered; however, a quantified assessment of risk from groundwater flooding is difficult to undertake, especially on a strategic scale. This is due to lack of groundwater level records, the variability in geological conditions and the lack of predictive tools (such as modelling) that can be used to make assessments of groundwater flow and risk of groundwater flooding following rainfall events.

6.6.84 The existing Making Space for Water report with UK coverage on groundwater flooding records, monitoring, risk and consolidation (HA5 project) has been used to determine broad susceptibility of groundwater flooding. Geological ground conditions in the region have been considered in establishing the level of risk associated with this flood source. Historical groundwater flooding records have been sought from the Environment Agency.

[28] Environment Agency. 2011. Groundwater Source Protection Zones. http://www.environment-agency.gov.uk/homeandleisure/37833.aspx

6.6.85 The Environment Agency released a new dataset entitled Areas Susceptible to Groundwater Flooding (AStGWF) in March 2011. This data has used the top two susceptibility bands of the British Geological Society (BGS) 1:50,000 Groundwater Flooding Susceptibility Map and thus covers consolidated aquifers (sandstone etc, termed 'clearwater' in the data attributes) and superficial deposits. It does not take account of the chance of flooding from groundwater rebound. It shows the proportion of each 1km grid square where geological and hydrogeological conditions show that groundwater might emerge.

6.6.86 The susceptible areas are represented by one of four area categories (listed below) showing the percentage of each 1km^2 that is susceptible to groundwater emergence.

- < 25%;
- >= 25% <50%;
- >= 50% <75%; and
- >= 75%.

6.6.87 It does not show the likelihood of groundwater flooding occurring. Absence of values for any grid square means that no part of that square is identified as being susceptible to groundwater emergence.

6.6.88 In common with the majority of datasets showing areas which may experience groundwater emergence, this dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding. The data should not be interpreted as identifying areas where groundwater is actually likely to flow or pond, thus causing flooding.[29]

Mapping

6.6.89 The AStGWF map is illustrated in Figure A-6 at Appendix A, highlighting areas potentially at risk of groundwater flooding in the future.

Climate Change

6.6.90 The current data does not enable a robust assessment of the effects of climate change on sewer flooding to be undertaken. Therefore in the absence of accurate data, it can only be assumed that the effects of climate change will increase groundwater flooding susceptibility.

Other Sources of Flooding – Canals, Reservoirs and other Artificial Sources

Data Sources and Requirements

6.6.91 Man-made/artificial sources of flooding include canals, reservoirs and lakes where water is retained above natural ground level, and operational and redundant industrial processes including mining, quarrying and sand and gravel extraction, as they may increase floodwater depths and velocities in adjacent areas. PPS25 therefore states that the potential effects of flood risk management infrastructure and other structures also need to be considered as part of an SFRA.

[29] Environment Agency. 2011. Areas Susceptible to Groundwater Flooding – Data Guidance and Usage.

6.6.92 BW provided GIS layers of their asset centrelines and structures (bridges, locks, sluices, weirs, aqueducts, culverts etc.) and their raised canal embankments which may present a residual risk of flooding in the unlikely event of catastrophic failure.

6.6.93 The EA have provided a spreadsheet containing amongst other data, the names, Ordnance Survey Nation Grid References (OSNGR) and capacities of all water bodies within Nottinghamshire under the Reservoirs Act (1975) (>25,000m^3 capacity).

Mapping

6.6.94 Figures D1- to D13 at Appendix D illustrate the locations of BW's canal centrelines and raised canal embankments. The EA's reservoir data has been digitised into GIS using the OSNGRs provided and illustrated relative to their capacity.

Climate Change

6.6.95 Until detailed models of canals are produced (currently on-going by BW), the effects of climate change can not yet be quantified. Therefore in the absence of accurate data, it can only be assumed that the effects of climate change will result in an increase in the probability of canal flooding.

Minerals and Waste Sites

Data Sources and Requirements

6.6.96 NCC have provided a GIS layer of 39 potential future minerals extraction site allocations put forward by the industry in response to a call for sites exercise for consideration at the site allocation phase. A number of these sites are currently unused allocations from the Adopted Minerals Local Plan (2005). A summary of the sites is detailed below in *Table 6-5*. A GIS layer of the existing operational mineral extraction sites was also provided to illustrate potential extensions.

6.6.97 Potential waste sites are currently being selected from a mixture put forward by industry and by NCC following a review of current employment land data. These sites are not at presently being progressed through the allocation system and therefore are not presented in the SFRA mapping. NCC and NCiC will however be able to use the SFRA GIS layers to compare any sites chosen against in the future.

Mapping

6.6.98 The existing and potential future minerals sites have been included in all maps presented in Appendices A-E. When overlain with flood risk and historical flooding GIS layers, it is possible to determine which of the potential minerals sites are located in areas at risk of flooding and to what extent to allow informed decisions regarding site allocation to be made.

Table 6-5: Potential Allocation Mineral Extraction Sites

Potential Allocation Reference*	Site Name	Mineral Type	Area (Ha)	OSNGR Easting	OSNGR Northing
PA01	Barnby Moor	Sand and Gravel	45	483863	370054
PA02	Bawtry Road, Bryans Close Lane	Sand and Gravel	18	481230	361970
PA03	Besthorpe East	Sand and Gravel	24	482320	363130
PA04	Besthorpe South	Sand and Gravel	66	482098	368703
PA05	Bestwood	Sherwood Sandstone	9	477954	355137
PA06	Botany Bay	Sand and Gravel	113	478685	360175
PA07	Bulcote Farm	Sand and Gravel	146	484118	355449
PA08	Burridge Farm	Sand and Gravel	54	480376	361090
PA09	Carlton Forest	Sherwood Sandstone	14	480382	357250
PA10	Coddington	Sand and Gravel	129	481995	359580
PA11	Cromwell	Sand and Gravel	52	480635	360552
PA12	Dorket Head	Brick Clay	8	481146	359580
PA13	East Leake A	Sand and Gravel	8	481731	361073
PA14	East Leake B	Sand and Gravel	28	475873	355388
PA15	East Leake C Rempstone	Sand and Gravel	19	477494	357698
PA16	East Leake D Elms Farm	Sand and Gravel	15	459045	360786
PA17	Flash Farm	Sand and Gravel	71	453536	356861
PA18	Foxholes Farm	Sand and Gravel	34	457258	352543
PA19	Girton West	Sand and Gravel	14	460350	346783
PA20	Holbeck	Magnesian Limestone	35	466803	342337
PA21	Home Farm	Sand and Gravel	170	457463	324814
PA22	Langford Quarry East	Sand and Gravel	31	466670	344213
PA23	Langford Quarry North	Sand and Gravel	31	465436	389794
PA24	Langford Quarry South	Sand and Gravel	47	465010	389570
PA25	Langford Quarry West	Sand and Gravel	35	453711	373515
PA26	Little Carlton	Sand and Gravel	73	466474	385341
PA27	Manor Farm	Sand and Gravel	151	465744	388861
PA28	Nether Langwith	Magnesian Limestone	31	467480	383141
PA29	Red Barn	Sherwood Sandstone	13	481788	384702
PA30	Rufford Quarry East	Sherwood Sandstone	23	456323	324664
PA31	Scrooby Top A	Sand and Gravel	9	456954	324791
PA32	Scrooby Top B	Sand and Gravel	9	461039	383369
PA33	Scrooby Top	Sherwood Sandstone	20	453435	369431
PA34	Shelford	Sand and Gravel	650	459894	382556
PA35	Sturton Le Steeple	Sand and Gravel	32	467680	395140
PA36	Two Oaks Farm	Sherwood Sandstone	103	456719	325264
PA37	Kirton	Brick Clay	25	469509	368834
PA38	Steetley	Limestone	20	455570	379460
PA39	Bantycock Extension	Gypsum	109	481484	348473

**As illustrated in SFRA mapping provided at Appendices A-E*

7 Review of Flood Risk in Nottinghamshire

7.1 Introduction

7.1.1 This section reviews all available flood risk data in terms of it relevance to the Study Area. The SFRA has made extensively use of data provided in the individual LPA SFRAs. The history of flooding in Nottinghamshire was reviewed and then the potential sources of flooding are highlighted. The current flood risk management and flood warning measures are also summarised for the County.

7.1.2 A table included in Appendix K provides a detailed review of all potential minerals extraction site allocations and associated works considered to date against the sources of flood risk information provided in Appendices A-E.

7.2 Historical Flooding

7.2.1 There have been numerous historical flood events in the Nottinghamshire. The EA were contacted regarding historic flood events and have provided a GIS copy of their Historic Flood Map (HFM) illustrated within Figures D1-D13 at Appendix D.

7.2.2 Records of major historical flooding events along the River Trent through Nottinghamshire as provided within the Trent CFMP have been summarised in below.

7.2.3 The River Trent catchment has a long history of flooding, with the earliest reports dating back to 530A.D. More detailed reports start to appear in the 1200s, making reference to embankments being overtopped or breached and the damage that was done. The flooding history provided by the British Hydrological Society (BHS) Chronology of British Hydrological Events[30] provides evidence of flooding from a wide range of sources, including fluvial and tidal, and, to a relatively lesser extent, surface water and groundwater. Overtopping and breach of flood embankments has long been a common cause of flooding. Table 3.1.1 of the CFMP details some of the most notable flooding events that have occurred in the Trent catchment.

7.2.4 The most significant river flooding on record occurred in February 1795. Widespread fluvial flooding resulting from a rapid thaw and over a week of constant heavy rainfall occurred on the River Trent at Burton, Nottingham and Newark. Tidal flooding breached embankments at Morton and Spalford, with flooding extending to Lincoln. The extent and depth of flooding was considered by The Fluvial Trent Strategy[31] to be the worst on record. The flooding covered an area of more than 8,000Ha to a depth of more than 3.0m in places.

7.2.5 The most severe tidal flooding took place in October/November 1954 as a result of a series of tidal surges. Other large events occurred in October 1875, March 1932, March 1947, December 1965, winter 2000 and the summer 2007.

7.2.6 Flooding resulting from overtopping of the Nottingham Canal was experienced pre 1952 in Cossall (in Broxtowe).

7.2.7 The individual SFRAs for Nottingham City and the other seven districts/boroughs within Nottinghamshire provide further detail of historical flooding events within their locality.

[30] British Hydrological Society. 2011. Chronology of British Hydrological Events. http://www.dundee.ac.uk/geography/cbhe
[31] Environment Agency. 2004. The Fluvial Trent Strategy.

7.2.8 It is noted that the number of properties having suffered internal flooding may be greater than those recorded as some residents may have chosen not to report flooding for fear of impact on household insurance.

7.2.9 None of the historical flooding incidents recorded as part of the ADC Flood Risk Survey undertaken in 2007 coincide with the potential minerals sites or within their immediate vicinity. The EA's HFM illustrates a number of potential sand and gravel sites were inundated in the past, predominantly those along the Trent valley and at an isolated site on the western outskirts of Mission (PA02) resulting from the River Idle.

7.3 Fluvial and Tidal Flooding

7.3.1 The predominant risk of flooding within Nottinghamshire is fluvial flooding from the overtopping of surface watercourses including rivers, streams and drainage channels (i.e. flows exceeding their bank-full capacity). The main watercourses within the SFRA Study Area are illustrated in Figure 2-1 and Figure A-1 at Appendix A.

River Trent

7.3.2 The River Trent is the dominant catchment draining Nottinghamshire. Major tributaries join the Trent from three main areas including;

- Peak District (Dove, Derwent and Erewash);
- South Midlands (Sow, Tame and Soar); and
- Lower catchment (Torne and Idle).

7.3.3 The River Trent bisects the Greater Nottingham administrative area, flowing in a north-easterly direction through all of the LPAs administrative areas (except Ashfield and Mansfield) across a broad and low relief alluvial floodplain. The River Trent rises in the Staffordshire Moorlands and is joined by its major tributaries in the upper catchment before flowing northeast towards the Humber Estuary.

7.3.4 A review of the National River Flow Archive (NRFA) database[32] highlighted that the Trent catchment is predominantly impervious with the catchment consisting largely of glacial clay and alluvium on top of Mercia Mudstone, but also of some sandstone and limestone. The River Trent has little or no hydrological interaction with the underlying aquifer however the catchment through the study area comprises extensive terrace gravels and alluvium within the river valleys which maintain its baseflow.

7.3.5 The Environment Agency confirmed that the River Trent is tidally influenced downstream from Cromwell Lock in the NSDC area and its tidal dominance is downstream of Gainsborough, which includes the left bank within the BDC area.

River Soar

7.3.6 The River Soar is a major tributary of the River Trent flowing generally northwards through Leicestershire. It forms the south-western border of Rushcliffe where it is joined by Kingston

[32] Centre for Ecology and Hydrology. National River Flow Archive. 2011. Trent at North Muskham. http://www.ceh.ac.uk/data/nrfa/data/station.html?28022

Brook and continues towards its confluence with the River Trent at Trentlock between Long Eaton and Ratcliffe on Soar.

7.3.7 The source of the river originates near Hinckley in Leicestershire proceeding to flow north east through Leicester where it is joined by the Grand Union Canal, River Sence, River Wreake and Rothley Brook upstream of the Greater Nottingham area.

7.3.8 The River Soar catchment is largely characterised by clay and alluvium, and is known to be rapidly responsive to rainfall events[33]. A review of the NRFA database[34] highlighted that the predominant geology of the River Soar catchment is Mercia Mudstone with some sandstones in the west and Lias clays and limestone in the east. It has a moderate to low relief.

River Erewash

7.3.9 The River Erewash is a tributary of the River Trent comprising a moderate to low relief catchment which drains Carboniferous Coal Measures with Permian and Triassic bedrock on the east and southern extents. Approximately 30% of the catchment is urban, whilst the remaining area is characterised by arable and grazing land uses[35]. The river flows from north to south forming the border between Erewash and Broxtowe Borough Councils where it flows through the Attenborough Lakes via breaches caused by mineral extraction before finally discharging into the River Trent.

River Leen

7.3.10 The River Leen comprises a moderate to low relief catchment flowing from Newstead Abbey south through Gedling and Ashfield through the centre of Nottingham City towards its confluence with the River Trent near Lenton. It has a complicated baseflow hydrology. The River Leen drains Magnesian Limestone in the west with Permian Mudstone and Sherwood Sandstone outcrops in the east, crossing the boundary between the two units several times before reaching the River Trent to the south-west of Nottingham. A significant fraction of the lower catchment is urban (approximately 50%). Other land uses include arable and grazing[36].

7.3.11 In the past, the Greater Nottingham area contained a large number of springs, many of which were located to the mudstone/sandstone boundary and drained into local river systems including the Rivers Leen and Trent. However, many tributaries of these rivers and related springs are believed to have now dried up.

Rivers Maun, Meden and Idle

7.3.12 The River Maun and River Meden form the upper catchment of the River Idle, originating in Ashfield. The River Meden flows generally north eastwards through Market Warsop. The River Maun also flows north eastwards through Ollerton before converging with the Meden at West Drayton in Bassetlaw. Continuing northwards through Retford as the River Idle, it is joined by the River Ryton west if Scafworth and redirects eastwards towards Misterton.

[33] River Trent Catchment Flood Management Plan – Scoping Report, Environment Agency, November 2006, Page 38.
[34] Centre for Ecology and Hydrology. National River Flow Archive. 2011. Soar at Kegworth. http://www.ceh.ac.uk/data/nrfa/data/station.html?28074
[35] Centre for Ecology and Hydrology. National River Flow Archive. 2011. Erewash at Sandiacre. http://www.ceh.ac.uk/data/nrfa/data/station.html?28027
[36] Centre for Ecology and Hydrology. National River Flow Archive. 2011. Leen at Triumph Road, Nottingham. http://www.ceh.ac.uk/data/nrfa/data/station.html?28035

7.3.13 A review of the NRFA database[37] highlighted that the catchment is comprised predominantly of low relief, but more moderate relief in the headwaters. Its tributaries rise on Magnesian Limestone, then traverse an outcrop of Sherwood Sandstone. The lower reaches are underlain by alluvium and Mercia Mudstone. Approximately 15% of the catchment is urban, therefore the land use is predominantly rural, inclusive of arable farming.

7.3.14 The Rivers Maun and Meden are not currently defended by any formal NFCDD defences. A significant tributary of the River Idle is the Retford Beck joining the right bank from the east. The lower reaches of the Retford Beck are heavily culverted and are considerably under capacity to convey resulting flows, causing frequent flooding at culvert entrances.

7.3.15 The Bassetlaw SFRA (2009) states that the River Idle has very few formal defences as it flows through Retford. Previously, the channel has been widened to now contain much of the 1 in 20 year (5% AEP) flows within bank. There are very few features along the River Idle banks to prevent a 1 in 100 year (1% AEP) flood spilling out of bank onto the adjacent land. Culverts present along the River Idle cause some backing up of flood water occurs due to the culverts under Albert Road and Bridgegate.

River Ryton

7.3.16 The River Ryton enters Bassetlaw from the west and flows eastwards through Worksop before redirecting northwards through Blyth and Bircotes to its confluence with the River Idle.

7.3.17 A review of the NRFA database[38] highlighted that the catchment is comprised of moderate and low relief. The headwaters drain part of the Magnesian Limestone outcrop; with the bulk underlain by Permian Marl and Sherwood Sandstone with little Superficial Drift deposits. Apart from Worksop, the catchment is wholly rural and is characterised by mainly arable farming.

7.3.18 The Bassetlaw SFRA (2009) states that in Worksop, the River Ryton has few maintained formal defences. The river passes through culverts in the town centre which are too small to carry a 1 in 100 year (1% AEP) flood event, resulting in water backing up and flooding out of bank onto the surrounding land.

River Smite

7.3.19 The River Smite flows north eastwards through eastern Rushcliffe in proximity to the settlements of Barnstone, Aslockton and Flawborough. The river is joined by the River Whipling east of Aslockton and is a tributary of the River Devon flowing northwards immediately north east of the study area boundary.

Smaller Watercourses

7.3.20 In addition to these major watercourses, there is an extensive system of streams and smaller watercourses including:

[37] Centre for Ecology and Hydrology. National River Flow Archive. 2011. Idle at Mattersey. http://www.ceh.ac.uk/data/nrfa/data/station.html?28015
[38] Centre for Ecology and Hydrology. National River Flow Archive. 2011. Ryton at Blyth. http://www.ceh.ac.uk/data/nrfa/data/station.html?28091

- River Greet,
- River Torne,
- River Poulter,
- Day Brook,
- River Whipling,
- Kingston Brook,
- Fairham Brook,
- Nethergate Brook,
- Dover Beck,
- Ouse Dyke,
- Crock Dumble,
- Baker Lane Brook,
- Polser Brook
- Lambley Dumble,
- Carlton Beck,
- Grassthorpe Beck,
- Lowfield Drain,
- Slough Dyke,
- Middle Beck,
- Woodborough Brook,
- Tinkers Leen,
- Retford Beck,
- Tottle Brook,
- Robins Wood Dyke,
- Oldcoates Dyke,
- Gamston Brook,
- Mill Dame Dyke;
- Beauvale Brook,
- Boundary Brook,
- Nut Brook,
- Ock Brook,
- Golden Brook.
- Laneham Beck,
- Saundby Beck,
- Cocker Beck,
- Greythorne Dyke,
- Lees Brook, and
- Adbolton Brook.

7.3.21 Kingston Brook IDB do not currently hold GIS data for its watercourse centre-lines, structures or area for which the Board is responsible for, however they did kindly provide the following information.

7.3.22 The Kingston Brook waterway runs from Costock Bridge on the A60 (OSNGR 4577000 3267000) and ends with its confluence with the River Soar (OSNGR 4494000 3278000). There are additionally several unnamed tributaries that drain into the Brook. There are no flood prone areas or records of flooded properties from any of the IDB's waterways, however there exists some washland that is known to build up with water.

7.3.23 No pumping stations are present within the Board's area as the Brook is solely gravity drained. Maintenance is regularly ongoing, typically including tree falls and silt removal. No formal flood defences are in place with the Board's area in place, however substantial straightening of the Brook was undertaken during the 1970's and 1980's which is considered to have reduced the flooding potential along the Brook's length. The existing British Gypsum workings at East Leake pump water from underground into the Brook. This is considered not to cause any flooding problems and is positively welcomed during periods of low flow (summertime).

Local LPA SFRAs

Ashfield District Council SFRA

7.3.24 ADC completed a Level 1 SFRA in February 2009 using existing information available such as the JBA hydraulic report for the River Erewash in 2005. Flood risk for the district of Ashfield is considered to be low however some specific locations require further investigation including the valley of Cuttail Brook, the valley below Sutton Lawn Dam, Mill Lane in Huthwaite and land to the north of Ashlands Road.

7.3.25 ADC provided a GIS layer used within their SFRA of reported historical flooding incidents following a survey undertaken in 2007. This is presented in the "Other Sources of Flooding" maps (Figures D1 to D13) at Appendix D.

Bassetlaw District Council SFRA

7.3.26 In July 2009 JBA Consulting Ltd completed a Level 1 and Level 2 SFRA for BDC. BDC is mainly at risk of flooding from fluvial sources. The main rivers in the district that pose a risk are the River Ryton which has few maintained formal defences, the River Idle which has few formal flood defences and the lower reaches of Retford Beck which are culverted and are already restricted in their capacity to carry catchment flows.

7.3.27 The BDC Level 1 SFRA included a review of existing historical information whereas the Level 2 SFRA involved the assessment of existing flood risk studies which involved hydraulic modelling (2D TU-FLOW) of the rivers Idle (JBA, 2005), Ryton (JBA, 2008) and Trent (Black & Veatch, 2005). JFLOW modelling which was used to model the breaches in the canal banks in Worksop and Retford and 2D JFLOW used to model the overtopping of defences on the River Trent were also assessed for the Level 2 SFRA.

7.3.28 GIS layers used within the BDC SFRA were provided to assist in this SFRA.

Mansfield District Council SFRA

7.3.29 RPS Group undertook a Level 1 SFRA in June 2008 for MDC. The SFRA used existing modelling information from the River Maun (JBA, 2007) and the River Meden (JBA, 2008). The SFRA concluded that MDC was generally at low risk from flooding.

Newark and Sherwood District Council SFRA

7.3.30 In July 2009 WSP produced a Level 1 SFRA for NSDC. The Level 1 assessment reviewed existing data including that from existing models from the EA, Halcrow and JBA Consulting. In June 2010 WSP produced a Level 2 assessment which focussed on three strategic sites which are centred on Newark's Growth Point. A hydrodynamic combined 1D/2D model was created for the River Trent and its tributaries, the River Devon, Middle Beck, Doge Dyke, Car Dyke, Lowfield Drain, Sidbridge Drain, the River Witham and Shire Dyke. The key finding for the Level 2 SFRA was that the majority of the land fell within areas of low fluvial flood risk; other sources of flooding also posed a low risk for flooding.

7.3.31 GIS layers used within the NSDC SFRA were provided to assist in this SFRA.

Greater Nottingham SFRA

7.3.32 The Greater Nottingham SFRA was completed by Black and Veatch in 2008. The urban area of Nottingham extends beyond the boundaries of its City Council taking in several surrounding towns and villages. The SFRA states that within the urban extent there are 20,000 properties at risk of flooding, on the right and left bank of the River Trent, from a 1 in 100 year event. A 1-D ISIS model for the Trent, Leen and Erewash was spliced together and modified to produce a 1D/2D ISIS/TU-FLOW model. In a 1 in 100 year event the existing flood defences in Sawley, Attenborough, Rylands, Nottingham City Centre, Colwick and Burton Joyce overtop into Sawley, Long Eaton, Attenborough, Dunkirk, Rylands, Nottingham City centre, Colwick, Netherfield and Burton Joyce. For the less frequent 1 in 100 year event there is modelled to be more extensive flooding of urban areas including flooding into West Bridgford, Wilford and Barton in Fabis which is presently protected for the 1 in 100 year event.

7.3.33 Table 7-1 summarises the flood risk findings of each individual district of which the urban area of Nottingham extends into.

Table 7-1: Flood Risk Areas identified from the Greater Nottingham SFRA for individual Councils

Council District/Borough	SFRA Comments
Broxtowe	• River Trent flooding would likely impact Beeston, Toton, Stapleford and Rylands areas. • Some limited locations adjacent to Boundary and Beauvale Brooks (previously modelled by BBC using HECRAS) are at risk of flooding in a 1 in 100 year (1% AEP) event. These locations include around the cricket pitch and upstream of Mansfield Road (Boundary Brook), and at Devonshire Drive and Roehampton Drive (Beauvale Brook). Flooding along Beauvale Brook is affected by the flap valve under the River Erewash defences
Gedling	• Ouse Dyke modelling revealed a small number of properties at risk from Day Brook.
Nottingham City	• Fairham and Nethergate Brooks were modelled by ISIS. This showed that four properties and Fairham Community College at risk from a 1 in 100 year (1% AEP) flood event; with more properties affected in a 1 in 1000 year (0.1% AEP) flood event.
Rushcliffe	• Fairham Brook was modelled by ISIS. The 1 in 100 annual flood event likely to affect many properties in Wilford and Clifton Boulevard. • Grantham Canal and Adbolton, Gamston and Polser Brooks are likely to cause additional flooding behind the River Trent defences.

7.3.34 The EA provided the hydraulic modelling outlines (GIS) used within the Greater Nottingham SFRA to assist in this SFRA, and included revised flood outlines for the River Trent completed more recently in October 2010.

7.3.35 Additional Ordinary Watercourse and culverted reaches GIS layers were provided by GBC.

River Leen and Day Brook SFRA

7.3.36 Black and Veatch were also commissioned by the EA, NCiC and Nottingham Regeneration Limited to carry out a SFRA of the River Leen and Day Brook. This was completed in 2008.

7.3.37 The SFRA predicts that major overtopping of the flood defences occurs at Bulwell, Basford, Bobbers Mill, Radford and Sherwood. Overtopping also affects major transport infrastructure such as the railway line, tram line and arterial roads in the north and west of Nottingham City. Generally, the River Leen channel and flood defences are considered to provide around a 1 in 25 year (4% AEP) SoP although flooding commences at a 1 in 5 year (20% AEP) flood event in parts of Bulwell, Basford and Sherwood.

7.3.38 The EA provided the detailed hydraulic modelling flood outlines (see Table 6-3) from this SFRA to assist this Level 1 Minerals and Waste SFRA for Nottinghamshire.

7.4 Flooding from Land (Pluvial/Surface Water Flooding and Overland Flow)

7.4.1 During periods of prolonged rainfall events and sudden intense downpours, overland flow generated from adjacent higher ground may flow across land and 'pond' in low-lying areas without draining into watercourses, surface water drainage systems or the ground. Intense rainfall that is unable to infiltrate into the ground or enter drainage systems can quickly run overland and result in local flooding.

7.4.2 One of the main issues with pluvial flooding is that relatively small changes to hard surfacing and surface gradients can cause flooding (garden loss and reuse of brownfield sites for example). This type of flooding is frequently experienced and often very destructive and it is possibly a more serious problem than suggested by historic records. Surface water flooding does not need a watercourse in close proximity to occur and is exacerbated by areas of highly impermeable hard standing such as tarmac, or low permeability soils and geology (such as clayey soils). In developed areas, this flood water can be polluted with domestic sewage where foul sewers surcharge and overflow.

7.4.3 As a result, development of minerals and waste sites inclusive of stockpiles and ancillary buildings could lead to more frequent surface water flooding and, although not on the same scale as fluvial flooding, it can still cause significant disruption to the site and surrounding land. However, any problems encountered from pluvial flooding are more likely to inconvenience the operator and are unlikely to be significant in assessing the suitability of sites.

7.5 Groundwater Flooding

7.5.1 Groundwater flooding occurs where groundwater levels rise above ground surface levels. The local geology is an important factor when assessing the risk of groundwater flooding. Groundwater flooding is most likely to occur in low-lying areas underlain by permeable rocks (aquifers), usually associated with chalk, sandstone and limestone catchments that allow groundwater to rise to the surface through permeable subsoil following long periods of wet weather.

7.5.2 High water tables may result in standing water on low lying ground that is unable to reach a ditch or watercourse and is unable to percolate through the ground due to seasonally high water perched groundwater levels.

7.5.3 Minerals workings in most cases excavate below the natural water table, which during periods of heavy rainfall, may rise. Mineral workings often operate a pumped system and can therefore interfere with groundwater flow. These issues would be most appropriately addressed in a site specific FRA at the planning application stage.

7.5.4 The EA's Areas Susceptible to Groundwater Flooding (AStGWF) map is presented in Figure A-6 at Appendix A.

7.6 Sewers Flooding

7.6.1 Sewer flooding generally results in localised short term flooding caused by intense rainfall events overloading the capacity of sewers. Flooding can also occur as a result of blockage, poor maintenance or structural failure.

7.6.2 Much of the sewer network dates back to Victorian times, some of which is of unknown capacity and condition. More recent sewers are likely to have been designed to the guidelines in 'Sewers for Adoption'[39]. These sewers tend to have a design standard of up to the 1 in 30 year storm event (equating to approximately a 1 in 5 year flood flow), although in many cases, it is thought that this design standard is not achieved, especially in privately owned systems.

7.6.3 It is therefore likely that parts of the sewer system will surcharge during large, high intensity rainstorm events resulting in frequent flooding, particularly if the systems are combined and if climate change forecasts are correct. Due to the limited capacities and design standards, the level of risk posed by and probability of sewer flooding is therefore greater/more frequent than that of fluvial flooding, where the SFRA examines the 1 in 100 and 1 in 1000 year return periods.

7.6.4 In addition, as towns and villages expand to accommodate growth, the original sewer systems are rarely upgraded, eventually becoming overloaded and reducing their efficiency. Compounding this problem are the effects of climate change. Climate change is forecast to result in milder and wetter winters and more thunderstorms in summer months. This combination will increase the pressure on existing sewer systems effectively reducing their capacity, leading to more frequent flooding.

7.6.5 The DG5 data register provided by STW (Figures D1 to D13 at Appendix D) has recorded a total of 1189 instances of pluvial flooding from overloaded sewers for the whole of Nottinghamshire over the last 10 years. Areas identified as having experienced the most 'significant' number of repetitions of sewer flooding instances reported to STW include those in Table 7-2 .

Table 7-2: Number of 'Significant' (=>20 only) Sewer Flooding Incidents per locality within Nottinghamshire reported to STW.

Area	Total No. of Sewer Flooding Incidents Reported
Beeston	20
Mansfield Woodhouse	27
Sutton in Ashfield	27
Kirkby in Ashfield	28
Hucknall	33
Retford	39
Gedling	40
West Bridgford	43
Worksop	47
Arnold	57
Carlton	61
Newark	82
Mansfield	93

7.7 Flooding from Canals, Reservoirs and other Artificial Sources

7.7.1 Reservoir or canal flooding may occur as a result of the facility being overwhelmed and/or as a result of dam or bank failure. The latter can happen suddenly resulting in rapidly flowing, deep water that can cause significant threat to life and major property damage. Industrial flooding can also occur when pumping ceases and groundwater returns to its natural level, for example in

[39] WRC. 2006. Sewers for Adoption. 6th Edition.

former mineral workings and urban areas where industrial water abstraction is reduced from its former rate. Some of this flooding may also be contaminated.

7.7.2 The Nottingham, Beeston, Erewash, Grantham and Chesterfield canals are all situated within the Study Area as illustrated in Figure 2-1 and Figure A-1 at Appendix A.

Nottingham Canal

7.7.3 The Nottingham Canal, opened in 1796, was formerly a 23.6km long canal stretching between Langley Mill in Derbyshire and Nottingham. The majority of its length was closed in 1937. The southern section is now part of the River Trent Navigation, and the northern section is a designated nature reserve. The downstream section through Nottingham and where it connects to the River Trent remains in use as part of the Beeston and Nottingham Canal[40].

Grantham Canal

7.7.4 The Grantham Canal stretches 53 km from Grantham to West Bridgford via 18 locks where it joins the River Trent. It was used as a water supply for agriculture, and as such most of the channel remains in water. Since the 1970s, the Grantham Canal Society has been working towards its restoration, and two stretches are now navigable to small vessels[41].

Erewash Canal

7.7.5 The Erewash Canal starts from the River Trent at Trentlock and proceeds through Long Eaton. After passing Long Eaton, the canal runs roughly parallel to the River Erewash, alongside the towns of Sandiacre and Ilkeston, crossing the River Erewash near Eastwood. The canal ceases at the Langley Mill (Great Northern) basin, where it joins the Nottingham Canal and the Cromford Canal (both now in a state of abandonment)[42].

Chesterfield Canal

7.7.6 The Chesterfield Canal is known locally as 'Cuckoo Dyke'. It was opened in 1777 and ran 74 km from the River Trent at West Stockwith in Nottinghamshire through Worksop to Chesterfield, Derbyshire[43]. The canal comprises 65 locks and two tunnels, of which one at Norwood collapsed at the start of the 20th century. As commercial traffic ceased, the lower reaches were retained and remain popular with pleasure boats. Much of the rest of the canal has been restored[44].

Flooding Mechanisms

7.7.7 Flood risk posed by the canals is at present un-quantified but they can represent as a potential flood risk.

7.7.8 Canals are considered to be controlled water bodies so flood risk is deemed to be minimal unless overtopped in storm conditions. There is, however, a residual risk of structural failure. BW is not a flood defence body, although they do manage some critical flood defense structures including the Beeston, Sawley and Cranfleet flood gates. River navigations tend to be self

[40] Wikipedia, The free encyclopedia, 2011. Nottingham Canal. http://en.wikipedia.org/wiki/Nottingham_Canal
[41] Wikipedia, The free encyclopedia, 2011. Grantham Canal. http://en.wikipedia.org/wiki/Grantham_Canal
[42] Wikipedia, The free encyclopedia, 2011. Erewash Canal. http://en.wikipedia.org/wiki/Erewash_Canal
[43] Wikipedia, The free encyclopedia, 2011. Chesterfield Canal. http://en.wikipedia.org/wiki/Chesterfield_Canal
[44] British Waterways. Waterscape. 2011. Chesterfield Canal. http://www.waterscape.com/canals-and-rivers/chesterfield-canal

maintaining (e.g. along the lower Trent), i.e. they are either operable or in flood, and severe floods can affect the structures by submerging them.

7.7.9 Water control manuals are currently being prepared for the Study Area. The principal behind these is to record what actions have to be taken to control feeds and structures in both normal and what is considered by BW to be flood conditions.

7.7.10 In general, the canal system is hydraulically closed down at relatively low river levels prior to the issuing of a flood alert from the EA. This is to protect the canal corridors from slightly high river levels which would overtop the banks, and to protect craft from venturing onto rivers at dangerous flows. The system however is dependant on the levels of associated EA flood defenses. Overtopping or breach of river defences into the canal corridor could result in transfer of flood waters to other vulnerable areas, for example problems at Beeston could lead to flooding in Nottingham city centre itself.

7.7.11 Canals generally work at relatively stable water levels with the various lock by-passes, and waste weirs passing and controlling excess feeds without leading to overtopping of the banks. The most likely cause of overtopping in canals is vandalism, highlighted by BW as a particular problem along the Erewash Canal. Incorrect use of lock gate sluices can drain pounds upstream and overwhelm pounds downstream leading to loss of water over the banks, particularly if the weirs have also been blocked by rubbish.

7.7.12 The other main cause of flooding is a failure of a canal embankment. This has been known to happen occasionally but the impact is not considered to be as extensive as a failure of a reservoir dam as studies have shown that maximum discharges are limited to the volume held within the canal cross section between two locks. This risk is managed by BW who perform monthly towpath side inspections and offside inspections at no more than quarterly intervals.

7.7.13 For potential mineral sites located adjacent to a canal, a detailed site specific FRA should be undertaken to determine the risk overtopping. For those located adjacent to raised canal embankments, the detailed site specific FRA should determine the residual risks from breaching or overtopping as a result of water level control infrastructure failure. If the development proposals are of a significant scale, consideration should be given to undertaking a Level 2 SFRA study for that area to determine these residual risks.

Reservoirs

7.7.14 From the data provided by the EA, 79 reservoirs classified under the Reservoirs Act (1975) (>25,000m^3 capacity) are located either within Nottinghamshire or upstream of the County boundary. These reservoirs are illustrated within Figures D-1 to D-13 of Appendix D.

7.7.15 Flood risk data is now available for reservoirs following a national Reservoir Inundation Mapping (RIM) project completed in 2010 in the form of flood extent outlines (now available on the EA's website[45]). Consultation with the EA will be required as part of a site specific FRA for any site located downstream of these reservoirs shown to be at risk to assess the residual risks flooding in the unlikely event of overtopping or breach failure.

[45] Environment Agency. Risk of Flooding from Reservoirs. 2011.
http://maps.environment-agency.gov.uk/wiyby/wiybyController?ep=maptopics&lang=_e

Infrastructure Failure

7.7.16 Flooding may result from the failure of engineering installations such as flood defence, land drainage pumping stations, sluice gates, floodgates and weirs. Hard defences may fail through the slow deterioration of structural components such as the rusting of sheet piling, erosion of concrete reinforcement and toe protection or the failure of ground anchors. Such deterioration is often difficult to detect, so that failure, when it occurs, is often sudden and unexpected. Failure is more likely when the structure is under maximum stress, such as extreme fluvial events when pressures on the structure are at its most extreme.

7.7.17 The council presume as a principal that they are maintained effectively but will consider for each of them the effect of a catastrophic structural failure resulting in rapid inundation of protected areas. It is considered that overtopping of such structures during conditions more severe than for which they have been designed would not itself lead to rapid inundation.

7.7.18 Section 7.8 provides further detail on flood risk management and infrastructure in Nottinghamshire.

Redundant Industrial Processes

7.7.19 Operational and redundant industrial processes such as mining, quarrying and sand and gravel extraction can pose a flood risk when pumping ceases and groundwater returns to its natural level.

7.7.20 The locations of all existing operation minerals sites are included in the mapping provided in Appendices A-E.

7.8 Existing Flood Risk Management in Nottinghamshire

7.8.1 The National Flood and Coastal Defence Database (NFCDD) identifies a significant number of flood defences throughout the study area, which are classified as fluvial defences. These include major flood defence assets along the River Trent.

7.8.2 The River Trent defences in Nottinghamshire consist of a range of methods of protection including embankments, walls and culverts with varying SoPs.

Trent Left Bank Flood Alleviation Scheme (FAS)

7.8.3 The £51 million Trent Left Bank FAS aims to reduce the risk of flooding to 16,000 homes and businesses along a 27km stretch of the River Trent, from Sawley to Colwick. It will also provide additional protection to key infrastructure along this stretch of the Trent. The Scheme aims to reduce the probability of flooding from 2% AEP (1 in 50 year) currently, to 1% AEP (1 in 100 year) once the works are complete.

7.8.4 The Nottingham Left Bank FAS was formally launched on Friday 12 June 2009 and is divided into five key stages:

- Sawley and Trent Meadows - Work now complete
- Beeston and Rylands - Work was started February 2010, expected completion date February 2011

- Attenborough (upstream and downstream of village) - Work was started January 2010, expected completion date March 2011
- Meadows - work started January 2011
- Colwick and Attenborough Village - Work at Colwick started in summer 2010 and is aimed to be finished in May 2012. Work at Attenborough Village works will start in September 2011 and hopefully finish in June 2012.

7.8.5 The scheme is to be completed and fully operational by late 2012.

Gainsborough Trent FAS

7.8.6 Gainsborough town lies low on the east bank of the lower tidal reach of the River Trent. This low lying position makes it particularly vulnerable to flooding when the spring tides coincide with high river levels.

7.8.7 A flood relief scheme for the town was first established in the early 1950s after a major flood in 1947. It was built onto existing structures, some of which were already over 100 years old. An Asset Survey in the early 1990s concluded that many of the walls and their foundations needed urgent replacement before they collapsed. In response, a FAS was commissioned.

7.8.8 The existing defences have been strengthened to provide increased protection to over 2,600 properties in Gainsborough. The new scheme aims to protect against flood events with a 0.5% AEP (1 in 200 year) chance of flooding at that location. The Gainsborough FAS was officially opened June 2010.

7.8.9 The efficient operation of channels and culverts is paramount if the existing standard of flood defence is to be maintained for the Study Area. This requires maintenance by the defence owners which include Local Authorities and private owners or by the responsible drainage authority where appropriate remedial action does not take place.

7.8.10 It must be noted that flood defences cannot be built to protect everything. With this in mind future proposals are to maximise the capacity of the floodplain as the floodplain is the best natural defence to combat flooding. This will include managed flooding of some areas and preventing development that compromises the capacity of the flood plain to retain water, particularly to reduce the impact of low order flooding. These options will include more appropriate use of the floodplain, making space for water, better flood awareness and flood-preparedness and improved emergency planning and response measures.

7.9 Flood Warning Areas

7.9.1 Ensuring people in areas of flood risk are aware of potential flooding is key to ensuring they are prepared, facilitating the protection of property and evacuation where necessary.

7.9.2 The EA operates a flood warning service for many areas at risk of fluvial and tidal flooding. The flood warning stages/codes were updated in November 2010. The service currently consists of three stages:

- **Flood Alert** - flooding is possible and that you need to be prepared;

- **Flood Warning** - flooding is expected and that you should take immediate action. Action should be taken when a flood warning is issued and not wait for a severe flood warning; and

- **Severe Flood Warning** - there is severe flooding and danger to life. These are issued when flooding is posing **significant** risk to life or disruption to communities.

7.9.3 Each code gives an indication of the expected level of danger. Although some members of the public find Flood Watches useful, they are predominantly targeted towards professional partners, alerting them to expected flooding of low lying land and roads. Flood Warnings and Severe Flood Warnings are more useful for the public, alerting them to expected property flooding.

7.9.4 All stages of warning are disseminated via Floodline Warnings Direct, which is a free service that provides warnings to registered customers by telephone, mobile, email, SMS text message and fax. Local radio, TV, loudhailers, sirens and Floodline are also used to deliver flood warning messages. The Floodline number is 0845 988 1188, and it is always kept up to date with the EA's latest flooding information.

7.9.5 Further information on Flood Warnings on force and Flood Warning Areas can be found from the EA website, under Flood Warnings and Midlands Region[46].

7.9.6 The EA's Flood Warning Areas (Section 6.6) are located predominantly along the River Trent through Beeston, Nottingham City and West Bridgford, and progress further downstream through the less densely populated Trent Valley past Newark and continuing throughout the wider flatter floodplain towards the confluence with the River Idle. Smaller areas are located alongside the River Erewash through Stapleford, River Leen and Day Brook through Nottingham City and within Worksop and Retford from the Rivers Ryton and Idle respectively.

7.9.7 The Flood Warning Areas present within the Nottinghamshire Study Area include those detailed in Appendix L.

7.10 Emergency Planning and Flood Risk

7.10.1 Local Authorities are classified as Category 1 responders in the context of the Civil Contingencies Act 2004. As such their responsibilities include risk assessment, emergency planning and warning and informing the public. Emergency plans are in place in Nottinghamshire. The Local Authorities would work closely with other Category 1 Responders, such as the Emergency Services, to minimise the impact of flooding.

7.10.2 When dealing with flood risk the multi-agency approach is as follows:

- **Preparation** – raising flood awareness, ensuring no inappropriate use of the floodplain, ensuring emergency access and egress routes are available, protecting vital infrastructure, ensuring adequate flood resilience measures are employed;
- **Response** – The emergency services would be responsible for rescuing operations with local authorities taking responsibility for providing safe refuge and short term accommodation;

[46] Environment Agency. 2011. Flood Warnings. http://www.environment-agency.gov.uk/homeandleisure/floods/31618.aspx

- **Recovery** – A Local Authority led Recovery Working Group would co-ordinate efforts to provide support to the community providing longer term temporary accommodation where appropriate.

Nottingham and Nottinghamshire Flood Response Plan

7.10.3 NCC provided an electronic copy of the Nottingham and Nottinghamshire Flood Response Plan (2009)[47]. Produced by the Local Resilience Forum (consisting of representatives from the EA, emergency services, local authorities, utility providers and many other organisations) this plan aims to:

- Identify types of flood risk in Nottingham and Nottinghamshire;
- Outline activation procedures for the emergency response to flooding;
- Agree areas of responsibility between organisations; and
- Outline the actions needed for successful recovery.

7.10.4 This details the agreed procedure for establishing a multi-agency emergency response to a major flooding incident in Nottingham and/or Nottinghamshire. No specific mention however is given to minerals and waste facilities.

7.11 Potential Future Minerals Sites and Flood Risk

7.11.1 Figure A-4 at Appendix A illustrates that a large proportion of Nottinghamshire's sand and gravel deposits occur in the valley bottom of the Trent and its tributaries and Figure A-2 at Appendix A illustrates that many of the mineral extraction sites so far identified for potential development lie wholly or at least partially within Flood Zones 2 and 3. Therefore, these sites are considered to be at a medium to high risk of fluvial flooding.

7.11.2 In the absence of a 5% AEP (1 in 20/25 year) detailed modelled Flood Zone 3b (functional floodplain) outline, all sites located within Flood Zone 3a are conservatively reclassified as being located within Flood Zones 3b. Additionally, in the absence of a 1% AEP (1 in 100 year) detailed modelled Flood Zone 3 including an allowance for climate change outline, all sites located within Flood Zone 2 are conservatively reclassified as being located within Flood Zones 3 plus climate change (see Section 6.6).

7.11.3 Stockpiles and ancillary buildings can reduce the storage capacity of the floodplain. In addition, they could alter the natural flow of the flood water by blocking flow paths and increasing flood risk to adjacent land. Typically in floodplain quarries, sand and gravel extracted in the spring and summer months are sold directly resulting in small stockpiles. However, stockpiles are often increased in late summer and autumn to provide sales during the winter months when pumps are switched off and excavation is inhibited.

7.11.4 This leads to a larger potential impact in the winter months. In order to mitigate this, the sequential approach should be applied on a site level to ensure that stockpiles and ancillary offices are located in areas at lowest flood risk to avoid being adversely affected by flooding or increasing flood risk elsewhere. Site specific FRAs submitted at the application stage can ensure that sites are designed, worked and restored accordingly.

[47] Nottingham and Nottinghamshire Local Resilience Forum. July 2009 Nottinghamshire and Nottingham Flood Response Plan, Public Version 1.
http://www.nottinghamshire.gov.uk/home/youandyourcommunity/staysafe/emergencyplanning/yrcom_emergency_planning-emergencyplans.htm#multiagencyfloodsresponseplan

7.11.5 It should be noted that the Sequential Test has not yet been completed by NCC. However, based on existing and potential locations available at the time of writing, the following comments can be made regarding the need for an Exception Test or potential Level 2 SFRA.

7.11.6 The potential Sherwood Sandstone, gypsum, brick clay and limestone extraction sites classified as 'less vulnerable' developments in PPS25 (see Table 4-3) and are predominantly located within Flood Zone 1 (<=0.1% AEP, 1 in 1000 year flood event) and therefore are considered to be at a 'low risk' of fluvial flooding. Therefore, NCC will therefore not be required to apply the Exception Test to these particular sites and it is not expected that a Level 2 SFRA study will need to be undertaken.

7.11.7 Potential limestone quarry PA38 at Steetley has a watercourse entitled Darfoulds Drain running through the centre of the site. A small area contained narrowly along the channel is illustrated as being located within Flood Zones 2 and 3 derived from what appears to be national broad-scale modelling (i.e. not a detailed model). It is recommended that any development within this site be limited to within a suitable margin of the extent of the relatively narrow Flood Zone 2 outline, meaning the site is located wholly within Flood Zone 1 (<=0.1% AEP). Neither an Exception Test nor a Level 2 SFRA would therefore be considered necessary for this site.

7.11.8 Sand and gravel sites are often located on low lying ground characteristic of lowland meandering floodplain deposits where there may be limited surface water drainage due to water tables being close to the ground surface. Therefore, these may be at increased risk of surface water and groundwater flooding resulting in standing water, and overland flow from adjacent higher ground. Overland flow paths should therefore be taken into account in spatial planning for waste and mineral developments.

7.11.9 Such sand and gravel workings are classified as 'water compatible' development (see Table 4-3) and it is not expected that an Exception Test will need to be undertaken for such sites. A Level 2 SFRA however may be required to determine the areas within these Flood Zones that poses the least hazard resulting from a combination of flood depth and velocity, within which to suitably locate the buildings and stockpiles.

7.11.10 The potential minerals sites are generally located in rural areas remote from settlements and scattered housing, therefore, sewer flooding is not thought to be a significant issue with regard to flood risk at potential minerals sites. None of the recorded sewer flooding incidents within the DG5 register are located within the boundary or immediate vicinity of any of the potential minerals sites.

7.12 Waste Management and Flood Risk

7.12.1 PPS25 Table D.2 and Table 4-4 in this report classify installations requiring hazardous substances consent as 'highly vulnerable' and are restricted to Flood Zone 1 and 2 (prior to the application of the Sequential Test). Landfill sites and facilities dealing with treatment of hazardous waste are classified as 'more vulnerable' developments, and are therefore restricted to Flood Zones 1, 2 and 3a (prior to the application of the Sequential Test).

7.12.2 Should a need to place these developments within Flood Zone 3a arise, then the Exception Test will need to be applied. All other sites including non-hazardous waste treatment facilities and waste recycling and composting uses are classified as 'less vulnerable' and are allowed within Flood Zones 1, 2 and 3a. An Exception Test will not be required for these.

7.12.3 Residual risks to these sites should be considered in a more detailed site specific FRA to determine residual risks from breaching or overtopping of canals, fluvial defences and reservoirs.

7.12.4 Emerging waste sites within the Study Area may include locations in redundant mineral site excavations. The relation of groundwater and potential contamination needs to be investigated prior to approval of any landfill.

7.12.5 As potential waste sites and uses are not yet presented, the need for a Level 2 SFRA should be kept under review during the preparation of the JWDF.

7.13 Climate Change and Future Flood Risk

7.13.1 PPS25 updates the approach to estimating the impacts of climate change on flooding by using newer scenarios predicted by the UKCIP02 (UK Climate Impacts Programme – Scenario 2). In addition to increasing the peak flow of larger watercourses (by up to 20%), PPS25 now also includes an increase in the peak rainfall intensity of up to 30%. This will seriously affect the impact from urban catchments causing rapid runoff to watercourses and surface water flooding, surcharging of gullies and drains and sewer flooding.

7.13.2 The Trent CFMP (Catchment Flood Management Plan) has also considered sustainable flood risk management for the next 50-100 years and has taken into account the flood risk drivers of climate change, urban development and changes in land use.

7.13.3 As stated in Section 6.6, in agreement with the EA, where available, detailed modelled fluvial outlines for Flood Zone 3 including a 20% increase in peak flows allowing for the effects of climate change up to 2111 have been presented in Appendix E for the defended scenarios, and GIS layers for the undefended scenarios have been provided to NCC.

7.13.4 **In areas where no detailed hydraulic modelled data is available Flood Zone 3 plus climate change, it has been agreed with the EA that Flood Zone 2 should be adopted as a conservative proxy** until such time that more detailed information is available, such as completion of a Level 2 SFRA, an EA SFRM study or a site-specific FRA, as recommended by PPS25 guidance. This is not to say that the entire area used as a proxy is representative of Flood Zone 3 plus an allowance for climate change, but moreover that the boundary of Flood Zone 3 plus an allowance for climate change falls somewhere within that area.

7.13.5 This is a conservative approach designed to help strategic planners identify where increased detail and resolution in the flood outlines is needed at either the Level 2 SFRA or Site Specific FRAs.

7.13.6 Sewer and surface water flooding are likely to become more frequent and widespread under urbanisation and climate change scenarios as the amount of impermeable surfaces and runoff increase, highlighting the importance of SuDS.

7.13.7 The supplement to PPS1 'Climate Change and Sustainable Development'[7] (see Section 3.3) sets out important objectives in order to tackle climate change, sea level rise and avoid flood risk. The purpose of design policies should be to ensure that developments are sustainable, durable and adaptable to natural hazards such as flooding. Following this guidance, it should be possible to mitigate against increased flood risk through incorporating 'flood proofing' measures such as raised finished floor levels into the development design, and/or development of compensatory storage and flood storage basins.

8 Future Flood Risk Management Options

8.1.1 All new minerals and waste site development should have flood risk management factored in at the planning stage to include the rigorous application of PPS25 with the use of Sustainable Flood Management measures encouraged where possible. This Chapter describes how flood risk management can be applied within Nottinghamshire.

In order to mitigate increased flood risk, NCC should seek opportunities to:

- Safeguard floodplains from development, ensuring the maximum possible capacity is available to attenuate floodwater and thereby safeguard existing property. Where development in the floodplain is unavoidable and flood plain storage is removed, the development should provide compensatory storage on a level for level basis to ensure that there is no loss in floodplain storage capacity.
- Restore natural river forms and floodplains (through managed retreat where possible) and in so doing restore river corridors and floodplains as areas of biodiversity and increasing their amenity value.

8.2 Sustainable Flood Risk Management

8.2.1 Traditional flood risk management measures have used hard engineering, the building of flood walls, embankments and large concrete bridges and culverts. Rivers have been straightened and floodplains drained to allow for farming and urban development. The result of these activities is that rivers flow faster and over smaller, more restricted areas than they would under natural conditions. This restricts the flow of water and can increase flood risk in other areas of the catchment. Climate change is threatening to make the situation worse so a more sustainable solution is required.

8.2.2 Sustainable Flood Risk Management promotes a catchment-wide approach to flooding that uses natural processes and systems (such as floodplains and wetlands) to slow down and store water. The use of softer engineering techniques is also promoted as is flood risk mapping, flood warning, education and emergency response.

8.2.3 Once mineral sites have become redundant, opportunities exist for floodplain creation and restoration.

8.2.4 Within the Trent CFMP (EA, December 2010) Nottinghamshire falls within six sub areas where a variety of different flood risk management policies are applicable (see Table 3-3).

8.2.5 The following action relevant to flood risk management in regards to mineral extraction sites will be carried out as part of the implementation of CFMP Policy Option 4 within Policy Units 1, 4 and 9 (Axholme and North West Lincolnshire, Shelford to Gainsborough, and Upper Soar and Upper Anker respectively):

> *"Prepare a plan identifying current and future opportunities to create restoration that is beneficial to both wildlife and flood risk management, providing*

additional flood storage potential to deal with future changes in flood frequency."

8.2.6 The following action relevant to flood risk management in regards to mineral extraction sites will be carried out as part of the implementation of CFMP Policy Option 3 within Policy Unit 2 (Sherwood):

"Identify opportunities to maximise the use and benefits of SuDS, particularly in areas where the sandstone geology will support extensive use, and where a strategy for retro-fitting SuDS may be developed."

8.2.7 The following action relevant to flood risk management in regards to mineral extraction sites will be carried out as part of the implementation of CFMP Policy Option 5 through Policy Unit Area 5 (Burton, Derby and Nottingham).

"Identify locations and opportunities where we can work with the aggregate extraction companies to improve planning for and restoration of gravel workings, - particularly in relation to FRM. "

8.2.8 The following action relevant to flood risk management in regards to mineral extraction sites will be carried out as part of the implementation of CFMP Policy Option 6 within Policy Unit 8 (Rural Leicestershire):

"Identify locations where flood attenuation ponds or wetland areas could be developed with associated habitat improvement. " and

"Identify potential sites for BAP habitat creation."

8.2.9 The Nottinghamshire Biodiversity Action Plan[48] outlines the County's (including Nottingham) strategy towards biodiversity and states that opportunities for enhancing biodiversity include *"restoring flooded gravel pits to maximise their value for biodiversity"*. There are opportunities with sustainable flood risk management techniques to enhance or create these and the following priority habitats.

Grazing Marsh/ Wet Grassland

8.2.10 This habitat is predominantly grassy habitat where the water level is controlled by ditches. These areas are particularly important for birds, beetles and dragonflies. Grazing marsh often forms part of the floodplain (functional floodplain in many cases). In other areas of wet grassland located on river floodplains, flooding may occur attracting wading birds and wildfowl whilst also providing valuable flood storage.

8.2.11 It is recommended that this SFRA and those undertaken for the individual Districts/Boroughs within Nottinghamshire should be taken into account for future biodiversity policy schemes to enhance or create grazing marsh/wet grassland to ensure that sustainable flood risk management is promoted.

[48] Nottinghamshire Biodiversity action Group. 2011. Nottinghamshire Local Biodiversity Action Plan. http://www.nottsbag.org.uk/projects.htm#bap

Wetland Habitat

8.2.12 This habitat includes areas of fenland, flushes, reedbeds and swamps. Wetland habitat can also provide attenuation to flood flows, which can help to reduce flood levels elsewhere.

8.2.13 It is recommended that this SFRA should be taken into account for future biodiversity policy and schemes to enhance or create wetlands to ensure that sustainable flood risk management is promoted.

Aquatic Habitat

8.2.14 The UK biodiversity Action Plan includes the category of eutrophic standing waters. The term aquatic habitat covers rivers and ditches, reservoirs, ponds, gravel pits and canals. The EA is responsible for the management of the Main Rivers and streams within Nottinghamshire. Their aim is to protect and enhance the value of watercourses through the appropriate management and implementation of appropriate policies.

8.2.15 It should be noted that aquatic habitat areas often have minimal flood storage capacity as they are already filled with water. Therefore, the potential flood risk management options using aquatic habitat may be limited.

8.2.16 Sustainable flood risk management techniques should be applied with conservation targets in mind to provide habitats and flood storage areas.

8.3 Sequential Working and Restoration of Minerals Sites

8.3.1 Sequential working and restoration can be designed to reduce flood risk by providing flood storage and attenuation.

8.3.2 Research carried out by Symonds Group on behalf of DEFRA, the Mineral Industry Sustainable Technology and the Mineral Industry Research Organisation looked into the influence of aggregate quarrying in floodplains on flood risk and has highlighted some flood risk issues, as discussed above in Section 7.

8.3.3 The results also showed that sand and gravel extraction in a floodplain will create a void that can be used to provide potential storage during a flood event, generally reducing flow and water levels in the vicinity of the extraction. However, long term benefits will only accrue where larger workings up-stream of a valuable settlement are restored to an open water environment; it is also thought that any benefits are diminished where workings are more than 2km upstream of a settlement.

8.3.4 This potential sequential working and restoration is likely to be most effective at a strategic (County) scale and is suggested in PPS25 Practice Guide. While restoration of minerals sites can be designed to provide flood storage during flood events, areas of open water also provide wildlife benefits and are a method of sustainable flood management. Water filled mineral extraction sites are valuable stopping off points for migrating wildfowl. Where marginal vegetation is present they can also provide nesting sites and a good habitat for invertebrates.

8.3.5 NCC has provided the following provisional restoration options detailed in Table 8-1 for their current potential minerals sites.

Table 8-1: Potential Allocation Mineral Extraction Sites – Potential Restoration Options

Potential Allocation Reference*	Site Name	Mineral Type	Area (Ha)	Potential Restoration Option
PA01	Barnby Moor	Sand and Gravel	45	Agriculture & Nature Conservation
PA02	Bawtry Road, Bryans Close Lane	Sand and Gravel	18	Heathland & Grass
PA03	Besthorpe East	Sand and Gravel	24	Water Nature Conservation
PA04	Besthorpe South	Sand and Gravel	66	Water
PA05	Bestwood	Sherwood Sandstone	9	Nature Conservation
PA06	Botany Bay	Sand and Gravel	113	Agriculture & Wetland
PA07	Bulcote Farm	Sand and Gravel	146	Agriculture & Water
PA08	Burridge Farm	Sand and Gravel	54	Water Nature Conservation
PA09	Carlton Forest	Sherwood Sandstone	14	Agriculture & Nature Conservation
PA10	Coddington	Sand and Gravel	129	Water
PA11	Cromwell	Sand and Gravel	52	-
PA12	Dorket Head	Brick Clay	8	Landfill
PA13	East Leake A	Sand and Gravel	8	Agriculture & Wetland
PA14	East Leake B	Sand and Gravel	28	-
PA15	East Leake C Rempstone	Sand and Gravel	19	-
PA16	East Leake D Elms Farm	Sand and Gravel	15	Agriculture & Water
PA17	Flash Farm	Sand and Gravel	71	Agriculture & Water
PA18	Foxholes Farm	Sand and Gravel	34	Water
PA19	Girton West	Sand and Gravel	14	Agriculture & Water
PA20	Holbeck	Magnesian Limestone	35	Water & Low Level Restoration
PA21	Home Farm	Sand and Gravel	170	Agriculture
PA22	Langford Quarry East	Sand and Gravel	31	Agriculture
PA23	Langford Quarry North	Sand and Gravel	31	Water & Nature Conservation
PA24	Langford Quarry South	Sand and Gravel	47	Wetland
PA25	Langford Quarry West	Sand and Gravel	35	Wetland Nature Conservation
PA26	Little Carlton	Sand and Gravel	73	Agriculture & Wetland
PA27	Manor Farm	Sand and Gravel	151	-
PA28	Nether Langwith	Magnesian Limestone	31	Agriculture & Nature Con
PA29	Red Barn	Sherwood Sandstone	13	-
PA30	Rufford Quarry East	Sherwood Sandstone	23	Nature Conservation
PA31	Scrooby Top A	Sand and Gravel	9	Farmland or Lakes
PA32	Scrooby Top B	Sand and Gravel	9	Farmland or Lakes
PA33	Scrooby Top	Sherwood Sandstone	20	-
PA34	Shelford	Sand and Gravel	650	Agriculture & Water
PA35	Sturton Le Steeple	Sand and Gravel	32	Water or Infill with PFA
PA36	Two Oaks Farm	Sherwood Sandstone	103	Agriculture & Conservation
PA37	Kirton	Brick Clay	25	Water Area & Nature Conservation
PA38	Steetley	Limestone	20	-
PA39	Bantycock Extension	Gypsum	109	-

**As illustrated in SFRA mapping provided at Appendices A-E*

8.4 Sustainable Drainage Systems (SuDS)

8.4.1 An overview of SuDS and why they should be used is included below. Further detail on SuDS including techniques and a map showing where they can be utilised is included in Appendix I.

What are SuDS?

8.4.2 SuDS are typically softer engineering solutions inspired by natural drainage processes such as ponds and swales which manage water as close to its source as possible.

8.4.3 Wherever possible, SuDS techniques should seek to contribute to each of the three goals identified below, with the preferred system contributing significantly to each objective. SuDS solutions for specific sites should seek to:

- reduce flood risk (to the site and neighbouring areas);
- reduce pollution; and,
- provide landscape and wildlife benefits.

8.4.4 These goals can be achieved by utilising a management plan incorporating a chain of techniques, (as outlined in Interim Code of Practice for Sustainable Drainage Systems[49] (2004) and The SuDS Manual[50] (2007)), where each component adds to the performance of the whole system. These include:

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

Why use SuDS?

8.4.5 Traditionally, built developments have utilised piped drainage systems to manage surface water and convey surface water run-off away from developed areas as quickly as possible. Typically these systems connect to the public sewer system for treatment and/or disposal to local watercourses. Whilst this approach rapidly transfers surface water from developed areas, the alteration of natural drainage processes can potentially impact on downstream areas by increasing flood risk and reducing water quality.

8.4.6 Due to the difficulties associated with upgrading sewer systems it is uncommon for sewer and drainage systems to keep pace with the rate of development/re-development and the increasingly stringent drainage discharge restrictions that are being placed upon them. As development continues and/or urban areas expand these systems can become inadequate to deal with the volumes of surface water that is generated, resulting in increased flood risk and/or

[49] National SUDS Working Group. July 2004. Interim Code of Practice for Sustainable Drainage Systems. http://www.ciria.org.uk/suds/pdf/nswg_icop_for_suds_0704.pdf
[50] CIRIA. 2007. The Sustainable Drainage Systems (SuDS) Manual 697. London

pollution to watercourses. Allied to this are the implications of climate change and increasing rainfall intensities.

8.4.7 Appropriate use of SuDS should be promoted on sites that taking into account the local geology (Figure A-4 at Appendix A), EA aquifer designation[26], groundwater vulnerability and GWSPZs (Figure A-5 at Appendix A) into account as well as any local ground contamination (known or suspected) to avoid mobilising pollutants that could pollute the watercourses or groundwater.

9 Site Specific FRA Guidance

9.1 Introduction

9.1.1 The requirements for site specific FRAs across Nottinghamshire will vary depending on the location of the site. The assessment of flood risk is a fundamental consideration for new development or redevelopment regardless of its scale or end-use. Understanding the flood risk posed to and by a development is key to managing the risk to people and property thereby reducing injury, property damage or even death.

9.1.2 The effects of climate change may exacerbate future flood risk. Current predictions indicate that milder, wetter winters and hotter, drier summers will be experienced in the future and there will be a continued rise in sea levels. These changes will potentially lead to changes in the magnitude, frequency and intensity of flood events. Some areas currently defended from flooding may be at greater risk in the future due to the effects of climate change or as the defence condition deteriorates with age.

9.1.3 Opportunities to manage flood risk posed to and from development exist through understanding and mitigating the risk. The location, layout and design of developments should be considered to enable the management of flood risk through positive planning. This positive planning approach must consider the risks to a development from local flood sources and the consequences a development may have on increasing flood risk to the surrounding areas. Early identification of flood risk constraints can ensure developments are sustainable whilst maximising development potential.

9.1.4 A Level 1 SFRA should present sufficient information to assist LPAs to apply the Sequential Test and identify where the Exception Test may be required. These documents are predominately based on existing data. The scale of assessment undertaken for an SFRA is typically inadequate to accurately assess the risks at individual sites within the study area as, for example, the EA and SFRA Flood Zone Mapping do not account for all watercourses within the study area.

9.1.5 Therefore, there are requirements for site specific FRAs to be submitted with many planning applications for individual development proposals.

9.1.6 For the sites currently under consideration by NCC and NCiC in the preparation of their MDF and JWDF, there are circumstances where a FRA would be expected to be submitted with a planning application, irrespective of whether the site has been identified as appropriate for development in the LDF. This is because the need for a FRA does not automatically infer that a Level 2 SFRA will have been undertaken prior to the inclusion of the site in the LDF.

9.1.7 Site-specific FRAs are required to assess the flood risk posed to and by proposed developments and to ensure that, where necessary, appropriate mitigation measures are included in the development.

9.1.8 The guidance presented in the following Chapter has been based on:

- The recommendations presented in PPS25 and the accompanying Practice Guide;
- The information contained within this Level 1 SFRA report.

9.2 When is a FRA Necessary?

9.2.1 When deciding if a FRA is required, Flood Risk Standing Advice (January 2011)[51] available on the EA's website should be referred to as this outlines when the EA should be consulted.

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

9.2.3 In the following situations a planning application should always be accompanied with a FRA:

- Development sites located in Flood Zone 2 or 3;
- Land in an area within Flood Zone 1 which has critical drainage problems and which has been notified for the purposes of article 10 of Article 10 of The Town and Country Planning (General Development Procedure) Order 1995 to the LPA by the EA;
- Proposed development that is classed as a major development and located in Flood Zone 1. In respect of non-residential development, a development where the new floor space to be provided is 1,000m^2 or more, or the site area is 1 Hectare (Ha) or more. Since the risk of fluvial or tidal flooding within these sites is minimal, such FRAs should focus on the management of surface water;
- Development sites located in an area known to have experienced flooding problems from any flood source;
- Development sites located within 9m (water environment) of any watercourse regardless of Flood Zone classification.

9.3 What are the Requirements of a FRA?

9.3.1 Annex E of PPS25 presents the minimum requirements for FRAs. These include:

- The consideration of the risk of flooding arising from the development in addition to the risk of flooding to the development;
- Identify and quantify the vulnerability of the development to flooding from different sources and identify potential flood risk reduction measures;
- Assessment of the remaining 'residual' risk after risk reduction measures have been taken into account and demonstrate that this is acceptable for the particular development;
- The vulnerability of people that could occupy and use the development, taking account of the Sequential and Exception Tests and the vulnerability classification, including arrangements for safe access and egress;
- Consideration of the ability of water to soak into the ground, which could change with development, along with how the proposed layout of development may affect drainage systems;
- Fully account for current climate change scenarios and their effect on flood zoning and risk.

[51] Environment Agency. 2011. Flood Risk Standing Advice, version 3.0. http://www.environment-agency.gov.uk/research/planning/33098.aspx

9.4 FRA Staged Approach

9.4.1 The Practice Guide to PPS25 (December 2009) advocates a staged approach to site-specific FRAs with the findings from each stage informing the next and site master plans, iteratively throughout the development process.

9.4.2 The staged approach comprises of three stages outlined below:

Level 1 - Screening Study

9.4.3 A Level 1 Screening Study is intended to identify if a development site has any flood risk issues that warrant further investigation. This should be based on existing information such as that presented in the Level 1 SFRA. Therefore this type of study can be undertaken by an Environment Agency Development Control Officer in response to the developer query or by a developer where the Level 1 SFRA is available. Using the information presented in the Level 1 SFRA and associated GIS layers a Development Control Officer could advise a developer of any flooding issues affecting the site. A developer can use this information to further their understanding of how flood risk could affect a development.

Level 2 - Scoping Study

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

Level 3 – Detailed Study

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

9.4.6 The staged approach is a flexible system as every FRA does not need to go through all three stages. Where sites are located next to a watercourse and it is known that modelling is required just a Level 3 FRA can be completed. At sites where less data is available a screening study may be required to establish if a Level 3 study is required.

9.4.7 At all stages, the LPA, and where necessary the EA and/or the Statutory Water Undertaker (STW / AWS) should be consulted to ensure the FRA provides the necessary information to fulfil the requirements for Planning Applications.

9.5 Flood Zone 1

9.5.1 A FRA is required within Flood Zone 1 if the proposed minerals or waste development is known to be or has historically been vulnerable to any type of flood source or the site area is greater than 1.0Ha. This is to ensure storm water generated by the site is managed in a sustainable manner and does not increase the burden on existing infrastructure and/or flood risk to neighbouring property. The FRA can be brief unless the factors above or local considerations require particular attention. Minimum requirements for a FRA can be found at Appendix E of PPS25.

9.5.2 The PPS25 policy aim for Flood Zone 1 is 'developers and local authorities should seek opportunities to reduce the overall level of flood risk to the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques'.

9.6 Flood Zone 2

9.6.1 All minerals or waste developments proposed within Flood Zone 2 require a FRA. The minimum requirements can be found at Annex E of PPS25. The land use appropriate for this Flood Zone, as classified by Table D2 of PPS25 are water compatible, less vulnerable, more vulnerable and essential infrastructure. Highly vulnerable types of land use are only appropriate in Flood Zone 2 if the Exception Test is passed.

9.6.2 With regard to Flood Zones 1 and 2, the aim of PPS25 is for developers to seek opportunities to reduce the overall level of flood risk to the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

9.7 Flood Zone 3a

9.7.1 All developments proposed within Flood Zone 3a require a FRA. The minimum requirements can be found in Annex E of PPS25. The PPS25 policy aims for this zone are:

- Reduce the overall level of flood risk in the area through the outlay and form of the development and appropriate application of sustainable drainage techniques;
- Relocate existing development to land in zones with a lower probability of flooding;
- Create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

9.7.2 The water compatible and less vulnerable uses of land as classified by Table D2 of PPS25 are permitted in this zone. The highly vulnerable uses in Table D2 should not be permitted in this zone. The more vulnerable and essential infrastructure uses in Table D.2 should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for use in times of flood.

9.8 Flood Zone 3b

9.8.1 A functional floodplain is defined as an area of land where water has to flow or be stored at times of flood (PPS25, DCLG 2010). All developments proposed within Flood Zone 3b require a FRA. The minimum requirements can be found in Annex E of PPS25. The PPS25 policy aims for this zone are:

- Reduce the overall level of flood risk in the area through the outlay and form of the development and appropriate application of sustainable drainage techniques;
- Relocate existing development to land in zones with a lower probability of flooding.

9.8.2 The water compatible uses and essential infrastructure listed in Table D2 of PPS25 that are permitted in this zone should be designed and constructed to:

- Remain operational and safe for use in times of flood;
- Result in no net loss of floodplain storage;
- Not impede flood risk elsewhere.

9.8.3 At all stages, the LPA and, where necessary, the EA and statutory water undertaker (STW/AWS) should be consulted to ensure the FRA provides the necessary information to fulfil the requirements for planning applications.

To achieve the aims of PPS25 with regard to FRAs, NCC and NCiC should:

- Ensure the PPS25 Sequential Test is undertaken for all occasions and windfall sites promoted for waste development within the Study Areas;
- Have regard to the vulnerability classification of the particular minerals or waste development and local emergency planning issues when determining suitable locations for development;
- Have regard to the cumulative impact of development on flood risk;
- Determine decisions for waste windfall development through application of the Sequential Test. Where this is not practical NCC should balance the flood risk at an individual site, the type of development proposed, emergency planning and the contribution the development would make to the wider sustainability of the area before determining a decision;
- Consider flood risk as one of a number of policies that in tandem can provide mechanisms to deliver sustainable developments with multiple benefits;
- Engage with developers and local regulators throughout the development process to develop and instigate initiatives for the reduction of flood risk;
- Require FRAs in accordance with PPS25 guidelines.

9.9 Management of Surface Water Runoff

9.9.1 All developments will require an assessment of the residual capacity of the surface water system that they propose to discharge to. It needs to be shown that the system has sufficient residual capacity so as not to surcharge up to the 1 in 30 year event and for events of higher severity the council will expect there to be confirmed overland flow routes so that surcharged waters can flow at no detriment to existing or proposed development before returning to an adequate drainage system. Consideration should be given to the use of SuDS techniques as described in Section 8.4.

9.9.2 All developments will require an assessment of the residual capacity under flood conditions of any foul sewerage system to which it is proposed the development may be connected. Such assessment will have regard to any recorded flooding as well as a hydraulic analysis of the systems concerned.

9.10 Residual Risk

9.10.1 PPS25 Practice Guide (December 2009) states that the residual risks of flooding should be identified as part of a FRA. Like other parts of the FRA the assessment should be proportionate to the scale of the development and the risks involved. This SFRA provides a starting point for obtaining information on the residual risk (see locations of raised fluvial flood defences in Appendix B).

9.10.2 As with all aspects of development and flood risk, this is best considered early in the development process so that measures to manage residual risk can be incorporated into site layout to make the best use of the developable land.

9.10.3 Measures to manage residual flood risk include:

- developer contributions towards publicly-funded flood alleviation schemes;
- flood resilience and resistance measures;
- flood warning and evacuation plans; and
- designing new SuDS taking account of storm events which exceed the design standard.

Appendix A: County Overview Maps

Study Area - illustrating Potential Minerals Sites and Main River names.

Environment Agency Flood Zone 2 and Flood Zone 3 (Undefended)

Internal Drainage Board Areas

Geology – BGS Solid Bedrock & Superficial Deposits

Environment Agency Groundwater Source Protection Zones & Groundwater Vulnerability

Environment Agency Areas Susceptible to Groundwater Flooding

Environment Agency Flood Warning Areas

Appendix B: Detailed Mapping - Fluvial

County Coverage - 1:50, 000 Scale Insets

Appendix C: Detailed Mapping – Pluvial

County Coverage - 1:50, 000 Scale Insets

Appendix D: Detailed Mapping – Other Sources of Flooding & Historical Flooding

County Coverage - 1:50, 000 Scale Insets

Appendix E: Detailed Mapping – Fluvial Hydraulic Modelling Outlines (Defended)

County Coverage - 1:50, 000 Scale Insets (except E5 and E7 where no data was available)

Appendix F: Data Register

Appendix G: Principal Contacts

Appendix H: GIS Layers

Appendix I: SuDS Review

Appendix J: How to Maintain and Update the SFRA

Appendix K: Potential Minerals Sites Review Tables

Appendix L: EA Flood Warning Areas

Appendix M: Level 2 SFRA Requirements