**Preliminary Flood Risk Assessment Review**

<table>
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<th>LLFA Name</th>
<th>Staffordshire County Council</th>
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<tr>
<td>If collaboration, list other LLFAs</td>
<td>N/A</td>
</tr>
<tr>
<td>LLFA Lead contact name</td>
<td>Matt Bulzacchelli</td>
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<td><a href="mailto:matt.bulzacchelli@staffordshire.gov.uk">matt.bulzacchelli@staffordshire.gov.uk</a></td>
</tr>
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<td>Contact telephone number</td>
<td>01543 510155</td>
</tr>
<tr>
<td>Date sent to Environment Agency</td>
<td>19/04/2011</td>
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**Documents submitted**

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<tr>
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**Flood Risk Areas**

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**Approvals**

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<tr>
<th>Name</th>
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<tr>
<td>Title</td>
<td>Flood Risk Manager</td>
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<td>Date</td>
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For completion by Environment Agency

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<td>Ministerial referral (if applicable)</td>
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Staffordshire Preliminary Flood Risk Assessment (PFRA)

Staffordshire County Council

March 2011
Final Report
9W4459
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Drafted by: R Ranger  
Checked by: G Daves  
Date/initials check:  
Approved by: D Worh  
Date/initials approval: 31/3/11
EXECUTIVE SUMMARY

This Preliminary Flood Risk Assessment (PFRA) report for Staffordshire has been prepared to comply with the Flood Risk Regulations 2009 and the Flood and Water Management Act 2010 and in accordance with the Environment Agency’s Final PFRA Guidance published in December 2010.

It summarises the findings from the first two stages of the flood risk management cycle for the County of Staffordshire and presents the results of a high level screening exercise, identifying areas of significant flood risk. Staffordshire County Council have recognised their role as the central point in the management of local flood risk and have strengthened and extended their partnership network to enable the collection, collation and assessment of available historic and future flood risk information for the County.

Using this information the scale and consequences of past flooding has been summarised, identifying four flood risk events with locally adverse consequences over the past ten years (all of which meet a defined local criteria). The potential impacts of future flood events have been summarised and the Environment Agency’s Flood Map for Surface Water (FMfSW), combined with the Surface Water Management Plan (SWMP) outputs, defined as the appropriate ‘Locally Agreed Surface Water Information’. The southern edge of the County falls within the West Midlands Indicative Flood Risk Area (IFRA) but no adjustments to this boundary are required.

The report concludes with structured actions for the County Council to implement, to support and progress local flood risk management in the future.
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<table>
<thead>
<tr>
<th><strong>GLOSSARY</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual Exceedence Probability (AEP)</strong></td>
<td>The probability associated with a return period (T). An event of return period 50 years has an AEP of 1/50, 0.02 or 2%.</td>
</tr>
<tr>
<td><strong>Antecedent Conditions</strong></td>
<td>The pre-existing condition before a rain event (e.g. waterlogged soil)</td>
</tr>
<tr>
<td><strong>Artificial Drainage Infrastructure</strong></td>
<td>Manmade water-conveyance infrastructure such as sewers, canals and highways drains.</td>
</tr>
<tr>
<td><strong>Assets</strong></td>
<td>Structures, or a system of structures, used to manage flood risk.</td>
</tr>
<tr>
<td><strong>Catchments</strong></td>
<td>An area that serves a river with rainwater. Every part of land where the rainfall drains to a single watercourse is in the same catchment.</td>
</tr>
<tr>
<td><strong>Climate Change</strong></td>
<td>Long-term variations in global temperature and weather patterns both natural and as a result of human activity, primarily greenhouse gas emissions.</td>
</tr>
<tr>
<td><strong>Cultural Heritage</strong></td>
<td>Buildings, structures and landscape features that have an historic value. These are known as heritage assets.</td>
</tr>
<tr>
<td><strong>Culvert</strong></td>
<td>Covered channel or pipe that forms a watercourse below ground level, or through a raised embankment.</td>
</tr>
<tr>
<td><strong>Defences</strong></td>
<td>A structure that is used to reduce the probability of floodwater or coastal erosion affecting a particular areas (for example a raised embankment or sea wall)</td>
</tr>
<tr>
<td><strong>Defra</strong></td>
<td>UK Government department responsible for policy and regulations on the environment, food and rural affairs.</td>
</tr>
<tr>
<td><strong>Enmained</strong></td>
<td>Watercourse designated as a Main River</td>
</tr>
<tr>
<td><strong>Environment Agency</strong></td>
<td>Executive Non-departmental Public Body responsible to the Secretary of State for Environment, Food and Rural Affairs and an Assembly Sponsored Public Body responsible to the National Assembly for Wales.</td>
</tr>
<tr>
<td><strong>Flood</strong></td>
<td>The temporary covering by water of land not normally covered with water.</td>
</tr>
<tr>
<td><strong>Flood probability</strong></td>
<td>The estimated likelihood of a flood of a given magnitude occurring or being exceeded in any specified time period.</td>
</tr>
<tr>
<td><strong>Flood risk</strong></td>
<td>An expression of the combination of the flood probability and the magnitude of the potential consequences of the flood event.</td>
</tr>
<tr>
<td><strong>Flood Risk Area</strong></td>
<td>An areas determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG.</td>
</tr>
<tr>
<td><strong>Flood Risk Threshold</strong></td>
<td>1km national grid squares created through an overlay of the FMfSW and the NRD that exceed a threshold determined by the Environment Agency.</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Flood Zones</strong></td>
<td>Flood Zones are defined in Table D.1 of Planning Policy Statement (PPS) 25: Development and Flood Risk. They indicate land at risk by referring to the probability of flooding from river and sea, ignoring the presence of defences.</td>
</tr>
<tr>
<td><strong>Groundwater</strong></td>
<td>Water which is below the surface of the ground and in direct contact with the ground or subsoil.</td>
</tr>
<tr>
<td><strong>Groundwater Rebound</strong></td>
<td>Increase in the depth of groundwater below the ground surface often due to cessation of mining activities or reduced water extraction.</td>
</tr>
<tr>
<td><strong>Indicative Flood Risk Area</strong></td>
<td>Areas determined by the Environment Agency as indicatively having a significant flood risk, based on guidance published by Defra and WAG and the use of certain national datasets. These indicative areas are intended to provide a starting point for the determination of Flood Risk Areas by LLFAs.</td>
</tr>
<tr>
<td><strong>Lead Local Flood Authority</strong></td>
<td>Unitary Authorities or County Councils which issue Local Flood Risk Management Strategies for surface water run-off, groundwater and non-main rivers and have powers to carry out works for the management of surface water run-off and groundwater.</td>
</tr>
<tr>
<td><strong>Local Authority</strong></td>
<td>Administrative authorities (Districts and Boroughs) that operate in a two tier local government system under the County Councils.</td>
</tr>
<tr>
<td><strong>Local Flood Risk</strong></td>
<td>Flood risk from sources other than main river, the sea and reservoirs, principally meaning surface runoff, groundwater and ordinary watercourses.</td>
</tr>
<tr>
<td><strong>Main River</strong></td>
<td>A watercourse shown as such on a Main River Map, and for which the Environment Agency has responsibilities and powers.</td>
</tr>
<tr>
<td><strong>National Receptor Database</strong></td>
<td>A collection of risk receptors produced by the Environment Agency.</td>
</tr>
<tr>
<td><strong>Ordinary Watercourses</strong></td>
<td>All watercourses that are no designated Main River and which are the responsibility of the riparian owner.</td>
</tr>
<tr>
<td><strong>Pathway</strong></td>
<td>The connection between a particular source and a receptor that may be harmed.</td>
</tr>
<tr>
<td><strong>Preliminary assessment report</strong></td>
<td>A high level summary of significant flood risk, based on available and readily derivable information, describing both the probability and harmful consequences of past and future flooding.</td>
</tr>
<tr>
<td><strong>Preliminary assessment spreadsheet</strong></td>
<td>Reporting spreadsheet which LLFAs need to complete. The spreadsheet will form the basis of the Environment Agency’s reporting to the European Commission.</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Receptor</strong></td>
<td>Something that may be harmed by flooding.</td>
</tr>
<tr>
<td><strong>Regulations</strong></td>
<td>The Flood Risk Regulations 2009</td>
</tr>
<tr>
<td><strong>Resilience</strong></td>
<td>The ability of the community, services, area or infrastructure to withstand the consequences of an incident.</td>
</tr>
<tr>
<td><strong>Risk</strong></td>
<td>Measures the significance of a potential event in terms of likelihood and impact.</td>
</tr>
<tr>
<td><strong>Risk assessment</strong></td>
<td>A structure and auditable process of identifying potentially significant events, assessing their likelihood and impacts, and then combining these to provide an overall assessment of risk, as a basis for further decisions and actions.</td>
</tr>
<tr>
<td><strong>River basin district</strong></td>
<td>There are 11 river basin districts in England and Wales, each comprising a number of contiguous river basins and catchments. The Environment Agency is responsible for collating LLFA reports at a river basin district level.</td>
</tr>
<tr>
<td><strong>Runoff</strong></td>
<td>Water flow over the ground surface to the drainage system.</td>
</tr>
<tr>
<td><strong>Source</strong></td>
<td>The origin of a hazard (e.g. heavy rainfall, strong winds, surge etc).</td>
</tr>
<tr>
<td><strong>Surface runoff</strong></td>
<td>Rainwater (including snow and other precipitation) which is on the surface of the ground (whether or not it is moving) and has not entered a watercourse, drainage system or public sewer.</td>
</tr>
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<td><strong>Sustainable Drainage Systems (SuDS)</strong></td>
<td>A sequence of management practices and control structures, often referred to as SuDS, designed to drain surface water in a more sustainable manner. Typically, these techniques are used to attenuate rates of runoff from potential development sites.</td>
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</table>
ABBREVIATIONS

AEP  Annual Exceedence Probability
ASTSWF  Areas Susceptible to Surface Water Flooding
ASIGWF  Areas Susceptible to Ground Water Flooding
BGS  British Geological Survey
CFMP  Catchment Flood Management
COMAH  Control of Major Accident Hazard (sites)
Defra  Department for Environment, Flood and Rural Affairs
DTM  Digital Terrain Model
FMSW  Flood Map for Surface Water
HS2  High Speed Two
GIS  Geographical Information Systems
IPCC  International Pollution Prevention and Control (sites)
LLFA  Lead Local Flood Authority
NRD  National Receptor Database
PFRA  Preliminary Flood Risk Assessment
PPS25  Planning Policy Statement 25
SAB  SuDS Approval Board
SAC  Special Area of Conservation
SPA  Special Protection Areas
SSSI  Sites of Special Scientific Interest
SuDS  Sustainable Drainage Systems
UKCP09  United Kingdom Climate Projections 2009
WAG  Welsh Assembly Government
1 INTRODUCTION

1.1 Aims and Objectives

The Flood Risk Regulations 2009 came into force on 10th December 2009. The regulations implement the European Floods Directive in England and Wales (the aim of which is to provide a consistent approach to managing flood risk across Europe). These regulations require four stages of activity within a six year flood risk management cycle, as illustrated in Figure 1.1.

Figure 1.1 - Stages of the Flood Risk Regulations and Flood Risk Management Cycle

Inline with the Floods and Water Management Act (FWMA), which gained Royal Assent on the 8th April 2010, the Flood Risk Regulations place responsibility upon all Lead Local Flood Authorities (LLFAs) to manage local flood risk and deliver the requirements shown in Figure 1.1. Please note, within England the LLFAs are identified as the Unitary Authority or County Council, in this case Staffordshire County Council. As such the LLFAs are responsible for undertaking a Preliminary Flood Risk Assessment (PFRA) and identifying Flood Risk Areas for local sources of flood risk. This PFRA report summarises the findings from the first two stages of the flood risk management cycle for Staffordshire County.

The aim of the PFRA is therefore to provide an assessment of local flood risk (both historical and future) and the consequence of flooding across the study area to enable the identification of Flood Risk Areas. The objectives of the process are to:

- prompt LLFAs to act upon their legislative requirements;
- instigate partnership relationships;
- source flood risk information relevant to their area;
formulate an action plan to enable completion of the flood risk management cycle (and its subsequent reviews); and

develop an efficient method of recording future flood events and their impacts.

1.2 Scope

This Preliminary Flood Risk Assessment (PFRA) report has been written to the specification provided within the Environment Agency’s final guidance document, dated December 2010\(^1\), and presents the results of a high level screening exercise to identify areas of significant flood risk within Staffordshire County.

The screening exercise has consisted of a desk-based analysis of all existing and readily available flood risk data and information within Staffordshire to provide an assessment of the following four key areas:

1. Past flood risk and identification of floods with significant harmful consequences;
2. Future flood risk and the potential consequences of future floods;
3. Identification of Flood Risk Areas; and
4. Identification of measures to support the review of the PFRA every six years.

However, only the sources of flooding that are classified as being the responsibility of the LLFA (Staffordshire County Council) are included within the PFRA, as summarised in Table 1.1. A full description of these sources of flooding, as presented in the PFRA guidance, is included in Annex 6.

Table 1.1 - Sources of Flooding

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<thead>
<tr>
<th>Source of Flooding</th>
<th>Responsible Organisation</th>
<th>Lead Local Flood Authority (included within PFRA)</th>
<th>Environment Agency (not included in PFRA)</th>
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<tbody>
<tr>
<td>Ordinary Watercourses</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Surface Runoff (from rain or snowmelt)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundwater</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Artificial Water Bearing Infrastructure*</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Main Rivers</td>
<td>Interactions with sources above only</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>The Sea</td>
<td>Not applicable to Staffordshire</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reservoirs</td>
<td>Interactions with sources above only</td>
<td></td>
<td>✓</td>
</tr>
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* includes canals, highways drains, water supply systems and sewers (where flooding is wholly or partially caused by rainwater or other precipitation entering or affecting the system)

As outlined in the PFRA guidance, the key steps followed to produce this report are summarised in Figure 1.2 below:

---

\(^1\) Preliminary Flood Risk Assessment (PFRA) Final Guidance, Environment Agency, 07/12/2010
Figure 1.2 - Key PFRA Steps

1. Set up governance and develop partnerships
2. Determine appropriate data systems
3. Collate information on past and future floods and their consequences
4. Determine locally agreed surface water information
5. Complete the PFRA report
6. Record information on past and future floods with significant consequences
7. Illustrate information on past and future floods
8. Review indicative Flood Risk Areas
9. Identify Flood Risk Areas
10. Record information including rationale
1.3 Study Area

The study area for this PFRA is the County of Staffordshire, located in the West Midlands region of England. Staffordshire County has two tiers of Local Government which, in addition to the County Council also comprises eight District/Borough Councils, listed below and shown in Figure 1.3:

- Newcastle-under-Lyme Borough;
- Tamworth Borough;
- South Staffordshire District;
- Cannock Chase District;
- Lichfield District;
- Stafford Borough;
- Staffordshire Moorlands District; and
- East Staffordshire District

The City of Stoke on Trent is a Unitary Authority in its own right and administered separately to the rest of the County. Therefore, it is excluded from Staffordshire County Council’s flood risk responsibilities and is producing its own PFRA. As a consequence, no account of flood risk associated with the area of Stoke on Trent has been considered within this report.

Staffordshire is a land-locked County with an administrative area of approximately 2,620km². It is bounded to the south by the Black Country, Birmingham conurbation and the tip of Worcestershire. Shropshire lies to the west, Cheshire to the northwest, Derbyshire to the northeast and Warwickshire and Leicestershire to the southeast. The County has a number of large towns, mainly located to the south of the County, close to the midlands conurbation, but also large areas of agricultural land and wild moorlands (to the north). The central area is low lying, bisected by the River Trent and its tributaries, whereas the southern and, in particular, northern areas are more hilly, with the northern district of the Staffordshire Moorlands forming part of the Peak District.

The river network is mostly located within the catchment of the River Trent, although the very northwest area of the County drains into the River Mersey and the southwest into the River Severn. As such Staffordshire falls into the three Environment Agency River Basin Districts of the Humber, Severn and Northwest (covering 82.7%, 11.9% and 5.3% of the County area respectively)². Wastewater services are provided to Staffordshire by United Utilities and Severn Trent Water and water supply by both of those companies in addition to South Staffordshire Water.

² Percentages provided by the Environment Agency
Figure 1.3 - PFRA Study Area
2 LEAD LOCAL FLOOD AUTHORITY RESPONSIBILITIES

2.1 Introduction

In addition to the completion of the PFRA process, the new legislation, outlined in Section 1, will in due course require LLFAs to take on new flood risk management responsibilities, including:

- coordinating and leading on local flood management;
- the development, maintenance, application and monitoring of a Local Strategy for Flood Risk Management;
- the investigation of flood incidents;
- the maintenance of an asset register;
- the fulfilment of their duty as a SuDS Approving Body (SAB);
- utilisation of works powers to manage flood risk; and
- utilisation of designations powers in order to safeguard assets.

To enable them to fulfil these responsibilities the LLFAs need to determine appropriate governance and partnership arrangements and communication links, as discussed below.

2.2 Governance and Partnership Arrangements

In response to the previous Government’s desire for Local Authorities to progress the recommendations of Sir Michaels Pitt’s Review into the events of the 2007 Floods, Staffordshire County Council established the Staffordshire Strategic Flood Partnership in June 2009. As a result of this partnership numerous links have been formed between the County Council and key organisations and these existing partnerships have been embraced and strengthened during this PFRA process. In addition, many new partnerships have been formed, most notably with the Parish Councils through the distribution of a ‘flood survey’, ensuring their knowledge of local flood events was incorporated into the PFRA process. A network diagram illustrating the current partnership arrangements is included in Figure 2.1 below. As it is recognised that affected members of the public hold key information regarding the impacts of flood events, particular emphasis will be placed on the collation of first hand data following future floods into a standardised database.

2.3 Communication

Staffordshire County Council recognises the importance of regular communication with both its partners and members of the public. Regular flood forum meetings are already held by the Council to which all key partners are invited. These meetings encourage dissemination of information, sharing of best practice and strengthening of partnerships between the organisations. To facilitate more rapid exchange of information in the future the Council is seeking to find ways to standardise processes and is exploring the practicalities of setting up a web based portal between the partner organisations.

Potential issues surrounding property blight and personal identity are recognised by the Council and, as such, dissemination of information to the general public will currently be limited to a simplified, non property-specific, format. To enable this, a consensus will be
sought between the partnership organisations shown in Figure 2.1 regarding data sharing and display arrangements.

Figure 2.1 - Staffordshire County Council Existing Partnership Arrangements
3 METHODOLOGY AND DATA REVIEW

3.1 Introduction

As outlined in Sections 1 and 2 above, this PFRA report is a high level screening exercise that has been written to the specification included within the Environment Agency’s PFRA final guidance document. As such it has been based solely on existing data that was available within the timeframe of this study. Certain limitations in this data have been identified and are discussed below.

3.2 Methodology

Completion of this PFRA report has followed the methodology outlined in Figure 1.2, with the key steps discussed below.

3.2.1 Governance and Partnerships

This is discussed in Section 2 above.

3.2.2 Data Systems - Current and Future

To centralise the collation of data from numerous sources, Staffordshire County Council developed a spreadsheet to capture the following key attributes regarding historic floods:

- Source of data;
- Location of flood;
- Time and date of flood;
- Duration of flood;
- General comments;
- Origin of floodwater;
- Details of flow pathway (if known);
- Location of photo records or event plan;
- Extent of flooding - properties;
- Extent of flooding - highway/rail; and
- Immediate actions and required actions

To assist in prioritising the management of maintenance and repairs the Council has determined a risk calculation for each flood location, based upon the consequences of the flooding. The spreadsheet has also been extended to enable the recording of post event investigation records and maintenance job details. To enhance the efficiency of this system in the future, the Council is currently investigating the potential of using a combined database/GIS system to record future flood event records as soon as possible during or after the flood event. This is discussed further in Section 7.

The data collected has been analysed using a combination of Excel data interrogation and GIS mapping.
3.2.3 Collation of Information on Past Floods

Existing datasets, reports and anecdotal information have been collected from numerous partners, shown in Figure 2.1, to obtain as much information on each of the spreadsheet attributes listed above as possible. This data has been collected in a variety of formats, including GIS shapefiles, hard copy documents and maps. A summary of the historic data obtained is provided in Table 3.1 below. Due to concerns over property blight and personal data security not all these datasets are publicly available. Where they have been used within this report they are included at a scale which does not identify individual properties or personal details.

This information has been used in Section 4 of this report to identify the key flood events that have affected Staffordshire, determine which have resulted in significant harmful consequences, identify appropriate local thresholds for significant floods, map the extent and conveyance routes, where available, and complete Annex 1.

Table 3.1 - Sources of Information on Past Floods

<table>
<thead>
<tr>
<th>Source</th>
<th>Dataset</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment Agency</td>
<td>Historic Flood Map</td>
<td>GIS flood extent for historic floods, mainly Main River flooding.</td>
</tr>
<tr>
<td>Catchment Flood Management Plans (CFMPs)</td>
<td>Reports to plan and agree management of future flood risk. Includes historic reports of flooding from all sources.</td>
<td></td>
</tr>
<tr>
<td>Sandyford Brook Scoping Document</td>
<td>Part of a project to investigate potential options to reduce flooding from the Sandyford Brook - includes a summary of historical flood events.</td>
<td></td>
</tr>
<tr>
<td>Rainfall Data</td>
<td></td>
<td>Rain gauge information for key flood events.</td>
</tr>
<tr>
<td>Staffordshire County Council</td>
<td>Historic Flooding Records</td>
<td>Historic flooding records form all sources.</td>
</tr>
<tr>
<td>Anecdotal Information</td>
<td></td>
<td>Anecdotal information from Council officers for all sources of flooding (mainly related to more recent flood events)</td>
</tr>
<tr>
<td>Highways Flooding Reports</td>
<td></td>
<td>Historic highways flooding records.</td>
</tr>
<tr>
<td>Emergency Helpline Records</td>
<td></td>
<td>Records from telephone calls to the emergency helpline during flood events.</td>
</tr>
<tr>
<td>Staffordshire Civil Contingencies</td>
<td>Staffordshire Emergency Flood Plan</td>
<td>Multi agency strategy to prepare for, respond to and recover from the risk of flooding in Staffordshire.</td>
</tr>
</tbody>
</table>

This information has been used in Section 4 of this report to identify the key flood events that have affected Staffordshire, determine which have resulted in significant harmful consequences, identify appropriate local thresholds for significant floods, map the extent and conveyance routes, where available, and complete Annex 1.
<table>
<thead>
<tr>
<th>Source</th>
<th>Dataset</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Authorities (District and Borough Councils)</td>
<td>Strategic Flood Risk Assessments</td>
<td>Contain information on historical flooding from all sources.</td>
</tr>
<tr>
<td></td>
<td>Historic Flooding Records</td>
<td>Records of flooding from all sources</td>
</tr>
<tr>
<td></td>
<td>Flood Event Photographs</td>
<td>Photographs taken by Council officials or members of the public during flood events.</td>
</tr>
<tr>
<td></td>
<td>Southern Staffordshire Surface Water Management Plan (SWMP)</td>
<td>Assessment of surface water flood risk and identification of key surface water hot spot areas.</td>
</tr>
<tr>
<td></td>
<td>Anecdotal Information</td>
<td>Anecdotal information from Council officers for all sources of flooding (mainly related to more recent flood events)</td>
</tr>
<tr>
<td></td>
<td>Flood Plan</td>
<td>Strategy to prepare for, respond to and recover from the risk of flooding in the District/Borough.</td>
</tr>
<tr>
<td>Parish Councils</td>
<td>Flood Survey Questionnaires</td>
<td>Questionnaires sent by Staffordshire County Council during the preparation of the PFRA.</td>
</tr>
<tr>
<td>British Waterways</td>
<td>Historic Breach Locations</td>
<td>GIS locations for historic canal breach locations, including date.</td>
</tr>
<tr>
<td></td>
<td>Historic Overtopping Locations</td>
<td>GIS locations for historic canal overtopping locations, including date.</td>
</tr>
<tr>
<td>United Utilities and Severn Trent Water</td>
<td>DG5 Register</td>
<td>Register log of sewer flooding incidents in each area. Includes repeat occurrences and sewer type.</td>
</tr>
<tr>
<td>Highways Agency</td>
<td>Flooding Records</td>
<td>Records of highways flooding. No records available at time of request.</td>
</tr>
<tr>
<td>Internet</td>
<td>News Reports</td>
<td>Additional records of large flood events, often containing date, location and consequences.</td>
</tr>
</tbody>
</table>
3.2.4 Collation of Future Flood Risk Information

There is a limited amount of model data available for the assessment of future flooding, with most provided from the Environment Agency. The datasets collected for use in this PFRA report are summarised in Table 3.2 below. This information has been used to summarise and map the future flood risk and possible consequences for Staffordshire in Section 5 and Annex 2.

Table 3.2 - Sources of Future Flood Risk Information

<table>
<thead>
<tr>
<th>Source</th>
<th>Dataset</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment Agency</td>
<td>Areas Susceptible to Surface Water Flooding (AStSWF)</td>
<td>First generation national mapping, outlining areas of risk from surface water flooding across the country with three susceptibility bandings (less, intermediate and more)</td>
</tr>
<tr>
<td></td>
<td>Flood Map for Surface Water (FMfSW)</td>
<td>Second generation national surface water flood mapping containing two flood events (1 in 30 and 1 in 200) and two depth bandings (greater than 0.1m and greater than 0.3m)</td>
</tr>
<tr>
<td></td>
<td>Areas Susceptible to Groundwater Flooding (AStGWF)</td>
<td>National mapping showing areas susceptible to groundwater flooding on 1km² grid based on four bands (&lt;25%, 25-50%, 50-75% and &gt;75%)</td>
</tr>
<tr>
<td></td>
<td>Flood Map</td>
<td>Extent of flooding from rivers with a catchment of more than 3km² and the sea for two probability events (1% and 0.1%)</td>
</tr>
<tr>
<td></td>
<td>National Receptors Database</td>
<td>National dataset of social, economic, environmental and cultural receptors, including residential properties, schools, hospitals, transport infrastructure and electricity substations.</td>
</tr>
<tr>
<td></td>
<td>Indicative Flood Risk Areas</td>
<td>Nationally identified flood risk areas, based on the definition of ‘significant’ flood risk described by Defra and WAG.</td>
</tr>
<tr>
<td></td>
<td>Places Above Flood Risk Thresholds</td>
<td>National dataset identifying 1km² where one of the flood risk indicators (number of people, critical services, non-residential properties) is above defined thresholds.</td>
</tr>
<tr>
<td></td>
<td>Reservoir Inundation Maps</td>
<td>National Dataset of areas at risk of flooding if a reservoir were to fail.</td>
</tr>
<tr>
<td>Staffordshire County Council</td>
<td>Critical Infrastructure, Property, Structure and Street Gazetteers</td>
<td>County wide shapefiles of key infrastructure locations.</td>
</tr>
<tr>
<td>Local Authorities (District and Borough)</td>
<td>Southern Staffordshire Surface Water Management Plan (SWMP)</td>
<td>Integrated surface water models of five settlements in Southern Staffordshire run for ten return periods (50%, 20%, 10%, 5%, 4%, 3.33%, 2%, 1.33%, 1% and 0.5%) and climate change scenarios for the 5%, 2% and 1% events.</td>
</tr>
</tbody>
</table>

3.2.5 Determination of Locally Agreed Surface Water Information

The information collected on future flooding has been used to identify and map the ‘locally agreed surface water information’, discussed in Section 5.
3.2.6 Completion of PFRA Report

All the data discussed above has been used to complete this report to the specification set out in the Environment Agency’s PFRA final guidance, including the completion of the standard Annexes.

3.2.7 Identify/Review Flood Risk Areas

The indicative areas provided by the Environment Agency have been reviewed using the local information contained within the PFRA report (see Section 6).

3.3 Data Limitations

Numerous datasets have been collected from a variety of sources. As such there is very little consistency in the data format, availability, coverage and quality, summarised below. These limitations have been recognised by Staffordshire County Council, who, through the implementation of a centralised flood risk recording database, intend to improve the collection of flood risk data in the future (see Section 7).

3.3.1 Variability in Data Format

Data has been received from partners in a variety of formats ranging from georeferenced GIS shapefiles and data points to anecdotal hand written notes and maps constructed from memory. This has had an impact on the accuracy of locating and correlating individual flood records in both space and time and, as a consequence, the ability to identify duplicates in flood data from different sources. Where detailed location information is not provided the position of a flood report has been interpreted by the user from general details, introducing the potential for error in the record.

3.3.2 Data Availability

Although the partnership approach has had a positive impact on the willingness to provide flood data, variability in recording mechanisms has meant data has not been readily available from all sources. The short timescales available for the collection of anecdotal information from such sources may have limited the accuracy of the flood records or number of events recorded. Other organisations, such as the water companies, only hold flood records for a certain number of years, limiting the length of the flood record and placing greater emphasis on more recent flood events.

3.3.3 Incomplete Records

Due to the variations in recording flood incident information within different organisations, not all events, or the attributes of each event, have been comprehensively documented. As such the details of some events, or in other cases entire flood events, are missing from the flood record. This is particularly common with reference to the source or consequences of flood events, which are often absent in the historic record.
3.3.4 Varying Quality

Due to all the limitations mentioned above there is a variance in the quality of data received from different sources and therefore the confidence in the accuracy of the data. It is hoped this will be improved in the future through the implementation and consistent use of the Staffordshire spreadsheet, or resulting database.

3.3.5 Future Flooding Model Data

Due to the immense complexity of the real world, all model simulations have inherent assumptions and limitations within them and should not be considered prescriptive forecasts of future scenarios. The assumptions within all the models used in this PFRA can be determined from the original source (e.g. the SWMP documents and Environment Agency guidance notes).

3.4 Quality Assurance, Security, Licensing and Restrictions

All data collected and entered into Staffordshire County Council’s historical flood records spreadsheet has been assigned a data quality score. This is a qualitative assessment based on the Data Quality System provided in the SWMP Technical Guidance document (March 2010) and the Flood and Coastal Risk Management ‘Multi Coloured Manual’\(^3\), outlined below. This provides a basis for analysing and monitoring the quality of the data collected and used in this PFRA.

Table 3.3 - Data Quality System

<table>
<thead>
<tr>
<th>Data Quality Score</th>
<th>Description</th>
<th>Explanations</th>
<th>Example (from PFRA Data)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Best available</td>
<td>No better available; not possible to improve in near future</td>
<td>Detailed georeferenced and surveyed records or real-time distress calls</td>
</tr>
<tr>
<td>2</td>
<td>Data with known deficiencies</td>
<td>Best replaced as soon as new data is available</td>
<td>Newspaper cuttings or post-event reports</td>
</tr>
<tr>
<td>3</td>
<td>Gross assumptions</td>
<td>Not invented but based on experience and judgement</td>
<td>Anecdotal records from affected residents.</td>
</tr>
<tr>
<td>4</td>
<td>Heroic assumptions</td>
<td>An educated guess</td>
<td>Anecdotal records from ‘hearsay’</td>
</tr>
</tbody>
</table>

Data security is a key consideration, especially for third party datasets. The requirement to use data within the PFRA on a non-property specific basis has been adhered to and all discussion of the extent and consequences of flood events have been left geographically vague. All sensitive data is held in a secure manner, with the raw information only been accessed by Staffordshire County Council. The restrictions on the use of data are included in Table 3.4 below. Information available to the public is indicated in Tables 3.1 and 3.2 above.

---

\(^3\) The Benefits of Flood and Coastal Risk Management: A Manual of Assessment Techniques, Flood Hazard Research Centre, 2005
Table 3.4 - Restrictions on the Use of Third Party Data

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Restriction on Use of Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severn Trent Water and United Utilities</td>
<td>A confidentiality agreement has been signed which restricts the use of this data to Staffordshire County Council and their consultants for the preparation of this PFRA.</td>
</tr>
<tr>
<td>British Waterways</td>
<td>A confidentiality agreement has been signed which restricts the use of this data to Staffordshire County Council and their consultants for the preparation of this PFRA.</td>
</tr>
<tr>
<td>Environment Agency</td>
<td>The use of some data is restricted to Staffordshire County Council and their consultants for the preparation of this PFRA. The use of other data is unrestricted.</td>
</tr>
<tr>
<td>Local Authorities</td>
<td>Historic flood information cannot be used at a property specific scale. The model outlines for the SWMP are not available to the public due to concerns over property blight.</td>
</tr>
<tr>
<td>Police and Fire and Rescue Call Centre Records</td>
<td>Personal information cannot be used and locations must only be used at a property specific scale.</td>
</tr>
</tbody>
</table>

4 PAST FLOOD RISK

4.1 Overview of Past Flooding in Staffordshire

Flood records across Staffordshire were collected from the data sources identified in Table 3.1 and entered into the spreadsheet discussed in Section 3.2.2. A total of 1,663 records of historic flooding have been collected across Staffordshire County Council’s administrative area, split by Local Authority area as illustrated in Figure 4.1. Due to the variation in data recording systems between different organisations this distribution should not be interpreted as a direct representation of the distribution of flood risk across the County (e.g. one record may represent an individual property or an town or village).

Figure 4.1 - Number of Flood Records Collected within Each Local Authority Area
The flood records collected span from 1795 to 2010, with a significant increase in record numbers from 1990 (see Figure 4.2 below).

Figure 4.2 - Number of Flood Records per Year

The locations of each of the historic flooding records are shown in Figure 4.3. The symbology on this figure has been set to show the source of the flood risk information by the shape of the symbol and the frequency of the flooding by the colour, as outlined below:

Table 4.1 - Symbology of Past Flooding

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Property Flooding</th>
<th>Symbol</th>
<th>Frequency of Flooding</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Authority</td>
<td>Yes</td>
<td>○</td>
<td>Unknown</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>No/Not Recorded</td>
<td>○</td>
<td>Every 1 - 2 years</td>
<td>■</td>
</tr>
<tr>
<td>Water Company</td>
<td>Yes</td>
<td>■</td>
<td>Every 2 - 5 years</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>No/Not Recorded</td>
<td>■</td>
<td>Exceptional (&gt; every 5 years)</td>
<td>⊙</td>
</tr>
<tr>
<td>British Waterways</td>
<td>Yes</td>
<td>⊙</td>
<td>Unknown</td>
<td>⊙</td>
</tr>
<tr>
<td></td>
<td>No/Not Recorded</td>
<td>⊙</td>
<td>Every 2 - 5 years</td>
<td>⊙</td>
</tr>
<tr>
<td>Highways Agency</td>
<td>Yes</td>
<td>⊙</td>
<td>Unknown</td>
<td>⊙</td>
</tr>
<tr>
<td></td>
<td>No/Not Recorded</td>
<td>⊙</td>
<td>Every 2 - 5 years</td>
<td>⊙</td>
</tr>
<tr>
<td>Environment Agency</td>
<td>Yes</td>
<td>⊙</td>
<td>Unknown</td>
<td>⊙</td>
</tr>
<tr>
<td></td>
<td>No/Not Recorded</td>
<td>⊙</td>
<td>Every 2 - 5 years</td>
<td>⊙</td>
</tr>
</tbody>
</table>
Key:
- Properties at Risk of Flooding

Source:
- British Waterways
- Councils
- Environment Agency
- Highways Agency
- Water Utility

Frequency of Flooding:
- Exceptional
- 2 - 5 Years
- 1 - 2 Years
- Unknown

Copyright © The Automobile Association

Title:
Location, Source and Frequency of Past Flooding Records in Staffordshire

Project:
Staffordshire Preliminary Flood Risk Assessment

Client:
Staffordshire County Council

Date:
March 2011

Scale @ A3:
1:340,000

Figure:
4.3
4.2 Source of Flooding

Multiple sources of flooding were identified within the record of past flooding, as shown in the excerpt from the recording spreadsheet below. Due to the number of gaps and uncertainties in the flood records the source of the flooding has not been mapped on Figure 4.3. In addition many flood records identify multiple flood sources, leading to confusion within the symbology when mapped together.

Figure 4.4 - Excerpt of Past Flood Record Showing Flood Origin Categorisation

When categorised into the sources of flooding specified within the PFRA guidance, the following distribution is shown. As many records display multiple sources of flooding representing interactions between different flood mechanisms this distribution must be viewed with a degree of caution.

Figure 4.5 - Distribution of Source of Flooding Within Past Flood Records

Although flooding from Main Rivers is not the responsibility of the LLFA, most occurrences within Staffordshire result in interactions with the drainage network. As such, records of Main River flooding have been retained in the record of past flooding.
4.2.1 Surface Water Flooding

Surface water flooding occurs as a result of excess rainfall that has not entered a watercourse, drainage system or sewer. They tend to occur as a result of a heavy rainfall event proceeding a period of persistent rain, resulting in very wet antecedent conditions and therefore rapid runoff. Records of this type of event cover most of Staffordshire and have been collected from a variety of sources. Due to the interaction between different sources of flooding during a rainfall event, such flooding is often not identified separately to watercourse or artificial drainage infrastructure exceedence.

4.2.2 Artificial Drainage Infrastructure

This type of flooding includes the exceedence of the sewer network, highways drains and canals as a result of an excess of surface water. Water companies record sewer flooding the information on a DG5 register, which targets funding to resolve flooding issues, and British Waterways maintains a register of occurrences of canal overtopping and breaching. No information was available directly from the Highways Agency in respect of flooding associated with motorways and trunk road, but highway flooding information for the remainder of the road network has been collected from the County Council highway maintenance teams.

Figure 4.5 implies that flooding from artificial drainage infrastructure accounts for almost 50% of all flooding in Staffordshire. However, due to the number of organisations (including Severn Trent Water Ltd and United Utilities) who record this type of flooding in a systematic manner (whereby each record identifies a separate event, covering a very specific geographical location, e.g. an individual property). The number of records therefore appears inflated compared with other types of flooding, which are often recorded on a settlement wide scale. However, given the importance and the location of such infrastructure in urban areas, on road networks and connecting inside properties, the consequences of any associated flooding are often very severe.

4.2.3 Groundwater Flooding

Groundwater flooding occurs as a result of water rising up from under the ground surface, usually in locations underlain by permeable rocks (aquifers). There are limited records of groundwater flooding occurrences in Staffordshire. Where groundwater flooding has occurred, it is usually recorded in combination with multiple other sources of flooding after periods of sustained rainfall. There is reference within the PFRA guidance document to a risk of groundwater flooding from groundwater rebound within Lichfield. No incidences of this type of flooding are known to either Lichfield District Council or Staffordshire County Council. It should, however, be monitored and addressed in future revisions of this PFRA if identified.

4.2.4 Ordinary Watercourses

These are the minor tributary watercourses (including rivers, streams, ditches, cuts, dykes and non-public sewers) within Staffordshire that have not been enmained by the Environment Agency. As such their maintenance is the responsibility of the Local Authority. There are a large number of ordinary watercourses across Staffordshire, many of which are culverted in urban areas. Excess flow, blockages in the channel,
elevated Main River water levels, often result in the flooding of settlements, including urban areas.

4.2.5 Interactions with Main River Flooding

As ordinary watercourses and many surface water sewers and highways drains outfall into Main Rivers, there is a strong interaction between flooding from these sources and flooding from the rivers. Most past flooding within Staffordshire has occurred following a period of sustained rainfall, resulting in multiple sources of flooding at one time. As such it is often difficult to distinguish between the separate sources listed above.

4.3 Consequences of Past Flooding

Information regarding the consequences of past flood events in Staffordshire is often limited or missing from the flood record and, where it is included, it is often estimated from anecdotal sources. As such, a degree of caution must be employed when interpreting the data. A summary of the consequences of flooding within the past record is provided in Table 4.2 below.

<table>
<thead>
<tr>
<th>Table 4.2 - Summary of Flood Consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consequence of Flood</td>
</tr>
<tr>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>Properties Affected</td>
</tr>
<tr>
<td>Garden/Parking Areas Impacted</td>
</tr>
<tr>
<td>Carriageway Flooded</td>
</tr>
<tr>
<td>Footway Flooded</td>
</tr>
<tr>
<td>Verge Damage / Mud on Highway</td>
</tr>
<tr>
<td>Highway Closure</td>
</tr>
<tr>
<td>Internal Flooding</td>
</tr>
<tr>
<td>Commercial Properties</td>
</tr>
<tr>
<td>Inside Garage</td>
</tr>
<tr>
<td>Rail Route Flooded</td>
</tr>
<tr>
<td>Traffic Wash Affecting Premises</td>
</tr>
<tr>
<td>Inside Suspended Floors and Cellars</td>
</tr>
<tr>
<td>Sandbags Requested</td>
</tr>
</tbody>
</table>

Please note that individual flood records cover a variety of geographical scales, from one property to whole settlements. These figures are therefore not representative of the exact number of properties or locations affected.

Due to the length of the flood record and number of individual flood events it is not feasible to list the consequences recorded from each historic flood here, although significant records only appear from 1990 onwards. They are, however, discussed for the significant flood events below.
4.4 Flood Events with Significant Harmful Consequences

Due to the lack of robust records and consequence data on historic flood events, it was agreed with Staffordshire County Council that only the last ten years of the flood record (2000 - 2010) provided sufficient data to be used in the determination of flood events with significant harmful consequences for the County. The criteria used by the Environment Agency for determining the Indicative Flood Risk Areas were considered and scaled down for Staffordshire. As the number of properties flooded was considered to be the most robust and comprehensive record of harmful consequences of flooding, this was used as the baseline for selecting the significant flood events within the last decade.

**Figure 4.6 - Methodology for Selecting Significant Flood Criteria**

- Identification of ‘peaks’ in number of flood records.
- Identification of ‘peaks’ in numbers of properties flooded.
- Identification of years/months with > 20 properties flooded.
- Identification of events occurring in the last 10 years.
- Identification of clusters within months to determine individual flood events.
- Identification of other consequences recorded for selected events.
- Sensibility check with local knowledge of known ‘large flood events’.
- Identification of significant events and selection criteria.
- Check of flooded area with rain gauge information.
Using this methodology the following selection criteria for floods with significant harmful consequences were determined for Staffordshire:

1. Greater than 20 properties flooded AND
2. More than one commercial property (including farms) flooded OR
3. One or more items of critical infrastructure flooded OR
4. More than 1 transport route (road or railway) closed for six hours or more.

Using this criteria the following four past flood events in Staffordshire are noted as having significant harmful consequences:

- Autumn 2000
- August 2004
- June/July 2007
- October 2010

The consequences of these events are summarised in Table 4.3 below and recorded in more detail in Annex 1. The correlation of the extent of these significant flood events with rainfall events is assessed in Table 4.4.

Table 4.3 - Summary of Past Floods with Significant Harmful Consequences in Staffordshire

<table>
<thead>
<tr>
<th>Flood Event</th>
<th>Recorded Duration</th>
<th>Source of Flooding</th>
<th>Number of Properties Flooded</th>
<th>Estimate Number of People</th>
<th>Commercial Properties Flooded</th>
<th>Critical Infrastructure Flooded</th>
<th>Key Transport Routes Flooded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autumn 2000 (30th Oct - 1st Nov)</td>
<td>4 hrs - several days</td>
<td>Interaction of all forms due to excess rainfall</td>
<td>&gt;60 internally</td>
<td>140 approx</td>
<td>Public House</td>
<td>School (externally)</td>
<td>A51 (closed)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt;70 total</td>
<td>165 approx</td>
<td>JCB Factory</td>
<td></td>
<td>A5 (closed)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Shop - externally</td>
<td></td>
<td>Stoke on Trent - Derby railway line (closed)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5 Unspecified approx</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16th August 2004</td>
<td>5 hrs - 1 day</td>
<td>Interaction of all forms due to excess rainfall</td>
<td>&gt;50 internally</td>
<td>120 approx</td>
<td>Shop</td>
<td>School</td>
<td>A34 at Stone (closed)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt;70 total</td>
<td>165 approx</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer 2007 (June and July)</td>
<td>Several days</td>
<td>Interaction of all forms due to excess rainfall</td>
<td>350 (approx) internally</td>
<td>820 approx</td>
<td>Public Houses</td>
<td>Sheltered accommodation</td>
<td>A34 (closed)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>500 (approx) total</td>
<td>1170 approx</td>
<td>Shops</td>
<td>Residential home (marooned)</td>
<td>A4091 (closed)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Arboretum</td>
<td></td>
<td>A50 (closed)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Livestock</td>
<td></td>
<td>A51 (closed)</td>
</tr>
<tr>
<td>Flood Event</td>
<td>Recorded Duration</td>
<td>Source of Flooding</td>
<td>Number of Properties Flooded</td>
<td>Estimate Number of People</td>
<td>Commercial Properties Flooded</td>
<td>Critical Infrastructure Flooded</td>
<td>Key Transport Routes Flooded</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------</td>
<td>--------------------------------------------------------</td>
<td>------------------------------</td>
<td>---------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>3rd October 2010</td>
<td>&lt; 1 day</td>
<td>Combination of heavy rainfall and trash screen blockage</td>
<td>&gt;25</td>
<td>60 approx</td>
<td>Public House</td>
<td></td>
<td>B5044 (closed)</td>
</tr>
<tr>
<td>CENTRED ON NW CORNER OF COUNTY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>U2067 (closed)</td>
</tr>
</tbody>
</table>

NOTES

1. Due to interactions between the two events and impact of antecedent conditions from June contributing to flooding in July, they have been classified as one significant flood event.
2. This count includes properties where it is specified as ‘unknown’ whether they were flooded internally within the recording spreadsheet.

Table 4.4 - Correlation of Significant Flood Events with Rain Gauge Data

<table>
<thead>
<tr>
<th>Event</th>
<th>Date of Rain Gauge Reading</th>
<th>Rain Gauge Reading (mm) by Location</th>
<th>Conclusion / Match with Historic Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>31</td>
<td>28.2</td>
<td>25.7</td>
</tr>
<tr>
<td>16th August 2004</td>
<td>16/08/2004</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>Summer 2007 (June and July)</td>
<td>14/06/2007</td>
<td>72</td>
<td>51.5</td>
</tr>
<tr>
<td></td>
<td>24/06/2007</td>
<td>26.8</td>
<td>15.9</td>
</tr>
<tr>
<td></td>
<td>20/07/2007</td>
<td>47</td>
<td>22.5</td>
</tr>
<tr>
<td>3rd October 2010</td>
<td>01/10/2010</td>
<td>17.8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>02/10/2010</td>
<td>14</td>
<td>15.2</td>
</tr>
<tr>
<td></td>
<td>03/10/2010</td>
<td>5.4</td>
<td>11.8</td>
</tr>
</tbody>
</table>

NOTES

M = Data ‘Missing’ from rain gauge record.

The rough extent of these flood events are illustrated in Figures 4.7 - 4.10, based on the locations of past flooding data points. For reference, all the rain gauges listed in Table 4.4 are also marked on these maps. Please note that as a high rainfall reading does not directly imply flooding in the vicinity, the shading indicating an estimated extent of
flooding for each event does not always include the gauge locations. In each case, however, they do indicate the extent of the rain band which has resulted in the flooding.

The only event for which a conveyance route has been documented is the July 2007 flood in Kidsgrove, which is included in Figure 4.11. Data collection of future flooding events will include information on conveyance routes, where available.

4.5 Drainage Capacity

No information is readily available regarding drainage capacity within Staffordshire. However, the Annual Exceedence Probability (AEP) for the County-wide significant events listed above ranges from 5% (1 in 20 chance of occurring in any one year) to 0.5% (1 in 200 chance of occurring in any one year). As such an estimation can be made that the drainage capacity in the County is exceeded in rainfall events greater than the 5% AEP (higher than a 1 in 20 chance of occurring in any one year): such an event is slightly greater than the design capacity of most underground drainage systems.
Figure 4.7 - Areas Affected by Autumn 2000 Significant Flood Event
Figure 4.8 - Areas Affected by August 2004 Significant Flood Event
Figure 4.9 - Areas Affected by Summer 2007 Significant Flood Event

Conveyance routes shown in Figure 4.11 below.
Figure 4.10 - Areas Affected by October 2010 Significant Flood Event
Figure 4.11 - Conveyance Route of July 2007 Significant Flood Event in Kidsgrove

Surface Water Flow Paths Identified on YouTube Video Kidsgrove Staffordshire

4 Provided by Staffordshire County Council
5  FUTURE FLOOD RISK

5.1  Overview of Future Flood Risk

As identified in Table 3.2, a number of national datasets and model outputs are available to simulate surface water flooding, groundwater flooding and flooding from ordinary watercourses. In addition, settlement specific integrated SWMP models have been constructed for five settlements within Staffordshire. These sources of information are discussed in more detail below.

5.1.1  Areas Susceptible to Surface Water Flooding (ASiSWF)

This is a first generation national surface water mapping dataset, produced by the Environment Agency. It contains three susceptibility bandings (‘less’ to ‘more’ susceptible to surface water flooding) for a rainfall event with a 1 in 200 (0.5%) chance of occurring in any year. The rainfall event is simulated over coarse resolution (5m) Digital Terrain Model (DTM) grid, allowing water to flow to and gather in the lowest points. The resulting map shows areas that are susceptible to surface water flooding without any allowance for the underground sewerage or drainage networks, or buildings.

5.1.2  Flood Map for Surface Water (FMfSW)

The second generation national surface water mapping dataset produced by the Environment Agency, the FMfSW models include more detail than the ASiSWF, namely:

- more storm events;
- the influence of buildings; and
- the influence of the sewer system

The FMfSW mapping has been produced for the 1 in 30 (3.33%) and 1 in 200 (0.5%) chance of occurring in any year and for two depths for each - greater than 0.1m (shallow) and greater than 0.3m (deep). Reductions in rainfall have been applied in rural and urban areas to represent the impact of infiltration and sewers.

5.1.3  Surface Water Management Plan (SWMP)

Integrated SWMP models have been constructed by Royal Haskoning and Richard Allitt Associates for areas within the watersheds of Lichfield City, Tamworth town, Cannock town, Stafford town and Penkridge village. These include a representation of the surface topography (1m resolution), sewers (through inclusion of the water company sewer models), building footprints (using mastermap) and, where feasible, available watercourse models. Outputs have been produced for the rainfall events with the following annual probabilities: 1 in 2 (50%), 1 in 5 (20%), 1 in 10 (10%), 1 in 20 (5%), 1 in 25 (4%), 1 in 30 (3.33%), 1 in 50 (2%), 1 in 75 (1.33%), 1 in 100 (1%) and 1 in 200 (0.5%) chance of occurring in any year.
5.1.4 Flood Maps

The Environment Agency have produced a national dataset showing the modelled flood outlines for all watercourses with a catchment greater than 3km² for flood events with a 1 in 100 (1%) and 1 in 1000 (0.1%) chance of occurring in any year. The detail of the modelling varies between watercourses with the Main Rivers generally having more precise outlines than the ordinary watercourses. For this study the Main River flood zones have been removed from the mapping to provide a representation of future flooding from ordinary watercourses.

5.1.5 Areas Susceptible to Groundwater Flooding (ASGWF)

Another dataset produced by the Environment Agency, the ASGWF is a strategic scale map showing flood areas on a 1km² grid. The data uses the top two susceptibility bands of the British Geological Society (BGS) 1:50,000 Groundwater Flood Susceptibility Map (which includes consolidated aquifers and superficial deposits) but not groundwater rebound. The mapping shows the proportion (for four classifications) of each 1km grid square over which groundwater might emerge.

5.2 Consequences of Future Flooding

To estimate the possible harmful consequences of future flooding, the Environment Agency carried out an initial assessment by overlaying the ASGSWF and FMISW (200 year) with the National Receptor Database (NRD) v1.0 and provided the resulting receptor counts to the LLFAs (please note this assessment does not include an allowance for climate change). However, following the release of this information the NRD was updated to NRD v1.1. It was also noted that the LLFAs may hold more accurate local databases of receptors.

To provide an assessment of the updated NRD dataset and the information held by Staffordshire County Council, the possible harmful consequences of future flooding have been re-estimated using GIS software, with regards to human health, economics and the environment. Numbers of receptors such as dwellings, commercial properties, land use, transport networks, pollution sources and nationally designated sites (both environmental and cultural) have been calculated using the National Receptor Dataset v1.1 (NRD). However Staffordshire County Council hold a detailed local dataset for critical infrastructure and this has been used in preference to the NRD for the relevant receptors.

Where receptor data has been made available as point locations (e.g. property locations within the NRD dataset), they have been overlaid with the Mastermap building polygon data and an assessment of number of properties at risk made using the building footprints rather than the points.

A summary of the consequences assessed are outlined below.
5.2.1 Consequences to Human Health

- Number of dwellings at risk;
- Number of people at risk (*number of properties multiplied by 2.34*); and
- Number of critical services at risk (*including schools, hospitals, nursing/care/retirement homes, emergency services, prisons, sewage treatment works and electricity installations*).

5.2.2 Economic Consequences

- Number of non residential properties at risk;
- Area of agricultural land (Grades 1, 2 and 3 only) at risk;
- Length of road at risk; and
- Length of rail at risk.

5.2.3 Environmental Consequences

- Number of Pollution Prevention and Control (PPC) and Control of Major Accident Hazard (COMAH) sites at risk;
- Area of internationally and nationally designated sites (*including Special Areas of Conservation (SACs), Special Protection Areas, Ramsar sites and Sites of Special Scientific Interest (SSSIs)*); and
- Number/area of internationally and nationally designated heritage sites (*including World Heritage Sites, Scheduled Monuments, Listed Buildings and Registered Parks and Gardens*).

---

5 Scaling factor stated in the PFRA final guidance
5.2.4 Summary of the Consequences of Future Flooding

A detailed record of the consequences of future flooding for each of the flood risk datasets (using the new analysis of NRD v1.1 and the critical infrastructure data held by Staffordshire County Council) is included in Annex 2 of this report and a summary is provided in Table 5.1 below.

Table 5.1 - Summary Consequences of Future Flooding

<table>
<thead>
<tr>
<th>Data Set</th>
<th>Source of Flooding</th>
<th>Number of Residential Properties at Risk</th>
<th>Number of People at Risk</th>
<th>Number of Non Residential Properties at Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASiSWF</td>
<td>Surface Water (County wide)</td>
<td>62,429</td>
<td>146,084</td>
<td>23,323</td>
</tr>
<tr>
<td></td>
<td>Intermediate</td>
<td>23,924</td>
<td>55,982</td>
<td>10,874</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,965</td>
<td>6,938</td>
<td>1,759</td>
</tr>
<tr>
<td>FMfSW</td>
<td>Surface Water (County wide)</td>
<td>37,437</td>
<td>87,603</td>
<td>13,893</td>
</tr>
<tr>
<td></td>
<td>1 in 30 (&gt;0.1m depth)</td>
<td>9,397</td>
<td>21,989</td>
<td>4,261</td>
</tr>
<tr>
<td></td>
<td></td>
<td>89,316</td>
<td>208,999</td>
<td>27,853</td>
</tr>
<tr>
<td></td>
<td>1 in 200 (&gt;0.3m depth)</td>
<td>25,524</td>
<td>59,726</td>
<td>9,238</td>
</tr>
<tr>
<td>SWMP</td>
<td>Lichfield City (1 in 200, &gt;0.1m depth)</td>
<td>1,051</td>
<td>2,459</td>
<td>359</td>
</tr>
<tr>
<td></td>
<td>Stafford town (1 in 200, &gt;0.1m depth)</td>
<td>523</td>
<td>1,224</td>
<td>398</td>
</tr>
<tr>
<td></td>
<td>Cannock town (1 in 200, &gt;0.1m depth)</td>
<td>1,082</td>
<td>2,532</td>
<td>383</td>
</tr>
<tr>
<td></td>
<td>Tamworth town (1 in 200, &gt;0.1m depth)</td>
<td>175</td>
<td>410</td>
<td>87</td>
</tr>
<tr>
<td></td>
<td>Penkridge village (1 in 200, &gt;0.1m depth)</td>
<td>1,120</td>
<td>2,621</td>
<td>308</td>
</tr>
<tr>
<td>Flood Maps</td>
<td>Ordinary Watercourses</td>
<td>1,455</td>
<td>3,405</td>
<td>1,132</td>
</tr>
<tr>
<td></td>
<td>1 in 100 (FZ3)</td>
<td>1,766</td>
<td>4,132</td>
<td>1,357</td>
</tr>
<tr>
<td>ASiGWF</td>
<td>Groundwater</td>
<td>92,877</td>
<td>217,332</td>
<td>26,679</td>
</tr>
</tbody>
</table>

NOTES

1 Using a factor of 2.34 as stated in the PFRA final guidance

A comparison between the newly calculated results (above) and those calculated using NRD v1.0 (provided by the Environment Agency) are shown in Table 5.2 below. In all cases the new analysis has resulted in an increase in the number of properties at risk. Although both calculations utilised the property footprint method, the difference will be mostly attributable to variations in the detailed methodology or changes within the NRD (either in terms of property numbers or the designation of receptors). Without a detailed comparison between the two methods, the reasons for the differences are unknown.

However, for consistency, as the NRD v1.1 and Staffordshire County Council’s critical infrastructure dataset have been used to calculate the number of properties within the datasets not assessed by the Environment Agency (i.e. the SWMP, Flood Map, ASiGWF extents, FMfSW 30 year and ASiSWF ‘more’1) the new values have been used to complete all entries within Annex 2.
**Table 5.2 - Comparison Between Property Numbers from NRD v1.0 and NRD v1.1**

<table>
<thead>
<tr>
<th>Future Flood Layer</th>
<th>Property Type</th>
<th>Source of Property Data</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>NRD v1.0$^1$</td>
<td>NRD v1.1$^2$</td>
</tr>
<tr>
<td>FMfSW 200 yr 0.1</td>
<td>Residential</td>
<td>64,700</td>
<td>89,316</td>
</tr>
<tr>
<td></td>
<td>Commercial</td>
<td>21,700</td>
<td>27,853</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>86,400</td>
<td>117,169</td>
</tr>
<tr>
<td>FMfSW 200 yr 0.3</td>
<td>Residential</td>
<td>19,000</td>
<td>25,524</td>
</tr>
<tr>
<td></td>
<td>Commercial</td>
<td>7,300</td>
<td>9,238</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>26,300</td>
<td>34,762</td>
</tr>
<tr>
<td>ASfSW Less</td>
<td>Residential</td>
<td>46,600</td>
<td>62,429</td>
</tr>
<tr>
<td></td>
<td>Commercial</td>
<td>18,000</td>
<td>23,323</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>64,600</td>
<td>85,752</td>
</tr>
<tr>
<td>ASfSW Intermediate</td>
<td>Residential</td>
<td>18,700</td>
<td>23,924</td>
</tr>
<tr>
<td></td>
<td>Commercial</td>
<td>8,600</td>
<td>10,874</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>27,300</td>
<td>34,798</td>
</tr>
</tbody>
</table>

**NOTES**

$^1$ Data calculated by the Environment Agency using NRD v1.0 and Mastermap building footprints.

$^2$ Property numbers calculated by Royal Haskoning using an overlay of the NRD v1.1 and Mastermap building footprints.

The Environment Agency has used the FMfSW mapping (1 in 200 deep) and the NRD (v1.0) to identify a number of 1km² national grid squares across the Country that exceed the following threshold:

1. 200 people at risk of flooding or
2. 20 businesses at risk of flooding or
3. 1 critical service at risk of flooding

The grid squares in Staffordshire that exceed this threshold are illustrated in Figure 5.1. These are the areas where flood risk, based upon the FMfSW, is considered to be the most severe across Staffordshire. It is possible that if Figure 5.1 was redrawn using the new property calculations (derived from the NRD v1.1 data) the number of blue squares may marginally increase. However, as the current mapping exercise has been undertaken on a national scale, it enables comparison between different LLFA areas. As it cannot be ascertained that the recalculated NRD v1.1 property numbers are directly comparable to the NRD v1.0 numbers and an identical exercise has not been carried out on a national scale, it is not considered appropriate for this map to be updated using the new information. Although a re-mapping exercise may result in minor adjustments to the boundaries of the ‘blue squares’ shown in Figure 5.1, as a result of the relatively low density of population within Staffordshire it is highly unlikely that any resulting changes will impact on the designation of Indicative Flood Risk Areas (see Section 6).

Within southern Staffordshire the areas identified as having a flood risk ‘above threshold’ in Figure 5.1 match those included within the Phase 2 SWMP modelling exercise, with the exception of Stone and Burntwood, both of which were identified in the Phase 1 as locations for potential future models. Outside of the southern Staffordshire SMWP study area, Burton upon Trent, Newcastle under Lyme and Leek are the key settlements...
identified on Figure 5.1. All of these locations match those identified within the records of past flood risk.

Although details of the number of area of environmentally designated and culturally significant sites is provided in Annex 2, the Environment Agency has provided the following list of key sites at risk of flooding from surface water:

Parks and Gardens
- Patshull Hall, with a total area of 7.8% at risk of surface water flooding, placing it 11th in a ranked list of parks and gardens in the Country.

RAMSAR sites
- Midland Meres and Mosses Phase 1 with a total area of 6.2% at risk of surface water flooding;
- Midland Meres and Mosses Phase 2 with a total area of 1.4% at risk of surface water flooding.

SAC sites
- Cannock Extension Canal
- Mottey Meadows
- West Midlands Mosses
- Cannock Chase
- River Mease
- Pasturefields Salt Marsh
- Peak District Dales

SPA sites
- Peak District Moor (South Pennine Moors Phase 1)

SSSI sites
- A total of 49.4% of the area classified as SSSI within Staffordshire County is at risk of surface water flooding.

---

6 Please note that RAMSAR, SAC, SPA and SSSI sites are combined as ‘Environmentally Designated Sites’ in Annex 2.
5.3 **Locally Agreed Surface Water Information**

A definition of ‘locally agreed surface water information’ has been considered to agree the surface water information that best represents local conditions across Staffordshire. This consists of:

- The SWMP outputs for Lichfield City, Tamworth town, Cannock town, Stafford town and Penkridge village; and
- The FMfSW for the rest of the County.

However, these two datasets have not been merged. To calculate the number of properties within the extent of the Locally Agreed Surface Water Information (included within **Annex 4**), the number of property points counted from the FMfSW maps within the SWMP model watersheds have been deducted from the FMfSW property count and the number of properties falling within the SWMP models added onto the resulting FMfSW count.

With regards to ordinary watercourses and groundwater, there is no local information available so, for these sources of flood risk the Environment Agency’s Flood Maps and AStGW are considered the best outlines.

Summary maps showing the outlines for the FMfSW combined with the SWMP outlines, (**Figure 5.2**), the AStGW (**Figure 5.3**) and the Flood Maps for ordinary watercourses (**Figure 5.4**) are shown below.

---

7 The FMfSW is considered to be more accurate than the AStSWF maps within Staffordshire due to the increased detail included within the model. Comparison with the available past flooding point data does not identify any anomalies within the outline of the FMfSW as compared to the AStSWF.
Figure: Locally agreed Surface Water Information

Project:
Staffordshire Preliminary Flood Risk Assessment

Client:
Staffordshire County Council

Date: March 2011

Scale @ A3: 1:340,000

Title:
Flood Map for Surface Water (FMfSW)

Key:
- SWMP Outlines
- > 0.1m

Copyright (c) The Automobile Association
Key:

Areas Susceptible to Groundwater Flooding (ASGWF)

- >= 75%
- >= 50% <75%
- >= 25% <50%
- < 25%

Copyright © The Automobile Association

Title: Groundwater Flooding

Project: Staffordshire Preliminary Flood Risk Assessment

Client: Staffordshire County Council

Date: March 2011

Scale @ A3: 1:340,000

Figure: 5.3
5.4 Climate Change

5.4.1 The Evidence

There is clear scientific evidence that global climate change is happening now. It cannot be ignored.

Over the past century around the UK we have seen sea level rise and more of our winter rain falling in intense wet spells. Seasonal rainfall is highly variable. It seems to have decreased in summer and increased in winter, although winter amounts changed little in the last 50 years. Some of the changes might reflect natural variation, however the broad trends are in line with projections from climate models.

Greenhouse gas (GHG) levels in the atmosphere are likely to cause higher winter rainfall in future. Past GHG emissions mean some climate change is inevitable in the next 20-30 years. Lower emissions could reduce the amount of climate change further into the future, but changes are still projected at least as far ahead as the 2080s.

We have enough confidence in large scale climate models to say that we must plan for change. There is more uncertainty at a local scale but model results can still help us plan to adapt. For example we understand rain storms may become more intense, even if we can’t be sure about exactly where or when. By the 2080s, the latest UK climate projections (UKCP09) are that there could be around three times as many days in winter with heavy rainfall (defined as more than 25mm in a day). It is plausible that the amount of rain in extreme storms (with a 1 in 5 annual chance, or rarer) could increase locally by 40%.

As stated in Section 1.3 of this report, Staffordshire is split between three River Basin Districts - the Humber, Severn and Northwest. The climate change predictions and impacts for flood risk for each of these Districts is given below.

5.4.2 Key Projections for Humber River Basin District

If emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past are:

- Winter precipitation increases of around 12% (very likely to be between 2 and 26%)
- Precipitation on the wettest day in winter up by around 12% (very unlikely to be more than 24%)
- Relative sea level at Grimsby very likely to be up between 10 and 41cm from 1990 levels (not including extra potential rises from polar ice sheet loss)
- Peak river flows in a typical catchment likely to increase between 8 and 14%

Implications for Flood Risk

Climate changes can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability.

Wetter winters and more of this rain falling in wet spells may increase river flooding. More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers, so we need to be prepared
for the unexpected. Drainage systems in the district have been modified to manage water levels and could help in adapting locally to some impacts of future climate on flooding, but may also need to be managed differently. Rising sea or river levels may also increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses. Even small rises in sea level could add to very high tides so as to affect places a long way inland.

Where appropriate, we need local studies to understand climate impacts in detail, including effects from other factors like land use. Sustainable development and drainage will help us adapt to climate change and manage the risk of damaging floods in future.

5.4.3 Key Projections for North West River Basin District

If emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past are:

- Winter precipitation increases of around 14% (very likely to be between 4 and 28%)
- Precipitation on the wettest day in winter up by around 11% (very unlikely to be more than 25%)
- Relative sea level at Morecambe very likely to be up between 6 and 36cm from 1990 levels (not including extra potential rises from polar ice sheet loss)
- Peak river flows in a typical catchment likely to increase between 11 and 18%

Increases in rain are projected to be greater near the coast than inland.

Implications for Flood Risk

Climate changes can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability.

Wetter winters and more of this rain falling in wet spells may increase river flooding especially in steep, rapidly responding catchments. More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers, so we need to be prepared for the unexpected.

Drainage systems in the district have been modified to manage water levels and could help in adapting locally to some impacts of future climate on flooding, but may also need to be managed differently. Rising sea or river levels may also increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses.

Where appropriate, we need local studies to understand climate impacts in detail, including effects from other factors like land use. Sustainable development and drainage will help us adapt to climate change and manage the risk of damaging floods in future.
5.4.4 Key Projections for Severn River Basin District

If emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past are:

- Winter precipitation increases of around 12% (very likely to be between 2 and 26%)
- Precipitation on the wettest day in winter up by around 9% (very unlikely to be more than 22%)
- Relative sea level at Bristol very likely to be up between 10 and 40cm from 1990 levels (not including extra potential rises from polar ice sheet loss)
- Peak river flows in a typical catchment likely to increase between 9 and 18%

Increases in rain are projected to be greater at the coast and in the south of the district.

Implications for Flood Risk

Climate changes can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability.

Wetter winters and more of this rain falling in wet spells may increase river flooding along the Severn and its tributaries. More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers, so we need to be prepared for the unexpected.

Drainage systems in the district have been modified to manage water levels and could help in adapting locally to some impacts of future climate on flooding, but may also need to be managed differently. Rising sea or river levels may also increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses.

Where appropriate, we need local studies to understand climate impacts in detail, including effects from other factors like land use. Sustainable development and drainage will help us adapt to climate change and manage the risk of damaging floods in future.

5.4.5 Local Information Regarding Climate Change

The SWMP modelling carried out for the five settlements\(^8\) in southern Staffordshire, included three climate change runs - for the 5% (1 in 20 chance of flooding in any given year), 2% (1 in 50 chance of flooding in any given year) and 1% (1 in 100 chance of flooding in any given year). These scenarios were simulated by increasing the current associated rainfall intensity by 30%. The resulting impact on the number of properties at risk is summarised for the 1% (1 in 100 chance of flooding in any given year) in Table 5.3 below.

\(^8\) Please note the Stafford town model outline was not available for inclusion in this report
Table 5.3 - Impact of Climate Change on SWMP Future Flood Outlines for the 1% Flood Event

<table>
<thead>
<tr>
<th>Future Flood Event</th>
<th>Number of Residential Properties at Risk</th>
<th>Number of People at Risk</th>
<th>Number of Non Residential Properties at Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Current</td>
<td>With Climate Change</td>
<td>Current</td>
</tr>
<tr>
<td>Lichfield City</td>
<td>757</td>
<td>1,073</td>
<td>1,771</td>
</tr>
<tr>
<td>Tamworth Town</td>
<td>138</td>
<td>177</td>
<td>323</td>
</tr>
<tr>
<td>Cannock Town</td>
<td>836</td>
<td>1,117</td>
<td>4,956</td>
</tr>
<tr>
<td>Penkridge Village</td>
<td>959</td>
<td>1,127</td>
<td>2,244</td>
</tr>
<tr>
<td>Stafford Town</td>
<td>388</td>
<td>550</td>
<td>908</td>
</tr>
</tbody>
</table>

5.4.6 Adapting to Change

Past emission means some climate change is inevitable. It is essential we respond by planning ahead. We can prepare by understanding our current and future vulnerability to flooding, developing plans for increased resilience and building the capacity to adapt. Regular review and adherence to these plans is key to achieving long-term, sustainable benefits.

Although the broad climate change picture is clear, we have to make local decisions against deeper uncertainty. We will therefore consider a range of measures and retain flexibility to adapt. This approach, embodied within flood risk appraisal guidance, will help to ensure that we do not increase our vulnerability to flooding.

5.5 Long term developments

5.5.1 General

It is possible that long term developments might affect the occurrence and significance of flooding. However current planning policy aims to prevent new development from increasing flood risk.

In England, Planning Policy Statement 25 (PPS25) on development and flood risk aims 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 highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall."

Adherence to Government policy ensures that new development does not increase local flood risk. However, in exceptional circumstances the Local Planning Authority may accept that flood risk can be increased contrary to general Government policy, usually because of the wider benefits of a new or proposed major development. Any exceptions would not be expected to increase risk to levels which are "significant" (in terms of the Government's criteria).
5.5.2 Staffordshire Developments

As a result of the proposed abolition of the Regional Spatial Strategies (RSS), long term large scale development locations within Staffordshire are currently uncertain. As such it is not appropriate to identify particular locations within this PFRA report.
6 IDENTIFICATION OF INDICATIVE FLOOD RISK AREAS

6.1 Identification of Indicative Flood Risk Areas

To ensure a consistent national approach, Defra and WAG have identified significance criteria and threshold to be used for defining flood risk areas\(^9\). The Environment Agency has applied these criteria and thresholds to produce ten Indicative Flood Risk Areas, shown in Figure 6.1. The southern edges of South Staffordshire District and Lichfield District are included in the West Midlands Indicative Flood Risk Area, as shown in the insert.

Figure 6.1 - Indicative Flood Risk Areas in Staffordshire\(^{10}\)

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\(^9\) See Defra’s guidance document “Selecting and Reviewing Flood Risk Areas for Local Sources of Flooding”

\(^{10}\) Figure extracted from Environment Agency map
The consequences within Staffordshire of this Indicative Flood Risk Area, as compared to the other LLFAs are summarised in Table 6.1 below.

Table 6.1 - Consequences of Flooding within West Midlands Indicative Flood Risk Area

<table>
<thead>
<tr>
<th>LLFA</th>
<th>Human health consequences: residential properties</th>
<th>Human health consequences: Number of people (2.34 multiplier)</th>
<th>Other human health consequences - number of critical services flooded</th>
<th>Economic Consequences - number of non-residential properties flooded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birmingham</td>
<td>24220</td>
<td>56675</td>
<td>166</td>
<td>4755</td>
</tr>
<tr>
<td>Dudley</td>
<td>7932</td>
<td>18561</td>
<td>77</td>
<td>1944</td>
</tr>
<tr>
<td>Sandwell</td>
<td>7004</td>
<td>16389</td>
<td>70</td>
<td>1685</td>
</tr>
<tr>
<td>City of Wolverhampton</td>
<td>7421</td>
<td>17365</td>
<td>59</td>
<td>1245</td>
</tr>
<tr>
<td>Walsall</td>
<td>5238</td>
<td>12257</td>
<td>40</td>
<td>1116</td>
</tr>
<tr>
<td>Solihull</td>
<td>3137</td>
<td>7341</td>
<td>20</td>
<td>385</td>
</tr>
<tr>
<td>Worcestershire</td>
<td>436</td>
<td>1020</td>
<td>2</td>
<td>65</td>
</tr>
<tr>
<td>Staffordshire</td>
<td>221</td>
<td>517</td>
<td>1</td>
<td>15</td>
</tr>
</tbody>
</table>

6.2 Review of Indicative Flood Risk Areas

Historical incidences of flooding within the Staffordshire area of the IFRA have been identified (although the only significant flood event which provides overlap in these marginal areas of Staffordshire is the summer 2007 event). Although there are no significant urban areas within the boundary of the IFRA in Staffordshire, the catchments within the IFRA are linked to settlements downstream within the County boundary. As such, the Council requires no adjustment to the IFRA boundaries and wishes to remain included within the West Midlands IFRA group.

As outlined in Section 5.2, a number of 1km squares in Staffordshire have been identified as having risk of flooding above the Flood Risk Threshold. Some of these locations have been identified as forming a 3km² cluster, including the settlements of Stone, Cannock, Burntwood, Lichfield and parts of Newcastle-under-Lyme (see Figure 6.2 below).
The numbers on the map refer to the rank of the settlement in terms of the number of people at risk on a scale of 1 (highest number of people at risk) to 219 (the lowest number of people at risk). Table 6.2 summarises the information provided by the Environment Agency with regards to these clusters:
Table 6.2 - Details of Surface Water Flood Risk within Clusters Shown in Figure 6.2

<table>
<thead>
<tr>
<th>Flood Risk Indicator</th>
<th>Stone</th>
<th>Cannock</th>
<th>Burntwood</th>
<th>Lichfield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rank (out of 219)</td>
<td>186</td>
<td>75</td>
<td>166</td>
<td>148</td>
</tr>
<tr>
<td>National Grid Reference</td>
<td>SJ9050033500</td>
<td>SJ9891911048</td>
<td>SK0516708500</td>
<td>SK1250009000</td>
</tr>
<tr>
<td>Area</td>
<td>900ha</td>
<td>3100ha</td>
<td>1800ha</td>
<td>1200ha</td>
</tr>
<tr>
<td>Number of Residential Properties at Risk</td>
<td>Not provided</td>
<td>Not provided</td>
<td>Not provided</td>
<td>Not provided</td>
</tr>
<tr>
<td>Number of People at Risk</td>
<td>Not provided</td>
<td>Not provided</td>
<td>Not provided</td>
<td>Not provided</td>
</tr>
<tr>
<td>Number of Critical Services at Risk</td>
<td>Not provided</td>
<td>Not provided</td>
<td>Not provided</td>
<td>Not provided</td>
</tr>
<tr>
<td>Number of Non Residential Properties at Risk</td>
<td>Not provided</td>
<td>Not provided</td>
<td>Not provided</td>
<td>Not provided</td>
</tr>
<tr>
<td>Length of Road or Rail at Risk from Surface Runoff</td>
<td>4.9km</td>
<td>13.4km</td>
<td>5.5km</td>
<td>3.9km</td>
</tr>
<tr>
<td>Area of Agricultural Land at Risk from Surface Runoff</td>
<td>22.8ha</td>
<td>39.1ha</td>
<td>32.4ha</td>
<td>19.8ha</td>
</tr>
<tr>
<td>Number of PPC sites potentially at risk from surface runoff</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Number of Listed Buildings (all grades) at risk from Surface Runoff</td>
<td>7</td>
<td>3</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td>Number of Listed Buildings (Grades I and II*) at risk from Surface Runoff</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Number of Scheduled Ancient Monuments at risk from Surface Runoff</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mean Potential for Groundwater Flooding over Cluster</td>
<td>45.8%</td>
<td>38.5%</td>
<td>37.5%</td>
<td>125%</td>
</tr>
<tr>
<td>Area of Cluster with &gt; 75% Groundwater Flooding Potential</td>
<td>200ha</td>
<td>200ha</td>
<td>300ha</td>
<td>0ha</td>
</tr>
<tr>
<td>Area of Cluster with &gt; 50% Groundwater Flooding Potential</td>
<td>400ha</td>
<td>800ha</td>
<td>300ha</td>
<td>0ha</td>
</tr>
<tr>
<td>Area of Cluster with &gt; 25% Groundwater Flooding Potential</td>
<td>600ha</td>
<td>1500ha</td>
<td>300ha</td>
<td>300ha</td>
</tr>
</tbody>
</table>

Although all these locations have been identified in the assessments of both past and future flood risk within this PFRA and further assessments of surface water have already been carried out in Lichfield and Cannock, the required criteria for a cluster to have a population at risk of flooding of greater than 30,000 is not met for any of these locations, even as a result of the recalculation of property numbers using NRD v1.1 (see Section 5). As such, no additional Indicative Flood Risk Areas have been identified within Staffordshire.
7 NEXT STEPS

To support the six year review of the PFRA and to support the development of the Local Flood Risk Strategy, the following actions have been identified by Staffordshire County Council:

1. Following the Environment Agency’s National Strategy, all information collated within this PFRA will be used to inform the Local Flood Risk Strategy.

2. A robust system for recording flooding information will be developed, based upon the spreadsheet utilised within this PFRA. This will possibly be in the form of a database or web-based GIS and will include all the information required within the PFRA process;

3. Investigations into the cause of flood events will be prioritised based upon a risk matrix currently linked to the flood record spreadsheet;

4. An asset database will be developed. This will include all the information currently held regarding the location of assets, but will be expanded to include additional data, such as asset condition;

5. Further historic flood risk information, where available, will be collected and assimilated into the flood event spreadsheet;

6. All relationships identified in Figure 2.1 will be strengthened and maintained;

7. To streamline the process of data exchange, increased data sharing will be encouraged between all the partners shown on Figure 2.1;

8. The existing partnership arrangements will be reviewed inline with the new flood risk responsibilities, with regards to decision making. This will be promoted through regular meetings of the Staffordshire Strategic Flood Forum;

9. The relationships developed with the Parish Councils and communities at risk of flooding will be maintained and engagement increased to provide more informed information regarding flood risk;

10. Staffordshire County Council are already committed to assist the Environment Agency in the production of Operational Flood Response plans for areas at risk from fluvial flooding. The data collected as part of this PFRA will be reviewed to identify additional operational plan areas with regards to surface water flooding;

11. All information collected as part of this PFRA will be utilised by the LLFA within their upcoming SuDS Approval Board (SAB) role;

12. Staffordshire County Council recognise the need to engage with the Local Authorities to agree the best method by which their local flood risk responsibilities should be delivered under the two tier Council arrangement; and

13. The current links between the flood risk and highways departments within the Council should be strengthened to ensure that all highways schemes and maintenance works account for the risk posed by flooding;

14. That the inspection and maintenance regimes for SCC owned bridges, culverts, trash screens and drainage systems together with other important third party assets are reviewed, to take into account their current condition and importance in preventing flooding to built up areas and critical infrastructure.
8 REFERENCES


Environment Agency ‘Flood Map for Surface Water Property Count Method’, November 2010


Annex 1
Records of Past Floods and Their Significant Consequences (Preliminary Assessment Spreadsheet)
### ANNEX 1: Records of past floods and their significant consequences

<table>
<thead>
<tr>
<th>Event Date</th>
<th>Location</th>
<th>Source of Flooding</th>
<th>Consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>16/08/2004</td>
<td>Staffordshire Borough Council</td>
<td>Surface Runoff, Ordinary Watercourse</td>
<td>Flooding of roads, Closure of A34, Stone, closed</td>
</tr>
<tr>
<td>13/06/2007</td>
<td>Cannock Chase, Staffordshire Council</td>
<td>Main River, Ordinary Watercourse,</td>
<td>Flooding of National Watercourses, Surcharging of a church, flooding of care home</td>
</tr>
<tr>
<td>16/08/2004</td>
<td>Staffordshire Borough Council</td>
<td>Groundwater</td>
<td>Flooding of National Watercourses, Closure of a key railway line</td>
</tr>
<tr>
<td>10/11/2011</td>
<td>East Staffordshire and Newcastle-under-Lyme</td>
<td>Artifical Drainage, Surface Runoff</td>
<td>Flooding and closure of a number of roads, Flooding of National Watercourses</td>
</tr>
</tbody>
</table>

### Additional Sources of Flooding

- Human health
- Cultural heritage
- Other economic
- Property count
- Other human health
- Significant economic

### Method

- Mandatory / optional
- Reference
  - Max 250 characters
  - 'yyyy' or 'yyyy-mm' or 'yyyy-mm-dd'
  - Max 25 characters
  - Pick from drop-down
- Max 250 characters
  - Pick from drop-down
  - Number between 1-9999
  - Pick from drop-down
  - Max 250 characters
  - Pick from drop-down
  - Max 1,000 characters
  - Max 250 characters
- Information collected
  - Unknown
  - Low
  - Public
  - NA
  - Information collected
  - Unknown
  - Low
  - Public
  - NA

### Survey date

- 'yyyy' or 'yyyy-mm' or 'yyyy-mm-dd'

### Sensitive data

- Mandatory
- Surcharging of a number of settlements, most notably Silverdale, Kidsgrove Silverdale as a result of overland flow, stemming from the blockage of a trash screen culvert. In addition roads and a commercial property were flooded. As most property event occurring in any given year.
Annex 2

Records of Future Floods and Their Significant Consequences (Preliminary Assessment Spreadsheet)
### Annex 2: Records of future floods and their consequences between 1-9999

The following tables provide information on flood risk management, including models used, software, and data sources. Details on the extent and impact of flooding are also included.

#### Models used

- **Environment Agency 2m Composite Topography**
- **OS 1:10 Boundary Topography**
- **Department for Environment, Food 
  and Rural Affairs (DEFRA) and Staffordshire County Council**

#### Data sources

- **LiDAR, OS 1:10 Boundary Topography**
- **Western Survey System, OS 2009 MasterMap (building footprints)**
- **NEXTMap SAR (on 5m grid; original accuracy ± 1.0m)**

#### Assumptions within Models

- For the purpose of flood risk management, models assume that there are no raised defences.
- Models assume that there are no raised defences.

#### Other obstructions

- Underground drainage network represented by water company sewer models.

#### Buildings

- Buildings included as solid structures defined from MasterMap.

#### Areas susceptible to flooding

- Areas that may flood are defined for settlement watershed by routing appropriate flows through the model to ascertain water level and thus depth and extent.
- Underground drainage network represented by water company sewer models.

#### Defences

- Buildings included as solid structures defined from MasterMap.
- Areas that may flood are defined for settlement watershed by routing appropriate flows through the model to ascertain water level and thus depth and extent.

#### Sources

- LiDAR, OS 1:10 Boundary Topography
- Western Survey System, OS 2009 MasterMap (building footprints)
- NEXTMap SAR (on 5m grid; original accuracy ± 1.0m)

#### Table: Case Counting

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
<th>Methodology</th>
<th>Strengths</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural</td>
<td>388</td>
<td>Detailed GIS</td>
<td>7 Nursing/Care/</td>
<td>388 Detailed GIS</td>
</tr>
<tr>
<td>High Natural</td>
<td>1051</td>
<td>Detailed GIS</td>
<td>7 Schools</td>
<td>1051 Detailed GIS</td>
</tr>
<tr>
<td>Low Natural</td>
<td>231</td>
<td>Detailed GIS</td>
<td>48ha Agricultural</td>
<td>231 Detailed GIS</td>
</tr>
<tr>
<td>Medium Natural</td>
<td>1 Listed Building</td>
<td>Detailed GIS</td>
<td>1 Listed Building</td>
<td>1 Listed Building</td>
</tr>
<tr>
<td>Medium High</td>
<td>5ha Registered Parks</td>
<td>Detailed GIS</td>
<td>5ha Registered Parks</td>
<td>5ha Registered Parks</td>
</tr>
<tr>
<td>High Medium</td>
<td>2.7km Roads</td>
<td>Detailed GIS</td>
<td>2.7km Roads</td>
<td>2.7km Roads</td>
</tr>
<tr>
<td>High Natural</td>
<td>1.7km Railways</td>
<td>Detailed GIS</td>
<td>1.7km Railways</td>
<td>1.7km Railways</td>
</tr>
<tr>
<td>High Natural</td>
<td>83 Scheduled Monuments</td>
<td>Detailed GIS</td>
<td>83 Scheduled Monuments</td>
<td>83 Scheduled Monuments</td>
</tr>
<tr>
<td>High Natural</td>
<td>84 Scheduled Monuments</td>
<td>Detailed GIS</td>
<td>84 Scheduled Monuments</td>
<td>84 Scheduled Monuments</td>
</tr>
</tbody>
</table>

#### Additional Information

- For the purpose of flood risk management, models assume that there are no raised defences.
- Buildings included as solid structures defined from MasterMap.

#### Further Reading

- For more information on flood risk management, refer to the Environment Agency's 'National Generalised Modelling for Flood Protection' report.

#### Contacts

- Stafford SJ9323724151 Stafford Phase 2
- Lichfield SK1154109674 Lichfield Phase 2
- Staffordshire SJ9817828803 Areas Susceptible to LLFA.
Annex 3
Records of Flood Risk Area and Rationale
| Property count | Significant | Cultural heritage | Human health | Notes | European Flood Risk Area Code | New Flood Risk Area | Linked Local Flood Authority (LLFA) Flood ID | National Grid | Name of the locality | Main source of flooding | Additional source(s) | Confidence in main source of flooding | Main mechanism of flooding | Main characteristic of flooding | Rationale detail | Application ID | LLFA ID | Stage of review | LLFA ID | Rationale | Rationale detail | Rationale detail | Rationale detail | Rationale detail | Rationale detail | People at risk | People at risk | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | Details of flooding | 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Annex 4
Review Checklist
Step 1: Set up governance and develop partnerships

1.1 Is a project lead for the Flood and Water Management (FWM) assessments in place?
   - Yes

1.2 Is there a Flood Risk Management Partnership (FRMP) and a Flood Risk Management Strategy (FRMS) for the LLFA area?
   - Yes

Step 2: Undertake appropriate data collection

2.1 Has a data management system been established and implemented?
   - Yes

Step 3: Collect information on past and future floods and their consequences

3.1 Was the initial Flood Risk Assessment (FRA) undertaken for the LLFA?
   - Yes

3.2 Has the locally agreed surface water information been clearly defined and presented (or a map in the Preliminary Assessment Report)?
   - Yes

3.3 Has an indicative Flood Risk Area (FRA) been clearly stated and presented (on a map) in the Preliminary Assessment Report?
   - Yes

3.4 Has additional information been included on climate change and long-term developments?
   - Yes

Step 4: Determine locally agreed surface water information

4.1 Has an indicative Flood Risk Area been determined as ‘locally agreed surface water information’ text box in section 3.5.1 (p.17) of guidance.
   - Yes

4.2 Has the locally agreed surface water information been clearly defined and presented (or a map in the Preliminary Assessment Report)?
   - Yes

4.3 Has the locally agreed surface water information been included in the Preliminary Assessment Report?
   - Yes

Step 5: Complete Preliminary Assessment Report Document

5.1 Has the Preliminary Assessment Report covered all of the content described in Annex 2 of the Environment Agency’s FRMS guidance?
   - Yes

5.2 Has a summary table of flood events been produced?
   - Yes

5.3 Has a description of past flood events been included?
   - Yes

5.4 Has an additional statement been made on future changes and long-term developments?
   - Yes

Step 6: Review indicative Flood Risk Areas

6.1 Is a Flood Risk Area proposed?
   - Yes

6.2 Are the Preliminary Assessment Report spreadsheet (Annex 2 of the Preliminary Assessment Report) consistent with the content described in Annex 2 of the Preliminary Assessment Report?
   - Yes

6.3 Are the Preliminary Flood Risk Areas in the Preliminary Assessment Report spreadsheet (Annex 2 of the Preliminary Assessment Report) consistent with the content described in Annex 2 of the Preliminary Assessment Report?
   - Yes

Step 7: Review indicative Flood Risk Areas

7.1 Is the scale of the changes made to the indicative Flood Risk Area because of Geography, past flooding, planning, and any other local information provided by the Environment Agency?
   - Yes

7.2 Have any additional records of future flooding (other than those included in the Indoors/Streams database) been used to inform the determination of the indicative Flood Risk Area? (please confirm).
   - Yes

Step 8: Consider additional criteria

8.1 Has an indicative Flood Risk Area been deleted? LLFA - if an indicative Flood Risk Area has been deleted please provide a short description why.
   - Yes

8.2 Has an indicative Flood Risk Area been amended due to Geography, past flooding, planning, and any other local information provided by the Environment Agency?
   - Yes

Step 9: Review indicative Flood Risk Areas

9.1 Is a Flood Risk Area proposed?
   - Yes

9.2 Has an indicative Flood Risk Area been amended due to Geography, past flooding, planning, and any other local information provided by the Environment Agency?
   - Yes

9.3 Has an indicative Flood Risk Area been deleted? LLFA - if an indicative Flood Risk Area has been deleted please provide a short description why.
   - Yes

9.4 Has an indicative Flood Risk Area been amended due to Geography, past flooding, planning, and any other local information provided by the Environment Agency?
   - Yes

Step 10: Consider additional criteria

10.1 Has a data management system been established and implemented?
   - Yes

10.2 Has additional information been included in the Preliminary Assessment Report?
   - Yes
Annex 5
GIS Layer of Flood Risk Areas

[No Alterations Required in Staffordshire]
Annex 6
Sources of Flooding
Sources of Flooding (taken from Box 2, Page 3 of the PFRA Final Guidance)

**Main river** – watercourses legally defined and marked as such on the main river map. Generally they are larger streams or rivers, but can be smaller watercourses. The Environment Agency has legal responsibility for them.

**The sea** – coastal flooding can occur as a result of a combination of high tides and stormy conditions. If low atmospheric pressure coincides with a high tide, a tidal surge may cause serious flooding. We are responsible for managing risk from sea flooding.

**Reservoirs** – we are responsible for regulating large raised reservoirs under the Reservoirs Act 1975. We currently regulate reservoirs over 25,000 m³ in capacity. This will reduce to 10,000m³ by the commencement of provisions of the Flood and Water Management Act. Reservoirs below this size are unlikely to present significant flood risks in the context of the Regulations. On this basis there is no need for LLFAs to include information on reservoirs in their PFRAs.

**Local flood risk** – flood risk from sources other than main rivers, the sea and reservoirs, principally meaning surface runoff, groundwater and ordinary watercourses.

**Surface runoff** – rainwater (including snow and other precipitation) which is on the surface of the ground (whether or not it is moving), and has not entered a watercourse, drainage system or public sewer. Flooding from surface runoff is sometimes called pluvial flooding. Note that the term 'surface water' is used generically to refer to water on the surface.

**Groundwater** – water which is below the surface of the ground and in direct contact with the ground or subsoil. It is most likely to occur in areas underlain by permeable rocks, called aquifers. These can be extensive, regional aquifers, such as chalk or sandstone, or may be more local sand or river gravels in valley bottoms underlain by less permeable rocks.

**Ordinary watercourse** – any river, stream, ditch, cut, sluice, dyke or non-public sewer which is not a main river.

**Artificial water bearing infrastructure** – includes reservoirs (see above), sewers, water supply systems and canals. Flooding from canals that are non main river should be included in a PFRA. LLFAs do not need to assess flooding from sewers, unless wholly or partly caused by rainwater or other precipitation entering or otherwise affecting the system. Floods of raw sewage caused solely, for example, by a sewer blockage do not fall under the Regulations. The Regulations also do not apply to floods from water supply systems, e.g. burst water mains.

**Other** – other rare sources of flooding are mentioned in the Floods Directive and include snowmelt and tsunami. Snowmelt would count as precipitation and so could lead to surface runoff. Tsunamis are a form of flooding from the sea. It is anticipated that that the main focus of LLFAs in their PFRAs will be ordinary watercourses, surface runoff and groundwater.