

West Sussex Preliminary Flood Risk Assessment

May 2011



Executive Summary

This report has been prepared so West Sussex County Council meets its duties to manage local flood risk and deliver the requirements of the Flood Risk Regulations (2009). West Sussex County Council, is defined as a Lead Local Flood Authority (LLFA) under the Regulations and the PFRA, comprising this document and the supporting annexes represents the first stage of the requirements of the Regulations.

The PFRA process is aimed at providing a high level overview of flood risk from local flood sources; that is surface water, groundwater, ordinary watercourses and canals. West Sussex County Council must submit its PFRA to the Environment Agency for review before all the PFRAs are collated and reported to the European Union.

The methodology for producing this PFRA has been based on the Environment Agency's Final PFRA Guidance and Defra's Guidance on selecting Flood Risk Areas. The Environment Agency has used a national methodology, set by Defra, to identify indicative Flood Risk Areas across England. Of the ten indicative Flood Risk Areas that have been identified nationally, one is located adjacent to West Sussex, covering the unitary authority of Brighton and Hove City Council. Within this Flood Risk Area, the Regulations require two subsequent key stages:

- Flood hazard maps and flood risk maps (to be completed by June 2013);
- Flood risk management plans (to be completed by June 2015).

West Sussex County Council will work with Brighton and Hove City Council to help achieve these steps and address any cross-boundary flood risks.

In order to develop a clear overall understanding of the flood risk across West Sussex, flood risk data and records of historic flooding were collected from a variety of local and national sources including the seven district and borough councils, the Environment Agency, water companies, emergency services and other risk management authorities.

Information relating to 2631 flood events, caused by flooding from local sources, was collected and analysed. However, comprehensive, verifiable details on flood extents and consequences of these events were largely unavailable. Based on the collected evidence, no past flood events were considered to have had nationally 'significant harmful consequences'. Therefore, the decision was made to not include any records of past flooding in Annex 1 of the Preliminary Assessment Spreadsheet.

National modelling by the Environment Agency shows a high risk of flooding from local sources across West Sussex, particularly from surface water. Approximately 76,600 properties are estimated to be at risk from flooding to a depth of 0.1m during a rainfall event with a 1 in 200 annual chance of occurring.

The information collected during the PFRA process will be used to inform the Local Flood Risk Management Strategy for West Sussex which looks at all sources of flood risk at a local scale. This work will begin later in 2011 following the publication of national guidance.

Glossary

Term/Acronym	Definition
Aquifer	A source of groundwater comprising water-bearing rock, sand or gravel capable of producing significant quantities of water
AStSWF	Areas Susceptible to Surface Water Flooding
CFMP	Catchment Flood Management Plan - a high-level planning document which the Environment Agency uses to agree flood risk management policies within a river catchment
Culvert	A channel or pipe that carries water below the level of the ground
Defra	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EC	European Commission
EU	European Union
FFR09	The Flood Risk Regulations 2009 – these transpose the EU Floods Directive into UK law. The EU Flood Directive is a piece of European Union (EU) legislation to specifically address flood risk by prescribing a common framework for its measurement and management
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a main river
FMfSW	Flood Map for Surface Water
F&WMA	The Flood and Water Management Act 2010 - part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing surface water flood risk in England
Groundwater flooding	Flooding that occurs when water levels in the ground rise above surface levels. Most likely to occur in areas underlain by permeable geology
IDB	Internal Drainage Board
IFRA	Indicative Flood Risk Area - an area determined by the Environment Agency as indicatively having a nationally significant flood risk, based on guidance published by Defra and the 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
LDF	Local Development Framework
LLFA	Lead Local Flood Authority – Local Authority responsible for taking the lead on local flood risk management
Main river	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibility and powers
NRD	National Receptor Database – a collection of risk receptors produced by the Environment Agency

Ordinary Watercourse	All watercourses that are not designated Main River, and which are the responsibility of Local Authorities or, where they exist, IDBs. N.B. Ordinary Watercourse does not imply a "small" river, although it is often the case that Ordinary Watercourses are smaller than Main Rivers.
PFRA	Preliminary Flood Risk Assessment
Pitt Review	Comprehensive independent review of the 2007 summer floods by Sir Michael Pitt, which provided recommendations to improve flood risk management in England
Pluvial flooding	Flooding from water flowing over the surface of the ground; often occurs when the soil is saturated and natural drainage channels or artificial drainage systems have insufficient capacity to cope with additional flow
PPS25	Planning and Policy Statement 25: Development and Flood Risk
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood
RFCC	Regional Flood and Coastal Committee
SAB	SuDS Approving Body
Sewer flooding	Flooding caused by a blockage or overflow in a sewer or urban drainage system
SFRA	Strategic Flood Risk Assessment
Stakeholder	A person or organization affected by the problem or solution, or interested in the problem or solution.
SuDS	Sustainable Drainage System – method of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques
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
SWMP	Surface Water Management Plan
SWS	Southern Water Services
TW	Thames Water
WAG	Welsh Assembly Government
Winterbourne	A stream or river that is usually dry throughout the summer but flows during the wetter winter months due to water released from the aquifer
WSCC	West Sussex County Council

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1 Introduction

1.1 Background

This Preliminary Flood Risk Assessment (PFRA) fulfils a number of West Sussex County Council's responsibilities under two sets of new legislation: the Flood Risk Regulations (FRR09), which came into force on the 10th December 2009, and the Flood & Water Management Act (F&WMA) which gained Royal Assent on the 8th April 2010.

The purpose of the FRR09 was to transpose the EC Floods Directive (Directive 2007/60/EC on the assessment and management of flood risk) into domestic law in England and Wales and to implement its provisions.

As a result of the new legislation all Unitary Authorities, and in two-tier systems, all County Councils, are designated a Local Lead Flood Authority (LLFA) and have formally been allocated a number of key responsibilities with respect to local flood risk management.

The implementation of the Floods Directive sets in motion a six yearly reiterative assessment, mapping and planning cycle that begins with the PFRA. The assessment forms the basis for determining areas of potential significant flood risk, which will subsequently be mapped and for which flood risk management plans will be then prepared.

Table 1.1 Preparation of documents in line with Flood Risk Regulations 2009

Delivery Date	Activity	Details
22 nd June 2011	Preliminary Assessment Report (PFRA)	<i>The PFRA should focus on local flood risk from surface water, groundwater, ordinary watercourses and canals.</i>
22 nd June 2011	Develop Flood Risk Areas based on the PFRA findings	<i>Flood Risk Areas are areas of nationally significant risk identified on the basis of the findings of the PFRA, national criteria set by the UK Government Secretary of State and guidance provided by the Environment Agency.</i>
22 nd June 2013	Derive Flood Hazard and Risk Mapping for each Flood Risk Area	<i>Used to identify the level of hazard and risk of flooding within each Flood Risk Area to inform Flood Risk Management Plans.</i>
22 nd June 2015	Develop an effective Flood Risk Management Plan for each Flood Risk Area	<i>Plans setting out risk management objectives and strategies for each Flood Risk Area</i>

The PFRA is a high-level screening exercise which involves collecting information on past flooding and potential future floods, assembling this information in a report, and using it to identify Flood Risk Areas, where the risk of flooding is significant in a national context.

West Sussex County Council (WSSCC) as LLFA are responsible for undertaking this PRFA report addressing local sources of flood risk, which are those solely from surface runoff, groundwater and ordinary watercourses, and in-combination effects. These sources of flooding are further discussed section 1.4.

As identified in Part 2 of the FRR09, flooding associated with the sea, main rivers and reservoirs is the responsibility of the Environment Agency and does not need to be considered by the LLFA as part of the PFRA process, unless it is considered that it may affect flooding from local flood sources.

The PFRA must consider floods which have 'Significant' harmful consequences for human health, economic activity and the environment. The work will also assess the existing Indicative Flood Risk Areas as designated by the EA and determine if any amendments should be made to this dataset.

1.2 Aims and Objectives

The aim of this document is to fulfil WSSCC's obligations as the LLFA under the requirements of the FRR09. The PFRA aims to locate areas in which the risk of surface water and groundwater flooding is significant and warrants further examination through the production of maps and management plans.

The aim of this PFRA is to provide an assessment of local flood risk across the study area, including information on past floods and the potential consequences of future floods. The key objectives can be summarised as follows:

- Identify relevant partner organisations involved in future assessment of flood risk; and summarise means of future and on-going stakeholder engagement
- Describe arrangements for partnership and collaboration for on-going collection, assessment and storage of flood risk data and information
- Provide a summary of the systems used for data sharing and storing, and provision for quality assurance, security and data licensing arrangements;
- Summarise the methodology adopted for the PFRA with respect to data sources, availability and review procedures
- Assess historic flood events within the study area from local sources of flooding (including flooding from surface water, groundwater and ordinary watercourses), and the consequences and impacts of these events
- Establish an evidence base of historic flood risk information, which will be built up on in the future and used to support and inform the preparation of WSSCC's Local Flood Risk Strategy
- Assess the potential harmful consequences of future flood events within the study area
- Review the provisional national assessment of Indicative Flood Risk Areas provided by the Environment Agency and provide explanation and justification for any amendments required to the Flood Risk Areas.

1.3 Study Area

The study area considered in this report is the area within the administrative boundary of West Sussex. West Sussex has a two-tier local authority structure, made up of the County Council acting as the LLFA and Adur, Arun, Chichester, Horsham and Mid Sussex Districts Councils, and Crawley and Worthing Borough Councils.

West Sussex covers an area of approximately 2000 km² on the south coast of England, as shown in figure 1.1. It extends from Crawley in the north, to the southern coastline, and from Southwick in the east, to Southbourne in the west. The largest urban areas are Chichester, Worthing and Crawley. Other significant conurbations include Horsham, Bognor Regis, Midhurst and Haywards Heath.

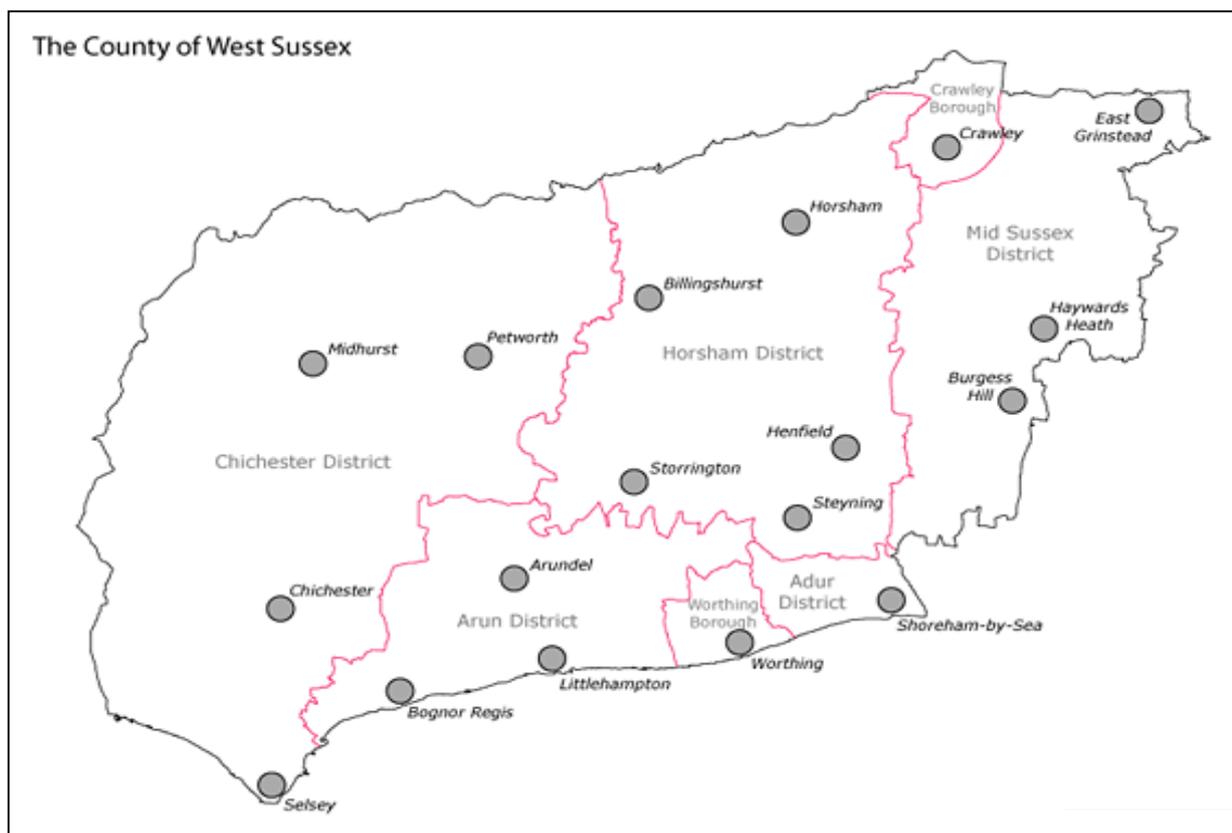


Figure 1.1 West Sussex County, district and borough boundaries and locations of major settlements

The county covers a number of large river catchments, including the rivers Adur and Arun and a number of smaller watercourses that make up the West Sussex rifies. The county sits within the South East River Basin District and the Thames River Basin District and is served by two sewerage providing water companies, Southern Water and Thames Water. Two EA Regional Flood and Coastal Committees also serve the study area. West Sussex has two members on the Southern committee and no members on the Thames committee. Precepts are paid to both committees depending on the number of households in the area, and membership is based on this representation.

The landscape of West Sussex is characterised by the distinctive South Downs, heathlands, the Coastal Plain, and the low and high weald areas. The underlying geology of this landscape, the location and geography of its watercourses and the level of development across the county significantly affects the risk of flooding from groundwater, ordinary watercourse and surface water sources.

The predominant topographical features affecting flood risk in the county are the tidal interactions on the county’s rivers with the sea and the meteorological and geological influence of the South Downs. Flood risk from water flowing out of the county through its rivers can become tide locked as high tides restrict flow out of the river valleys. The South Downs (and to some extent the North Downs) affect prevailing rainfall patterns across the county and the underlying chalk geology creates a complex system of groundwater aquifers along the Downs and coastal plain. The underlying geology of West Sussex is shown in figure 1.2

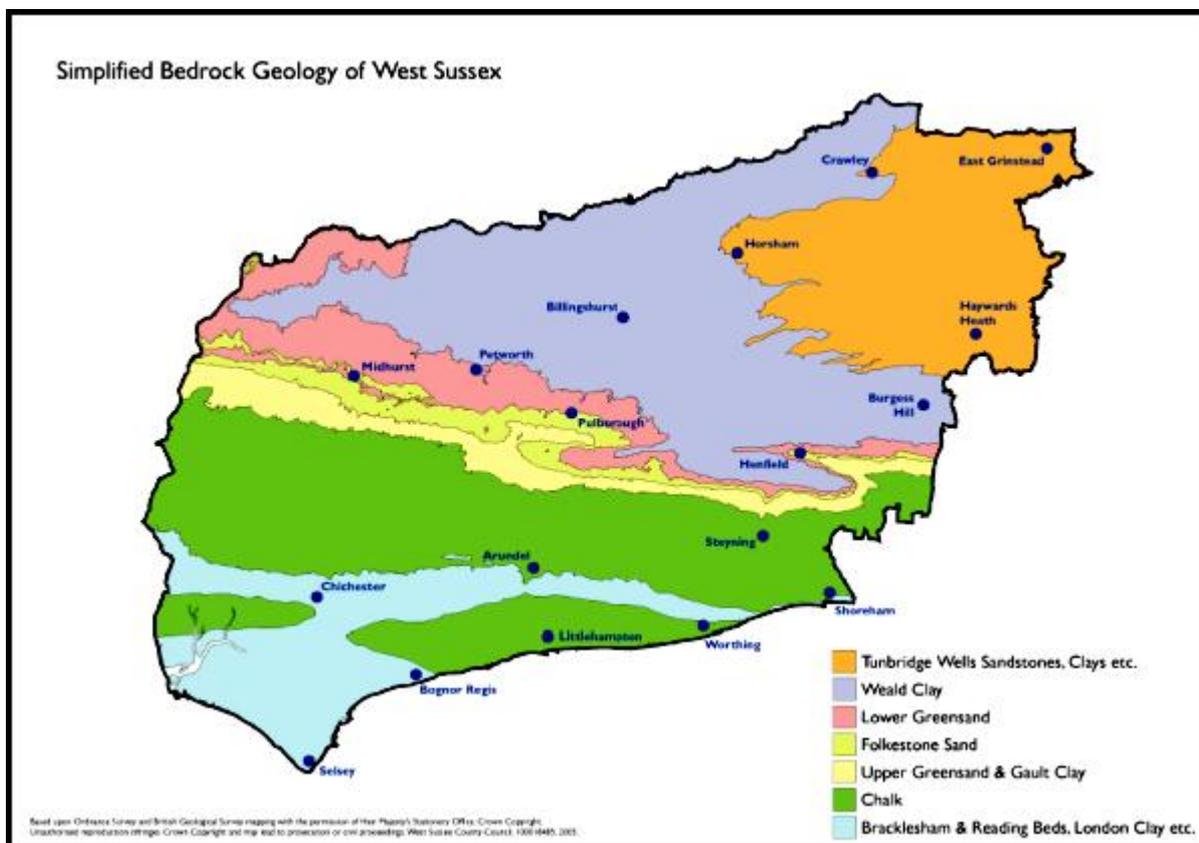


Figure 1.2 Bedrock Geology of West Sussex

Surface water flooding is also significantly affected by the degree of urbanisation in any particular area, the provision of surface water drainage infrastructure and the degree to which these areas are impermeable to natural infiltration of rainfall.

The interconnectivity of all these systems means that collaboration and cooperation between all those parties seeking to reduce flood risk is vital to ensuring an effective response.

1.4 Sources of Flood Risk covered by PFRA

The PFRA process for LLFAs highlights flood risk from local sources and not those to be reported by the Environment Agency, i.e. it excludes main river, tidal or large reservoir flooding.

1.4.1 Surface Water

Surface water flooding can be caused by rainwater (including snow and other precipitation) which is on the surface of the ground (whether or not it is moving), and which has not entered a watercourse, drainage system or public sewer. Although flooding from surface water and combined sewers can be considered a form of surface water flooding, sewer flooding for this PFRA has been considered separately where there is sufficient information available to indicate that the flooding was caused wholly or partly by rainwater entering the system.

1.4.2 Groundwater

Groundwater flooding can occur when groundwater rises up from the underlying aquifer to flood subsurface infrastructure or to emerge at the ground surface. Groundwater flooding is generally caused by the rise of groundwater levels to extreme high levels in permeable consolidated aquifers (primarily chalk) in response to prolonged above average rainfall; or from hydraulic continuity with high water levels in adjacent rivers.

There are three main flood mechanisms;

- flooding from groundwater levels rising above local surface levels,
- flooding from watercourses or waterbodies which are fed directly from groundwater sources, i.e. ponds or winterbournes,
- groundwater levels causing infiltration of sewerage systems creating in-combination flooding

1.4.3 Ordinary Watercourses

Flooding can occur from an ordinary watercourse overtopping its bank level. An ordinary watercourse is any watercourse (river, stream, ditch, cut, sluice, dyke or non-public sewer) that is not identified as a Main River on maps held by the Environment Agency.

2 Roles and Responsibilities

2.1 LLFA

2.1.1 Leadership and coordination of Flood Risk Management

In his review of the floods in summer 2007, Sir Michael Pitt stated that "*the role of local authorities should be enhanced so that they take on responsibility for leading the coordination of flood risk management in their areas*". Following the enactment of the Flood and Water Management Act in 2010, West Sussex County Council (WSCC) became the designated LLFA, and is therefore responsible for leading local flood risk management across West Sussex.

WSCC recognises that much of the local knowledge and technical expertise necessary for successful implementation of their duties as LLFA currently lies with the District and Borough councils and other partner organisations. It is therefore crucial that WSCC work alongside these groups as they undertake their responsibilities to ensure effective and consistent management of local flood risk throughout the county and to contribute to the provision of a coordinated and holistic approach to flood risk management across the study area.

As a result, the West Sussex Flood Risk Management Group (WSFRMG) was formed to help meet the requirements of the Flood & Water Management Act and harmonise work amongst relevant stakeholders and partners. Formed in October 2009, the operations group meets on a regular basis to solve local flooding issues. The following are members of the WSFRMG:

- West Sussex County Council (as LLFA)
- Arun District Council
- Chichester District Council
- Crawley Borough Council
- Horsham District Council
- Mid Sussex District Council
- Worthing Borough and Adur District Council
- Southern Water
- Environment Agency (Thames and Southern Regions)

West Sussex now has a two-tier approach to Flood Risk with the operations group (WSFRMG) sitting below a new Strategic Board. The West Sussex Strategic Flood Risk Board (WSSFRB) has been established and had its first meeting in December 2010, with senior officers from all Boroughs, Districts, EA and Southern Water in attendance.

An organogram showing the arrangement of flood risk management groups in West Sussex is shown in figure 2.1

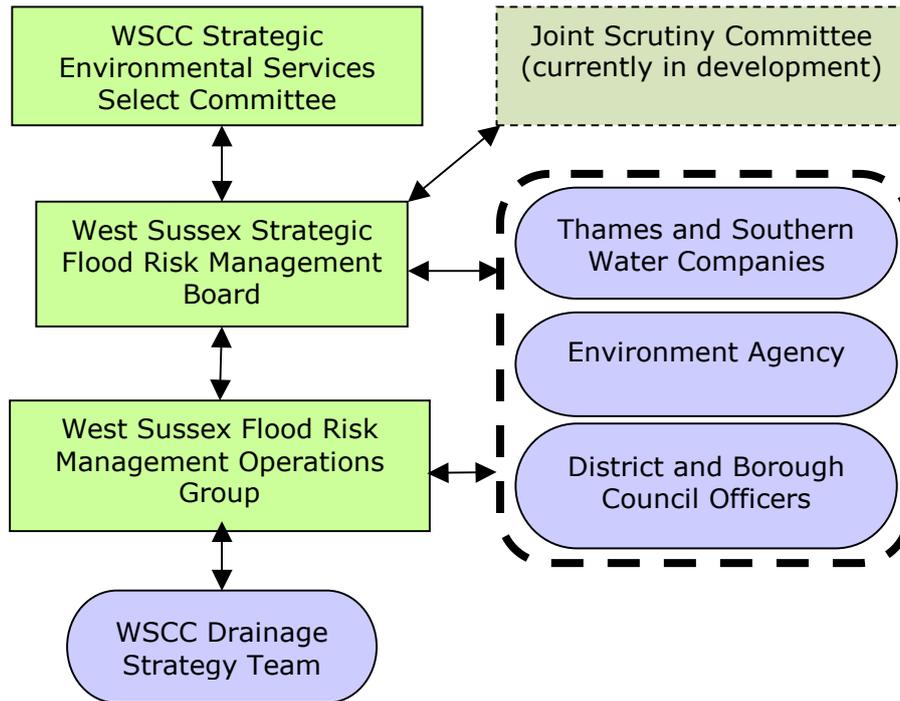


Figure 2.1 Organisation and composition of Flood Risk Management groups within West Sussex

2.1.2 Stakeholder Engagement

During preparation of the PFRA, consultation has been undertaken with all the members of the WSFRMG as listed in Section 2.1. In addition, engagement has been sought with the following organisations and authorities:

- West Sussex Fire and Rescue Service
- British Waterways
- Gatwick Airport
- Network Rail
- Parish Councils

2.1.3 Public Engagement

It is important that public engagement is incorporated into local flood risk management and this is recognised by WSCC. Significant benefits can be gained by public discussion such as gaining local knowledge, building trust and increasing the likelihood of acceptance of local flood management options and decisions.

It is recommended that WSCC follow the guidelines outlined in the Environment Agency’s ‘Building Trust with Communities’ document which provides a useful process of how to communicate risk including the causes, probability and consequences to the general public and professional forums such as local resilience forums.

During the PFRA data collection process WSCC consulted both the general public through an online ‘Flood Memories’ questionnaire which was available via the

WSSC website and a 'Parish Survey' which involved Parish Councils providing local information regarding flooding in their area.

2.1.4 Additional Responsibilities

Aside from forging partnerships and coordinating and leading on local flood management, there are a number of other key responsibilities that have arisen for Lead Local Flood Authorities from the F&WMA and the FRR09. These responsibilities include:

- Asset Register – LLFAs have a duty to maintain a register of structures or features which are considered to have an effect on flood risk, including details on ownership and condition as a minimum. The register must be available for inspection and the Secretary of State will be able to make regulations about the content of the register and records.
- Designation powers – LLFAs, as well as district councils and the Environment Agency have powers to designate structures and features that affect flooding or coastal erosion in order to safeguard assets that are relied upon for flood or coastal erosion risk management.
- Investigating flood incidents – LLFAs have a duty to investigate and record details of significant flood events within their area. This duty includes identifying which authorities have flood risk management functions and what they have done or intend to do with respect to the incident, notifying risk management authorities where necessary and publishing the results of any investigations carried out.
- Local Strategy for Flood Risk Management – LLFAs are required to develop, maintain, apply and monitor a local strategy for flood risk management in its area. The local strategy will build upon information such as national risk assessments and will use consistent risk based approaches across different local authority areas and catchments.
- SuDS Approving Body – Under the F&WMA LLFA's are designated the SuDS Approving Body (SAB) for any new drainage system, and therefore when this part of the F&WMA is enacted the LLFA will approve, adopt and maintain new sustainable drainage systems (SuDS) within their area.
- Works powers – LLFAs have powers to undertake works to manage flood risk from surface runoff and groundwater, consistent with the local flood risk management strategy for the area.

2.2 District and Borough Authorities

West Sussex contains seven 2nd tier Authorities, as shown on Figure 1.1. These are designated as 'local drainage authorities' under the Land Drainage Act 1991 and as Risk Management Authorities under the Flood and Water Management Act. District and Borough Councils have a number of permissive powers under the Land Drainage Act for prevention and mitigation of flood damage from ordinary watercourses as well as responsibilities for managing flood risk within their

responsibilities as the local planning authorities. To enable them to deliver this function they have powers to:

- Implement works to prevent, mitigate or remedy flood damage subject to consent by the Environment Agency;
- Serve notice on owners requiring them to remove obstructions from ordinary watercourses in order to secure a proper flow.
- Those authorities along the coast have additional powers relating to provision of coastal flood and erosion protection.

They also now have a duty to co-operate with LLFAs to develop local flood risk strategies and to share flood risk information.

As well as these permissive powers and duties, some councils have kept records of flood events and carried out both maintenance and new works within their area although the extent of these activities varies considerably depending upon the resources and priorities of each council.

2.3 Environment Agency

The Environment Agency has a national supervisory role over flood risk management. Their specific role is to:

- Exercise powers to carry out improvements or maintenance to designated 'main rivers'.
- Act as a regulating authority for works and activities in and alongside main rivers
- Influence, through the planning process, land use and development particularly within flood plains.
- Produce flood risk mapping and manage historical flood records and data.
- Install and operate flood warning systems
- Protect and conserve of the natural environment whilst carrying out flood risk management activities.
- Provide overview of coastal erosion work
- Provision of secretariat function of RFCC

2.4 Water Companies

Within West Sussex there are two water companies with a responsibility for sewerage, Thames Water and Southern Water. The areas they manage are shown in figure 2.2.

As many of the sewerage systems take combined surface water and foul sewerage, the water companies have an important part to play in managing surface water flooding.

Water Companies will have a more formal role in the management of surface water as they will be a statutory consultee for Sustainable Drainage Approvals. They are also required to co-operate and share flood risk information with the LLFA.

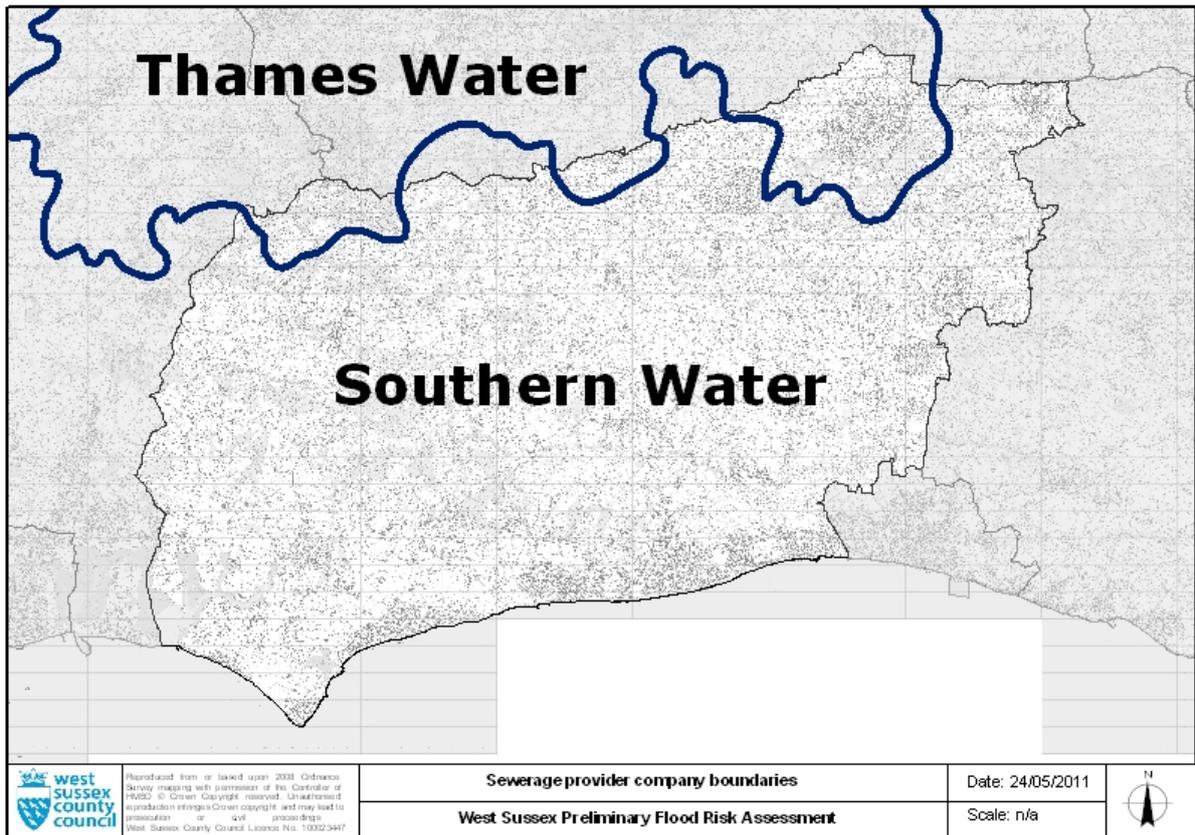


Figure 2.2 Sewerage provider company boundaries

2.5 Riparian Owners

Landowners with a watercourse passing through or adjacent to their land (riparian owners) retain the duties and responsibilities for these watercourses set out in the Land Drainage Act 1991. Private landowners drain their property through drainage systems that may be private or can be provided by water companies, highway authorities or councils. These drains eventually discharge into either ordinary watercourses or main rivers.

3 Methodology and Data Review

3.1 Methodology

The approach for producing this PFRA was based upon the Environment Agency’s PFRA Final Guidance, which was released in December 2010. This was based on readily available or derivable data therefore it was necessary for all relevant flood risk information to be located, collated and assessed.

In order to determine what information was available all relevant stakeholders were contacted so that they could provide whatever information they held on past and future flooding from local sources.

3.2 Data Sources

Local information about flooding was available from a wide range of sources. Some of these were area specific such as the Parish Surveys that WSSC distributed whereas others were a part of a much larger national database.

Table 3.1 catalogues the information and databases requested by WSCC which is held by partner organisations and provides a brief description of each of the datasets.

Table 3.1 Preliminary Flood Risk Assessment Sources

	Dataset	Description
West Sussex County Council	Highways Flooding Survey	Data taken from working knowledge of West Sussex highways system. Senior Highways engineers were interviewed about known flooding issues in the county.
	WSSC SFRA	A selection of GIS layers taken from the Strategic Flood Risk Assessment (2009) for West Sussex carried out to inform Minerals and Waste Strategy.
	‘Flood Memories’	Public consultation via the WSSC website inviting the public to share their memories and experiences of flooding.
Environment Agency	Areas Susceptible to Surface Water Flooding	The first generation national mapping (2008), outlining areas of risk from surface water flooding across the country with three susceptibility bandings (less, intermediate and more).
	Flood Map for Surface Water	The updated (2nd generation) national surface water flood mapping (2010). This dataset includes two flood events (with a 1 in 30 and a 1 in 200 chance of occurring) and two depth bandings (greater than 0.1m and greater than 0.3m).
	Flood Map (Rivers and Sea)	The extent of flooding from rivers where the catchment area is greater than 3 km ² or from the sea.

	Areas Susceptible to Groundwater Flooding	Coarse-scale national mapping showing areas which may be susceptible to groundwater flooding.
	National Receptors Dataset	National dataset which aims to capture all social, economic, environmental and cultural receptors of flooding, including all properties in England and Wales
	Indicative Flood Risk Areas	Nationally identified flood risk areas, based on clusters of 1 km ² grid squares with each square having more than 200 people, 20 businesses, or more than 1 critical service at risk, with the total cluster having more than 30,000 people at risk.
	Historic Flood Map	The Historic Flood Map shows the combined extents of known flooding from rivers, the sea, and groundwater.
	Adur, Arun & Western Streams, Ouse and Thames Region Catchment Flood Management Plan (CFMP)	CFMPs consider all types of inland flooding, from rivers, groundwater, surface water and tidal flooding and are used to plan and agree the most effective way to manage flood risk in the future.
District & Borough Councils	Strategic Flood Risk Assessment (SFRA)	SFRAs have been completed for all Boroughs and Districts and include information on historic flooding.
	Historical flooding records	Historical records of flooding events collected by the local council.
Parish Councils	West Sussex Local Flooding Survey	This survey, carried out by West Sussex County council in 2010/11, asked the Parish Councils to identify flood risk issues across their parishes (Parishes in Chichester DC were not surveyed as Chichester District Council have their own Parish Survey).
Water Companies	DG5 Register for Thames Water	DG5 Register logs and records sewer flooding incidents in postcodes.
	SIRF for Southern Water	Flood incidents caused by hydraulic overload from foul, combined and surface water sewers.
West Sussex Fire & Rescue Service	Records of historic flood events within West Sussex	Incidents recorded by West Sussex Fire and Rescue related to flooding.
Highways Agency	Records of flooding involving strategic highways within West Sussex	No Information Received.
Network Rail	Records of flooding involving railway network within West Sussex	No Information Received.

Gatwick Airport	Records of flooding involving Gatwick Airport	Details of major past flood events and extracts from consultants reports.
British Waterways	Records of flooding involving British Waterways canals	No Information Readily Available.

3.4 Availability and Limitations of Information

Existing datasets, reports and anecdotal information from the various stakeholders listed were requested, collated and reviewed to identify details of major past flood events and associated consequences including economic damage, environmental and cultural consequences and impact on the local population.

3.4.1 Inconsistent Recording Systems

All of the data within Table 3.1 has been recorded using differing methodology and systems which has led to major inconsistencies and difficulty in the analysis and comparison of this data. It is therefore intended that a standard template will be developed by WSCC and partner organisations to record future flooding incidents so that a consistent recording process is in place.

3.4.2 Incomplete Datasets

Whilst data has been received from all districts and boroughs in West Sussex, the quality and coverage of this data does vary. As a result of the combination of a lack of consistent flood data recording arrangements (as described above), no statutory duty to record or lack of available resources, many councils have poor flood records. Some of the datasets collated are not exhaustive and are unlikely to accurately represent the complete flood risk issues in a particular area. The most significant limitation relates to the lack of specific event information provided within the flood incident records. Some datasets had little information regarding location, source or consequences. The main factors being the amount of local knowledge and experience from both county council and district and borough employees, availability of historical records and the resources available. This may result in some areas appearing at greater or lesser flood risk (i.e. higher or lower numbers of recorded flood incidents) when in fact this is due to the volume or quality of flooding data recorded.

3.4.3 Variation in datasets used for analysis

In many cases, especially the modelling of future flooding, results from the analysis of data were provided wholesale by the Environment Agency. In the case of the property dataset this analysis was carried out using a version of the dataset which was not provided for use by the LLFA. As such there may be minor inconsistencies in the calculation of properties and critical infrastructure at risk, depending upon the dataset used. In all possible cases the same methodology has

been used to analyse the data, the major variance being the difference between a simple count of properties affected (using address points) used by the LLFA and a more accurate count (using building extents) provided by the EA.

Another consequence of the dataset used for property data is that, when comparing historic flood extents, the data provided is for current developments which may not have been in existence at the date of the actual flood event. The implications of this are discussed in section 4.3.

3.4.4 Quality Assurance, Security and Data Restrictions

All records and data collected are subject to quality assurance measures to monitor and record its quality and accuracy. Wherever possible the data is converted onto GIS, which allows the different datasets to be compared.

The flood data received was transferred onto secure local servers, where only certain personnel have access. Some data is freely available to the public, and therefore has no restrictions regarding publication. Other data, from sources such as the water companies and some of the datasets from the EA were provided with specific licenses, which restrict the use of their data.

3.5 Significant Harmful Consequences

The PFRA process as set out by the European directive requires the LLFA to decide whether a historic or past flood is to be considered to have had significant harmful consequences. When determining the criteria, the Lead Local Flood Authority is asked to consider the scale of the flooding; any harmful consequences and the level of response.

In order to provide consistency throughout this document regarding determination of whether a historic or future flooding is considered to have had significant harmful consequences WSCC has decided to use the same criteria for both the actual and modelled events. The main criterion set out by Defra in determining the areas for future flooding was the risk to human health from property flooding and affected critical infrastructure. In addition to this, WSCC have added a further criterion for historic flooding regarding fatalities from local flood sources. The three additional factors Defra indicated that should be considered when determining whether a flood event has had "significant harmful consequences" are the effect on the economy, the environment and the cultural heritage of the county. Below are a description of the factors and the assessment criteria used.

3.5.1 Human Health:

- The effect on
 - Risk to human life
 - Critical Infrastructure

As stated above, risk to life is considered when determining a significant flood. This has been assessed principally by looking at the number of properties impacted by local flooding and factoring the average occupation per household (2.34 persons per household). When determining whether a flood event has had a significant harmful consequence on human health, West Sussex County Council believes that a single case of loss of life, due directly to the flood, is also a case of significant harmful consequence.

There are other flood impacts which can put human lives at risk when critical infrastructure is affected by floodwater. This represents the likelihood of loss of power, safe drinking water or restricted access to hospitals, fire stations etc.

3.5.2 Economic:

- The effect on
- Places of business
 - Agricultural areas
 - Road and Rail links

The simplest determination as to whether a flood event had a significant economic harmful consequence is the number of commercial properties affected. Other potential impacts are from impacts on transport infrastructure and agricultural land.

3.5.3 Environmental:

- The effect on
- Environmental designated sites

West Sussex currently has a large number of Sites of Specific Scientific Interest (SSSIs) and there are also a number of Special Areas of Conservation (SACs), Special Protection Areas (SPAs) or Ramsar sites.

It is difficult to judge the harmful consequences of these effects as flood depth and the vulnerability of the receptor to flooding will dictate the level of consequence. These cases have only been included where specific harmful impacts have been recorded.

3.5.4 Cultural Heritage:

- The effect on
- Nationally or Internationally designated historic sites

There are a large number of internationally or nationally acknowledged cultural heritage sites within West Sussex.

It is difficult to judge the harmful consequences of these effects as flood depth and the vulnerability of the receptor to flooding will dictate the level of consequence. These cases have only been included where specific harmful impacts have been recorded.

4 Historic Flooding

4.1 Overview of Historic Local Flooding Data

In the process of collecting data on historic flooding in West Sussex, West Sussex County Council have made contact with a number of authorities including the Environment Agency, Southern Water, Local Fire and Rescue Services and other significant infrastructure providers such as Gatwick Airport and Network Rail. Information has also been obtained from Districts and Boroughs as well as from West Sussex County Council's own records and West Sussex Strategic Flood Risk Assessment (SFRA). A full list of sources and the data collected can be found in Section 3.2.

Data collected directly by West Sussex County Council is also held by the highways drainage team and includes areas at risk of flooding.

The collected data also included sites where remedial work has already been carried out. These sites have been excluded from this report if the circumstances surrounding these events are unlikely to reoccur in future. In many cases the data sources overlap in terms of specific events or extent, where this occurs the data which had the highest degree of confidence attached or most accurately matched the criteria set out below was given preference.

After the reduction of duplicate information, there are 2631 historic unique flood points in West Sussex, as shown in figure 4.1. Unfortunately, much of the information that has been collated does not have a definitive type of flooding allocated to it. Assumptions can be made based on the surrounding watercourses and the topography and geology but as these are only assumptions they cannot be used in this report. Below are descriptions of actual and likely sources of flooding. Please refer to the descriptions of types of flooding in section 1.4 when reading this section.

Across the county many of the records relate to individual households, or small clusters of property or asset flooding, and whilst these do not meet the significant harmful consequences criteria set out below, they do give an indication of areas where surface water, groundwater or ordinary watercourse flooding occurs in general across the county.

There are known areas at risk from flooding from surface water, for example Barnham and Yapton, or groundwater flooding, for example large parts of the Manhood Peninsula, but where existing individual records do not reach the set threshold criteria. The PFRA is designed to highlight flood events of national significance only; areas at flood risk of county significance or below will be captured in future iterations of the PFRA process (see section 7.1) and in the Local Flood Risk Management Strategy.

4.2 Analysis of Historic Flooding in West Sussex

Data collected about historic flooding in West Sussex has included information from a large number of differing authorities from borough and district councils to water companies and the Environment Agency. The data collected is not uniform in quality, and results in inconsistency issues across the county, which may suggest greater or lesser incidences of flood risk depending upon the number of reported incidents.

The main drawback of the data collected is that much of it does not have a specified date allocated to it so we are unable to determine which of these floods were attributed to any flood event in particular. Also, the lack of homogeneity in the data means that comparison of flood data between areas is unlikely to provide reliable results.

The variety of data can be attributed to the number of sources used to collect this data. For example, records held for the flood events witnessed by the Borough and District authorities vary depending on their resources and the extent of factual information recorded. The range of data varies from authorities that have recorded floods back to 1968 and some who have limited or no records of flooding at all within their boundary. Another issue with the data collected was the validity of the records. Some boroughs have computer-based records of flood events, some information was delivered to West Sussex County Council as a GIS layer. Other data was collected from the memories of employees of the council authorities.

This PFRA records only flood risk impacts from local sources of flood risk (i.e. not from main river or tidal sources) and in some cases this has not been determined in historic reporting. Many records can therefore not be assessed due to lack of clear source information, and cannot be included. Similarly in the records of flood extents the information is sporadic. Where GIS information on flood extents have been provided, and where other criteria have generally been met to suggest a likelihood of significant flooding, analysis has been carried out using a simple property or asset data count method to determine impacts. This has then been passed to the local drainage engineering contacts at District and Borough level to provide local verification of the extent and impact of the event. This was necessary as in many cases there has been extensive local increases in numbers of properties since the recorded date of the event, and hence the property count carried out may be erroneous. Events which did not pass this verification test were again not included.

Therefore although the maps below show many incidences of reported flood incidents, in order for an event to be considered to have significant harmful consequences on a national level the recorded events had to meet the hierarchy of criteria set out below:

1. Flooding is from not from Main River or Tidal sources
2. Flood records are complete to a good degree of confidence or have been verified locally from recorded sources (Press extracts, flood reports etc) or local expert knowledge.

3. Flood events meet the criteria for significant harmful consequences;
 - a. affected greater than 200 people (>86 properties)
 - b. affected more than one piece of critical infrastructure
 - c. affected more than 20 commercial properties, or had a recorded harmful impact on rail or road network
4. Confirmed to have negatively affected one or more sites designated nationally or internationally for environmental, cultural or historic interest.
5. Flood cause was not a result of circumstances which are unlikely to be repeated due to improvements to asset or maintenance systems

4.3 Consequences of Historic Flooding

Using the process and criteria set out in section 4.3 all of the collated historic information was assessed. This initial assessment yielded no events meeting all of the criteria. However 6 events appeared to meet the significance criteria chosen for harmful consequences and were worthy of further investigation. These events and the results of comparison with the set criteria are shown in table 4.1

Table 4.1: Information and Consequences on Past Floods

Flood Event	Flood Location and Recorded Information	Data Source	Consequences	Inclusion Criteria met Yes/No
14 th /15 th September 1968	Gatwick Airport 'Airport was closed for several days due to flooding onto the runway'	Gatwick Airport flooding notes	1 Critical National Infrastructure	NO Primary flood source was main river and lack of local impact verification data
20 th September 1968	Horsham "Various locations, main road flooded and adjacent properties internally flooded to 0.6m"	Environment Agency Local Flood Risk Extent GIS layer	422 properties	NO No further information on flood source, no local impact verification data and significant property development since event
20th September and October 1980	Durrington area, Worthing "Surface Water Flooding of gardens, properties and roads"	Environment Agency Local Flood Risk Extent GIS layer	488 properties	NO No local impact verification data and significant property development since event

10th October 1980	North Ferring "Surface Water Flooding of gardens, properties and roads"	Environment Agency Local Flood Risk Extent GIS layer	92 properties	NO No local impact verification data and significant property development since event
1 st June 1981	Billingshurst Blockage of culvert/surface water sewer in High Street "Drainage system not able to cope with rainfall intensity of 20mm per hour"	Environment Agency Local Flood Risk Extent GIS layer	221 properties	NO No local impact verification data, subsequent improvements and significant property development since event.
30 th December 1993	Barnham Surface Water Flooding to depth of 1m, u/s of railway culvert. Caused by blockage of the main river culvert grill by plastic sheeting	Environment Agency Local Flood Risk Extent GIS layer	98 properties	NO Primary flood source was main river and caused by system blockage which has been remedied.
December 1993 - January 1994	Chichester and other locations across the County Exceptionally high rainfall from October 1993 meant major overtopping/bursting of banks along the Lavant and numerous other flooding events across the County	Flood Reports and Working Party Response Report	Unknown	NO Primary flood source was main river (and groundwater) and unknown consequence data.
October 2000	Worthing Town Centre Commercial properties were flooded as a result of flash flooding arising from the incapacity of surface water and highway drainage to cope with the volume of water and poor maintenance of the system	Worthing Borough Council	Approximately 20 non-residential properties	NO Lack of verified impact data

December 2000	<p>Various locations including Chichester, River Ems Valley and River Rother Valley</p> <p>Exceptionally high rainfall throughout Autumn 2000 culminating with peak flows in December causing numerous other flooding events across the County including closure of A27</p>	County Council Cabinet report and newspaper reports	Unknown	<p>NO</p> <p>Primary flood source was main river and unknown consequence data</p>
25 th June 2007	<p>Worthing</p> <p>4 inches of rain fell within one hour resulting in widespread flooding. Emergency services received more than 297 calls and Worthing hospital was flooded</p>	West Sussex Local Climate Impact Profile 2009	Unknown	<p>NO</p> <p>Lack verified impact data and unknown consequence data</p>

Even when taking the data above into consideration, due to the lack of comprehensive knowledge of confirmed flood sources or consequences, **no historic flood events have been considered for inclusion in Annex 1 of the Preliminary Assessment Spreadsheet.**

5. Future Flood Risk

5.1 Summary of Future Flood Risk Data

The Environment Agency has produced modelled flood maps based on national assessment of surface water flood risk. The first generation national mapping, Areas Susceptible to Surface Water Flooding (AStSWF) was released in August 2008 and contains three susceptibility bandings for a rainfall event with a 1 in 200 chance of occurring. The national methodology has since been updated in November 2010 to produce the Flood Map for Surface Water (FMfSW), a revised model containing two flood events (1 in 30 annual chance and 1 in 200 annual chance) and two depth bandings (greater than 0.1m and greater than 0.3m).

Areas Susceptible to Groundwater Flooding (AStGWF) is a strategic scale map also released by the Environment Agency showing potential groundwater flood areas on a 1km square grid. It shows the proportion of each grid square where geological and hydrogeological conditions show the degree to which groundwater has the potential to emerge (<25%, 25% to 50%, 50% to 75% and >75%). The map only shows the area within which groundwater has the potential to emerge, and it is unknown whether it will emerge uniformly or in sufficient volume to flood properties. Instead, groundwater emerging at the surface may simply runoff to ponds in lower areas. Therefore, including the Groundwater Emergence Maps as an element of the 'locally agreed surface water information' was discounted as this would most likely have led to an overestimation of the receptors at risk.

There is no local information currently available on predicted surface water or groundwater flooding in West Sussex so it was determined that the following datasets should be considered for use in assessing future flood risk

- Areas Susceptible to Surface Water Flooding
- Flood Map for Surface Water

5.2 Locally Agreed Surface Water Information

The 'locally agreed surface water information' used has been agreed with officers from the District and Borough Councils in order to agree what surface water information best represents local conditions across West Sussex. Upon analysis of the available flood risk data it was agreed that the Flood Map for Surface Water would be considered as the most appropriate to represent flood risk in West Sussex. This map is illustrated in Figure 5.1

The AStSWF was discounted as a representative source of data as it did not take into account any drainage of any sort across the county, nor the impacts of buildings on surface water flooding.

The FMfSW is considered to provide the best representation as it considers a storm of relatively short duration, allowance for infiltration and sewer flow, is based on most recent topographic data and takes into account building footprints which are likely to have a substantial influence in directing surface flow. This is the best available information in the absence of any locally modelled data for surface water flooding.

Although this map has been agreed as the most suitable at this time, it is recognised that it does not necessarily provide an accurate picture of strategic surface water flood risk across the county, due to significant underlying assumptions about topography and drainage infrastructure. For instance, the Strategic Assessment Phase of Worthing's SWMP states that the 'flooding history largely correlates with the FMfSW' but 'some areas highlighted by the FMfSW as at risk of surface water flooding are being questioned by members of the working group'.

However it is currently the most comprehensive data available using a consistent modelled rainfall flood event. The FMfSW will require review as new information emerges.

The current modelled information should be cross-referenced to datasets / network maps showing existing drainage capacity in order to validate the modelling and identify where additional capacity may be required. However, given the variety of drainage systems across the County and the number of organisations with drainage assets within the West Sussex, it is difficult to assess the drainage capacity at the present time. However, it is recognised that for extreme flooding events such as the 1:200 (0.5%) annual probability, drainage capacity would likely be overwhelmed by the volume of water and would have a minimal impact on flooding and as such would not significantly affect this assessment.

5.3 Assessing Consequences of Future Flooding

The Environment Agency has used the Flood Map for Surface Water (1:200) combined with the National Receptor Database to identify areas of national flood risk that require submission to Europe. The United Kingdom was divided into 1km grid squares and those grid squares which exceed the threshold from the criteria in Table 5.1 were identified as a 'blue square'.

Table 5.1 Defra thresholds for significant flood risk

'Significant harmful consequences' as defined as greater than...	Description
200 people or	Flooded to a depth of 0.3m during a rainfall event with a 1 in 200 (0.5%) chance of occurring
20 businesses or	
1 critical service	

The grid squares within West Sussex where future flood risk is judged to surpass this criterion are illustrated in Figure 5.2. These areas represent where flood risk is considered to be most severe across West Sussex.

The Environment Agency then identified each square considered to have significant harmful consequences (blue squares), based on the criteria above, and combined squares in close proximity (five touching squares within a 3x3 grid) to create the clusters shown in Figure 5.3.

There are 127 'Blue Squares' within West Sussex. This represents approximately 6.4% of the County's total area.

Within West Sussex there are five clusters considered to have a substantial future flood risk and these are detailed together with the Environment Agency's estimation of the number of people potentially at risk and where they rank on a national scale although one of these (Brighton and Hove) is situated predominately outside the boundary of West Sussex.

Table 5.2 National ranking of West Sussex’s flood risk clusters

National Rank	Location of cluster	No. of people potentially at risk	No. of Critical Services potentially at risk	No. of non residential properties potentially at risk
35	Worthing	9189	19	676
53	Crawley	6868	17	445
81	Burgess Hill and Haywards Heath	4694	17	425
*	Southwick and Shoreham	3332	5	131
206	Chichester	1296	5	107

*This cluster is not nationally ranked as it was originally the West Sussex part of the Brighton and Hove IFRA.

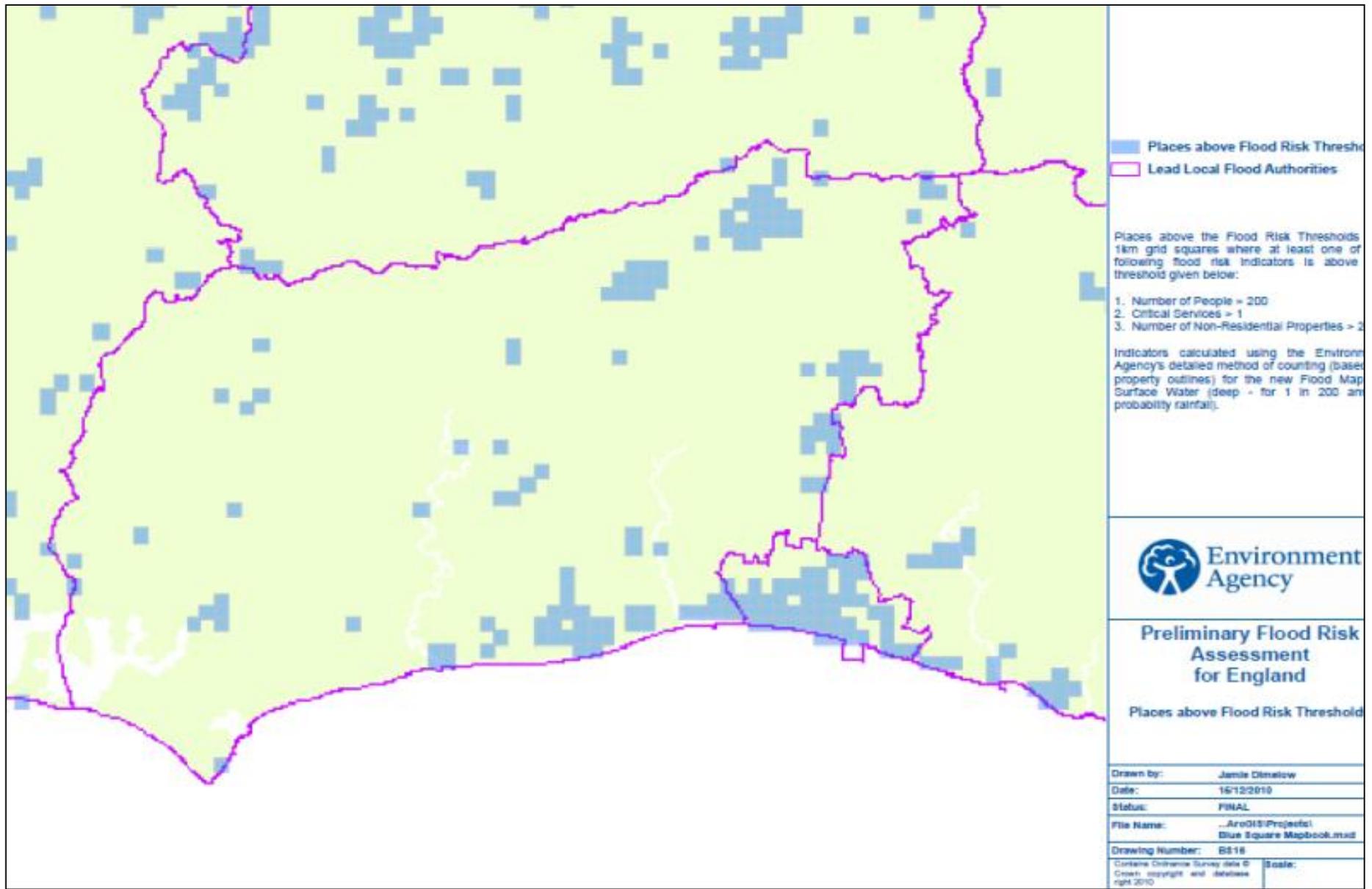


Figure 5.2 1km² 'Blue squares' above threshold criteria

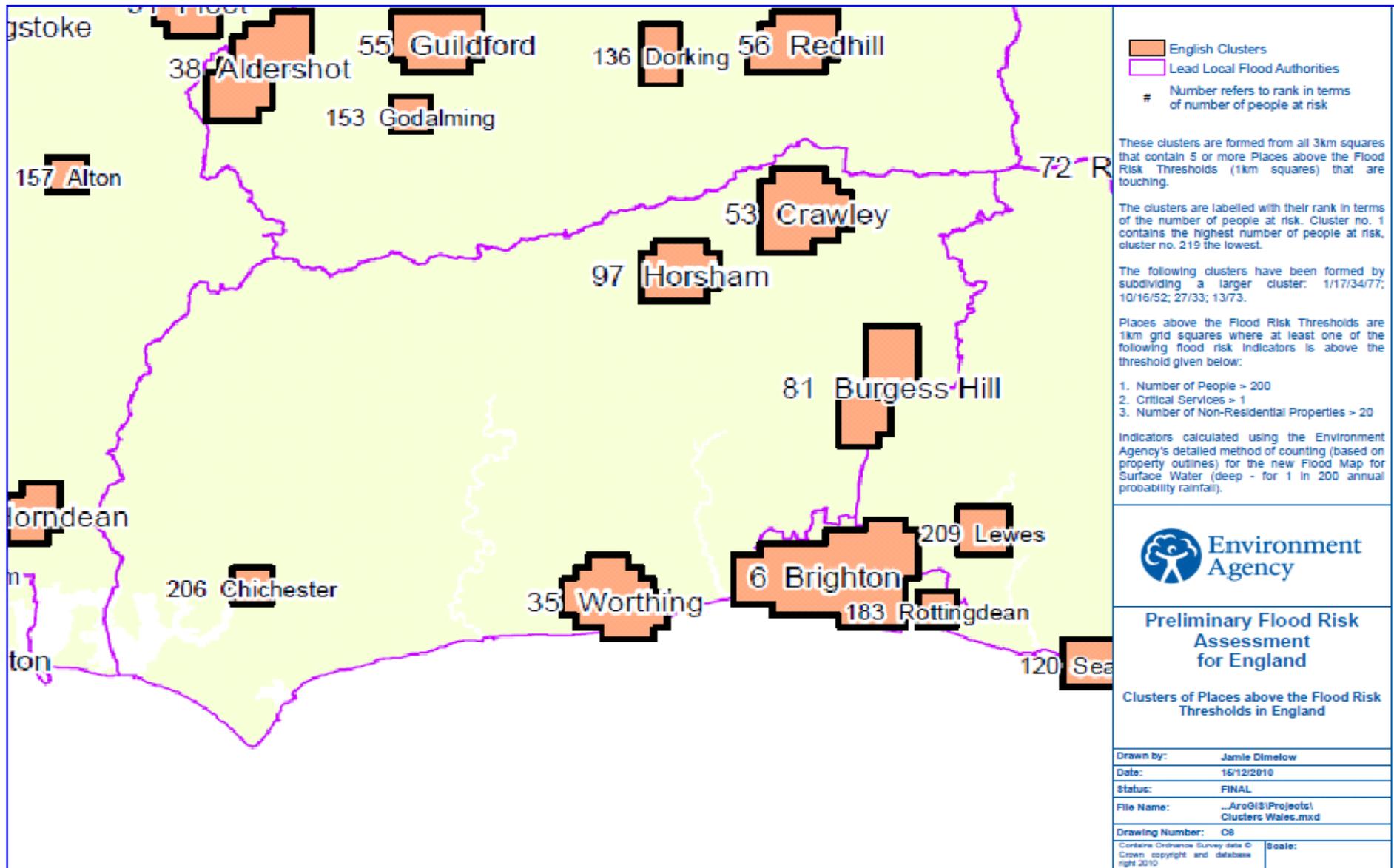


Figure 5.3 Clusters of blue squares indicating areas of high future flood risk

5.4 Potential consequences of Surface Water Flooding

The Environment Agency has used both the Flood Map for Surface Water and the Areas Susceptible to Surface Water Flooding mapping with the National Receptor Database to identify the number of properties at risk across the country.

The potential consequences on key flood risk indicators (as discussed in section 3.5) have been assessed by the Environment Agency; this information has been included in Annex 2 of the Preliminary Assessment Spreadsheet.

Table 5.3 Summary of properties at risk from surface water floods

Source	Flooding type	Residential Properties Affected	Non-residential Properties Affected
FMfSW	1 in200; shallow (> 0.1m)	76,600	20,100
FMfSW	1in 200; deep (> 0.3m)	22,500	6,500
AStSWF	1 in 200; less (0.1 – 0.3m)	77,200	18,500
AStSWF	1 in 200; intermediate (0.3m – 1m)	31,900	8,400

This data will be compiled by the Environment Agency and used to represent the flood risk for England and Wales for reporting to the European Union as part of the fulfillment of the EU Floods Directive.

Future work to assess surface water flood risk will use these figures and the areas identified by the 'blue squares' (figure 5.2) as a starting point. As more information becomes available through future investigations, modelling and survey work, the areas at risk of surface water flooding across West Sussex will be better identified to higher level of detail.

5.5 Effect of Climate Change and Long Term Developments

5.5.1 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%.

5.5.2 Key Projections for South East 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 18% (very likely to be between 2 and 39%)
- Precipitation on the wettest day in winter up by around 16% (very unlikely to be more than 34%)
- Relative sea level at Portsmouth 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 11 and 24% Increases in rain are projected to be greater at the coast and in the west of the district.

5.5.3 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 the rapidly responding catchments draining the South Downs and Weald. 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.

Rising sea or river levels may increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses. There is a risk of flooding from groundwater in the district. Recharge may increase in wetter winters, or decrease in drier summers.

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 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.

5.4.5 Long Term Developments

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 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).

5.4.6 Major Developments and Flood Risk

Managing flood risk is an important issue for any development. The location, layout and design of developments are fundamental factors which establish both the likelihood and consequences of flooding.

PPS25 requires Strategic Flood Risk Assessments (SFRAs) to be carried out by local planning authorities as part of a local development framework

(LDF). New development must be considered in the light of these assessments. SFRAs should consider the risk of flooding from all sources, taking into account climate change.

It is also a requirement of PPS25 that site-specific flood risk assessments (FRAs) are undertaken by applicants when a planning application is submitted in a flood risk area.

Given both of these requirements, every effort is made to ensure that new or proposed developments within West Sussex will not increase local flood risk and where practicable, actually reduce local flood risk.

6 Identification of Indicative Flood Risk Areas

In order to ensure a consistent national approach, DEFRA and WAG have established a series of significance and threshold criteria to define flood risk areas in the UK. Guidance on applying these thresholds has been provided from DEFRA. The Environment Agency used the DEFRA criteria to develop a national dataset which identified Indicative Flood Risk Areas. An Indicative Flood Risk Area was defined in areas where more than 30,000 people are at risk of flooding.

The methodology is based on using national flood risk information to identify 1km² squares where local flood risk exceeds a defined threshold; these areas within West Sussex are illustrated in Figure 5.3. Where a cluster of grid squares leads to an area where flood risk is most concentrated, and over 30,000 people are predicted to be at risk of flooding, this area has been identified as an Indicative Flood Risk Area (IFRA).

One of the ten nationally identified IFRA's, the Brighton and Hove IFRA originally overlapped the West Sussex County Council boundary as shown in Figure 5.3. The IFRA identified for Brighton and Hove ranked 6th most significant in the Country (based on the FMfSW) with 36,412 people deemed to be at risk.

As only 9% of the people at risk in the original outline Brighton and Hove IFRA live within West Sussex, it has been agreed that the boundary of this IFRA will be redrawn to only include the administrative area of Brighton and Hove City Council

The IFRA originally crossed the West Sussex boundary at the south eastern corner of the county. The area within West Sussex had in total eight 'blue squares' and 3,332 of the overall people at risk. These people at risk have now been removed from the Brighton and Hove IFRA, and this area (Southwick and Shoreham) will follow the standard PFRA process.

Therefore it has been agreed that there are no IFRAs within West Sussex, as no areas meet the threshold criteria.

WSCC and Brighton and Hove City Council will continue to work together to deal with cross boundary flood issues, as the next stages of the Flood Risk Regulations are prepared.

7 Next Steps

7.1 Scrutiny and Review

The scrutiny and review procedures that are to be undertaken during the production of the PFRA outputs are set out by the European Commission to assist in allowing the identification of the level of flood risk across the UK and EU and for the identification of the most significant flood risk areas. The scrutiny process will comprise two steps for this iteration of the PFRA:

7.1.1 Local Authority Review

The first element is for WSCC to undertake an internal review of the PFRA, in accordance with WSCC's review procedures, to both ensure the quality and accuracy of the output. In addition, this process will signal, as identified in the FRR09, for WSCC to deliver further requirements up to 2015.

Within WSCC, the PFRA will be taken to Strategic Environmental Services Select Committee, for scrutiny and approval. It is also likely that the PFRA will pass through some form of joint scrutiny involving elected members from the districts and borough councils within West Sussex before being delivered to the Environment Agency, but this is yet to be agreed.

7.1.2 Environment Agency Review

Under the FRR09, the Environment Agency has been given a role in reviewing, collating and publishing all of the PFRAs from across the England and Wales.

The Environment Agency will undertake a technical review (area review and national review) of the PFRA, which will focus on instances where Flood Risk Areas have been amended and ensure the format of these areas meets the provide standard. If satisfied, they will recommend submission to the relevant Regional Flood and Coastal Committee (RFCC) for endorsement.

RFCCs will make effective use of their local expertise and ensure consistency at a regional scale. Once the RFCC has endorsed the PFRA, the relevant Environment Agency Regional Director will sign it off, before all PFRAs are collated, published and submitted to the European Commission.

7.2 Future iterations of the PFRA

As set out by the EU flood Directive, Section 17 of the FFR09 states that the PFRA process requires review every 6 years. This will ensure that

data continues to be gathered so that the LLFA can monitor the changes in flood risk across the county.

Therefore the first review cycle of this PFRA will be carried out by West Sussex County Council and must be submitted to the Environment Agency by the 22nd of June 2017. They will then submit it to the European Commission by the 22nd of December 2017 using the same review procedure described above.

7.3 Future Flood Risk Management Actions

The PFRA is the first stage of the overall strategic risk management of flood risk in West Sussex. Some of the next steps to be carried out by West Sussex acting as LLFA are set out below

7.3.1 Local Flood Risk Management Strategy

The Local Flood Risk Management Strategy (LFRMS) will consider flood risk at a more local level and will identify where additional and/or SWMP's may be required. It will collate flood risk information at all levels and set out a framework for actions to address that risk. Work on the LFRMS will begin in July 2011.

7.3.2 Data Management

As identified in the analysis of data for this PFRA, the good management of data related to flooding is vital to creating a consistent picture of countywide flood risk, the recording of flood incidents and evaluation of measures to address risk. West Sussex County council will work with the other local authorities and other relevant parties to ensure data collection and recording is consistent across the county.

7.3.3 Further studies

The management of surface water and groundwater flood risk is a developing area of study across the UK. It is likely further surface water management and groundwater investigations at a number of scales will need to be carried out to gain insight into the specific risk faced by the county.

8 References

Brown, S. Beswick, M. et al. (2008) Met Office Submission to the Pitt Review - Executive Summary,

Defra (2006) The extreme rainfall of Summer 2007 and future extreme rainfall in a changing climate

Defra (2006) Flood and Coastal Defence Appraisal Guidance, FCDPAG3 Economic Appraisal, Supplementary Note to Operating Authorities – Climate Change Impacts. October 2006. Available from <http://www.defra.gov.uk/environment/flooding/documents/policy/guidance/fcdpag/fcd3cl>

Defra / WAG (2010) Selecting and reviewing Flood Risk Areas for local sources of flooding – Guidance to Lead Local Flood Authorities. Available from <http://www.defra.gov.uk/environment/flooding/documents/research/flood-risk-method.pdf>

Defra (2010) Surface Water Management Plan Technical Guidance

Environment Agency (2009) Thames Catchment Flood Management Plan

Environment Agency (2009) Arun and Western Streams Catchment Flood Management Plan

Environment Agency (2009) River Adur Catchment Flood Management Plan

Environment Agency (2009) Ouse Catchment Flood Management Plan

Environment Agency (2010) Preliminary Flood Risk Assessment - Final Guidance (Report –GEHO1210BTGH-E-E). Available from <http://publications.environment-agency.gov.uk/pdf/GEHO1210BTGHe-e.pdf>

Environment Agency (2010) Preliminary Flood Risk Assessment – Annexes to the Final Guidance (Report –GEHO1210BTHF-E-E). Available from <http://publications.environment-agency.gov.uk/pdf/GEHO1210BTHFe-e.pdf>

Environment Agency (2011), Flood Risk Regulations – PFRA FAQs (version 2), March 2011

Capita Symonds (2010) West Sussex County Council Level 1 Strategic Flood Risk Assessment

Mandigout, E. Westmore, G. (2010) West Sussex County Local Climate Impact Profile 2009

The Pitt Review (2008) Learning lessons from the 2007 floods